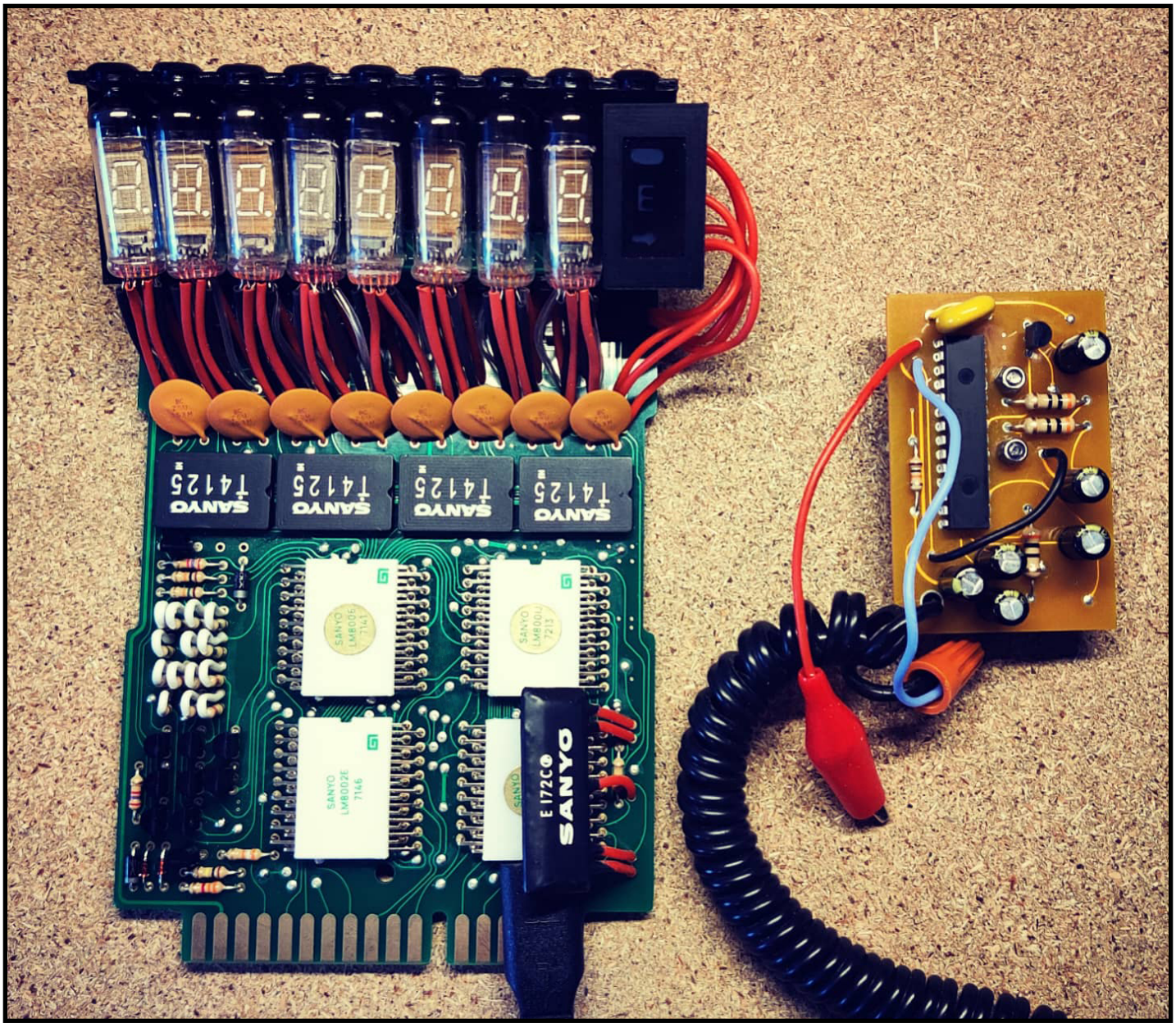
ECTOLABS

GIZMO 8410



Kit Assembly Guide & Operating Instructions

v1.2 – FOR KITS PURCHASED FROM JULY 2022

The **ECTOLABS GIZMO 8410** kit is a faithful recreation of a Sanyo ICC-808D calculator circuit board assembly - used as costume accessories in the early stages of filming for *Ghostbusters* in 1983.

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-glue 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**

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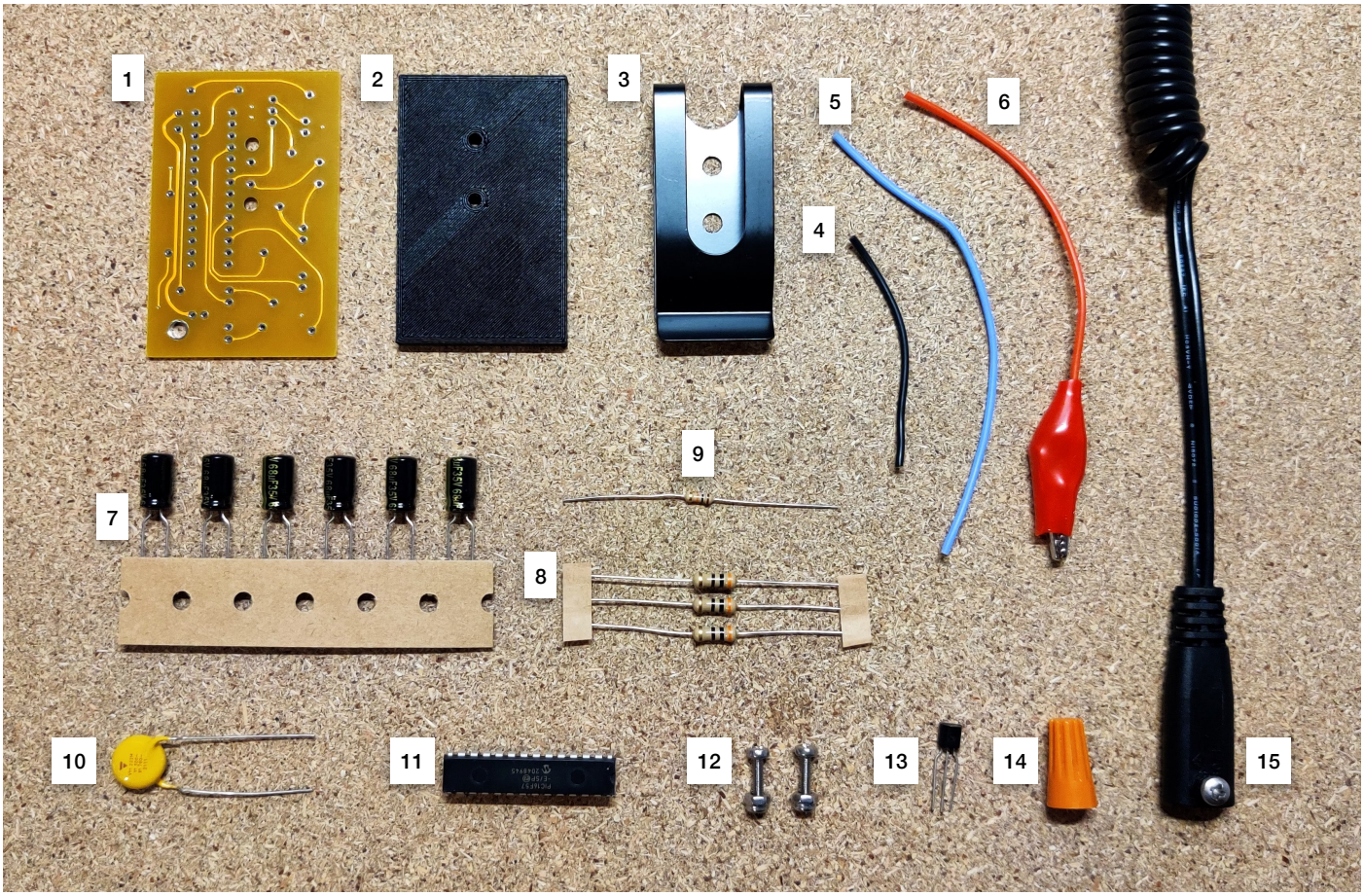
DAUGHTERBOARD ASSEMBLY

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

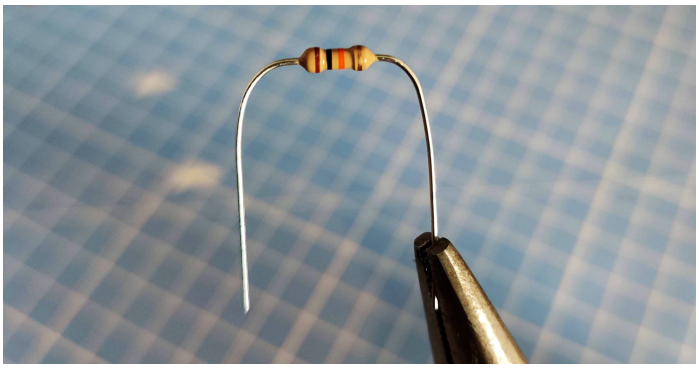
All the parts needed for the daughterboard assembly are shown in the photo below. Using the following list, double-check you have all of the parts from the bags in your kit and set them out on your workbench:

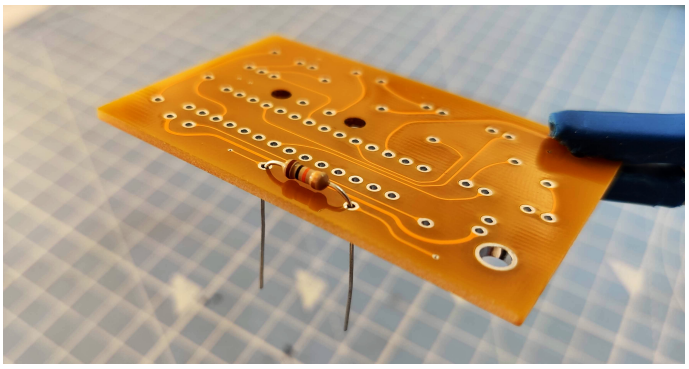


① 1x **Daughterboard PCB**
② 1x **Back panel**
③ 2x **Belt clip**
④ 1x **2" BLACK silicone wire**
⑤ 1x **4" BLUE silicone wire**
⑥ 1x **RED silicone wire + crocodile clip**
⑦ 6x **Black/gold aluminium capacitors**
⑧ 3x **30 Ω resistors [ORANGE-BLACK-BLACK-GOLD]**
⑨ 1x **10K Ω resistor [BROWN-BLACK-ORANGE-GOLD]**
⑩ 1x **Yellow disc capacitor**
⑪ 1x **Black 28-pin controller chip**
⑫ 2x **M2.5 10mm bolts + M2.5 lock nuts**
⑬ 1x **NPN transistor**
⑭ 1x **Orange wire nut**
⑮ 1x **Coiled cable + bolt and spacer**

1. ATTACH THE RESISTORS, CHIP AND TRANSISTOR

The resistors are the small tan coloured components fixed in the centre of a short length of silver wire. Each one has a four band colour code around the outside. Your kit contains various resistors in specific quantities (all with different colour codes) so make sure you select the right ones for the section you are working on.

