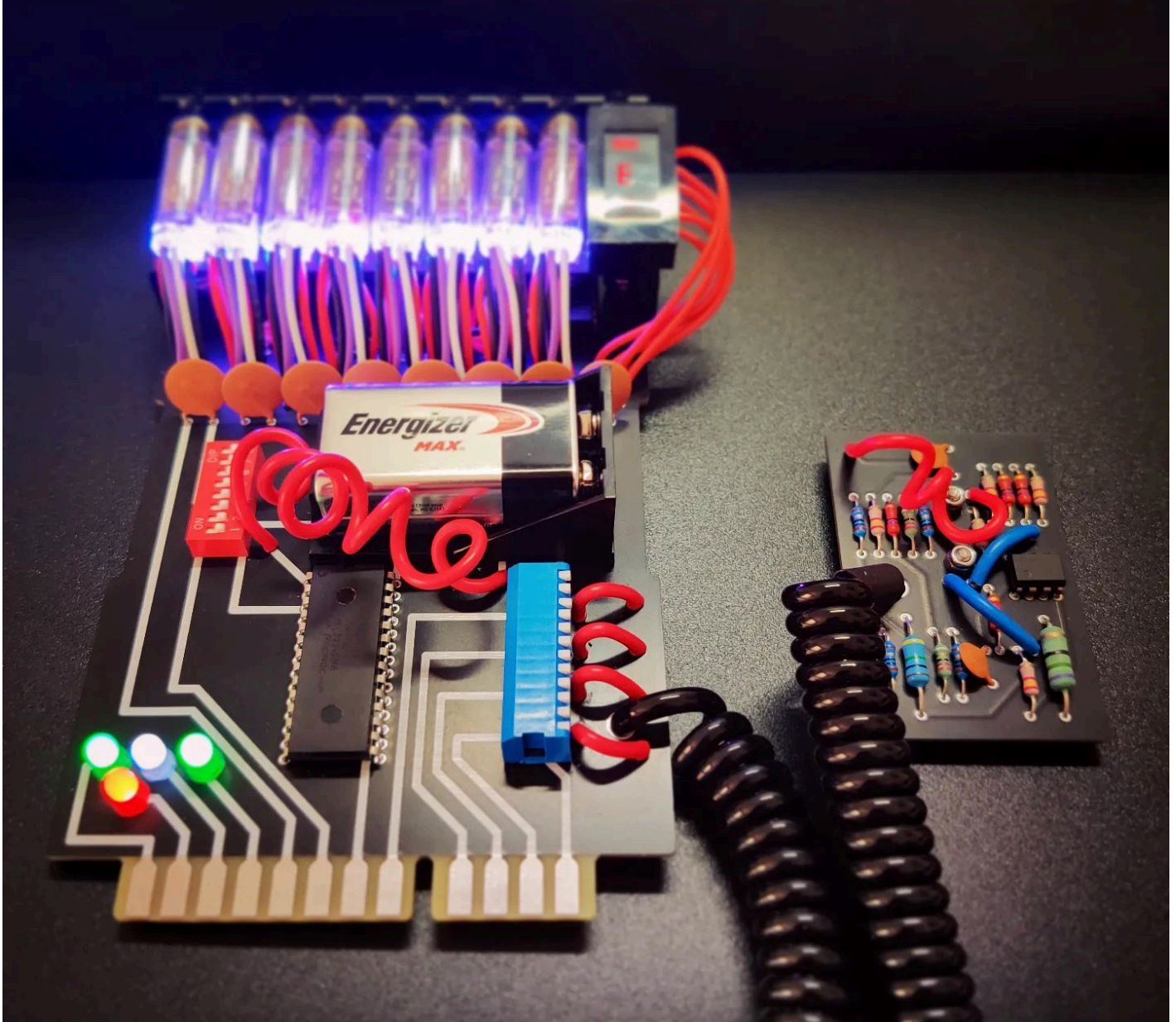


# ECTØLABS

## GIZMO 8920



**Kit Assembly Guide & Operating Instructions**

v1.0 – For kits purchased from MAY 2023

The **ECTOLABS GIZMO 8920** kit is an idealised rendition of the screen-used belt gizmos from Ghostbusters II in 1989.

If you have ordered a 'Standard' kit, you will need to use a soldering iron to assemble both the working electronics (that control the lighting effects) and the cosmetic components. If you have ordered a 'Non-Solder' kit, all working electronics and right-angle gold pins will have been assembled for you. You can then either solder or hot-glove the remaining components to the boards depending on you preference.

This manual is a step-by-step guide on how to assemble and operate your kit. It is fully illustrated with high-resolution photographs which are able to be zoomed in on to see highlighted details more clearly. We recommend reading through this guide before beginning your build so there are no surprises. Enjoy!

## TOOLS NEEDED

- **Soldering Iron** (Not required if opting to hot glue components to the gizmo boards)
- **Hot-Melt Glue Gun** (*Only required if NOT using a soldering iron. Gun with precision nozzle recommended*)
- **Epoxy Glue** (*Rapid cure type recommended*)
- **Super Glue** (*Liquid type with precision nozzle recommended*)
- **Pliers** (*Narrow or needle-nose*)
- **Wire Cutters**
- **Wire Strippers** or **Craft/X-Acto Knife**
- **Small Phillips screwdriver** (*Suitable for M2.5 & M4 screws*)
- **Heat Source** (*Heat gun or lighter*)
- **1x 9V Battery**
- **Etch Primer for metallic surfaces** (*Only required if opting to paint display shelf*)
- **Matt or Satin Black spray paint** (*Only required if opting to paint display shelf*)

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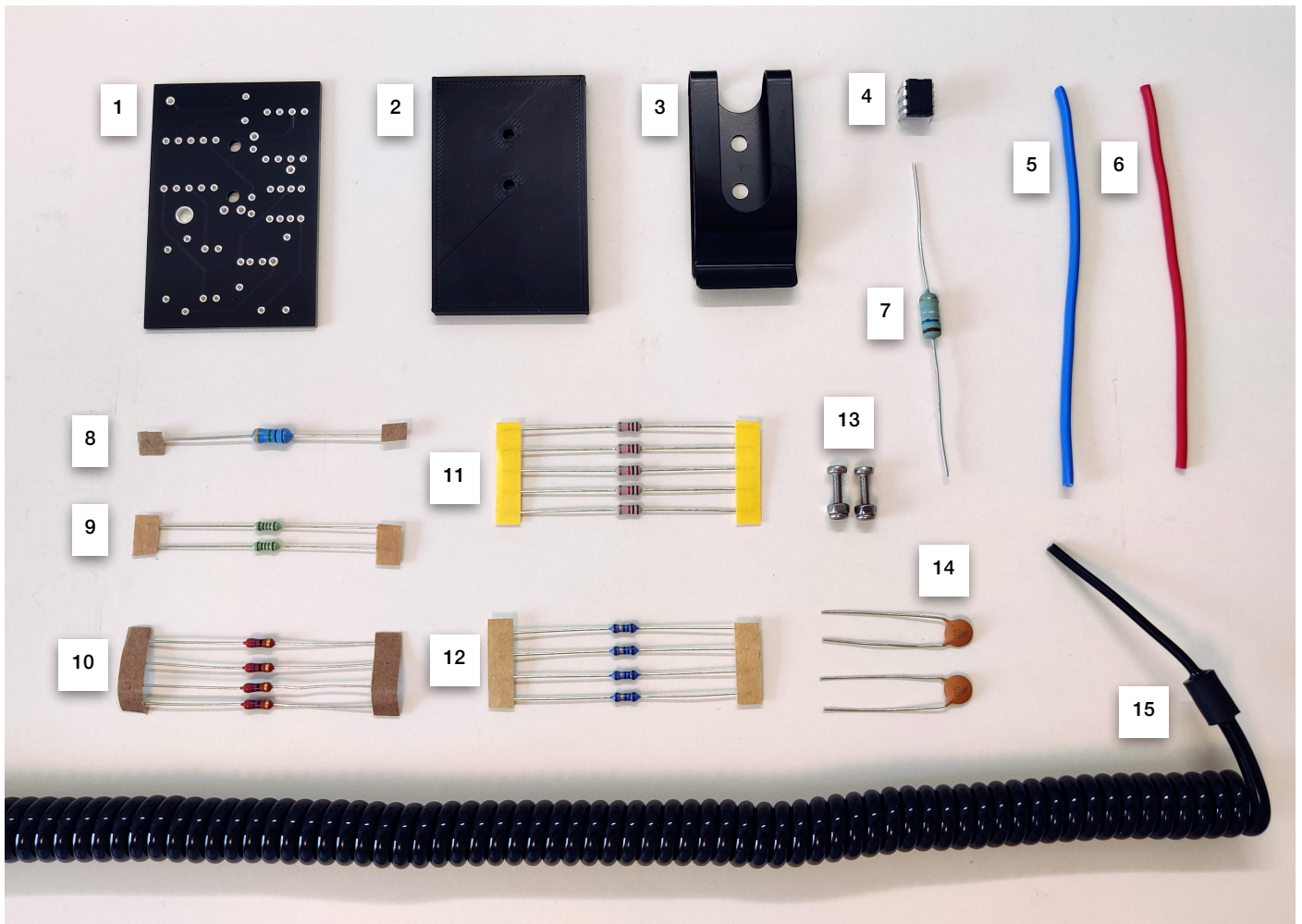
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# DAUGHTERBOARD ASSEMBLY

Let's start the build with the easier of the two boards to put together. We'll go through the method of how to securely attach the real electronics components to the board – this can then be used later to attach most of the other components to the motherboard as well.

## PARTS REQUIRED

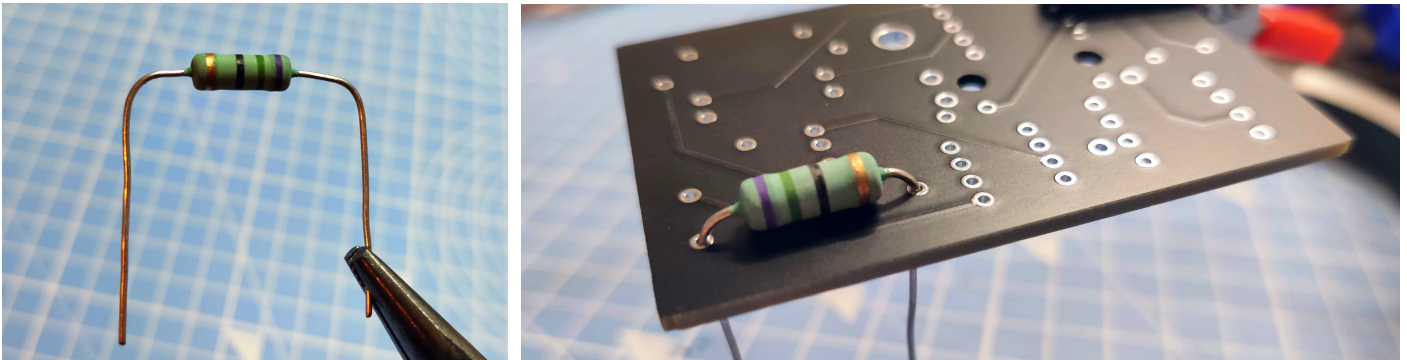
All the parts needed for the daughterboard assembly are contained in the bag labeled **GIZMO 8920 - Daughterboard** - these are shown in the photo below. Using the following list, double-check you have all of the parts from the bag in your kit and set them out on your workbench:



- |                           |                               |
|---------------------------|-------------------------------|
| ① 1x Daughterboard PCB    | ⑨ 2x Small GREEN resistors    |
| ② 1x Back panel           | ⑩ 4x Small RED resistors      |
| ③ 1x Belt clip            | ⑪ 5x Small WHITE resistors    |
| ④ 1x Timer chip           | ⑫ 4x Small BLUE resistors     |
| ⑤ 1x 100mm BLUE amp wire  | ⑬ 2x M2.5 lock nuts and bolts |
| ⑥ 1x 100mm RED amp wire   | ⑭ 2x Small disc capacitors    |
| ⑦ 1x Large GREEN resistor | ⑮ 1x Coiled cable             |
| ⑧ 1x Large BLUE resistor  |                               |

## 1. ATTACH THE RESISTORS

The resistors are the variety of cylindrical components fixed in the centre of short lengths of silver wire. Each one has a colour band around the outside but, for the purpose of this build, we will refer to each one by its main body colour. Your kit contains various resistors in specific quantities (all in different colours) so make sure you select the right ones for the section you are working on.

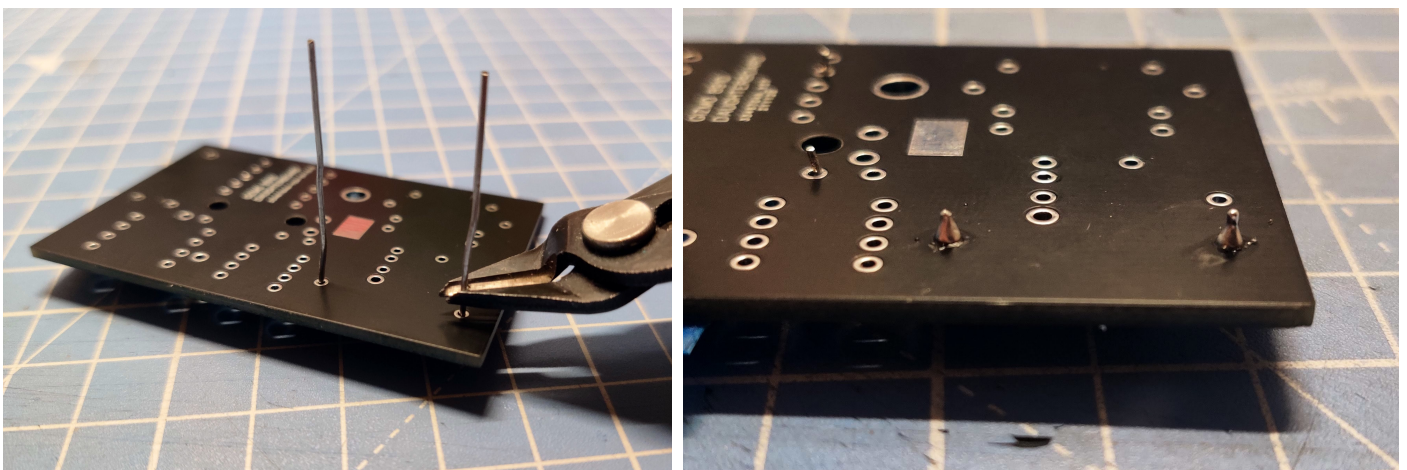


- Firstly, grab the daughterboard along with the largest **GREEN** resistor
- Using pliers or your fingers, gently bend both ends of the resistor wire to a 90 degree angle.
- Thread both ends of the resistor through the two holes in the daughterboard as shown in the photo above. Be sure to double-check the orientation of the daughterboard - **the side with white printed text is the back/bottom**.



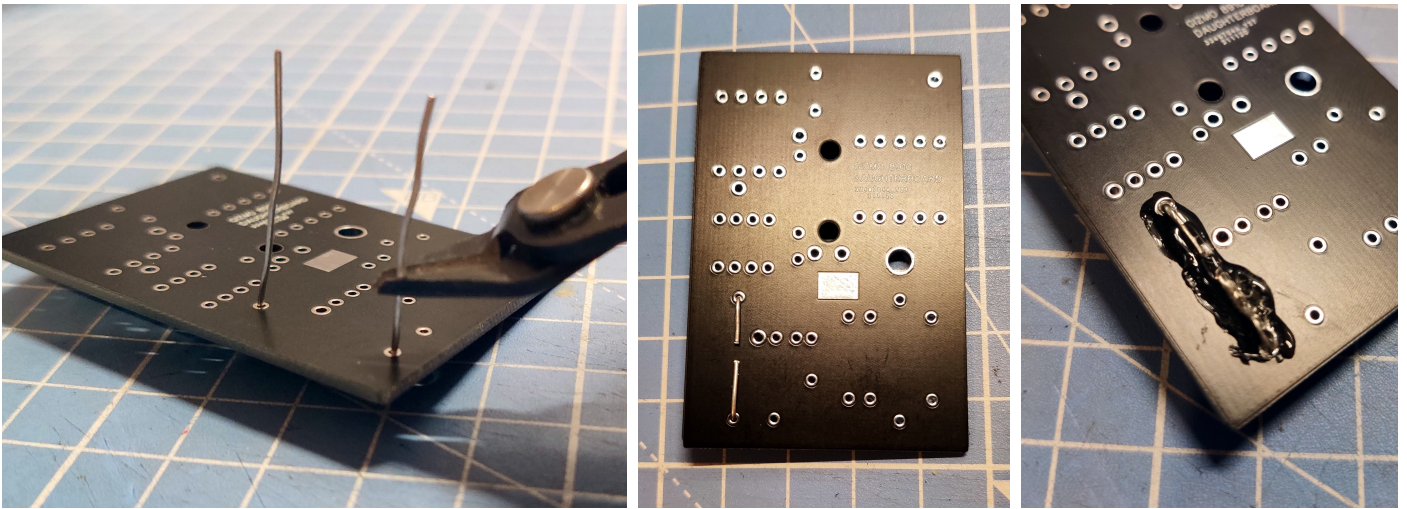
**The orientation of the resistor does not matter as these can be placed in either direction on a real circuit board. However, for the sake of aesthetics, it's nice to keep them all consistent so let's position the gold band at the TOP of each resistor.**

### IF YOU ARE USING A SOLDERING IRON:



- With your wire cutters, cut down each end of the wire leaving about 2-3mm.
- Use your soldering iron to apply solder around the ends of the wires. Make sure the solder flows all the way around the wire and over the surface of the pad to create good bond with the board. As these components are only cosmetic and do not require any electronic connection, the quality of your soldering is not important - just make sure these components are good and secure!
- If needed, cut away any sharp points with the wire cutter.

## IF YOU ARE USING A GLUE GUN:



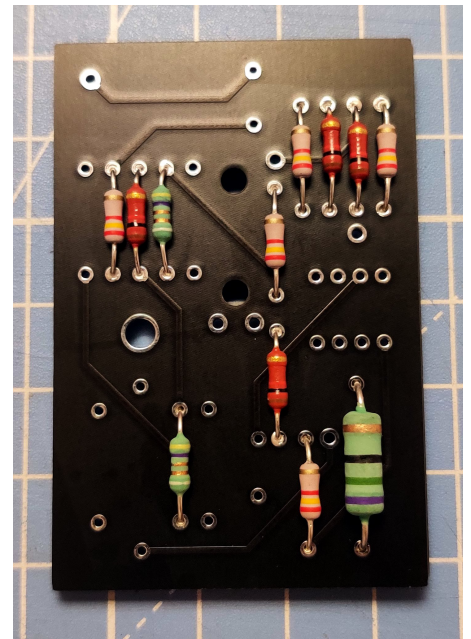
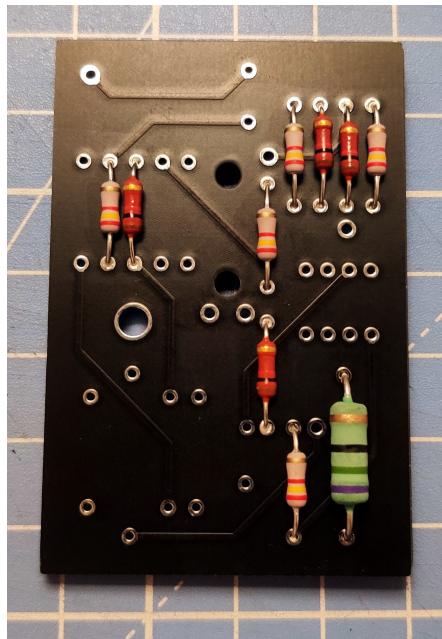
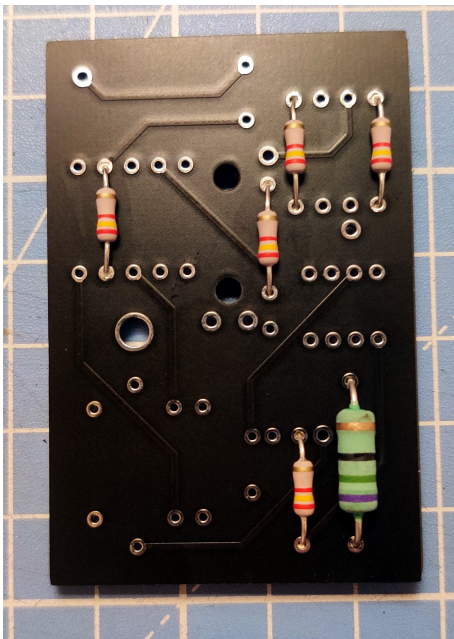
- With your wire cutters, cut down each end of the wire leaving enough to be able to folded over against the back of the daughterboard like a staple.
- Bend the shortened wires over until they sit flat on the back of the board as shown in the second photo above.
- Plug in your glue gun and wait until it has reached maximum temperature. This will help the hot melt glue flow better and create less mess.
- Apply hot glue to the folded wire, making sure you cover the holes and the ends of the wire. Be sure to avoid getting glue too close to any unused holes or to the edge of the board as this may make attaching the back panel difficult later.



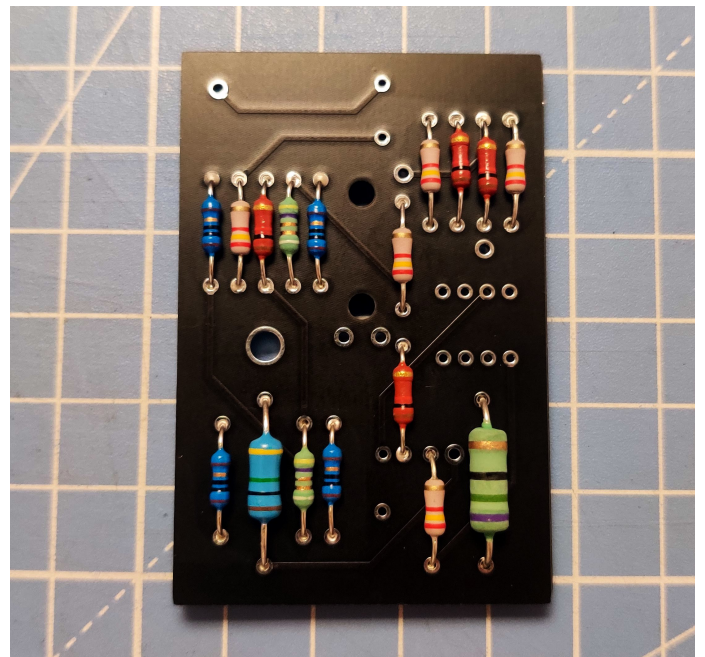
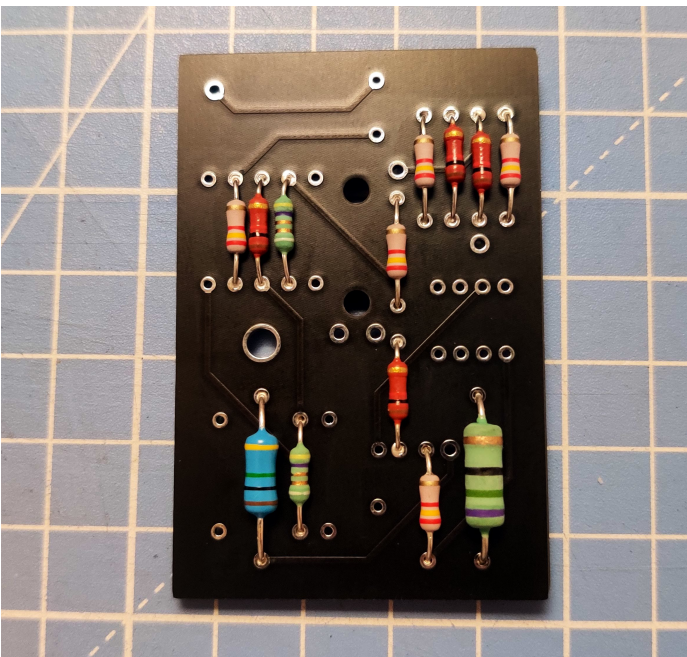
**It's easiest to hold the resistors in place with one hand, while you glue with the other. However, be aware that the heat from the glue gun will transfer easily through the resistor itself and may cause it to become very hot, so be careful when handling.**



**Be very careful when cutting the wires, as the sharp ends can easily fly off in any direction. We recommend using safety goggles to protect your eyes when cutting.**

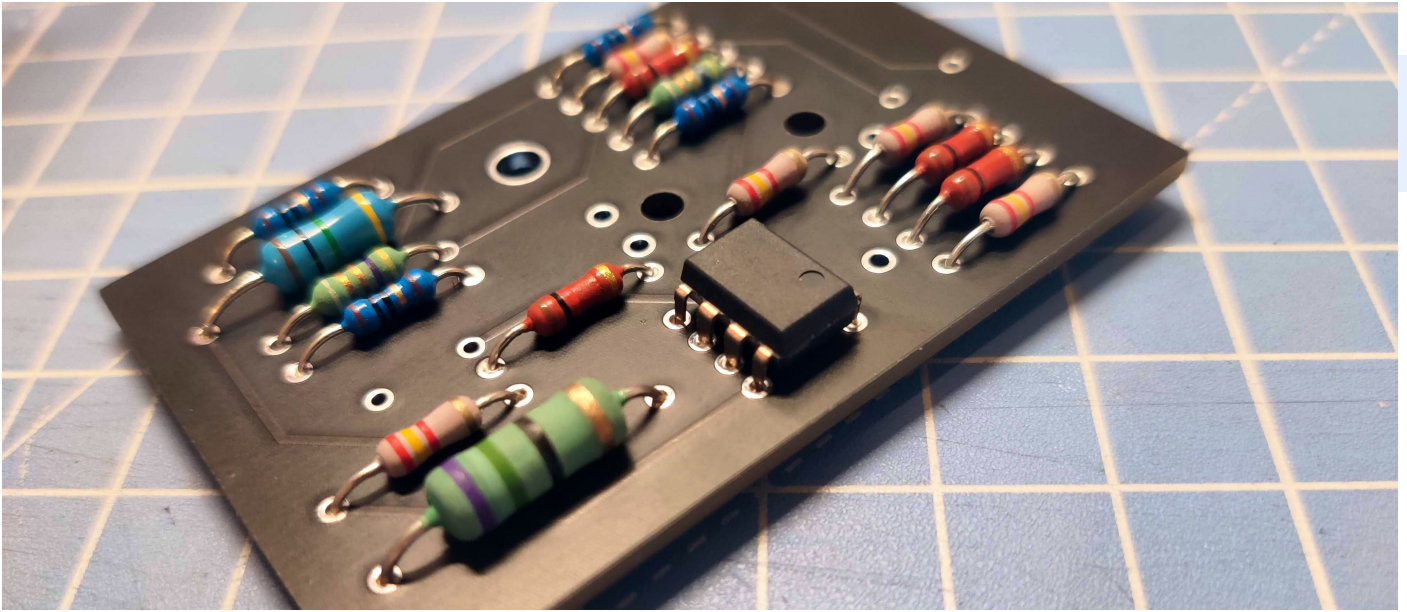


- Use your chosen technique to attach the five small **WHITE** resistors as shown in the first photo above. Be sure to zoom in for a clearer view of the holes in the board you need to use.
- Next add the four small **RED** resistors as shown in the second photo above.
- Now for the two small **GREEN** resistors as shown in the third photo.



- Next add the large **BLUE** resistor shown above in the first photo.
- Finally, attach the four small **BLUE** resistors as shown in the second photo.

## 2. ATTACH THE TIMER CHIP



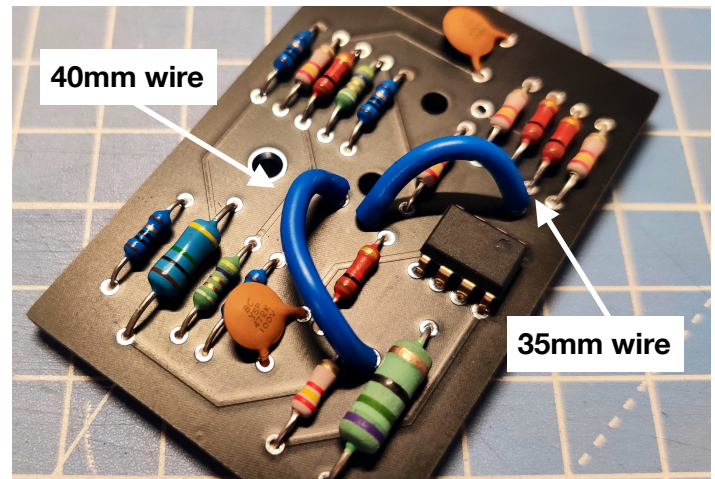
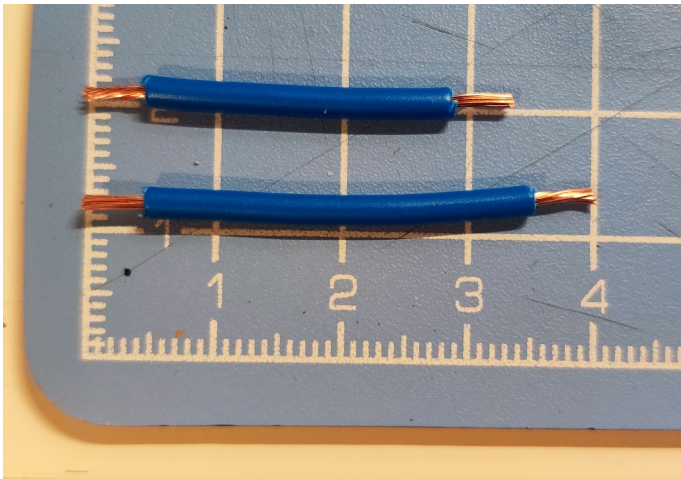
- Add the 8-pin timer chip by inserting it into the two parallel 4-hole rows as shown above. If the chip does not easily sit into the holes, check that the silver pins are straight and adjust with pliers if needed
- There is no need to cut any of the pins when flipping the board over - just solder into place or apply hot-glue along each row.

## 3. ATTACH THE DISC CAPACITORS

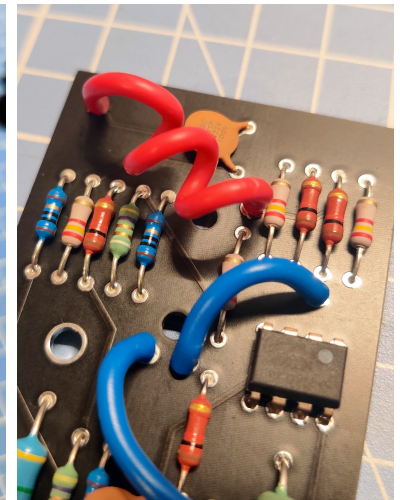
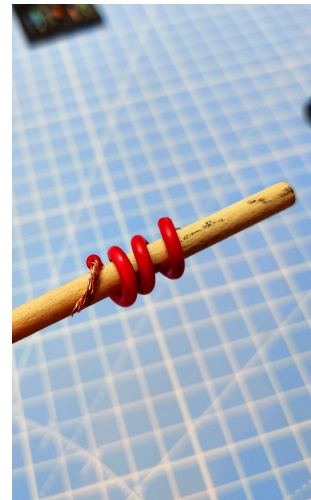
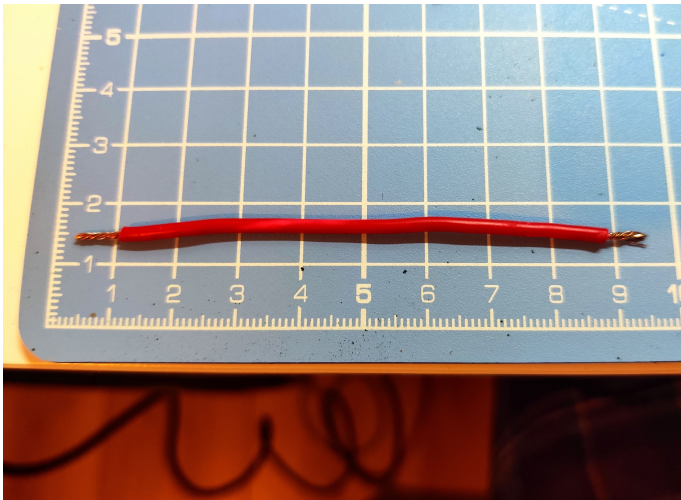


- Add the two small orange disc capacitors to the two positions as shown above. They should both be sitting over to the left rather than upright. If your capacitors are differing in size, attach the largest one to the top
- Trim the wires as we did with the resistors, then either solder or glue to the back of the board.

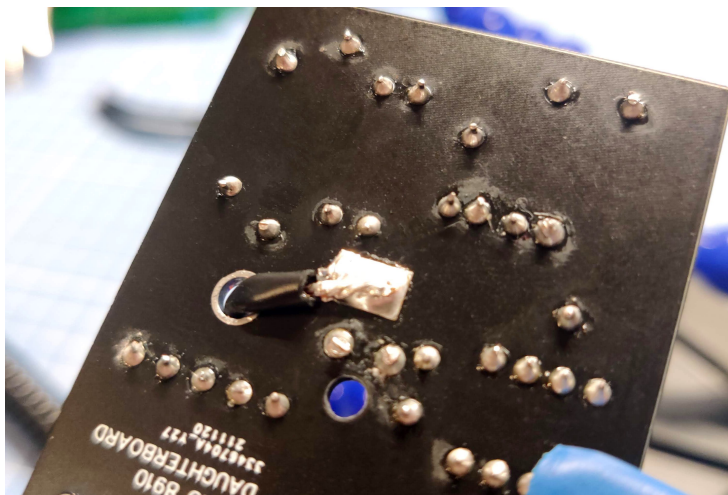
## 4. ATTACH THE WIRES AND CABLES



- Next, we need to create two sections from the **blue** amp wire. Make one section approximately 35mm and the other 40mm. Strip a section of the insulation away from each end and twist the bare wires together.
- Feed the ends of both wires into the holes as indicated in the second photo above - the longer 40mm wire in the lower position, and the 35mm in the upper.
- Secure the wires into place by soldering or hot-glueing to the back of the board. If glueing, make sure you glue away from the other free holes in the board. If the wire keeps lifting itself out of the hot glue, try pressing it back into the glue with the end of a small screwdriver for a few seconds until it sets into place. It may also help to strip a little more insulation away so you have more exposed wire to play with.