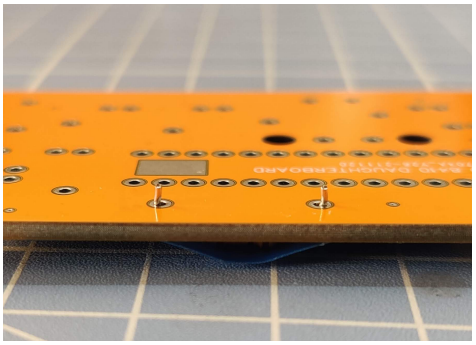


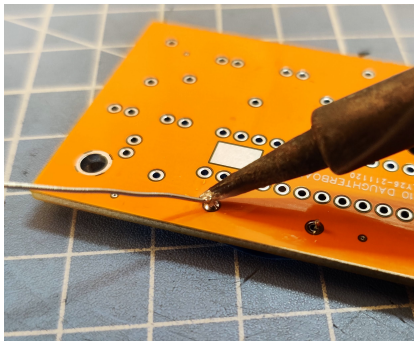


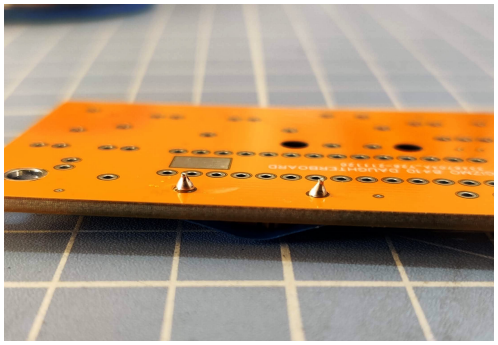
- Firstly, grab the daughterboard along with the small 10K Ω resistor **[BROWN-BLACK-ORANGE-GOLD]**
- Using pliers or your fingers, gently bend both ends of the resistor wire to a 90 degree angle.
- Thread both ends of the resistor through the two holes in the daughterboard as shown in the photo above. Be sure to double-check the orientation of the board - **the brighter yellow side with 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 with the gold bands in the same position.

IF YOU ARE USING A SOLDERING IRON:

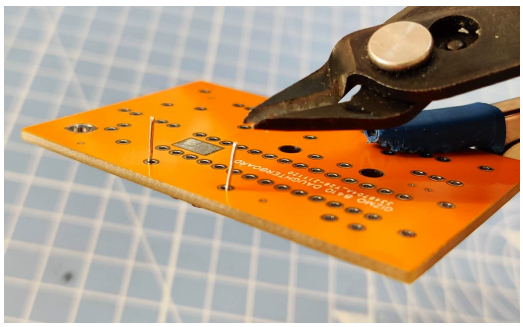


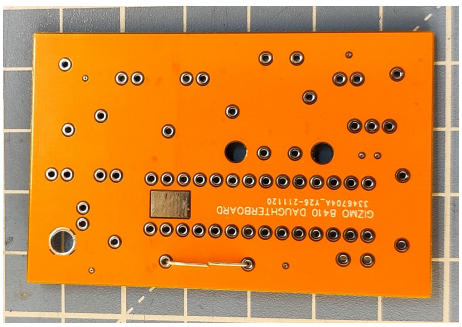


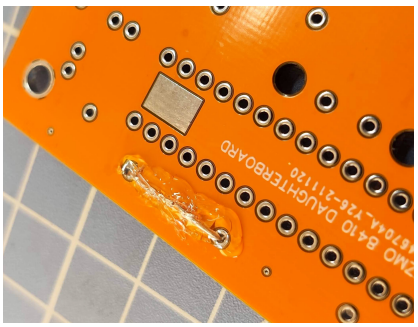


- Place some tape over the resistor to keep it in place and flip the board over.
- With your wire cutters, cut down each end of the wire leaving about 2-3mm.
- Use your soldering iron to apply solder around the ends of the wires. Make sure the solder flows all the way around the wire and over the surface 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:



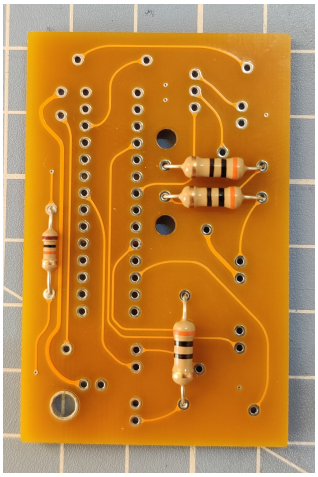
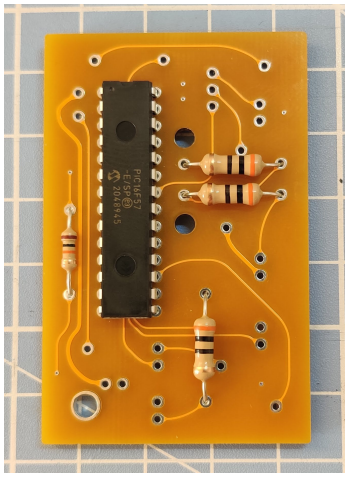
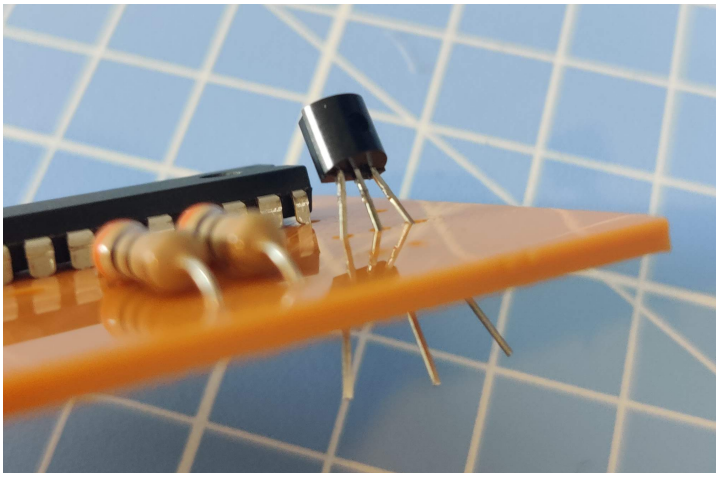




- With your wire cutters, cut down each end of the wire leaving enough to be able to folded over against the back of the daughterboard like a staple.
- Bend the shortened wires over until they sit flat on the back of the board as shown in the second photo above.
- Plug in your glue gun and wait until 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.

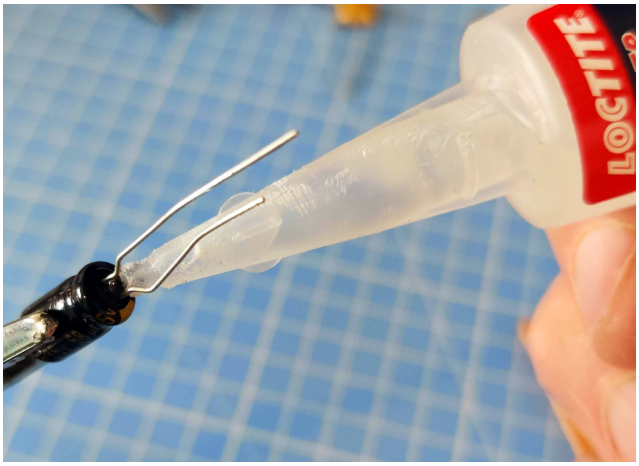
It's easiest to hold the resistor in place with one hand, while you glue with the other. However, be aware that the heat from the glue gun will transfer easily through the resistor itself and may cause it to become very hot, so be careful when handling.

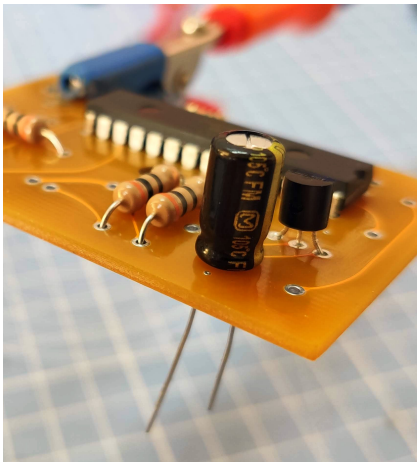
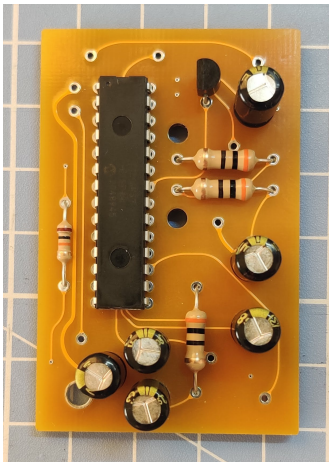
Be very careful when cutting the wires, as the sharp ends can easily fly off in any direction. We recommend using safety goggles to protect your eyes when cutting.

- Use your chosen technique to attach the three larger 30 Ω resistors **[ORANGE-BLACK-BLACK-GOLD]** as shown in the first photo above. Make sure to orientate them in a uniform way.
- Add the long black controller chip by inserting it into the two parallel 14-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. Note that there is a small notch at one end. This notch should be positioned at the **top** when you insert the chip. Solder into place or apply hot-glue along each row on the back of the daughterboard.
- Now add the black transistor to the vertical row of three holes right above the large resistors. Face the flat edge towards the controller chip.
- You may need to spread the three pins to fit the holes. Do this as evenly as you can and push the transistor down until the body hovers above the board by a couple of millimetres. Solder or glue into place. If gluing, the transistor will be more secure if you bend the pins on the back in different directions.

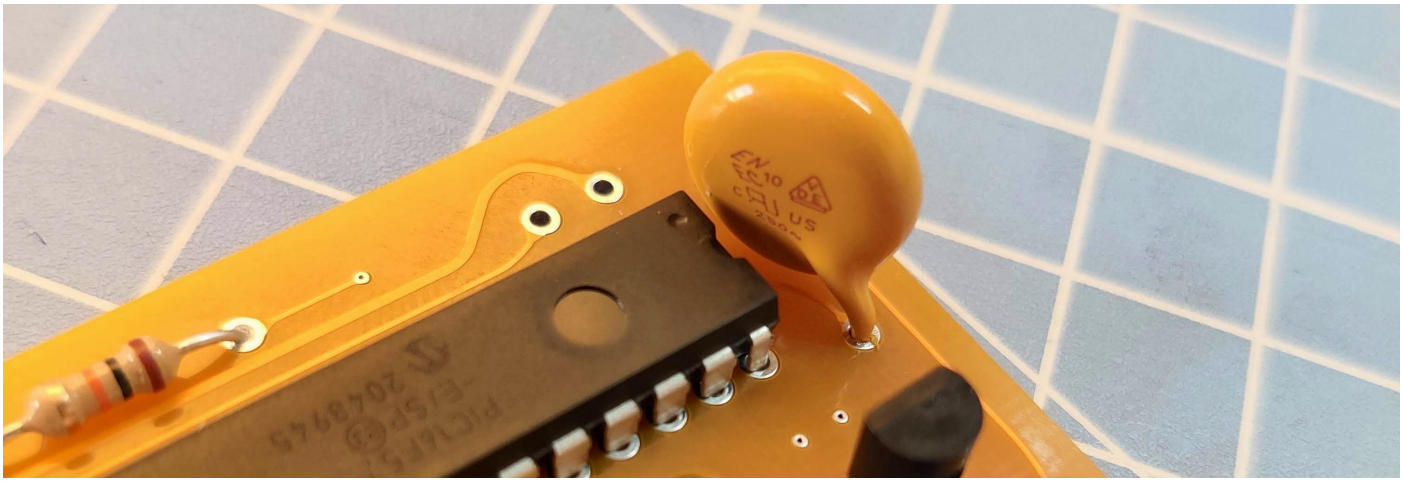
2. ATTACH THE ALUMINIUM CAPACITORS



- Time to add the six black and gold cylindrical capacitors. If they are connected together in your kit, remove the paper and tape before continuing.
- Thread the wires through the holes next to the transistor we just added. Trim the wires according to your mounting method and secure into place with solder or hot-glue. Notice the gold stripe along one side which should be facing towards the top of the board as shown in the second photo above.
- Now add the other five capacitors in the same way. The arrangement of these is shown in the third photo above. Make sure the gold stripes are facing upwards, apart from the one in the cluster of three at the bottom that should be facing to the left.

3. ATTACH THE DISC CAPACITOR



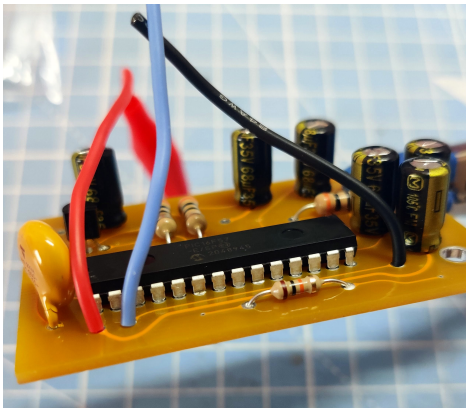
- Just one more component left to add. The yellow disc capacitor fits into the two holes above the controller chip.
- You will probably find that the wires are kinked, so it may help to straighten the wires first with a pair of pliers, or pull the wires through the holes from the bottom until the disc touches the board.
- Trim the wires as we did with the resistors, then either solder or glue to the back of the board.

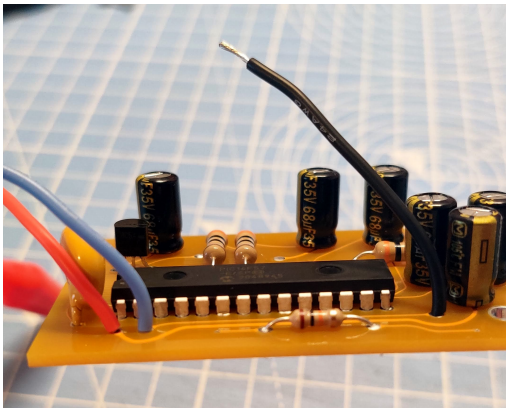
4. ASSEMBLE THE CROCODILE CLIP

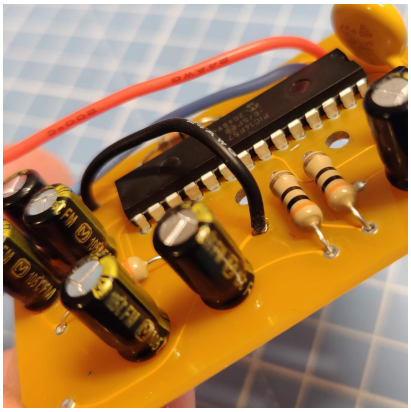
Some kits may already have the **red** wire connected to the crocodile clip. If yours does not, follow the next steps to assemble it:

- Remove the red rubber housing from the clip - it may help to keep the jaws of the clip open using pliers as you slide the housing off. This will reveal a hole and a clasp.
- Slide the end of the **red** wire underneath the clasp and bend the two metal sections down so they press into the wire and hold it securely in place. Replace the rubber housing.

5. ATTACH THE WIRES AND CABLES



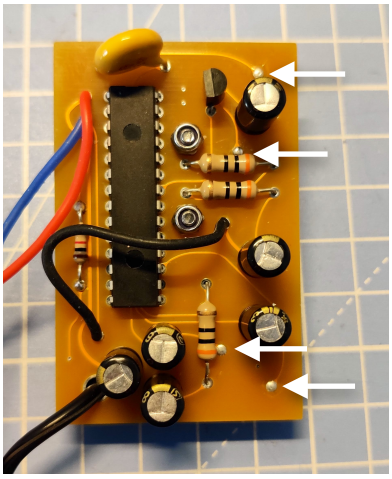


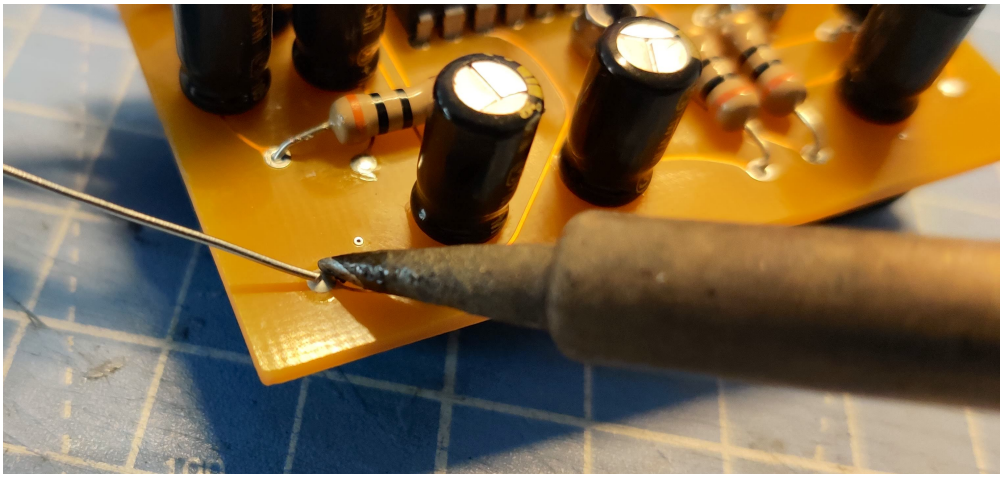


- Next, take the 2” **black** wire, the 4” **blue** wire and the **red** wire (now attached to the crocodile clip). Strip a small amount of the silicone insulation from ONE end of each wire.
- Attach the wires using the three holes shown above. If you are hot-glueing, you may need to strip more insulation away so you have enough exposed wire to glue to the back of the daughterboard.
- Strip the other end of the **black** wire and attach via the hole just below the two large resistors as shown in the third photo above.
- Leave the **blue** wire as it is for the moment - we will secure that shortly.

6. ADD SOLDER BLOBS (Optional)

A small blob of solder can be added to the additional holes found on the board. This is purely cosmetic and is designed to mirror the look of the motherboard. If you are not using a soldering iron, then you may skip this step if you wish.

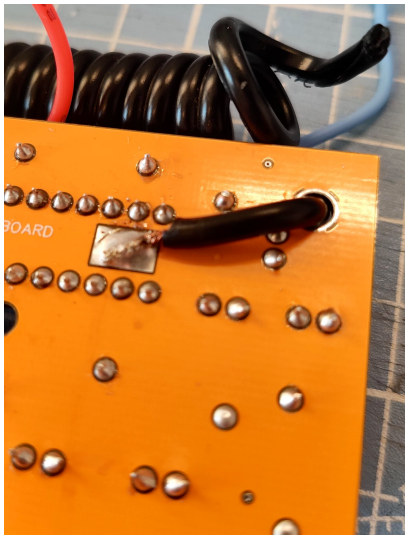


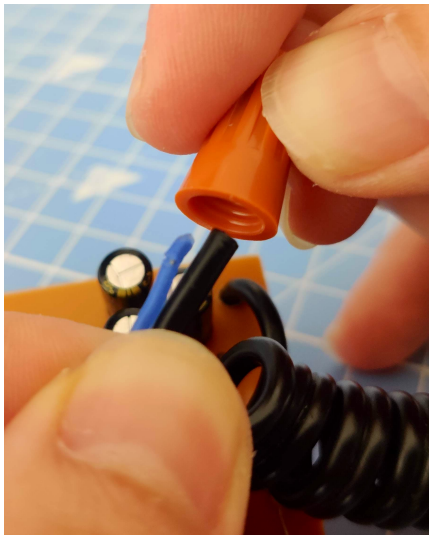


- Add a small amount of solder over the top of the four holes as indicated by the arrows above.

7. ATTACH THE COILED CABLE



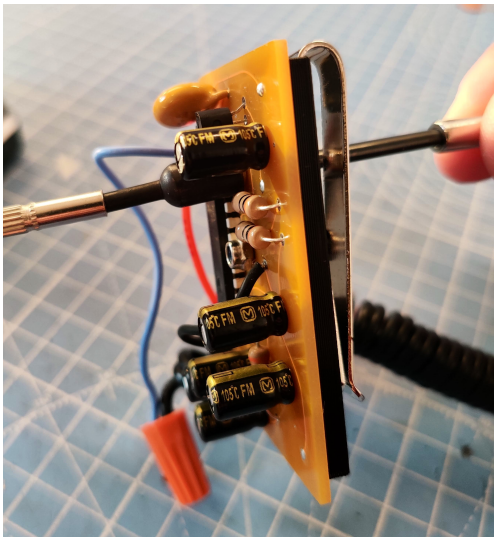


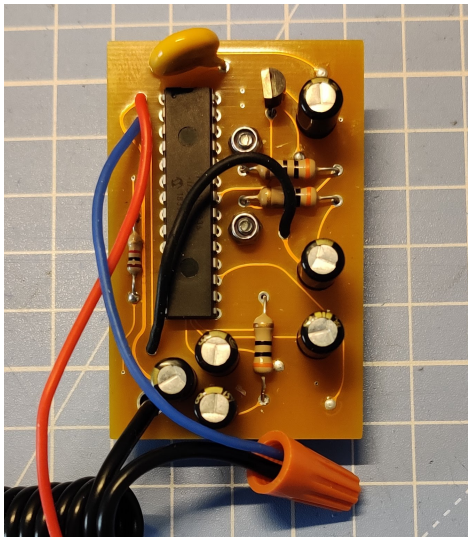


- The coiled cable actually consists of two individual wired moulded together with a short length separated at the end.
- Strip a good amount of insulation from the end of one of the loose ends and feed it through the large hole in the daughterboard. Pull this through until the exposed wire overlaps the rectangular silver pad. Apply a generous amount of solder over the wire and pad until the secured into place, as shown in the second photo above.
- If you are hot-gluing, you may wish to glue down the entire length of insulated wire to the back of the board. Be aware though, if there is too much glue at the edge of the board, the back panel may not sit flush when we attach it, so avoid this area if you can.
- With the cable now attached to the board, flip everything back over and hold the other loose wire together with the end of the **blue** cable we added earlier.
- Insert both wires into the orange wire nut as shown above. Twist the wire nut clockwise, pressing the two wires into it as you do so. The nut should cut a thread in the wire housing and hold them firmly together. If you cannot get them to join well enough, either strip the two wires and try again with the thinner copper inside, or simply super glue them inside the nut.

8. 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!