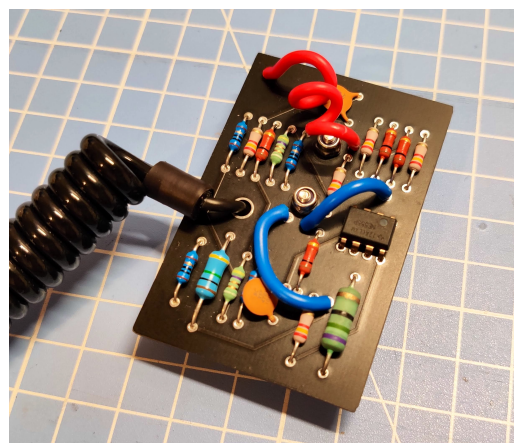
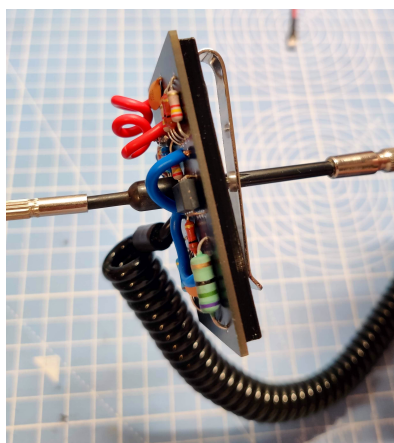
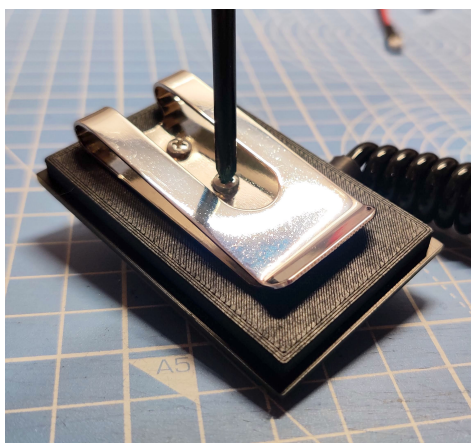


- Now take the 100mm **red** amp wire and strip some insulation from both ends. If you are using a hot-glue gun, strip around 8mm so that you have enough exposed wire to attach to the back of the board.
- This wire needs to appear coiled. To do this, wrap the wire tightly around a thin rod - we have used the wooden handle of a fine paintbrush. Pay attention to the direction of the coil.
- Slip the wire off the rod and add to the board using the holes indicated above. Solder or glue to the back of the board in the usual way.



- Finally, we add the black coiled cable that will link the daughterboard with the motherboard. Firstly, strip a few millimetres of insulation from the narrower, flexible end of the cable and feed it through the largest hole on the board.
- Bend the cable over until the exposed wire is over the silver rectangular pad and apply a generous amount of solder to secure the cable to the pad. If you are using hot glue, use as much as necessary for the cable to remain in place on the back of the daughterboard. You may wish to use a little superglue if the cable is moving.

## 5. ADD THE BACK PANEL



- Align the two holes in the back panel with the two centre holes on the board. If you have been using hot glue and there is some preventing the board from sitting flush, try cutting away some of the glue with your wire cutters and reseat the back panel.
- Add the belt clip on top of the back panel and use a Philips screwdriver to screw a 10mm bolt into the bottom hole until it just emerges through the front of the board.
- Screw one of the lock nuts onto the bolt. Lock nuts have a nylon ring inside which prevents them coming loose once they are tightened, but this makes gripping the nut with your fingers very difficult. Instead, grip the nut with pliers or a suitably sized socket screwdriver (shown above) from one side as you screw in the bolt from the other.
- Check the alignment of the belt clip on the back, straighten if needed and tighten the nuts until everything is nice and secure.

## DAUGHTERBOARD COMPLETE!

That's it... the daughterboard is done! Now that you have both the tools AND the talent, let's set the daughterboard aside for now and move on to the main event...

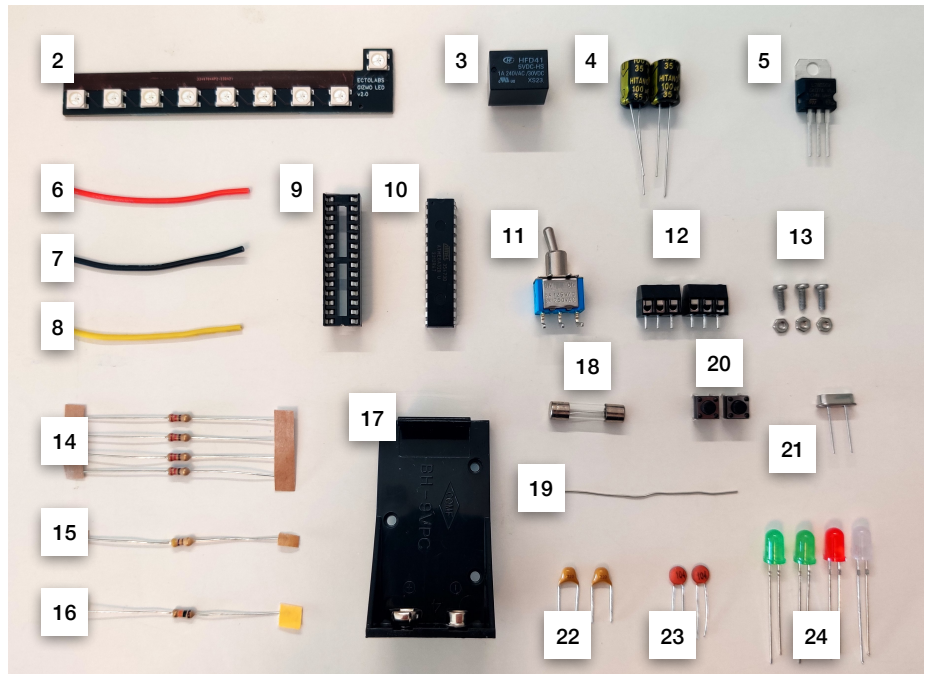
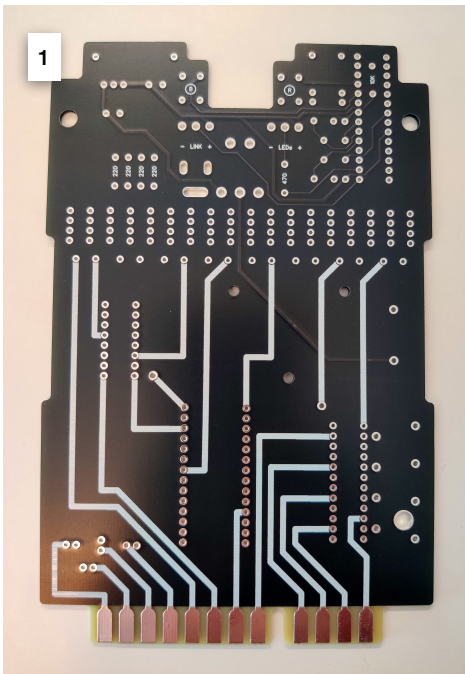
# MOTHERBOARD ASSEMBLY

Attaching components to the main gizmo board uses the same technique we learned with the daughterboard. Depending on your kit, you may find that some of the following steps have already been done for you. In this case, we recommend looking over these steps anyway to check everything is as it should be. Remember that you will need to supply a 9V battery (not included) to power the electronics.

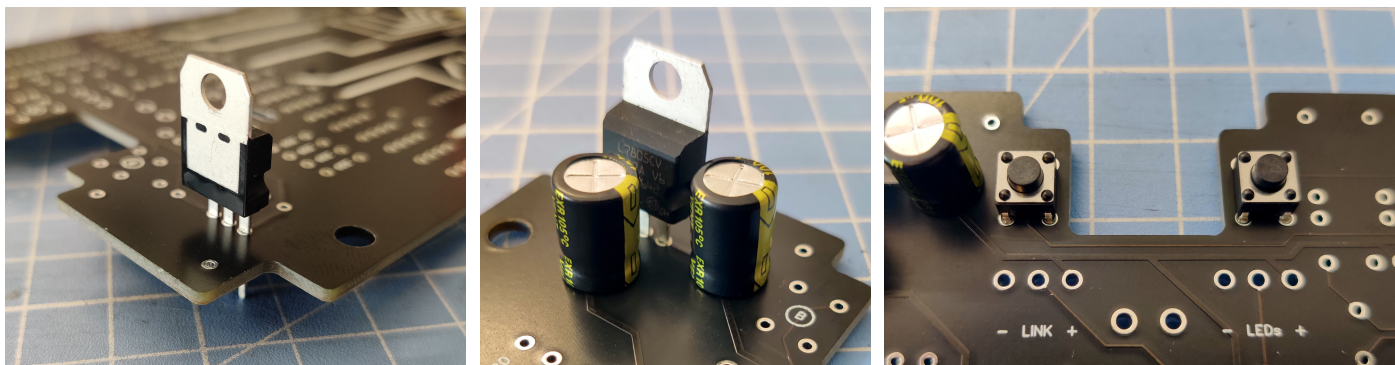
## 1. ATTACH THE FUNCTIONAL ELECTRONICS (Standard kits only)

### PARTS REQUIRED FOR THIS SECTION

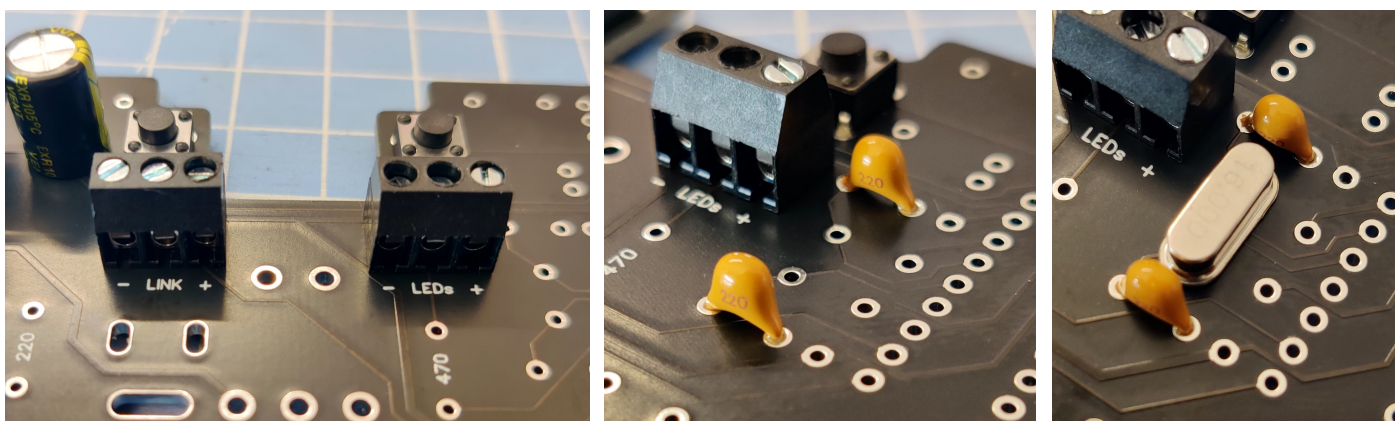
All the parts needed for the functional electronics are shown in the photos below. All the loose components you need can be found in the bag labeled **GIZMO 8920 - Functional Electronics**. These are the essential parts that make the lighting effects work, so it is essential that they are mounted to the board correctly. Don't worry... this is all relatively straightforward, so just follow the next steps carefully and you should have no issues! Using the following lists, find each part in your kit bags and set them out on your workbench:



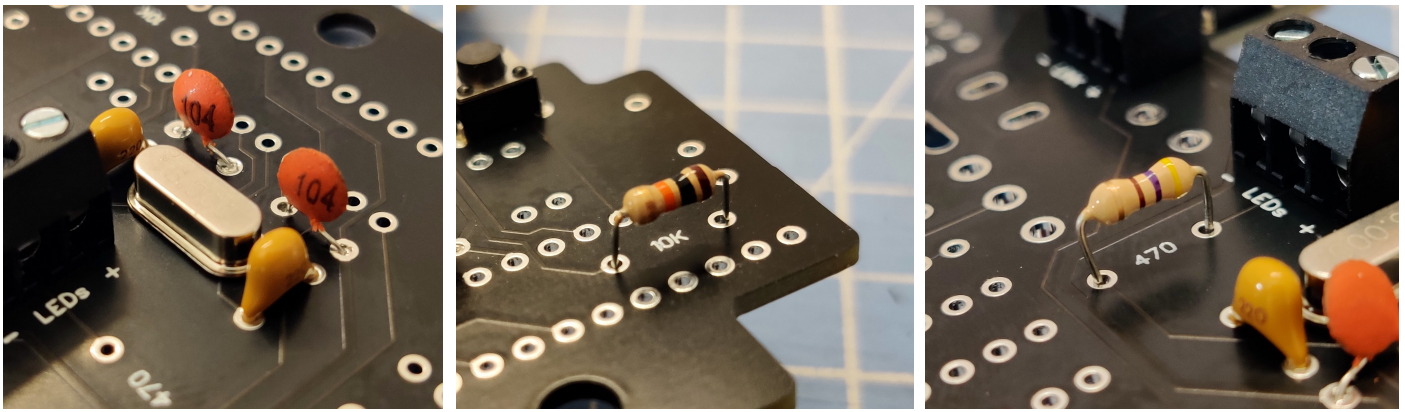
- ① 1x Black mainboard PCB
- ② 1x LED PCB
- ③ 1x Relay box
- ④ 2x 100uF aluminium capacitors
- ⑤ 1x 5V voltage regulator
- ⑥ 1x RED silicone wire
- ⑦ 1x BLACK silicone wire
- ⑧ 1x YELLOW silicone wire
- ⑨ 1x Microcontroller socket
- ⑩ 1x Microcontroller chip
- ⑪ 1x Toggle switch
- ⑫ 2x 3 pin screw terminal
- ⑬ 3x Battery holder nuts + bolts
- ⑭ 4x 220  $\Omega$  resistor [RED-RED-BROWN-GOLD]
- ⑮ 1x 470  $\Omega$  resistor [YELLOW-VIOLET-BROWN-GOLD]
- ⑯ 1x 10K  $\Omega$  resistor [BROWN-BLACK-ORANGE-GOLD]
- ⑰ 1x Battery holder
- ⑱ 1x Glass fuse
- ⑲ 1x Fuse wire
- ⑳ 2x Push buttons
- ㉑ 1x Crystal resonator
- ㉒ 2x 22pF tantalum capacitor
- ㉓ 2x 0.1uF disc capacitor
- ㉔ 4x LEDs (2x GREEN, 1x RED, 1x WHITE)



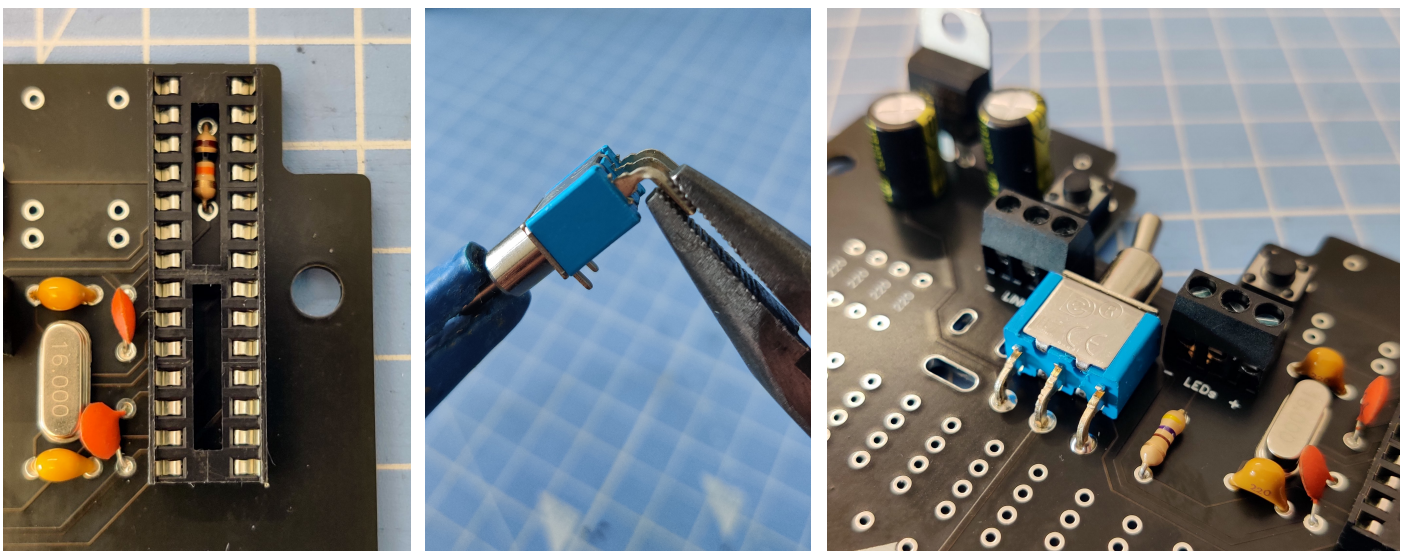
- Start by adding the voltage regulator to the three holes at the top-left of the mainboard as shown in the first photo above. **Make sure that the metal face of the regulator is facing the top of the board as it will not function correctly if mounted in the opposite direction.** The regulator can only be inserted by a certain amount, so push it as far as it will go, solder the three pins on the reverse side of the board, and trim the protruding pins using your wire cutters.
- Add the two aluminium capacitors next to the regulator as shown in the second photo above. Each capacitor has a gold stripe - **these stripes should be facing to the right of the mainboard in order to function correctly.** Solder the pins and trim.
- Now add the two mini push buttons as shown in the third photo above. The buttons should click into place when pushed into the four holes (it does not matter which way these are mounted). Solder all eight pins on the back of the board.