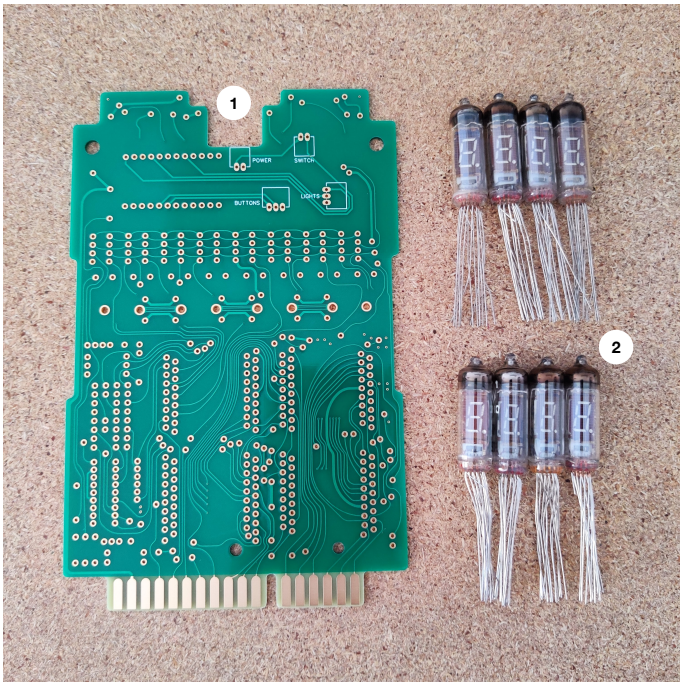
That's it… the daughterboard is done! Now that you have both the tools AND the talent, let's set the daughterboard aside for now and move on to the main event…

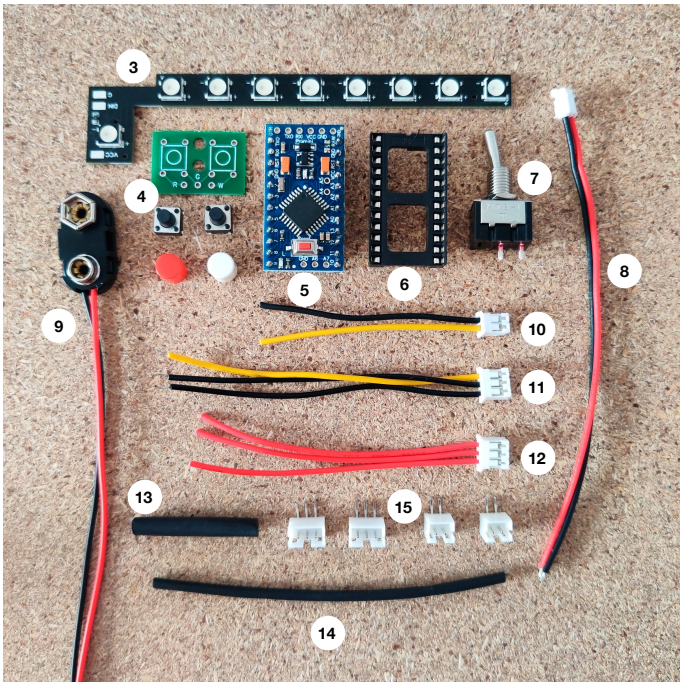
MOTHERBOARD ASSEMBLY

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.

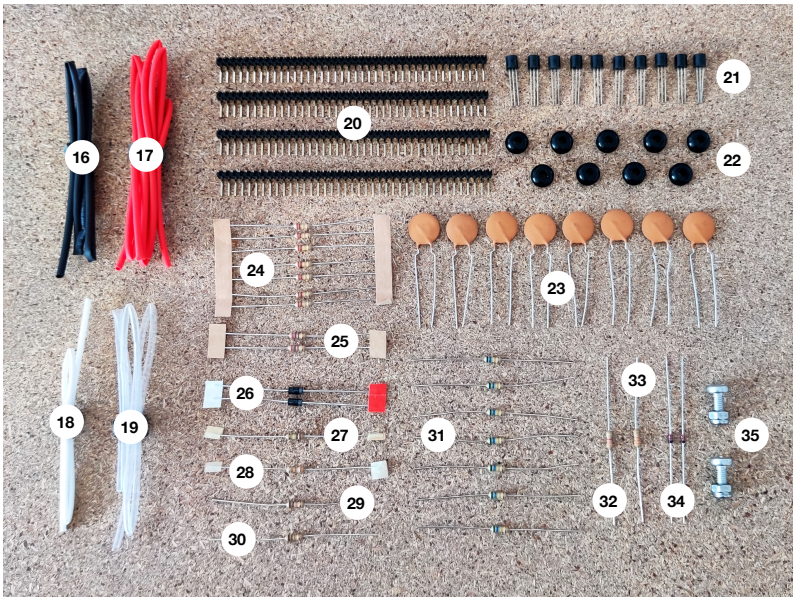
PARTS REQUIRED

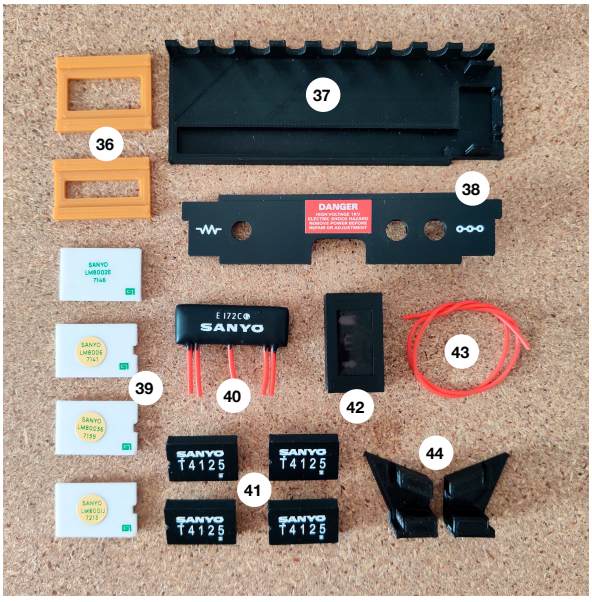
All the parts needed for the motherboard assembly are shown in the photo below. Using the following list, find each part in your kit bags and set them out on your workbench:





1. **1x Motherboard PCB**
2. **8x Vintage glass VFD display tubes**
3. **1x LED PCB**
4. **Button assembly components:**
   1x Button PCB; 2x Momentary buttons;
   1x Red button cap; 1x White button cap
5. **1x Pre-programmed microcontroller**
6. **1x 24-pin IC socket**
7. **1x Toggle switch**
8. **1x 2-wire battery extension cable**
9. **1x battery snap connector cable**
10. **1x 2-wire JST cable (yellow-black)**
11. **1x 3-wire JST cable (yellow-black-black)**
12. **1x 3-wire JST cable (red-red-red)**
13. **1x Medium heat shrink tubing**
14. **1x Narrow heat shrink tubing**
15. **Right-angled JST sockets**
    2x 3-pin; 2x 2-pin

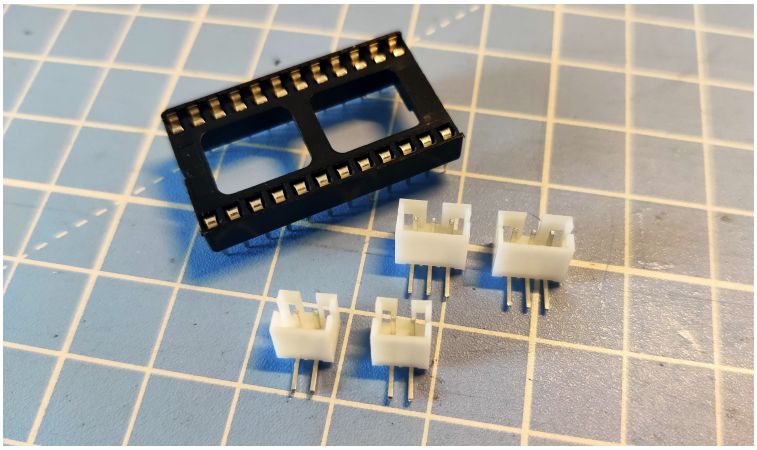


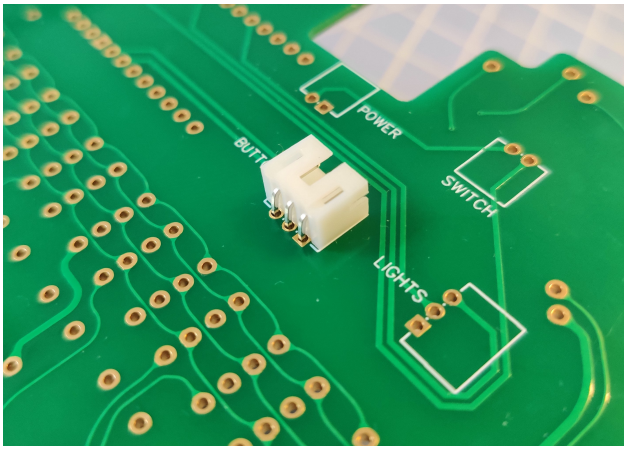


16. 1x 35” red heat shrink tubing
17. 1x 18” black heat shrink tubing
18. 1x 8” white heat shrink tubing
19. 1x 17” clear heat shrink tubing
20. 4x 40-pin right-angle header pins
21. 10x NPN Transistors
22. 9x Rubber grommets
23. 8x Disc capacitors
24. 7x 220KΩ resistors (red-red-yellow-gold)
25. 2x 2.7KΩ resistors (red-violet-red-gold)
26. 2x Schottky diodes (black/silver)
27. 1x 100KΩ resistor (brown-black-yellow-gold)
28. 1x 15KΩ resistor (brown-green-orange-gold)
29. 1x 33KΩ resistor (orange-orange-orange-gold)
30. 1x 3.3KΩ resistor (orange-orange-red-gold)
31. 7x 560KΩ resistors (green-blue-yellow-gold)
32. 1x 39KΩ resistor (orange-white-orange-gold)
33. 1x 100KΩ resistor (brown-black-yellow-gold)
34. 2x Glass signal diodes (red/black)
35. 2x M4 lock nuts and bolts
36. 2x Chip installation tools
37. 1x ‘Nixie Shelf’
38. 1x Shelf control panel
39. 4x Replica Sanyo LM800 white chips
40. 1x Replica Sanyo E172C capacitor
41. 4x Replica Sanyo T4125 black chips
42. 1x ‘Error Box’
43. 1x 240mm red silicone wire
44. 2x Shelf feet

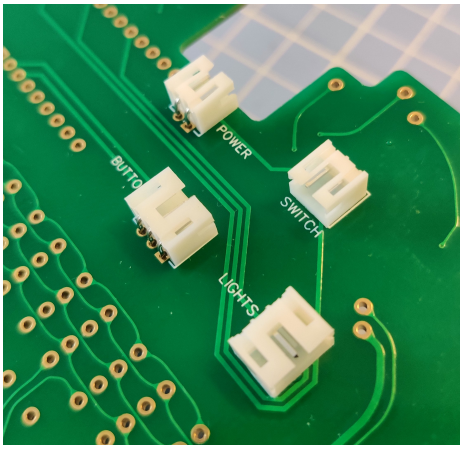
1. ATTACH THE ELECTRONICS CONNECTORS (Standard kits only)

Let's begin by attaching the working connectors to the top section of the motherboard. Unlike the other components, which are purely cosmetic, these parts form the basis of the lighting effects system, so it is important that these are soldered correctly. Luckily, this is a relatively simple job…





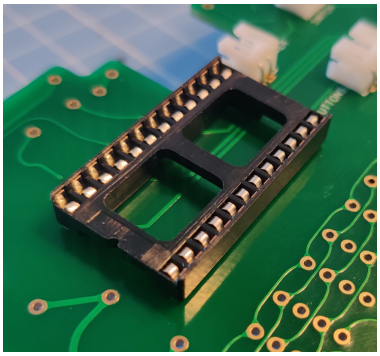
- We require the two 3-pin and two 2-pin right angled JST connectors, and the 24-pin IC socket as shown in the first photo above.
- The JST connectors will be placed in the areas of the board labeled "POWER", "SWITCH", "BUTTONS" and "LIGHTS".
- The body of each connector should sit on top of the white boxes printed on the board - this denotes their correct orientation.