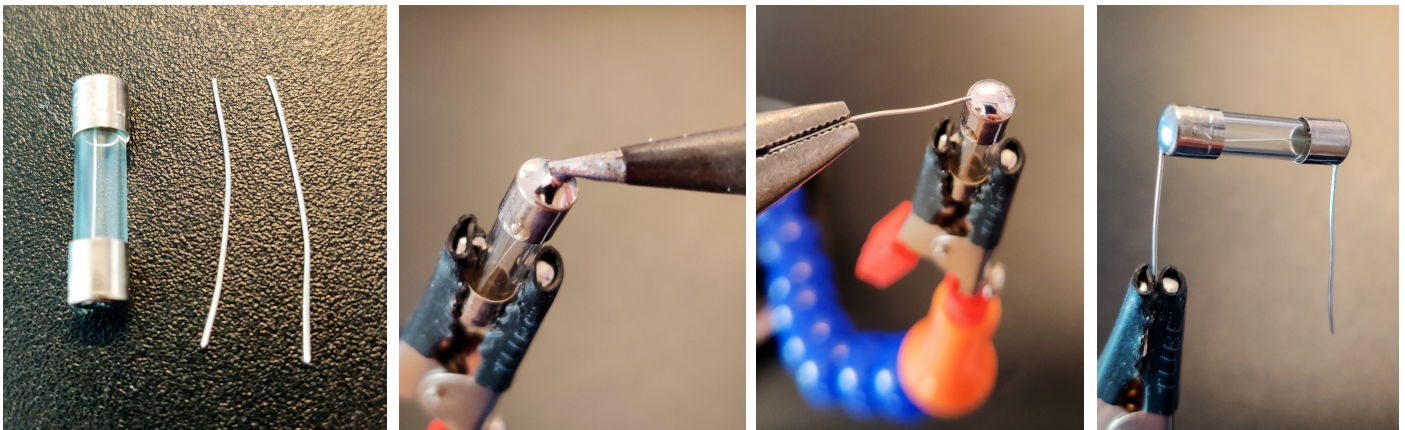
- Mount the two black screw terminals to the holes labeled 'LINK' and 'LEDs'. Make sure the connection points are facing towards you so that we can attach wires to them later. You may need to tape them in place while you flip the board over to solder them in place.
- Add the two yellow tantalum capacitors (these have markings that read '220') as shown in the second photo above. There are a number of holes in this area of the board, so make sure to double check they are in the correct positions before soldering.
- Now we add the crystal resonator between the two tantalum capacitors as shown in the third photo above. It does not matter which way this is mounted.



- Add the two orange disc capacitors (these have the markings '104') to the two positions shown in the first photo above. These will not sit flush with the board so just spread the two wires, thread through the holes and solder into place as securely as possible.
- The 10K  $\Omega$  resistor [BROWN-BLACK-ORANGE-GOLD] now should be placed through the two holes labeled '10K' on the board as shown in the second photo above. This can be inserted in either direction. Make sure the body of the resistor sits down on the surface of the board and solder into place in the usual way.
- Repeat this with the 470  $\Omega$  resistor [YELLOW-VIOLET-BROWN-GOLD] to the holes labeled '470' on the board as shown above.



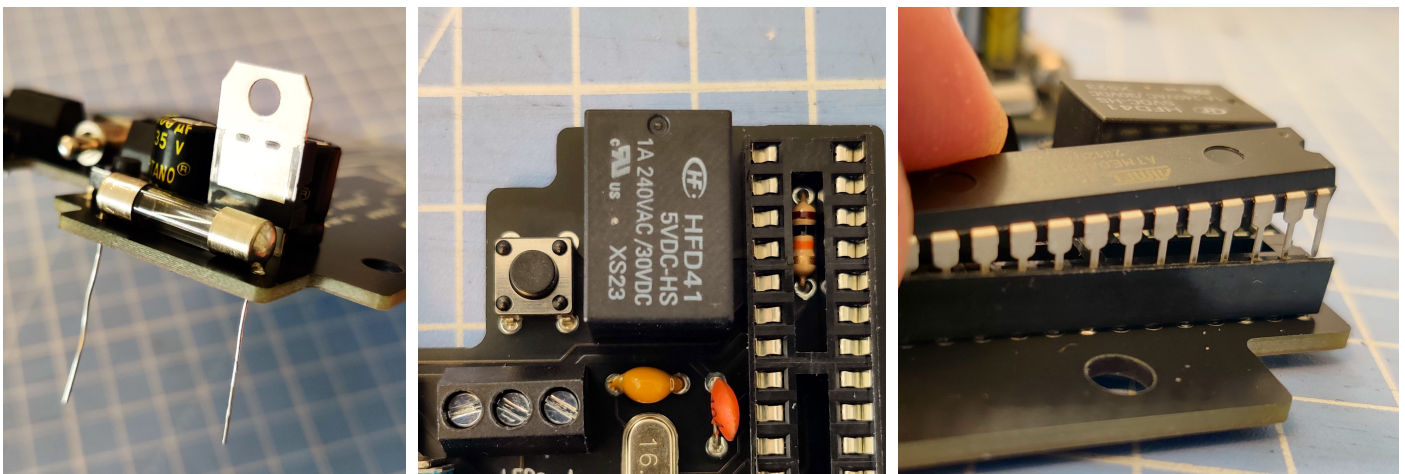
- Now add the 28-pin microcontroller socket as shown in the first photo above. You will see a small notch in one of the ends of the socket - this should be placed at the top. The resistor you added in the previous step should sit underneath the and within the cutout in the socket. Use tape to hold the socket in place while you flip the board over. Solder all 28 pins making sure that all the connections are sound.
- The toggle switch now needs to be added to the centre of our assembly. There are five mounting holes for this - if you find the switch's pins do not line up correctly, you may need to adjust the three right-angled pins on the bottom of the switch. To do this, use your pliers to carefully bend the pins so they are all pointing straight downwards at a 90 degree angle. Be careful with this as too much force may break the pins.
- Once the pins line up correctly, slot the switch into place and solder all five pins on the back of the board.
- If not already, flick the toggle itself so that is leaning over to the left hand side of the board as shown in the third photo above.



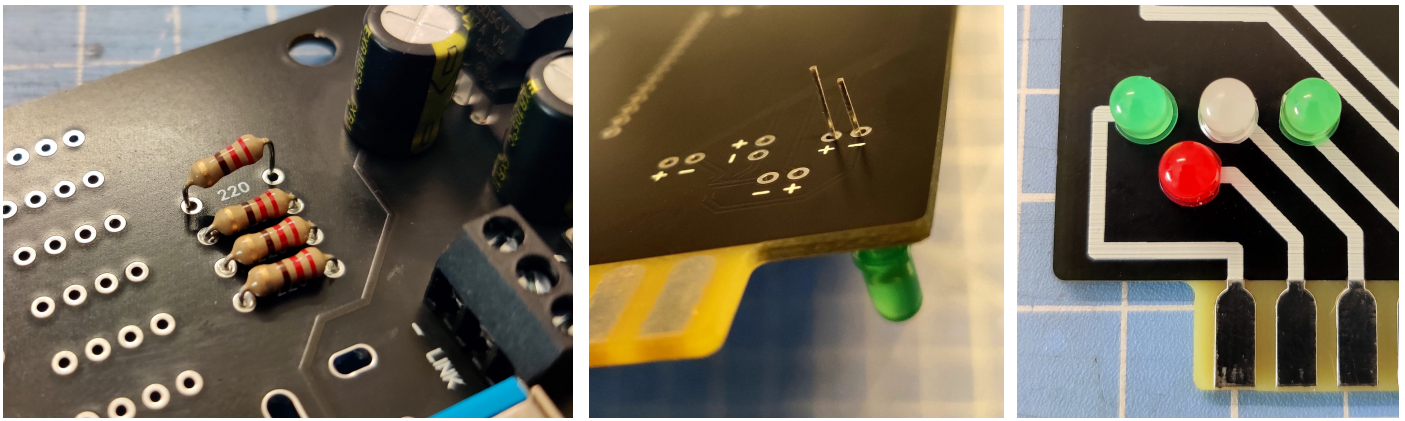
- Before we add the glass fuse, we need to modify it. This does not actually have any function within our lighting system - it is purely a cosmetic element to mimic the look of the circuitry on the original Sanyo calculators.
- Start by using your wire cutters to cut the fuse wire in half.
- Apply a generous amount of solder to one of the ends of the fuse. You may need to heat up the metal for a few seconds before the solder will flow. This will heat up the fuse significantly so be sure to use a helping hand tool or pliers to grip the fuse as you will likely burn yourself if holding it with your bare hands.
- Once a good blob of solder has been applied, heat it up again with your soldering iron and slide the end of one of the wire sections into the solder. Allow the solder to cool until the wire is firmly attached to the end of the fuse.
- Repeat this process for the other end of the fuse so that you have two wires attached. Make sure both wires are pointing in the same direction.



**Do not handle the fuse with your hands when applying solder. The fuse will heat up very quickly which may cause injury.**



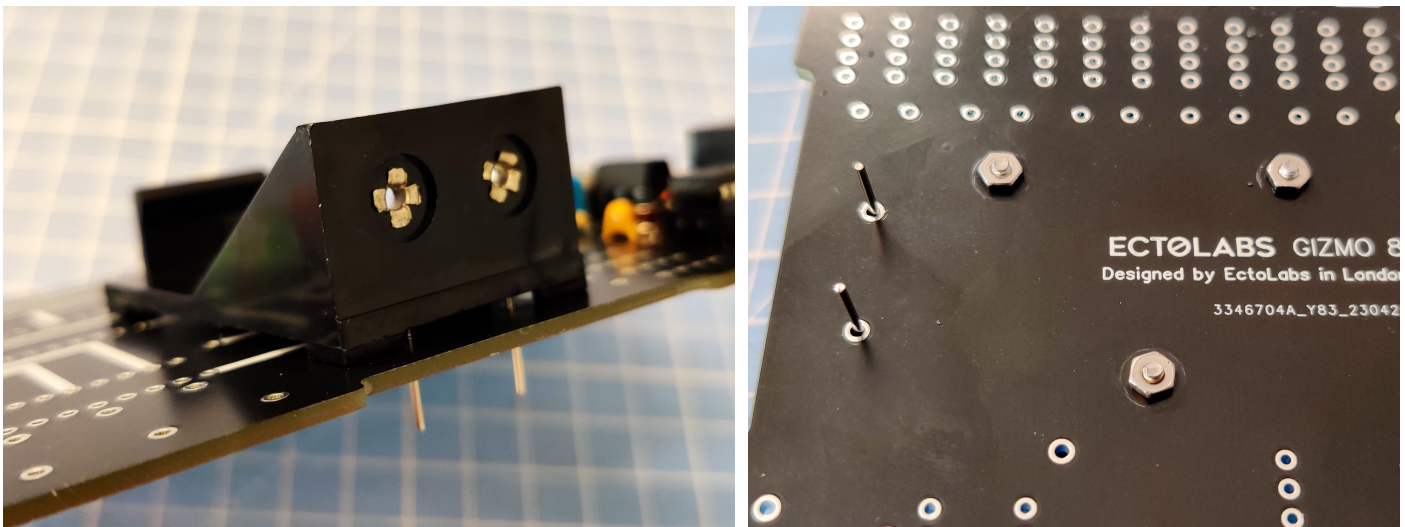
- Now we can add the glass fuse through the two holes behind the voltage regulator. Mount the fuse tight to the board, solder the wires in place and trim any excess as usual.
- Next, add the black relay box as shown in the second photo above. This is another cosmetic component designed to replicate the look of the Sanyo boards.
- Finally, insert the microcontroller into the socket we attached earlier. This is the brains of our lighting system. **Make sure the little notch in the chip is at the top to match the socket - it will not function correctly if inserted upside down.** You may need to straighten some of the pins to be able to insert it correctly - these can be damaged very easily, so it's important to handle the chip with care and take it slowly when aligning the pins.
- Push the microcontroller into the socket firmly until it is fully seated, making sure all pins are being fed into the respective connections in the socket.



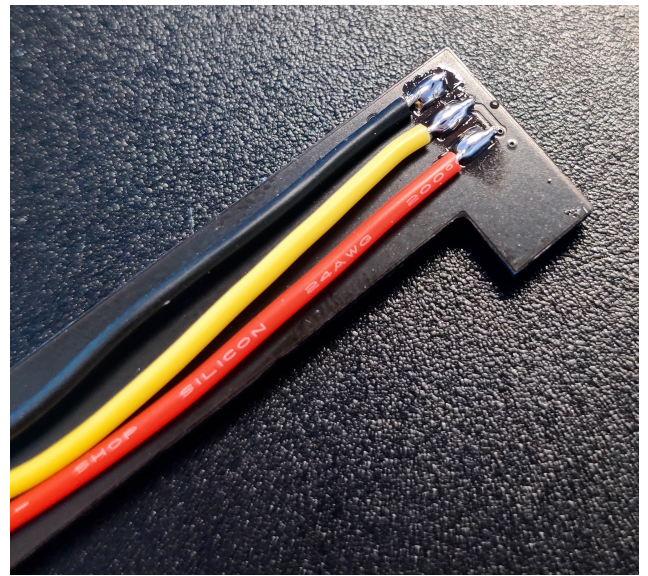
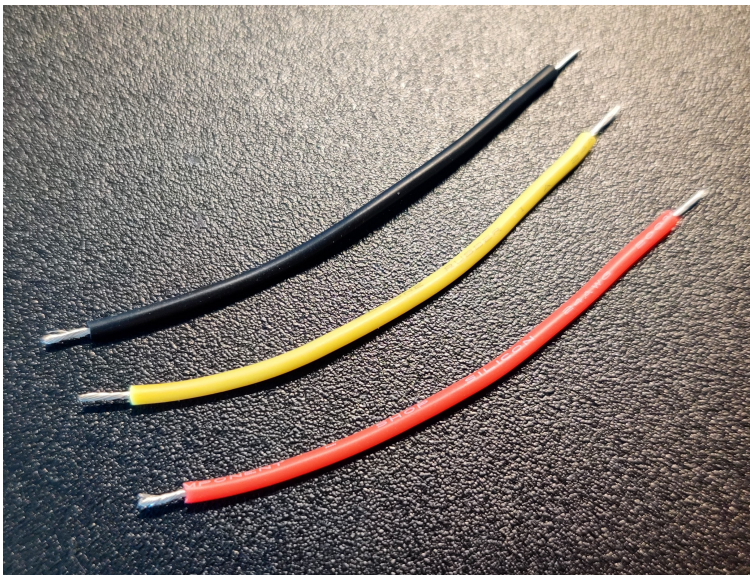
- Add the four 220  $\Omega$  resistors [RED-RED-BROWN-GOLD] to the four adjacent positions as shown in the first photo above.
- Now attach the four coloured LEDs to the bottom-left corner of the board. These should be arranged as shown. When threading them through the holes, make sure that the **longer** leg of each LED passes through the hole labeled '+' on the back of the board, and the **shorter** through the hole labeled '-'.



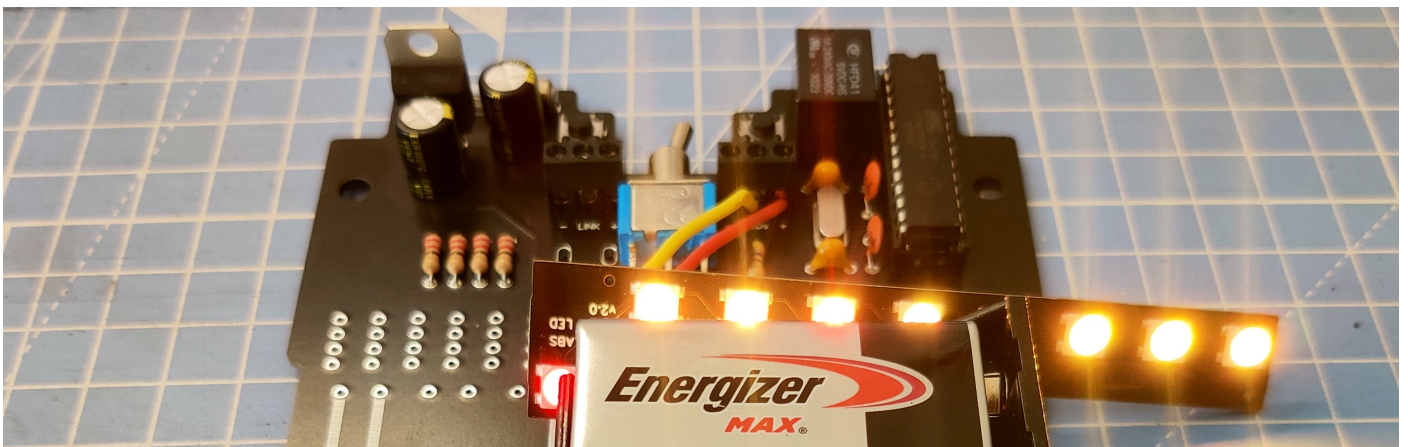
Be sure to double check the orientation of each LED against the '+' and '-' labels before soldering. They will not illuminate if mounted incorrectly.



- The final working component to be added is the 9V battery holder. Start by removing the protective rubber sheaths from the two metal pins and thread them through the two holes in the board as shown above.
- Before soldering, use the three nuts and bolts to secure the holder in place. Tighten the nuts on the back of the board.
- Make sure the holder is sitting tight to the surface of the board and finish off by soldering the two pins. Trim as necessary.



- In order to test the circuit we just assembled, we need to connect the LEDs to check everything is working correctly. **If you have the 'non-solder' kit, the following two steps will already have been done for you.**
- Strip away a small amount of silicone shielding from both ends of the **black**, **yellow** and **red** wires.
- Solder each wire to the appropriate pad on the back of the LED board. The **black** wire should be soldered to the pad labeled '-', the **yellow** wire to 'D' and the **red** wire to '+'.



- Now connect the three wires to the screw terminal labeled 'LEDs' on the mainboard. The **black** wire goes to the first '-' terminal, the **yellow** wire to the centre terminal and the **red** wire to the third '+' terminal on the right.
- Insert a fresh 9V battery into the holder. Be sure to use a new battery here as the lighting system can misbehave if not enough power is being supplied to the circuit.
- Finally, flick the toggle switch to power up the mainboard. You should see the LEDs light up and display the default pattern. Test the functionality by pressing the button on the left to change the lighting effect, then the button on the right to adjust the colour. If you only see one flashing red light, try pressing both buttons together to activate the preset lighting patterns. If nothing is happening at all, double check all your soldering, making sure that every component is properly connected and try again.
- Once you are happy everything is working, remove the battery, detach the LED board and set them aside.

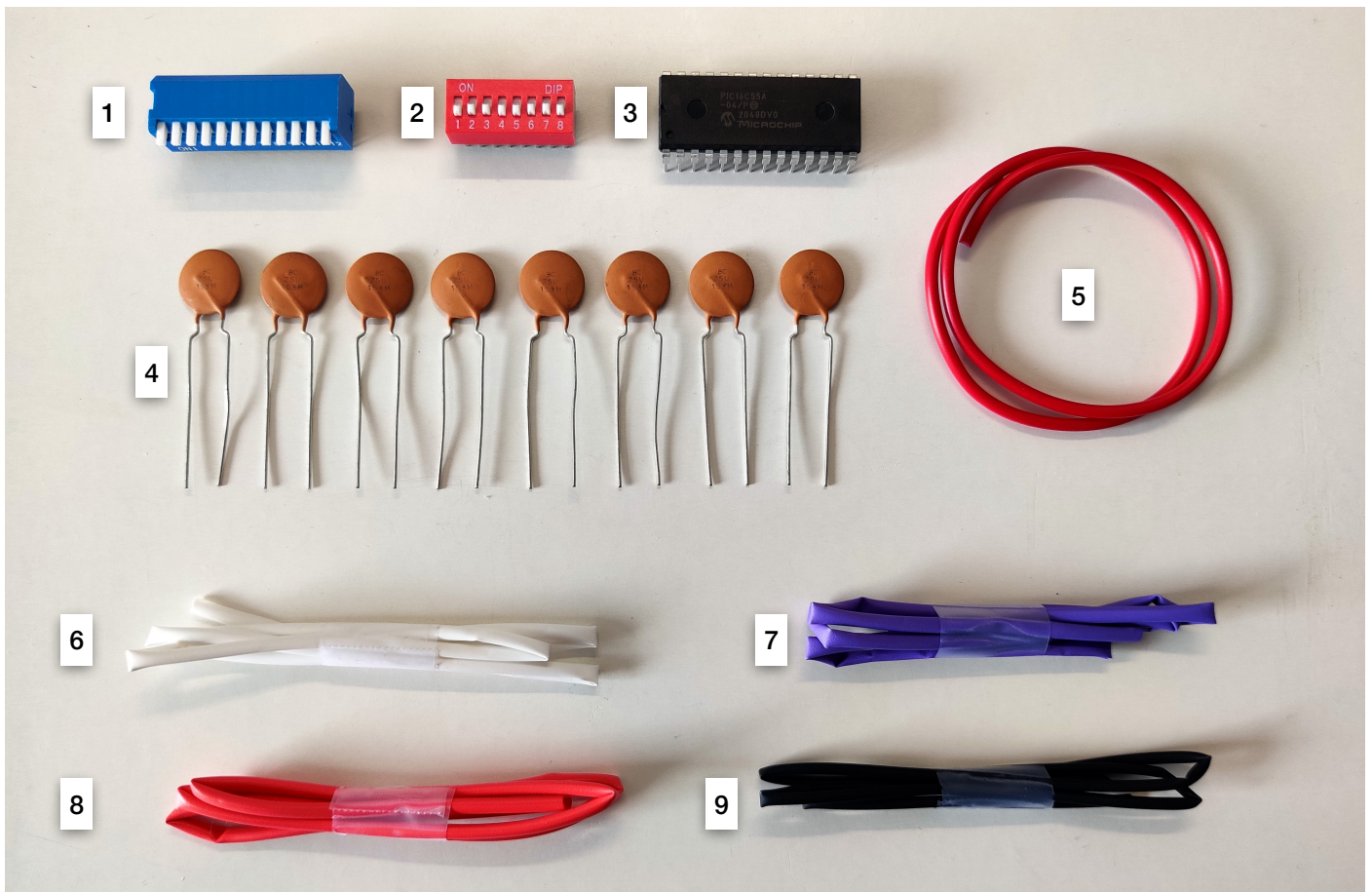
**Congratulations! You have completed the most important part of the build. You can now take a break, safe in the knowledge that you have a fully functional gizmo. When you're ready, proceed to the next section to start making this baby look awesome!**

## 2. ATTACH THE COSMETIC COMPONENTS

### PARTS REQUIRED FOR THIS SECTION

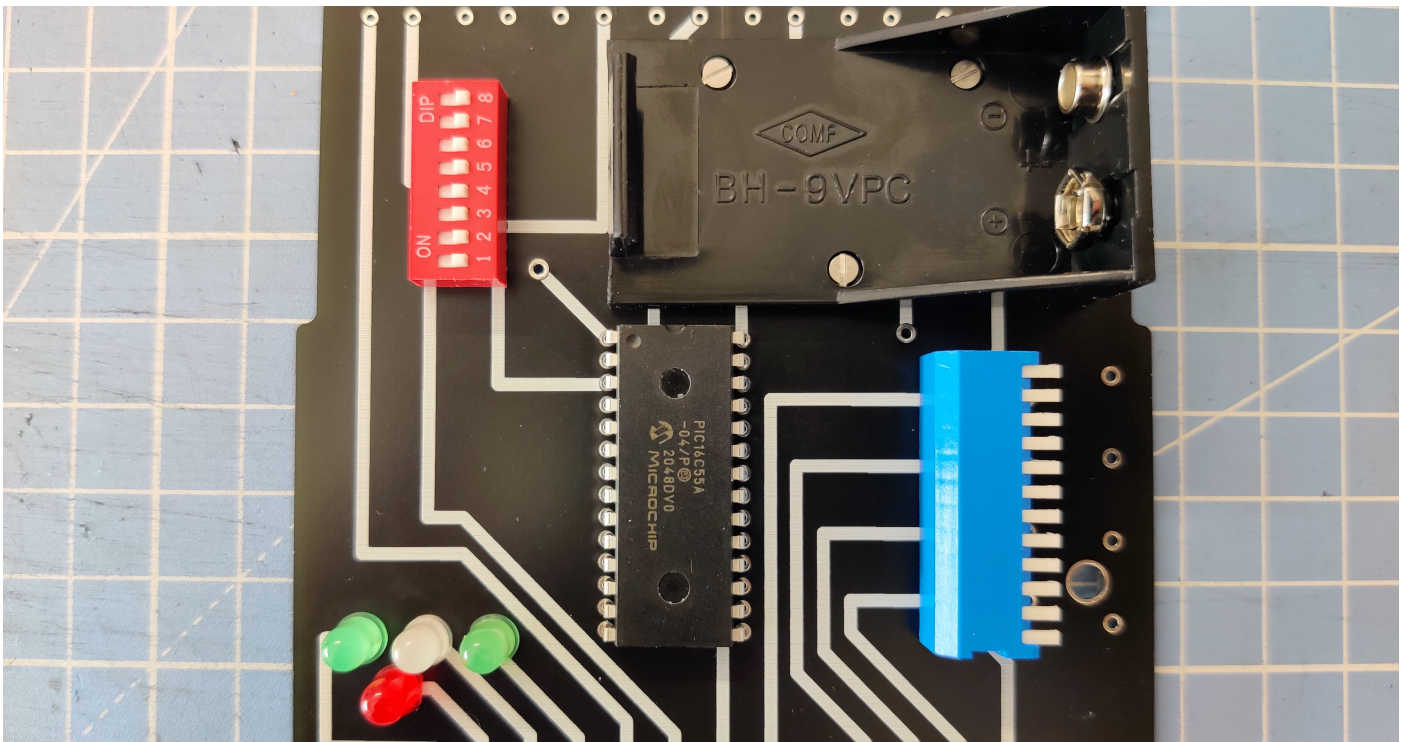
All the parts needed for this section are shown in the photos below. All the components you need can be found in the bag labeled **GIZMO 8920 - Cosmetic Components**. Everything we add from this point is simply for show, so the quality of your soldering is not as important, although we recommend doing the best job you can so that your gizmo remains as durable as possible. If you have ordered the non-solder kit, you can apply the hot-glue technique you applied with the daughterboard assembly.

Using the following list, find each part in your kit bags and set them out on your workbench:



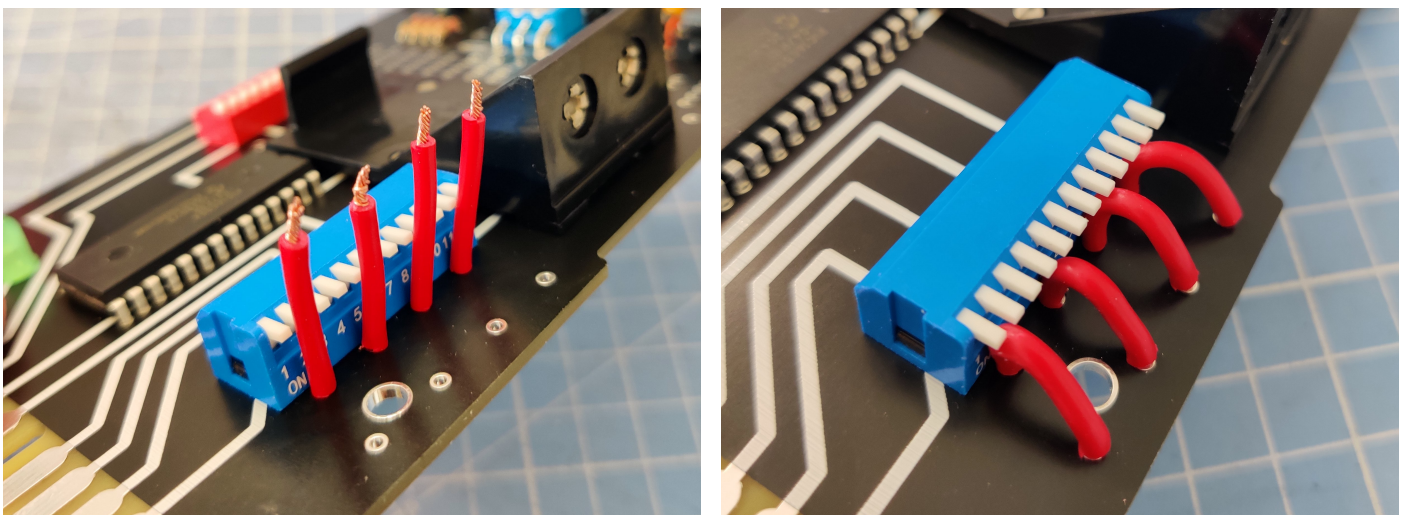
- ① 1x **BLUE** DIP switch
- ② 1x **RED** DIP switch
- ③ 1x **Controller chip**
- ④ 8x **12mm disc capacitors**
- ⑤ 1x **RED** amp wire (320mm)
- ⑥ 1x **WHITE** heat shrink tubing (440mm)
- ⑦ 1x **PURPLE** heat shrink tubing (440mm)
- ⑧ 1x **RED** heat shrink tubing (440mm)
- ⑨ 1x **BLACK** heat shrink tubing (460mm)

## 2.1. ATTACH THE DIP SWITCHES AND LARGE CHIP

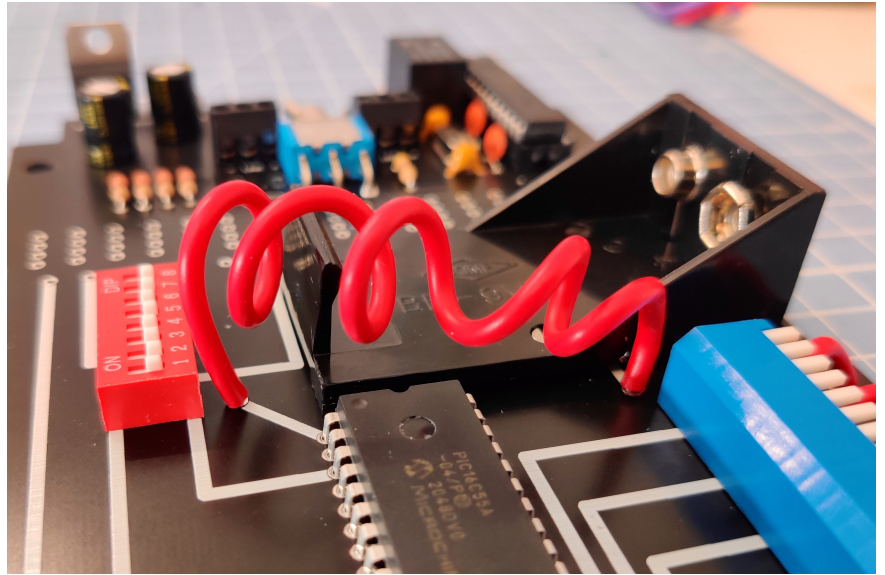
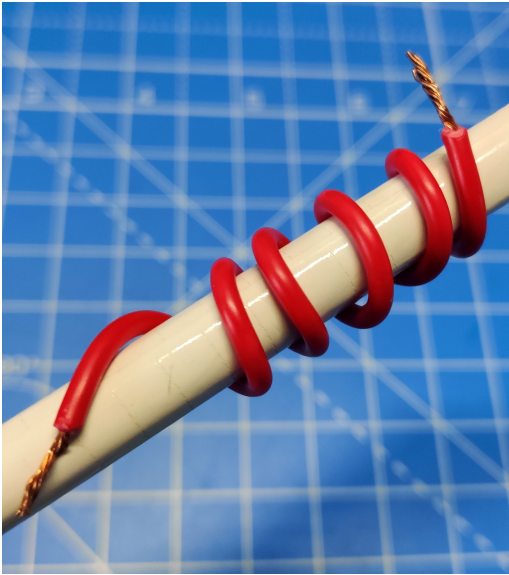


- Attach the **red** 8 position DIP switch, the large **black** controller chip (with the small notch at the top) and the **blue** 12 position DIP switch to the board as shown above. Make sure the white 'piano keys' on the blue switch are on the right-hand side.

## 2.2. ATTACH THE RED WIRES



- Using the 320mm length of **red** amp wire, cut four **30mm** sections and put the rest aside.
- Strip a couple of millimetres of shielding away from each end of the four wires, twist the bare wire tightly and attach using the four holes closest to the blue DIP switch. Solder or hot glue as usual.
- Once in place, bend each wire over and secure to the opposite four holes.



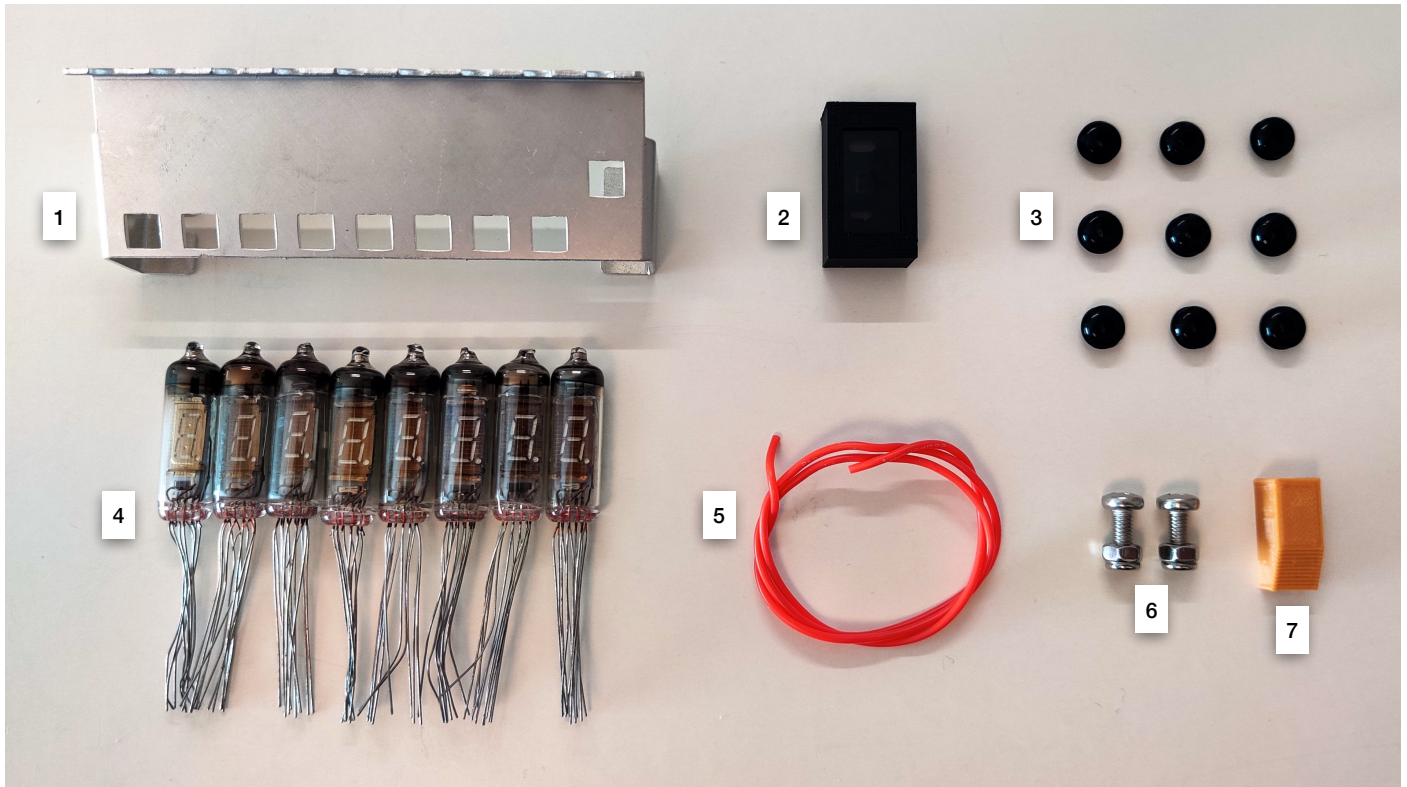
- Using the remaining **red** amp wire (this should be about 200mm), strip about 8mm of insulation from each end. Create a new coiled wire by wrapping it around a rod. This should be proportionately larger in appearance to the one on the daughterboard, so use a thicker rod such as a marker or larger paintbrush.
- Slide the coiled wire off the rod and insert the bare ends into the two holes on the board as shown above.
- Solder into place, or fold the ends of the wire over and hot-glove to the back the board.