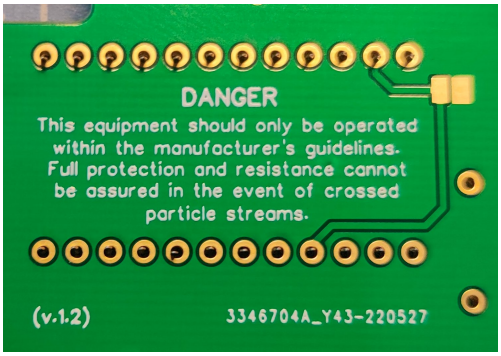






- Drop all four connectors into their corresponding locations, place some tape over them to hold them in place and flip the board over.
- The second photo above shows the 10 oval-shaped copper pads we need to solder the connector pins to. Also note the two separated rectangular pads in the centre - this is a jumper that connects three of the connector pins together.
- Proceed to solder the pins to the pads as shown in the third photo above.
- Complete the connection by joining the two jumper pads together - do this by applying one large blob of solder over the top of both pads as shown. **This is an important step - the two jumper pads must be soldered together in order for the electronics to function.**
- Make sure that your soldering is sound and each pin makes a good connection with the copper pad underneath. Also check that no pins have been accidentally soldered together.



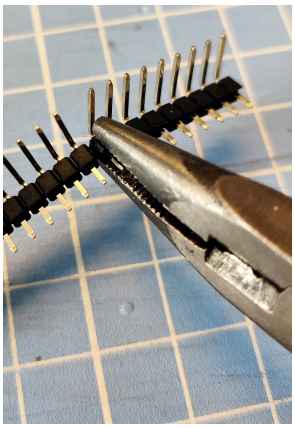
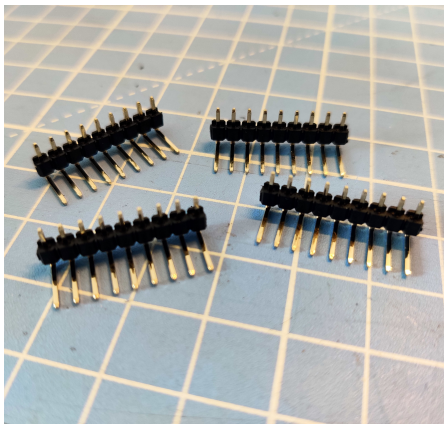
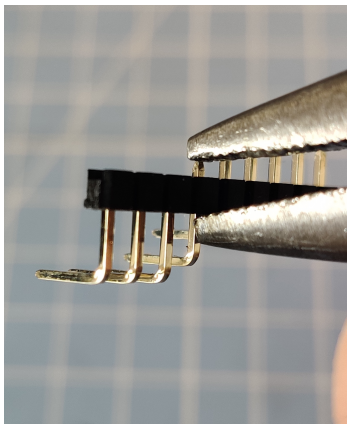
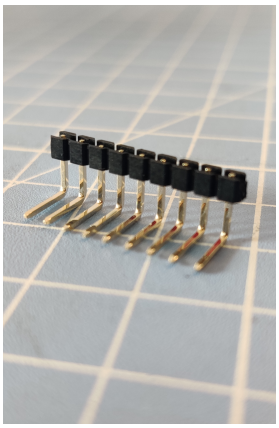




- Now let's add the black 24-pin IC socket. Slot the socket into the holes as show above making sure each pin passes through their respective hole in the board. Be aware the socket pins are thin and can bend very easily - you may need to carefully realign them before slotting the socket into the board.
- Once you are sure all 24 pins are correctly in place, add some tape over the socket and flip the board over.
- As with the JST connectors, solder each of the pins to the copper pads.
- You will see that there is a second jumper here connecting two of these pins together. As before, join the two rectangular pads together with a single large blob of solder.
- Verify all of your connections are correct as shown above before proceeding.

2. PREPARE THE GOLD HEADER PINS (Standard kits only)

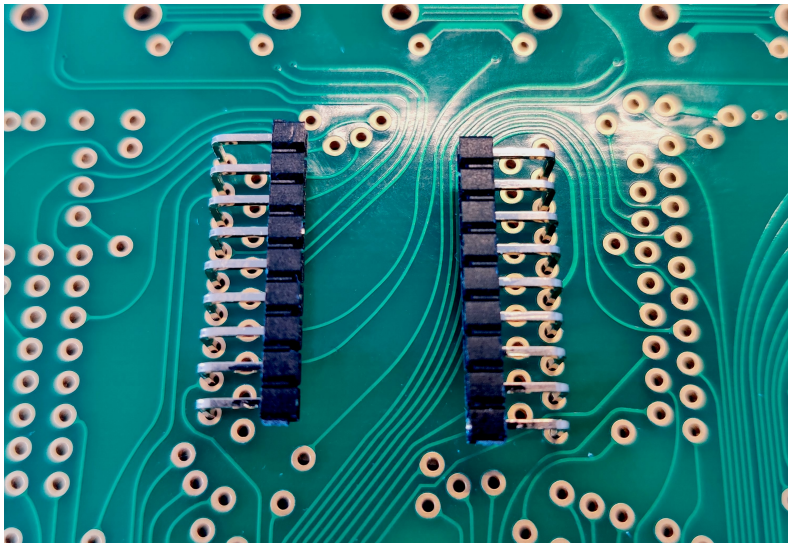
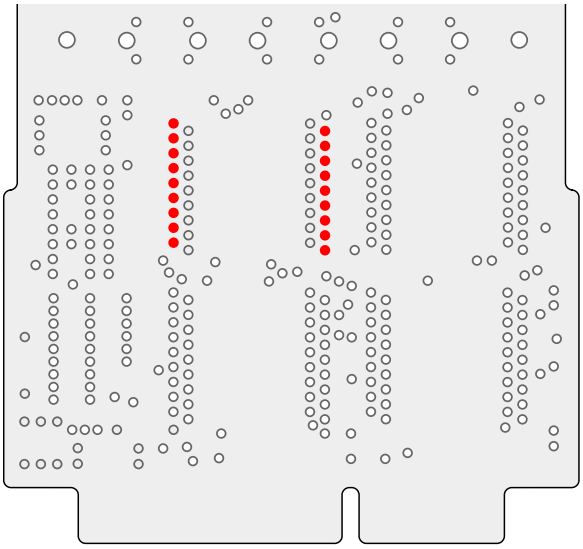
We will use the gold header pins to recreate the look of the four large white chips that float above the board. The pins in your kit will come as long strips, so we need to separate these into sections of nine pins.

- Using pliers, snap the black plastic spacer between the pins to leave you with four smaller sections of **NINE** pins.
- Repeat for each strip in your kit until you have a total of **16** 9-pin sections.
- Next, use your pliers to push each pin further out of the black plastic spacer so the end of the gold pin is flash with the top of the spacer as shown above. It is easiest to grip the edge of the spacer with your pliers as you squeeze, simultaneously pushing the pin downwards.

3. MOUNT THE GOLD HEADER PINS (Standard kits only)

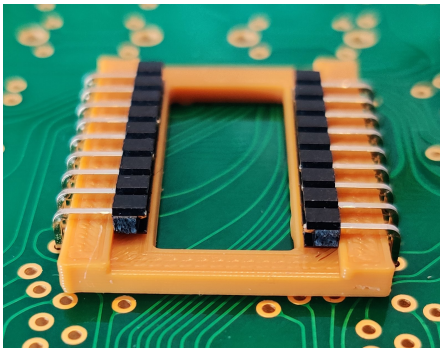
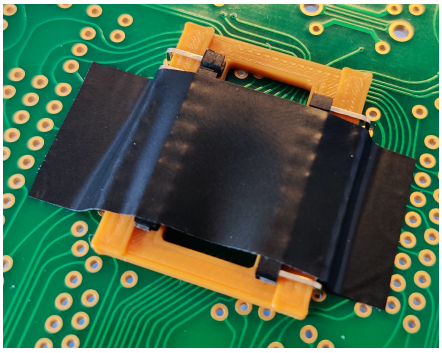
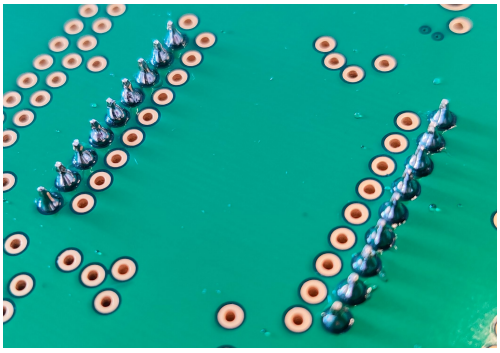
The following sections indicate where to add each component with the required holes. Each section has also been highlighted in the accompanying diagrams - **red** dots indicate the holes you need to use for the current step, solid **black** dots indicate the holes you have already used in previous steps and **grey** circles indicate the currently unused holes.