### 3. ADD THE DISPLAY SHELF AND TUBES

#### PARTS REQUIRED FOR THIS SECTION

All the parts needed for this section are shown in the photos below. All the components you need can be found in the bag labeled **GIZMO - DISPLAY SHELF** and **GIZMO - VFD TUBES**. You will also need the **LED BOARD** with attached wires that we assembled earlier.

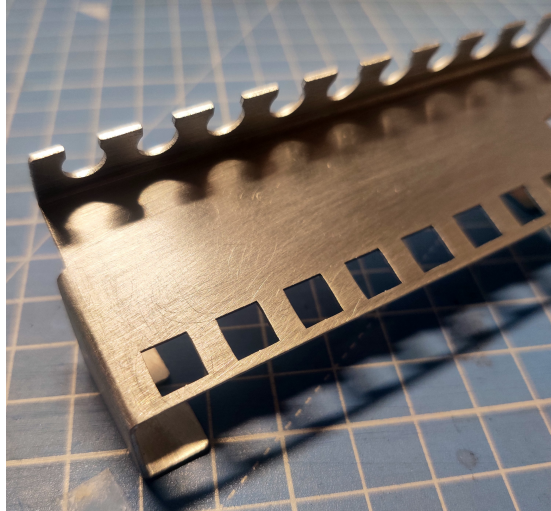
Using the following list, find each part in your kit bags and set them out on your workbench:



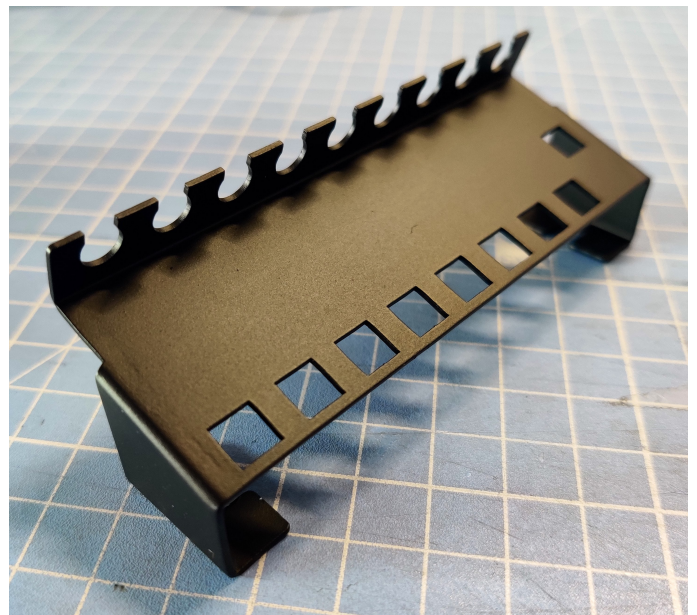
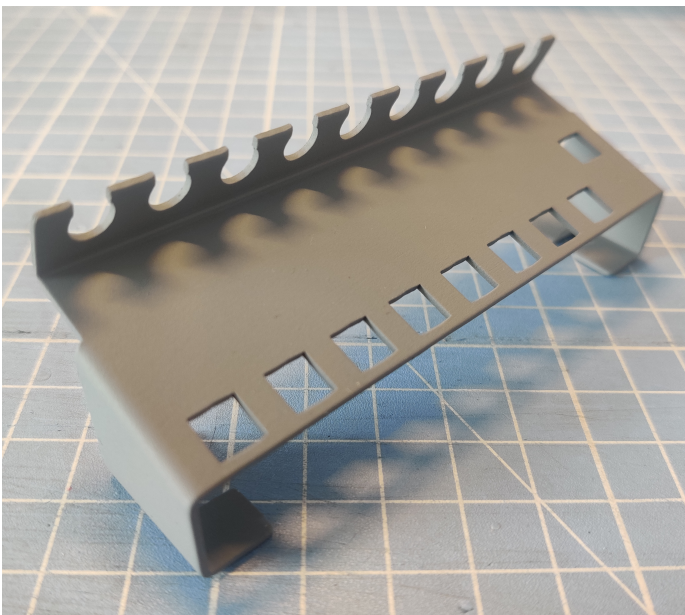
- ① 1x Aluminium display shelf
- ② 1x Error box
- ③ 9x Rubber grommets
- ④ 8x Glass VFD tubes
- ⑤ 1x RED silicone wire (38cm)
- ⑥ 2x M4 Bolt (10mm) + Lock Nut
- ⑦ 8x Shelf installation tool

### 3.1. PAINT THE NIXIE SHELF (Optional)

The brand new display shelf in the 8920 kit is made from a single piece of aluminium. While you can use this as it is, it more accurate and better cosmetically if this is painted black. For best results, we recommend using a matt or satin black automotive spray paint. As you are painting bare metal, be sure to use an **etch** primer before applying the black top coat, otherwise the paint is unlikely not last and will chip and peel very easily. An etch primer creates an ideal surface for the paint to adhere to for a lasting, durable finish. In the UK, we recommend the Halfords spray cans indicated below, although equivalent products are available globally.

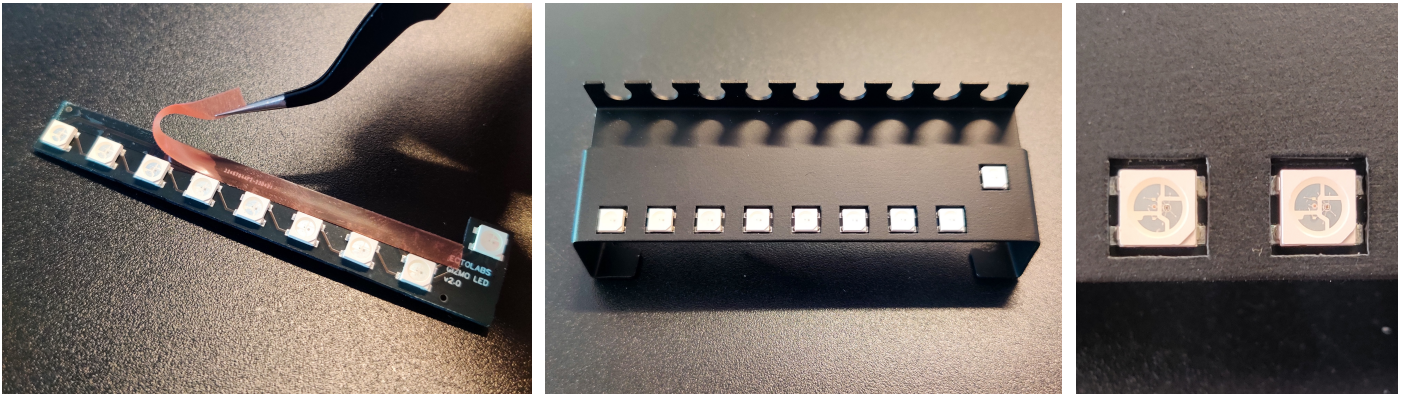


- Before painting, we must first remove the dull oxidised top layer from the aluminium. Using a fine grit sandpaper (we have used 400-500 grit), lightly sand the shelf. You do not need to be too meticulous about this, but make sure all areas are scuffed enough to give the primer enough of a 'bite' when spraying. This should result in a shinier appearance as shown in the second photo above.
- Prepare the shelf for painting by hanging it from one of the legs. If you do not have a spray booth, a cardboard box and a piece of wire will work just as well.
- Apply two coats of primer according to the instructions on the side of your can, making sure to leave enough time between coats and leave to fully dry.



- With your shelf now primed, you should have a nice smooth surface ready for painting.
- Use the same method above to spray two coats of black paint and leave to fully cure before continuing. Make sure the paint covers all parts of the shelf, including underneath and inside the square cutouts.

### 3.2. ATTACH THE LED BOARD



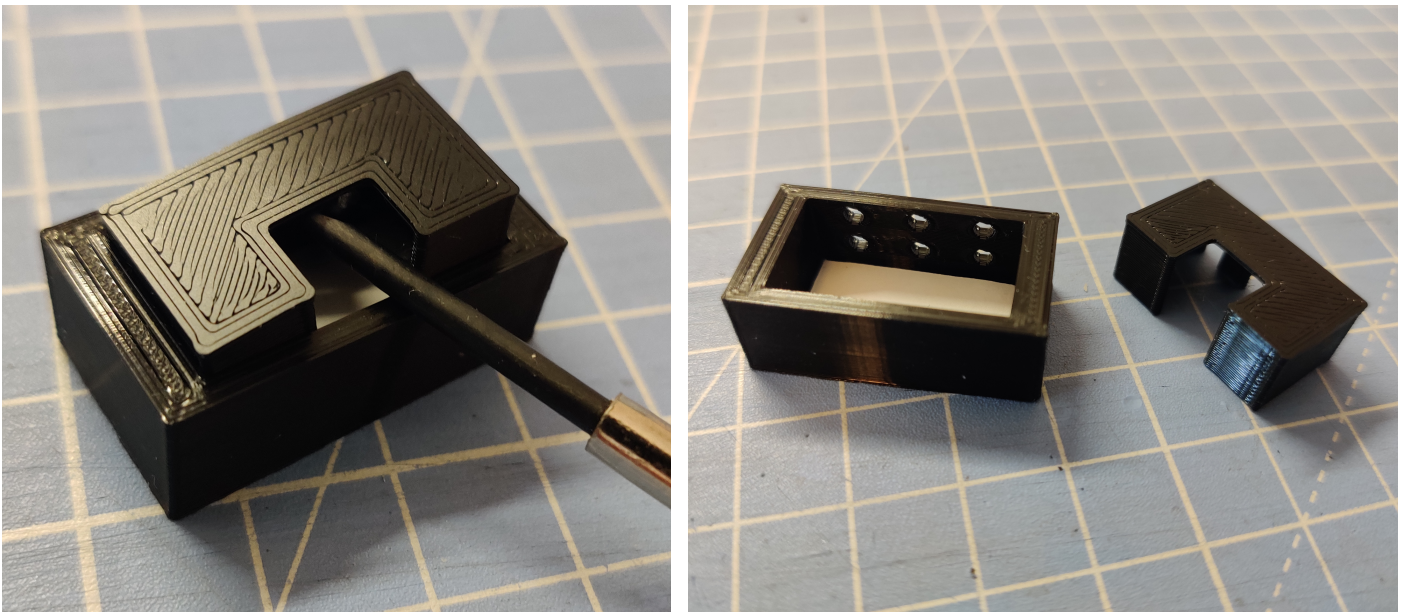
- Retrieve the LED board you assembled earlier. You will see a pre-installed strip of high strength double sided tape. Remove the protective plastic with tweezers.
- Position the LED board on the underside of the shelf so that the LEDs sit inside the square holes. Make sure that it is perfectly aligned and that none of the silver contacts next to the LEDs are touching the shelf itself as shown in the third photo above.



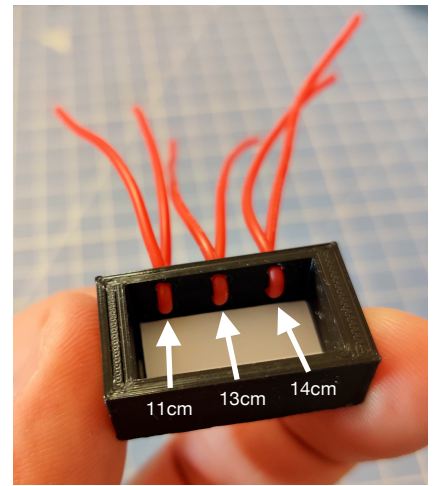
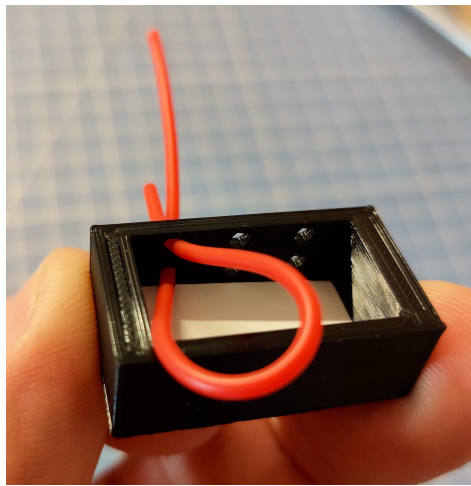
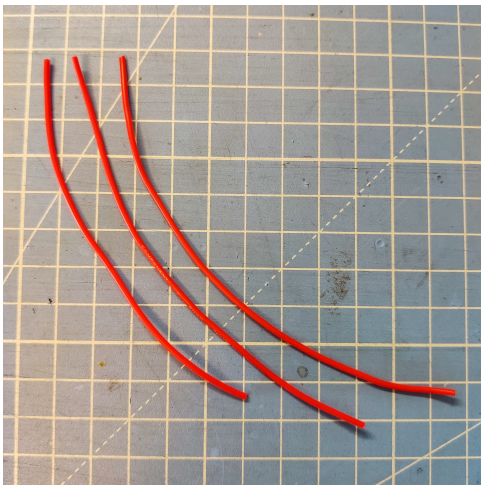
**IF YOU HAVE NOT PAINTED THE SHELF...** As aluminium is conductive, it is essential that it is not touching any of the small copper pads next to the LEDs otherwise this could interfere with the electronics and cause a short circuit. In this case, we recommend adding some electrical tape to the underside of the shelf, in between the holes to prevent any accidental shorts.

- Once you are happy with the positioning, apply pressure to the LED board to stick it into place.

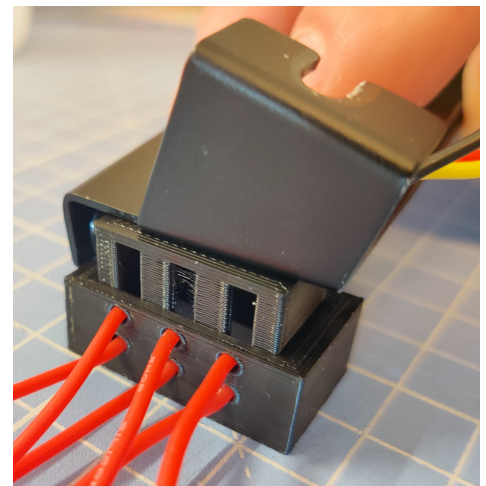
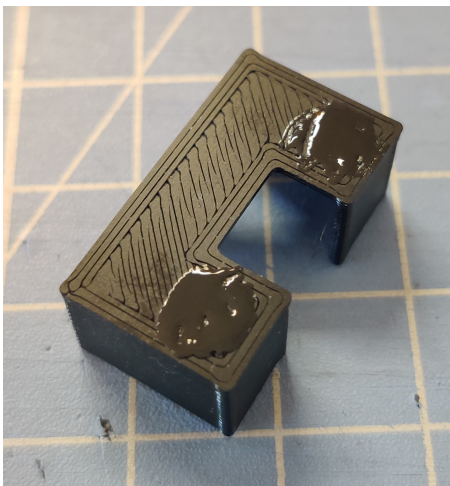
### 3.3. ATTACH THE ERROR BOX



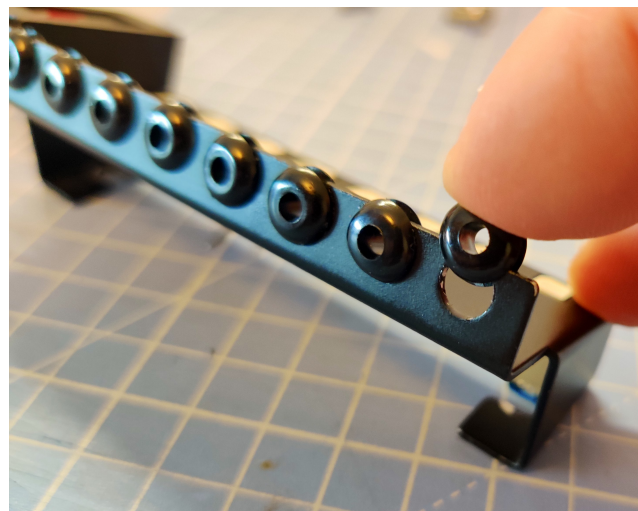
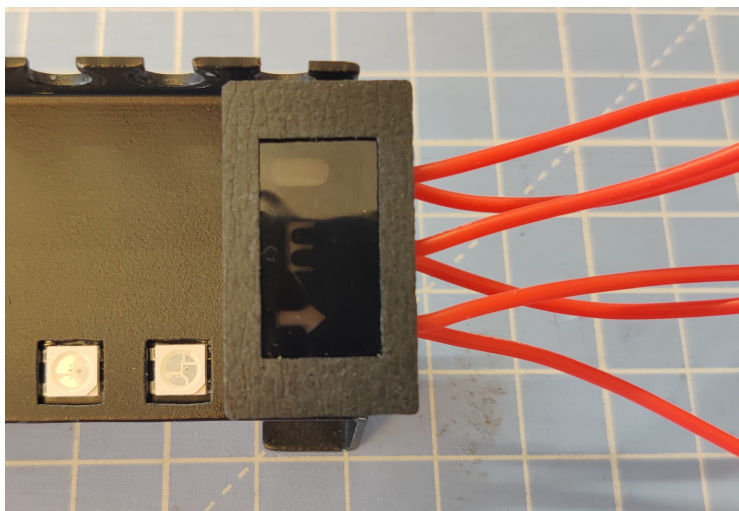
- Flip the Error Box upside down and use a small screwdriver to carefully lift out the 3D printed inner section. Keep the box upside down as there is a loose light filter, mask and paper diffuser inside which need to remain in place.



- Cut the red silicone wire into three sections. The first should be **14cm**, the second **13cm** and the third **11cm**.
- Thread the **shortest 11cm** section of wire and thread each end through the **first** two holes in the Error Box as shown in the second photo above. Pull the wire through until both ends are sticking out the side of the box. Make sure each end is of equal length.
- Repeat for the **13cm** section through the **second** two holes, and then for the the **longest 14cm** section through the **third** two holes as shown above.

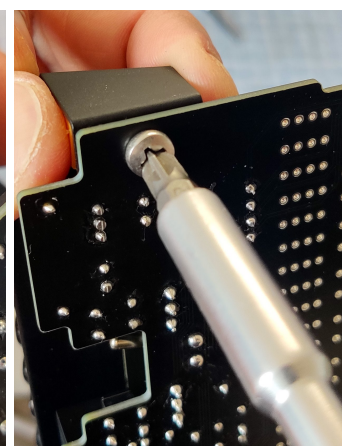
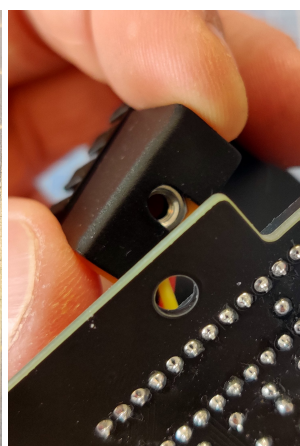
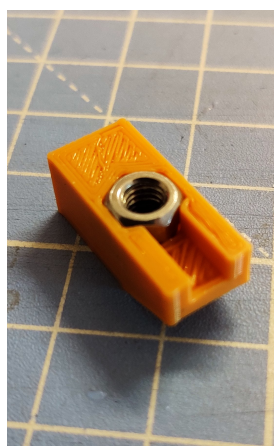
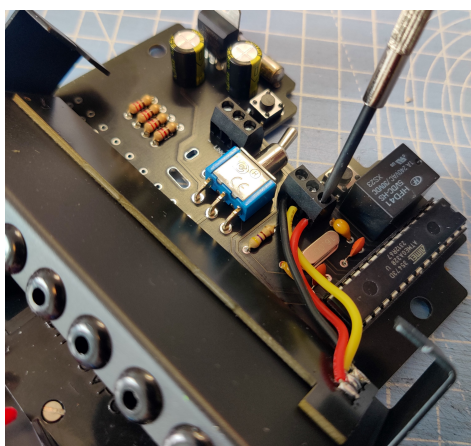


- Now flip over the 3D printed box insert and apply a very small amount of epoxy glue to the two areas shown above. Be liberal with this as applying too much will create an ooze with unsightly glue in visible areas of the shelf. You could use super glue here, but you may find that the box may come away from the painted surface too easily.
- Line up the cutout in the insert with the LED on the rightmost end of the display shelf as shown in the second photo above, making sure it is as vertically straight as possible. Wait until the glue fully cures before continuing.
- With the insert now fixed in place, flip the display shelf over and carefully push the insert into the Error Box, making sure that the loose parts inside the box are intact.



- Flip the entire shelf back over and give the Error Box a final press so that it remains firmly in place.
- Finish off the shelf assembly by adding the nine rubber grommets. Press one into each notch until they lock into position.

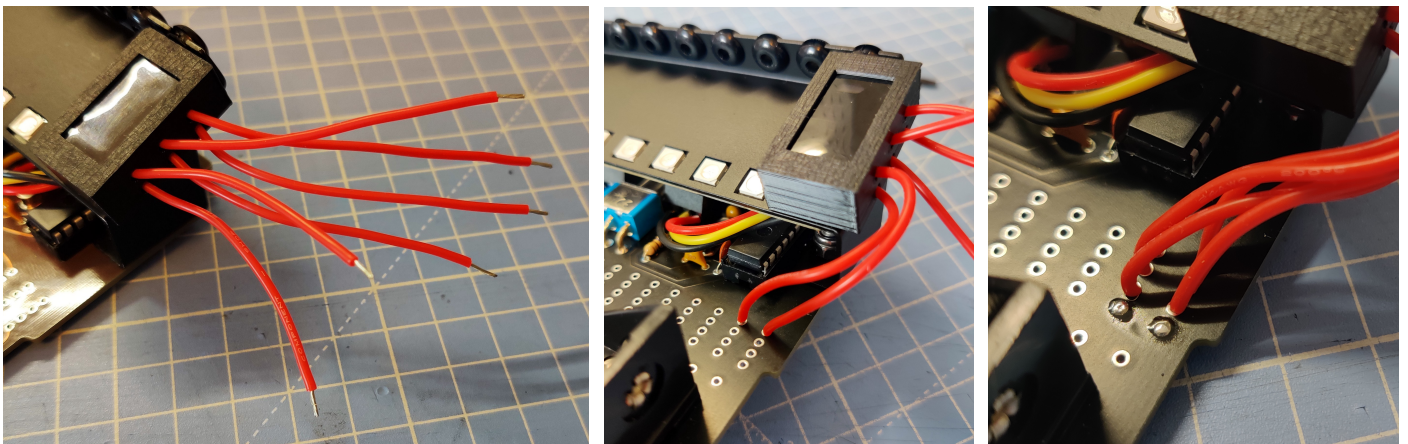
### 3.4. MOUNT THE DISPLAY SHELF



- Connect the wires from the LED board to the screw terminal labeled 'LEDs' on the mainboard. The **black** negative wire goes to '-', the **yellow** data wire to the centre, and the **red** positive wire to '+' as shown above.
- The arrangement of components that sit underneath the shelf make it tricky to access the screw holes in the board. Therefore, we have included an orange 3D printed installation tool to help grip the lock nut. Insert one of the M4 lock nuts into the hexagonal hole in the tool. Be sure that the circular side of the nut with the inner nylon ring faces down into the tool.
- With your thumb and forefinger, hold the tool behind the top of one of the shelf feet so that the nut lines up with the slot in the foot.
- Now place the foot over the corresponding mounting hole in the mainboard. Screw one of the M4 bolts through the hole and into the nut. Tighten the bolt with a screwdriver while gripping the sides of the installation tool with your fingers - this will hold the nut in place while you tighten. When done, singly lift the tool away from the nut and slide the tool out.



- Repeat the previous steps with the second nut and bolt. You should now have the completed shelf assembly securely in place on the mainboard as shown above.

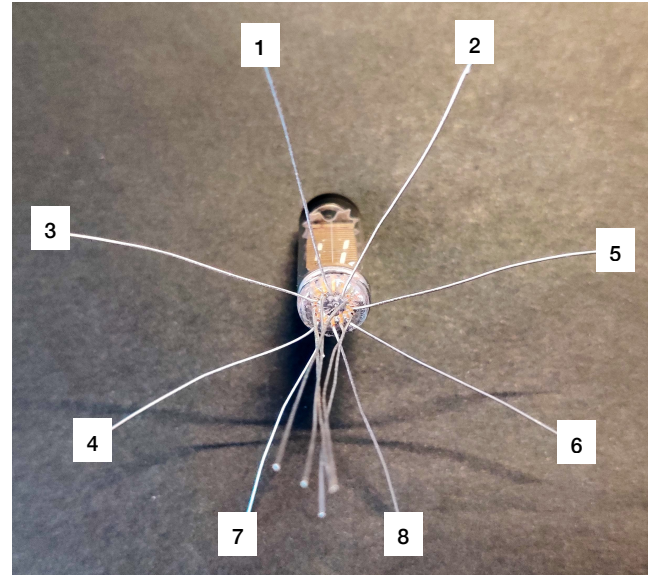
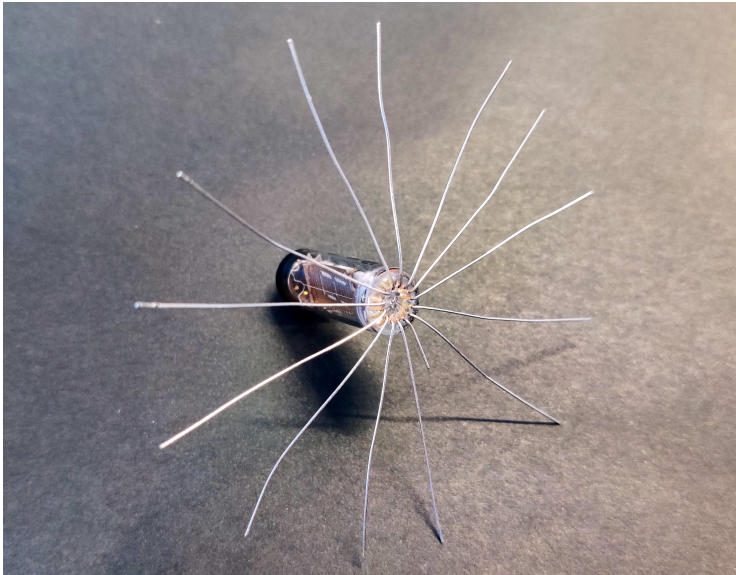


- Strip about 2mm of shielding from each of the Error Box's silicone wires.
- Starting with the first wire on the bottom row of wires, feed the bare end into the top-left hole of the final group of eight holes on the mainboard. Feed the wire directly above this into the top right of the group. This is demonstrated in the second photo above. Solder both wires to the back of the mainboard.
- Repeat for the remaining four wires so that all six wires are soldered to the board.
- The frontmost holes on the board are not used, so add a couple of blobs of solder as shown in the third photo above.

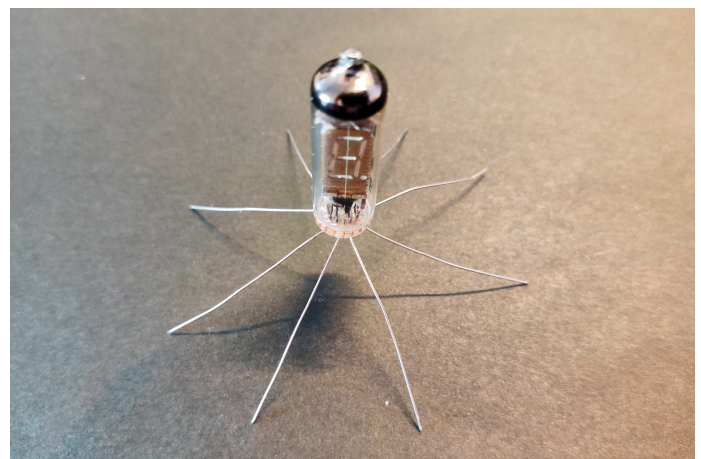
### 3.5. PREPARE THE VFD TUBES

Your kit contains 8 genuine vintage glass VFD tubes. Although we won't be able to light the numbers up themselves, the glass tubes will reflect the light from the LEDs underneath to create an awesome looking effect.

It's worth noting that, depending on availability, the exact model of the nixie tubes can differ slightly from kit to kit. Their appearance may have minor differences to those shown in the following photos, but they will always be the correct size and will always be shipped together in a matching set of eight.



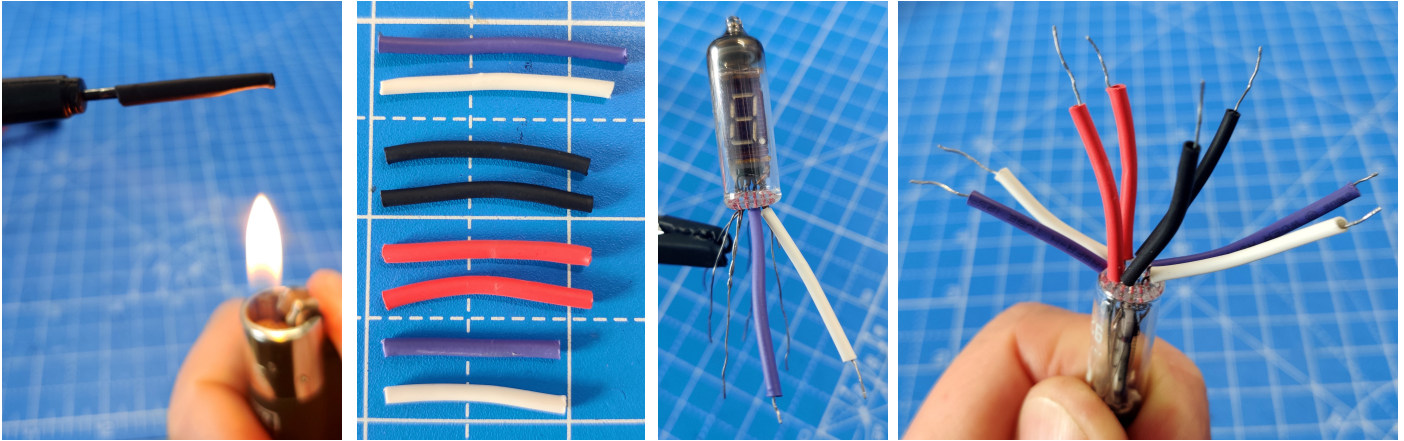
- Using one tube, separate and fan out each of the wires as shown in the first photo. Note that the number of wires attached to a tube can vary, so don't worry if yours has more or less than that shown above.
- We need to reduce the number of wires to just **EIGHT**. To do this, face the fan of wires towards you with the number segment of the tube facing upwards. Start by selecting the two wires that best create a V shape pointing upwards (as indicated by '1' and '2' in the second photo above). Then mirror this at the bottom with two wires pointing downwards (indicated by '7' and '8'). Next, repeat this with two wires pointing to the left (indicated by '3' and '4') and finally two wires pointing to the right (indicated by '5' and '6').
- Bunch all the other unselected wires towards you so the eight wires we will be using are clearly visible.



- With your wire cutters, snip off all the unwanted wires that you have bunched together. Be very careful not to remove any of the eight wires still fanned out as we will need these to attach to the motherboard.
- Once done, you should have a tube that looks like that in the second photo above with eight wires neatly spaced.
- Repeat this process for all the other seven tubes in your kit.

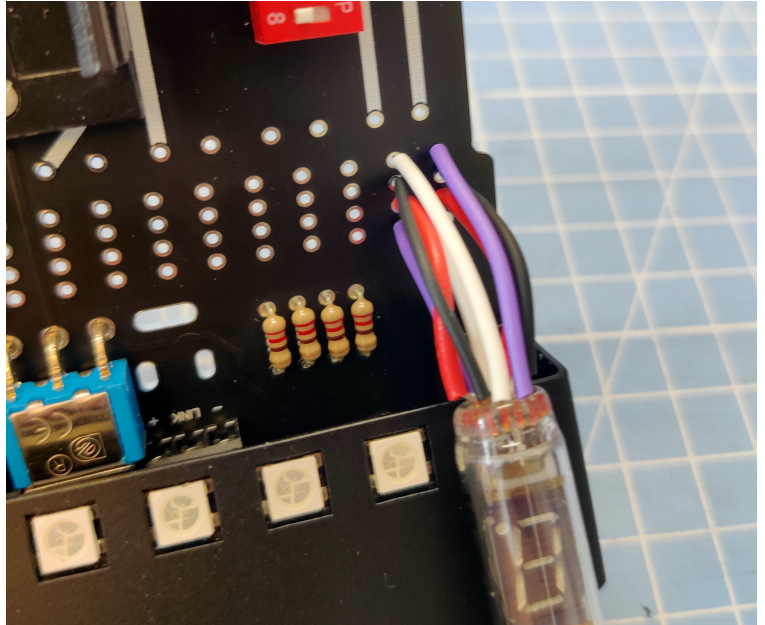
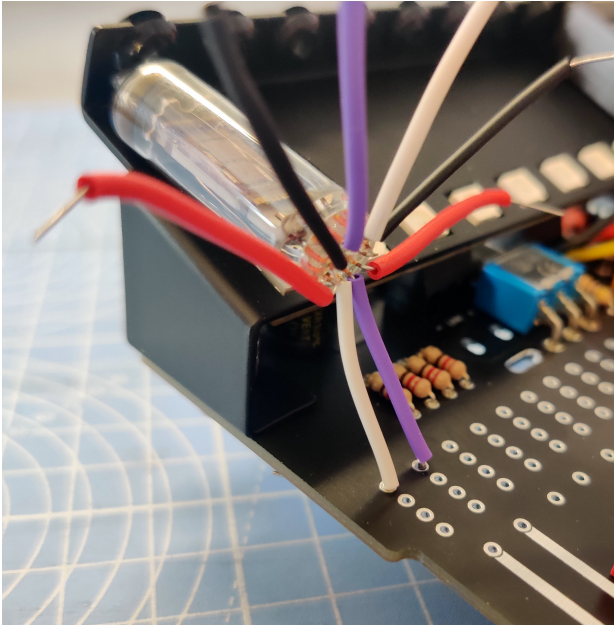
### 3.6. ADD THE COLOURED HEAT-SHRINK

Before we can mount the tubes to the shelf and attach them to the motherboard, we must add colour to the wires.