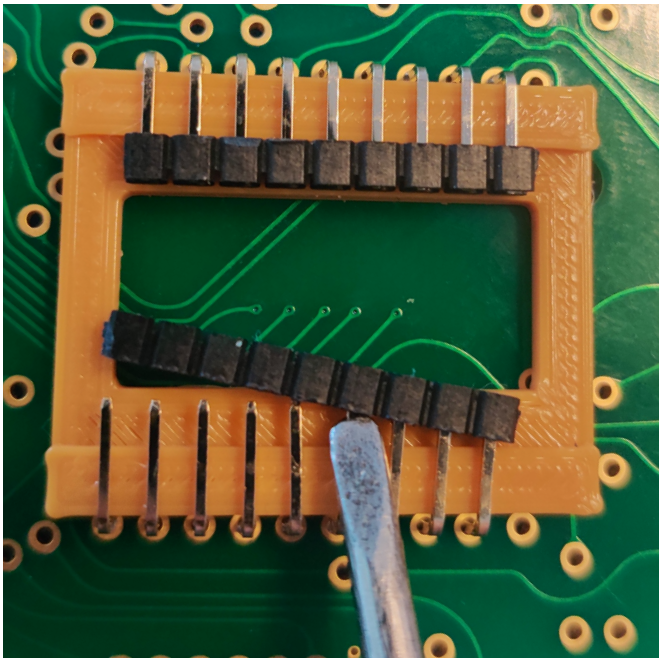
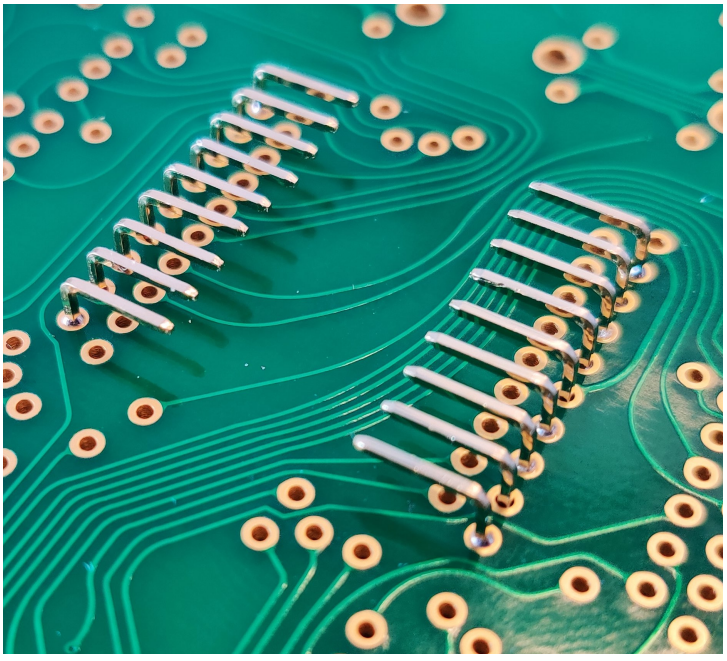
- Insert two of the 9-pin sections into the holes on the board as shown above. The pins should be angled so that the black plastic spacers are pointing towards each other.

Pay close attention to the holes you are using on the board as it is easy to mount the pins in the incorrect positions. Double check you are only using the holes indicated in red on the diagram above and not any of those in close proximity to them.

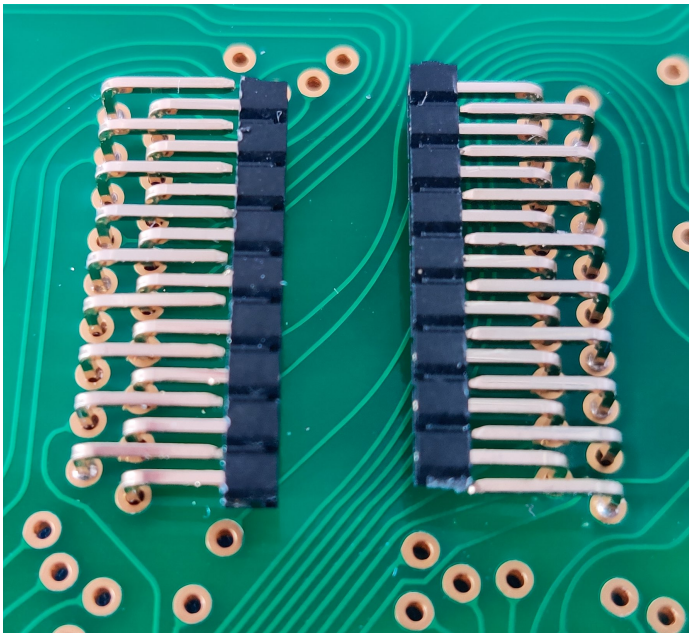
To install the pins in the correct position, you will need to use the two orange chip installation tools found in your kit. These will raise the pins up so the four white chips float above the board at a consistent height.

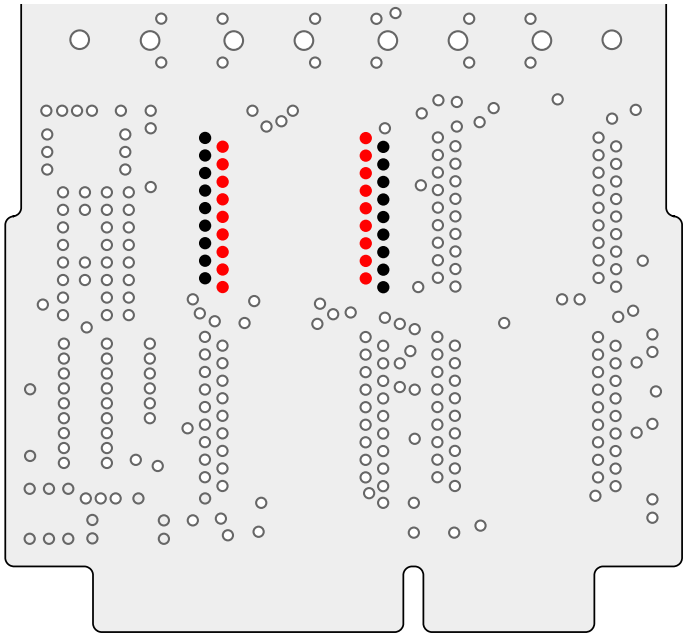




- Raise the pins up slightly and slide the wider of the the two orange installation tools underneath as shown in the first photo above.
- Push the pins back down so they sit flush along the raised edges of the tool. The black plastic spacers should sit in the recessed part of the tool.
- Once you are happy the two pin sections are positioned correctly, place a strip of tape over the top to hold everything in place.
- Flip the board over and solder the protruding ends of all 18 pins to the copper pads as shown in the third photo above.

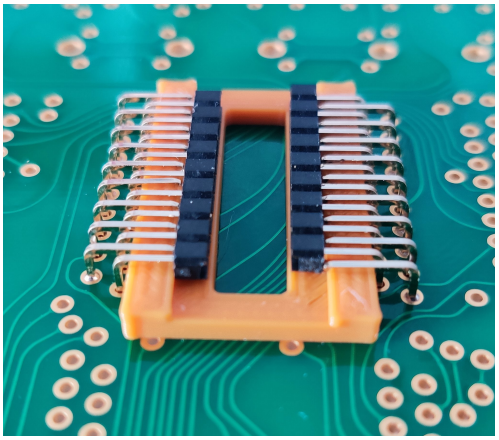



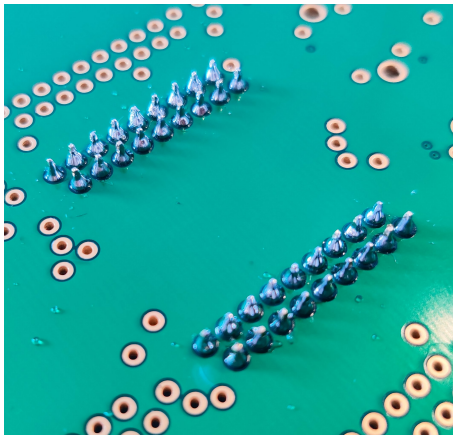
- Flip the board back over and use the end of a small screwdriver to gently force the black plastic spacers off the pins. There may be some resistance, so you may want to hold the board down securely with one hand as you push the spacers off with the other. Apply a little pressure to each end until the spacer pops off.
- You should now be left with all 18 pins suspended neatly in place on the board as shown in the second photo above.

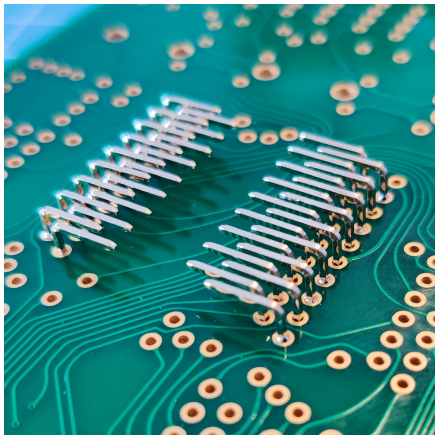




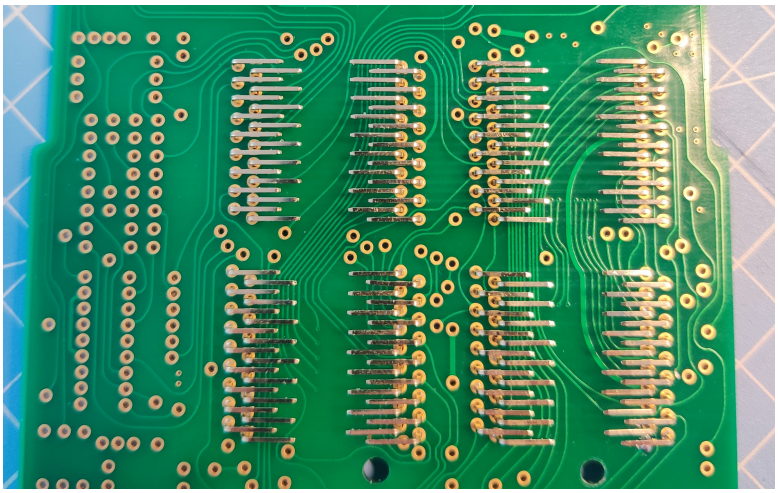
- Now repeat the process by adding the second two 9-pin sections to the holes in the board as indicated above.

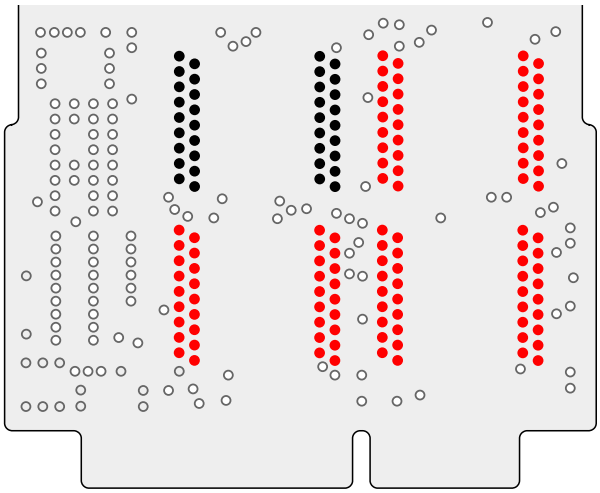






- Slide the narrower installation tool underneath the pins to align them, then place tape to hold everything in place.
- Flip the board over and solder the remaining 18 pins to the copper pads.
- Remove the plastic spacers from the pins as before and remove the installation tool. You should now have all 36 pins perfectly aligned on the board as shown in the third photo above.