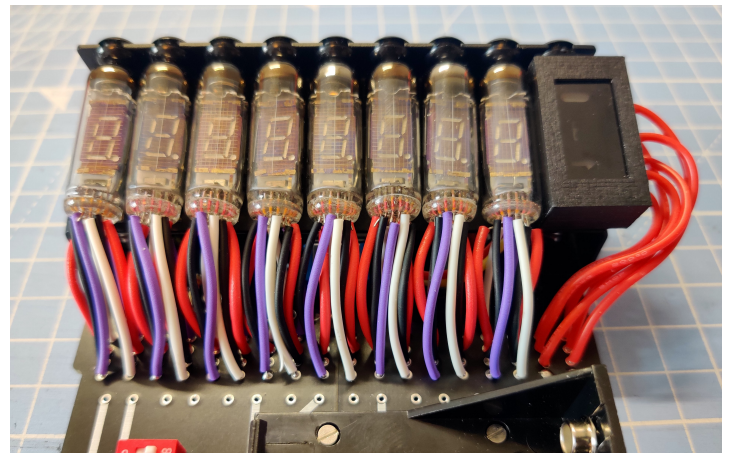
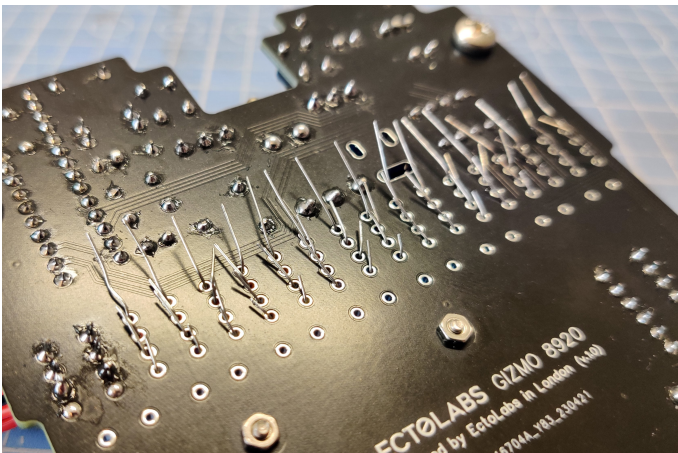


- From the **purple**, **black**, **red** and **white** lengths of heat shrink tubing, cut the following sections:
  - 2x 26mm **Red**; 2x 27mm **Black**; 1x 30mm **White**; 1x 30mm **Purple**; 1x 22mm **White**; 1x 22mm **Purple**
- Place a section of tubing over a wire or the end of a small screwdriver, and use a heat source to shrink it down. You can use a heat gun or lighter for this. If using a naked flame, be careful the tubing does not touch it, otherwise it will burn. Hold the lighter directly underneath and at a distance and apply even heat until the tubing is reduced to half its original size. Repeat for the remaining seven sections of tubing.
- With the display digit of one VFD tube facing you, arrange the eight wires into pairs from front to back.
- Slide the **longest** 30mm pieces of heat-shrink tubing over the front two wires. Place the **purple** one on the left and the **white** on the right as shown above.
- For the second two wires, repeat the process with the 27mm **black** tubing. For the third two strands, use the 26mm **red** tubing, and for the final two use the shorter 22mm tubing (alternate the **purple** and **white** so they are opposite to those at the front). The completed VFD tube should look like the last photo above.
- Repeat the process for the other seven VHD tubes.

### 3.7. MOUNT THE VFD TUBES



- To attach the first tube to the motherboard, feed the **back two purple** and **white** wires into the top two holes of the first cluster of eight holes as shown in the second photo above. Once fully inserted, bend the wires over on the back of the board to prevent them from slipping back out. As you do so, push the top of the glass tube into the first rubber grommet - this will help keep the tube in place as you insert the other wires.
- Now hold the board upside down in your hand and guide the **red** wires into the next two holes, followed by the **black** wires into the next two, and finally the longer **purple** and **white** wires into the front two holes.



- Once all of the wires are in place, gently rotate the tube until the digit appears straight, facing directly upwards.
- You can now choose to either solder (or hot glue) the wires into place now, or attach the rest of the tubes first and secure them all in one go. If opting for the latter, bend the wires over on the back of the board to prevent them from slipping back out (as shown in the first photo above).
- Repeat the process until all eight VFD tubes are mounted on the shelf.
- Secure the wires if you haven't already. Cut them short and solder as usual, or keep them bent over and apply a generous amount of hot glue over the ends of the wires to keep them in place.

## 4. ADD THE FINAL COMPONENTS

We're now on the home straight! Just a couple steps...

### 4.1. ATTACH THE DISC CAPACITORS



- Before adding the eight orange disc capacitors, we need to remove the kink in their wires. You can do this by bending the wires with a pair of pliers until they appear straight. This does not need to be neat - just enough so the wires slide through the holes unobstructed.
- Add each disc capacitor through the holes directly in front of the VHD tube wires. Finish off by shortening the wires and soldering (or hot gluing) into place in the usual way.



To help attach the disc capacitors and keep them lined up, you can push the body of each capacitor back so they rest on the tube wires. Use some tape to hold them in position as you flip the board over and solder or glue to the wires to the back.

### 4.2. LINK THE DAUGHTERBOARD

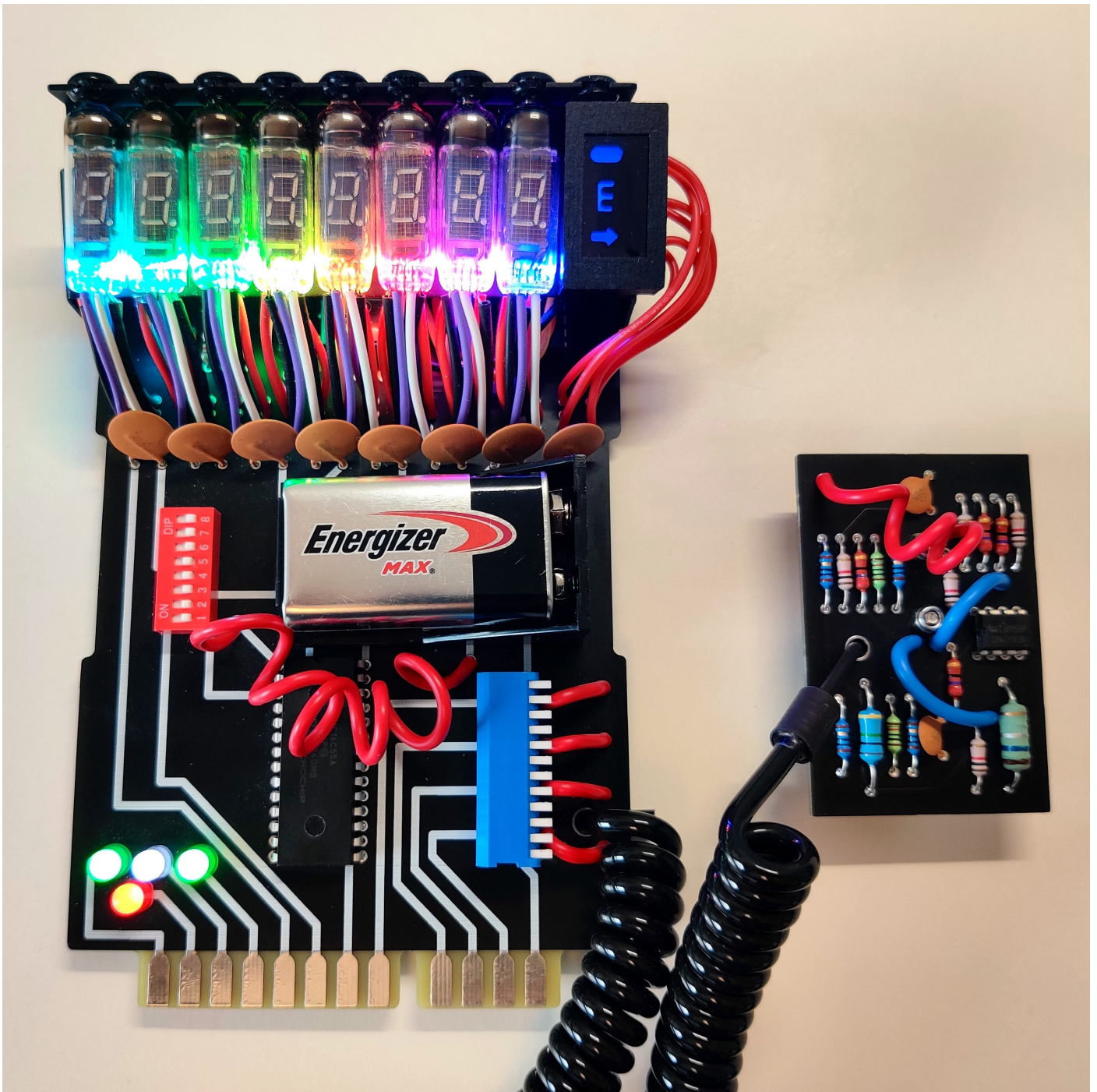
This is it! This is definitely it!



- Dust off the daughterboard and thread the loose end of the coiled cable through the large hole in the bottom right edge of the motherboard.
- The cable should be rigid enough to remain in place, yet easy to detach whenever you need.

## YOUR GIZMO 8920 IS COMPLETE!

Congratulations!!! You've done it! Your GIZMO 8920 is finished! Continue to the next section for the full operating instructions...



# OPERATING INSTRUCTIONS

Using the Gizmo lighting effects is simple. Once you have connected a 9V battery to the snap, flick the toggle switch to power on. The LEDs behind the VFD tubes (plus one inside the Error Box) will immediately display a pattern of light which will loop continuously. You may then press either of the two buttons underneath the display shelf to change the lighting pattern or LED colour:

Looking down at the Gizmo when mounted on your belt, pressing the **right** button will cycle through the following patterns:

1. **“CHASE”** — A fast chasing pattern from left to right across the shelf in the currently selected colour, followed by a quick flash of the Error Box in red.
2. **“WIPE”** — Each tube is illuminated in the currently selected colour - one-by-one from left to right and immediately turned off one-by-one in the same way. The Error Box lights up in red for a full second.
3. **“BOUNCE”** — Each tube is illuminated in the currently selected colour - one-by-one from left to right and then from right to left. This is looped to simulate a bouncing motion. The Error Box illuminates in red quickly after every five cycles.
4. **“PULSE”** — A pulsating fade-in and fade-out of all tubes and the Error Box together in the currently selected colour.
5. **“RANDOM PULSE”** — A pulsating fade-in and fade-out a single tube in a random sequence using the currently selected colour. The Error Box remains on in red.
6. **“SPARKLE”** — Individual tubes flash quickly at random in the currently selected colour. The Error Box remains on in red.
7. **“STRETCH”** — Individual tubes are illuminated one by one from left to right and are turned off again from right to left. The Error Box remains on in red.
8. **“CENTRE FAN”** — Illuminated tubes fan out from the centre. The Error Box remains on in red.
9. **“STEADY ON”** — All tubes are turned on at full brightness in the currently selected color. The Error Box remains red. There is no motion effect in this mode.
10. **“RAINBOW”** — All nine LEDs display a continuously changing pattern in a full spectrum of colours. This mode overrides the currently selected colour.

Pressing the **left** button will cycle through all of the available colours. Changing the colour during a running pattern will restart that pattern. The pre-programmed colours are:

- |                  |                     |                  |
|------------------|---------------------|------------------|
| 1. <b>RED</b>    | 4. <b>GREEN</b>     | 7. <b>PURPLE</b> |
| 2. <b>ORANGE</b> | 5. <b>TURQUOISE</b> | 8. <b>PINK</b>   |
| 3. <b>YELLOW</b> | 6. <b>BLUE</b>      | 9. <b>WHITE</b>  |

To power off the Gizmo, flick the toggle back to its original position. The microcontroller will remember your last selections, so whatever pattern and colour you used previously will illuminate immediately when powering back on.

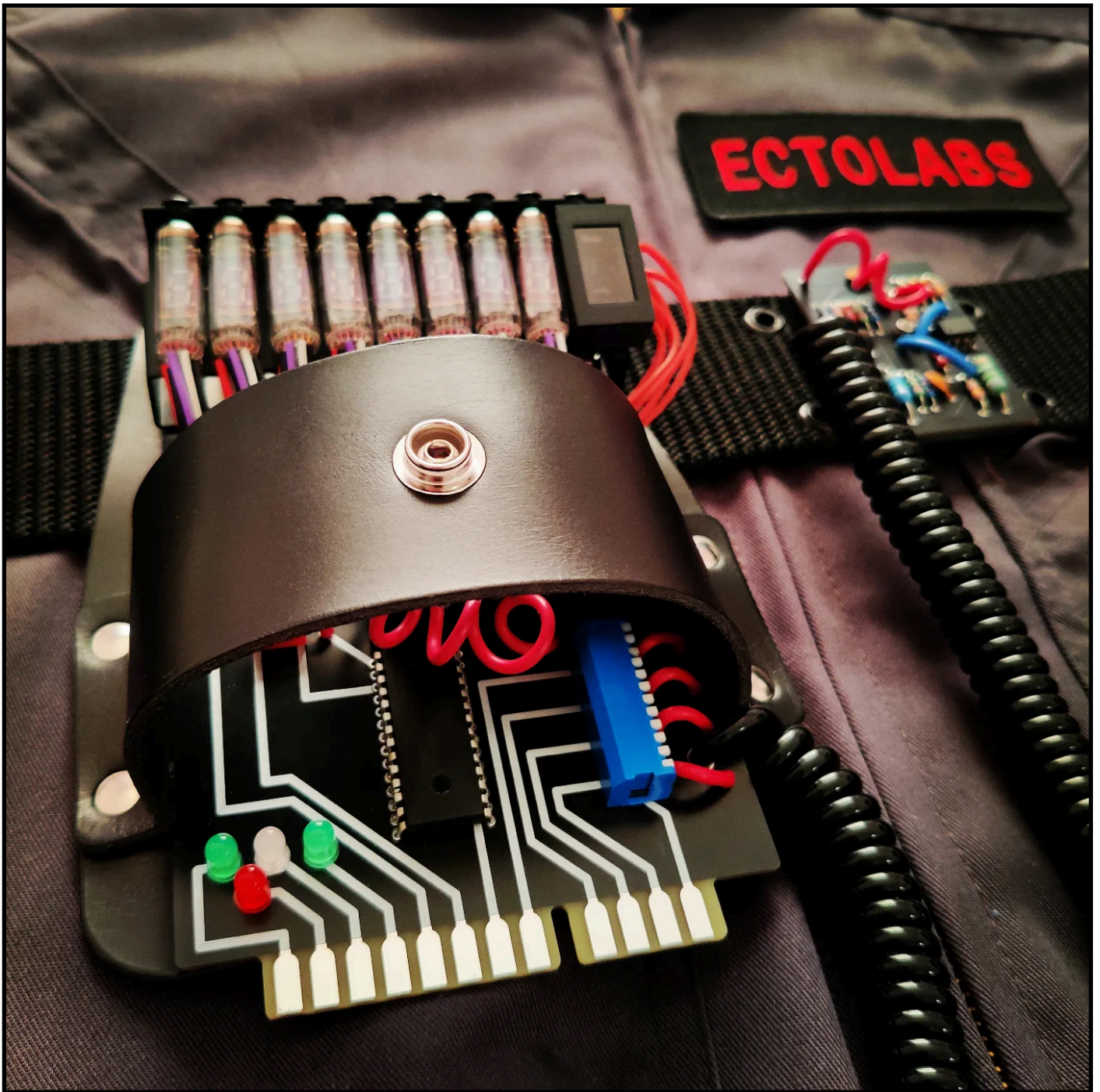


**If the lighting effects do not appear to be working or you see only a flashing red Error Box, try pressing both buttons simultaneously to reset to the default patterns.**



**IMPORTANT: Make sure you are using a fresh battery with your Gizmo. Depleted or semi-depleted batteries may cause the lighting effects to behave erratically or not display at all.**

THANK YOU SO MUCH FOR PURCHASING THIS KIT. WE HOPE YOU HAVE ENJOYED THE BUILD  
AND THAT IT BRINGS YOU MANY HAPPY YEARS OF PARANORMAL ELIMINATION!



Kit designed and assembled in London  
by David Tremain, 2023

# ECTOLABS

[www.ectolabs.net](http://www.ectolabs.net)