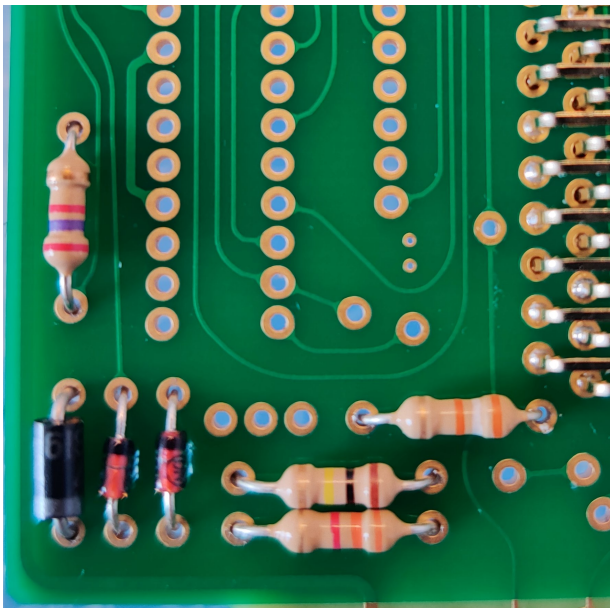


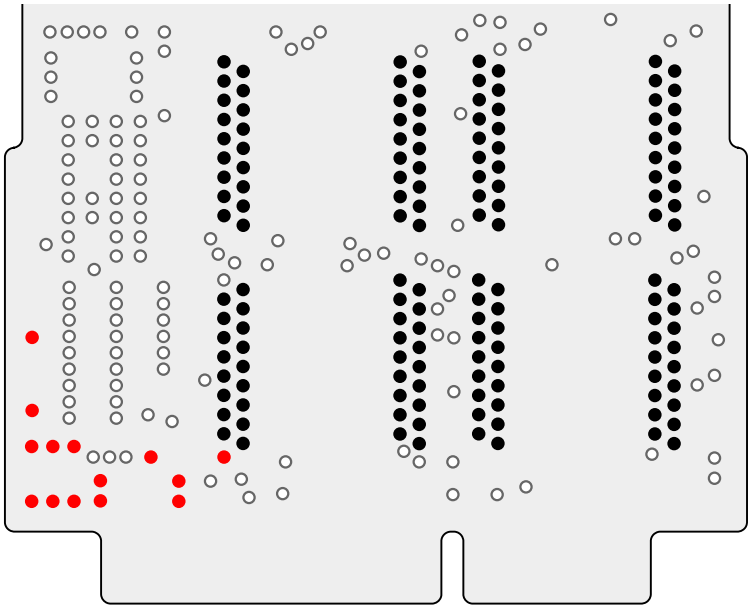
- Finally, repeat the entire process for rest of the 9-pin sections using the holes indicated above. Once finished, leave the pins as they are - we will add the replica white chips later.

4. ADD THE SMALL COMPONENTS

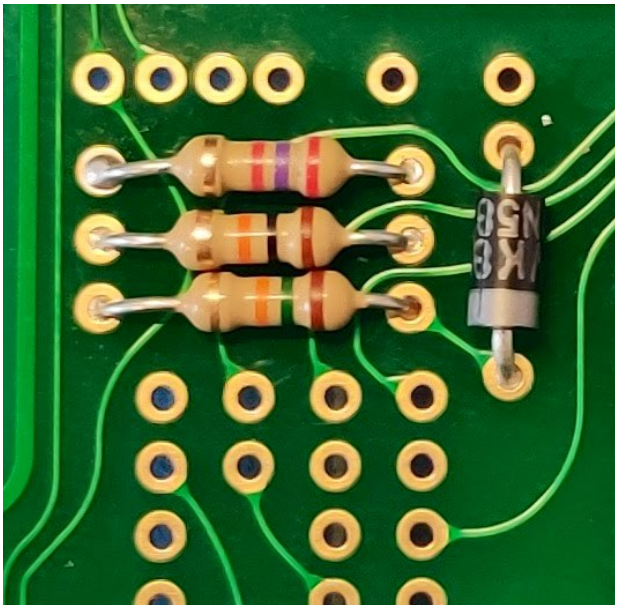
The following sections indicate where to add each component with the required holes. Each section has also been highlighted in the accompanying diagrams - **red** dots indicate the holes you need to use for the current step, solid **black** dots indicate the holes you have already used in previous steps and **grey** circles indicate the currently unused holes.

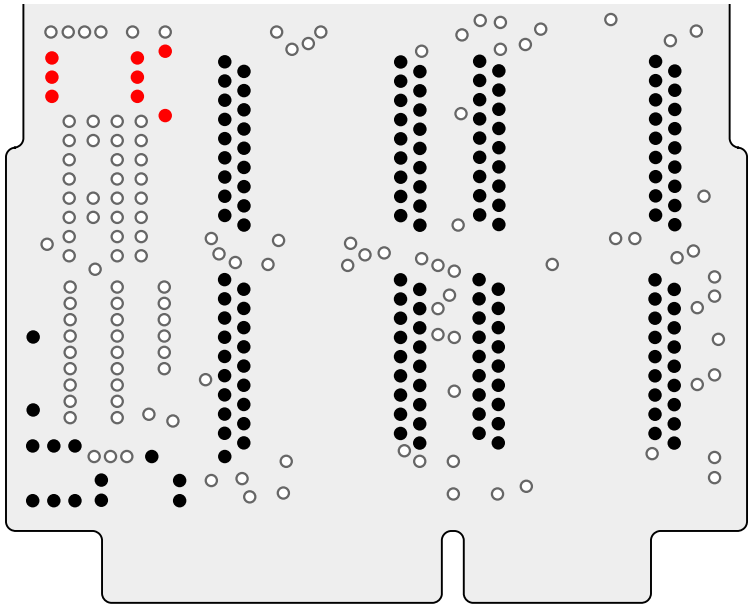
As with the daughterboard – feed the components through the holes, cut the wires according to your chosen mounting method and solder or hot glue into place…



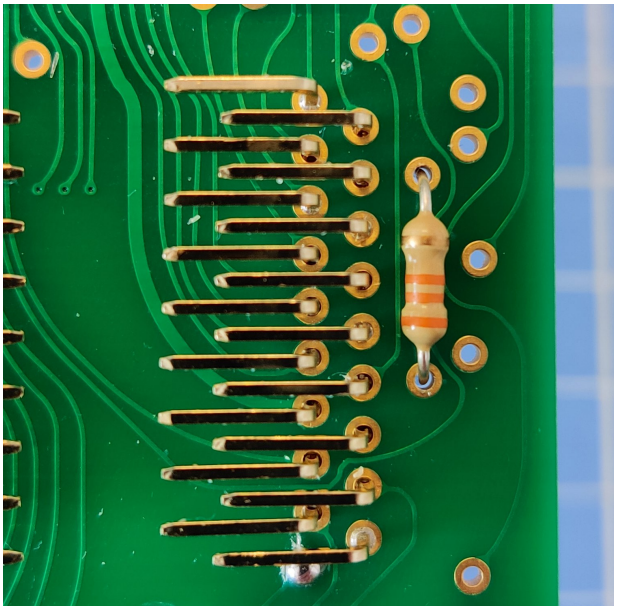


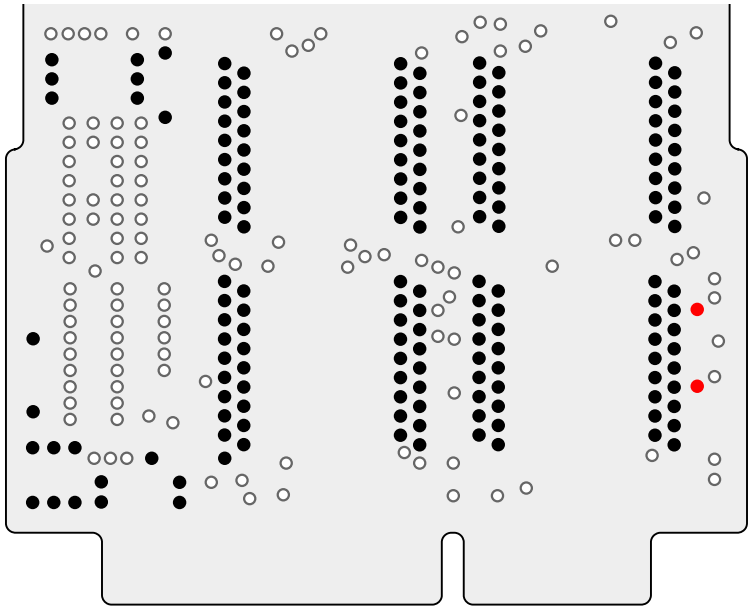
- Add the following components as shown above:
  - Resistors: 1x **RED-VIOLET-RED-GOLD**; 1x **ORANGE-WHITE-ORANGE-GOLD**; 1x **BROWN-BLACK-YELLOW-GOLD**; 1x **ORANGE-ORANGE-RED-GOLD**
  - 1x black/silver Schottky diode. Make sure the silver band is at the **bottom**.
  - 2x red/black glass signal diodes. Make sure the black bands are at the **top**.



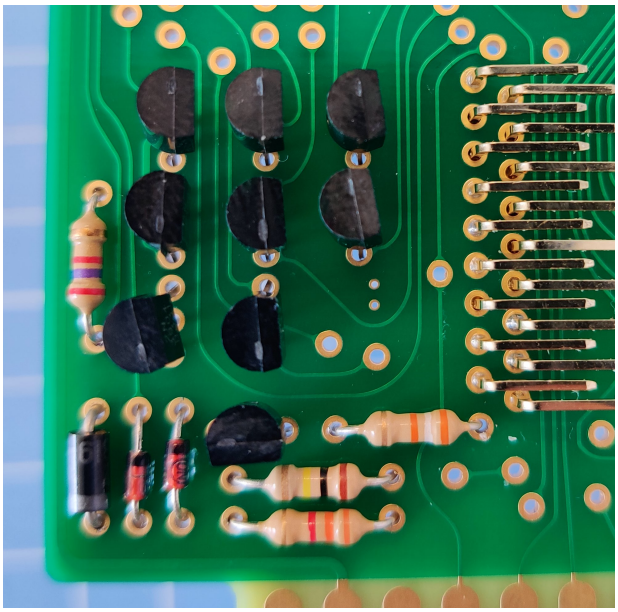


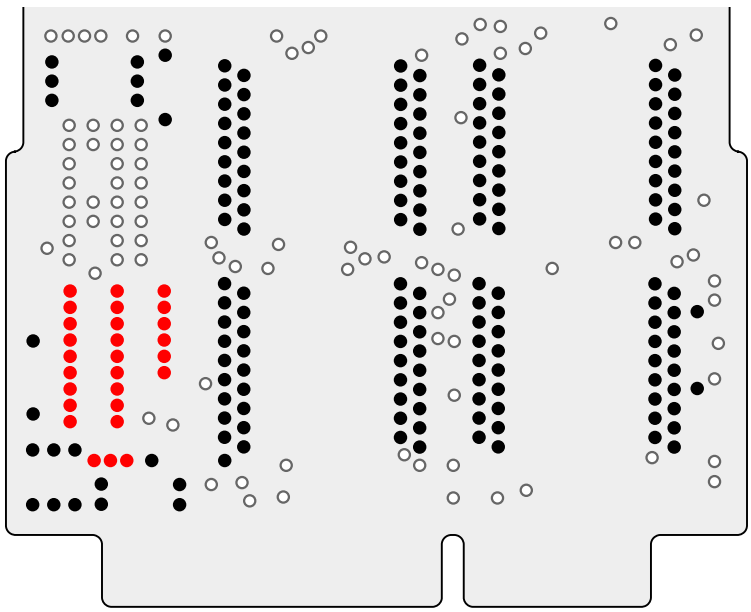
- Add the following components as shown above:
  - Resistors: 1x **RED-VIOLET-RED-GOLD**; 1x **BROWN-BLACK-ORANGE-GOLD**; 1x **BROWN-GREEN-ORANGE-GOLD**
  - 1x black/silver Schottky diode. The silver band should be at the **bottom**.



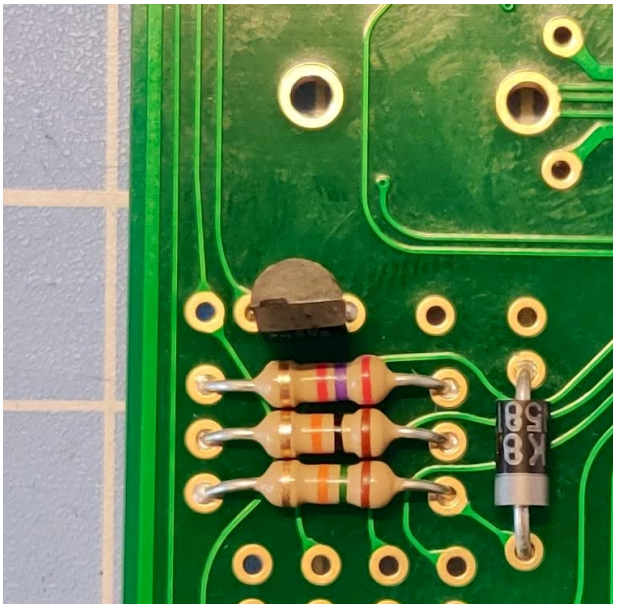


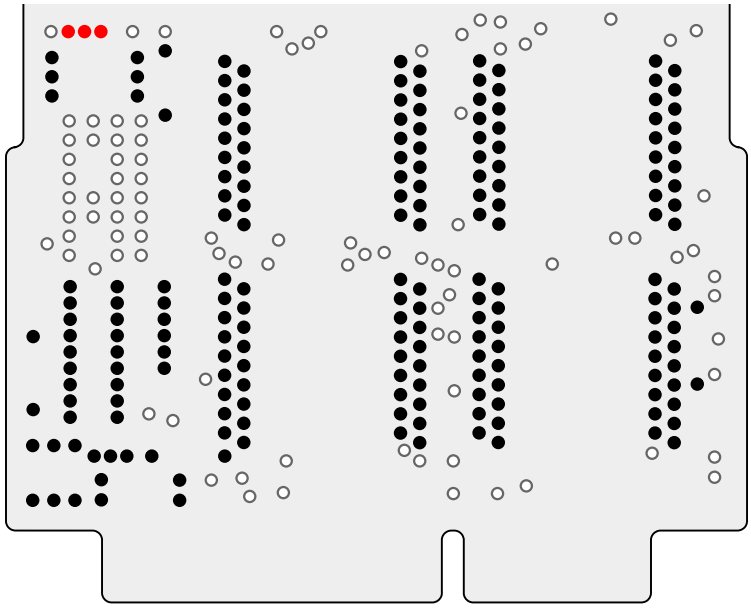
- Add the following components as shown above:
  - Resistors: 1x **ORANGE**-**ORANGE**-**ORANGE**-**GOLD**





- Add the following components as shown above:
  - 9x transistors, with the flat edges facing to the **right**, except for the separate transistor at the bottom, which should have its flat edge facing **downwards**. As with the daughterboard, the body of the transistors should hover by a couple of millimetres.

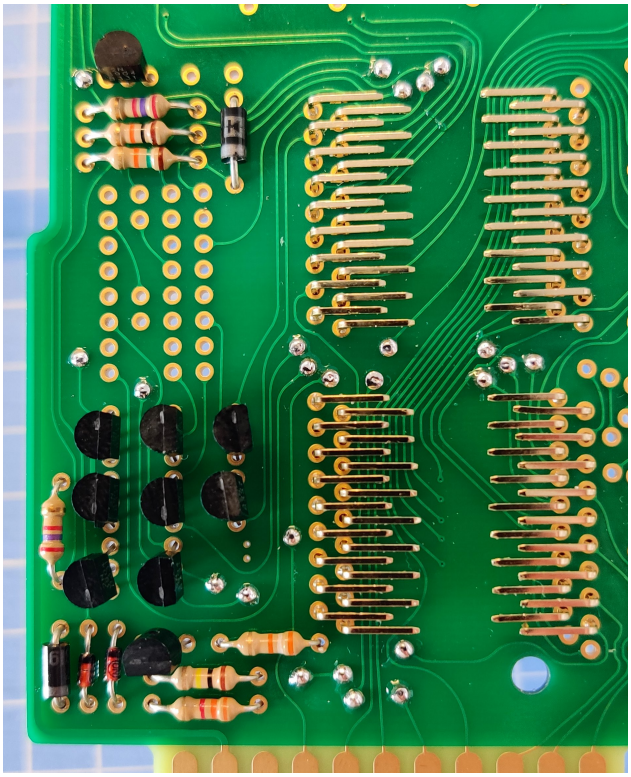


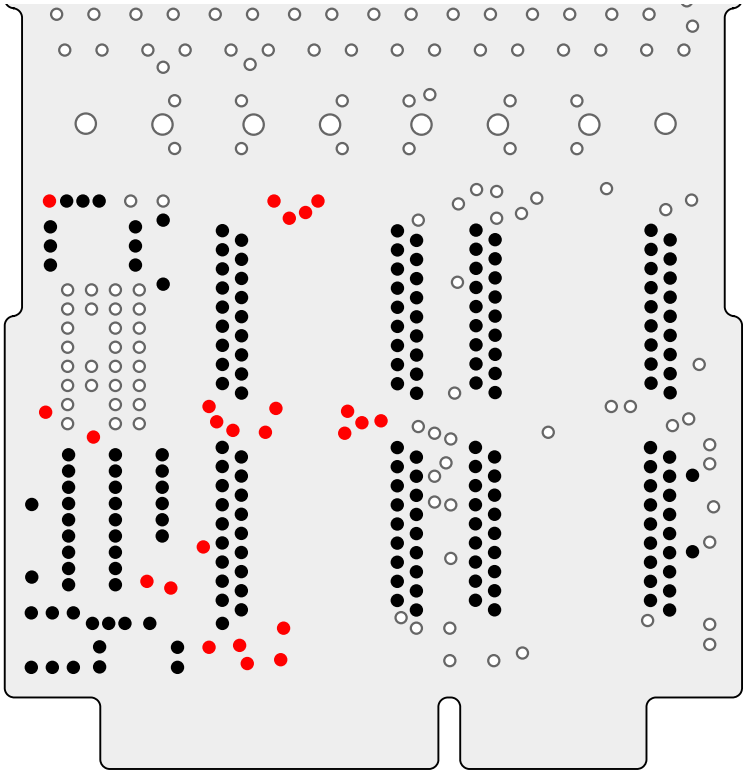


- Add the following component as shown above:
  - 1x transistor, with the flat edge facing **downwards**.

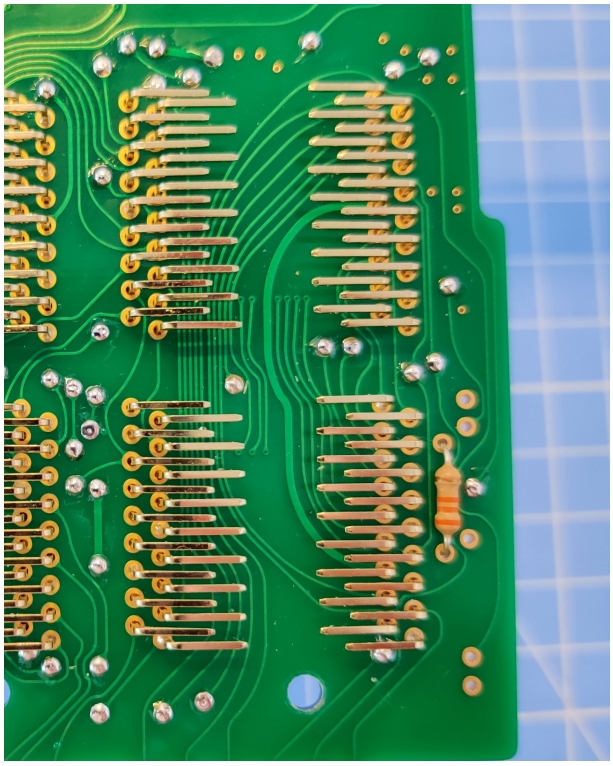
5. ADD SOLDER BLOBS (Optional)

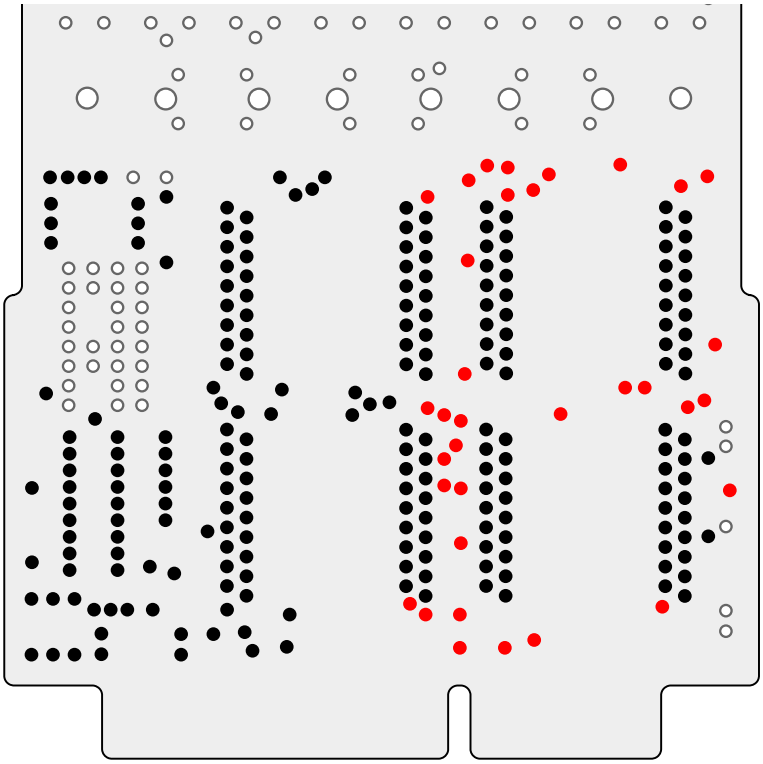
If you are using a soldering iron, we recommend adding small blobs of solder over the top of the 24 holes indicated in **red** below. These replicate the solder points found on the original Sanyo calculators and add an extra element of authenticity to your Gizmo board. If you are not soldering, then you may skip this step if you wish.



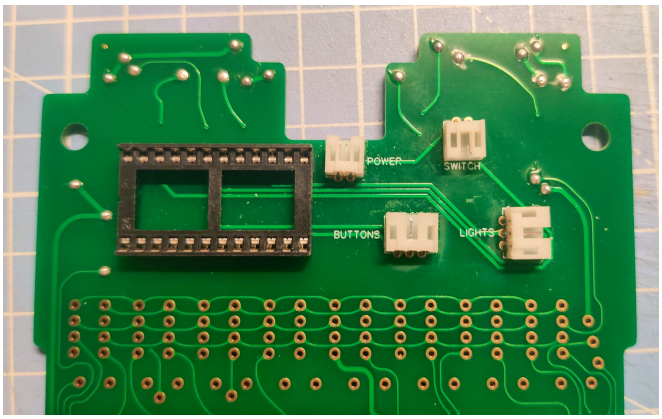


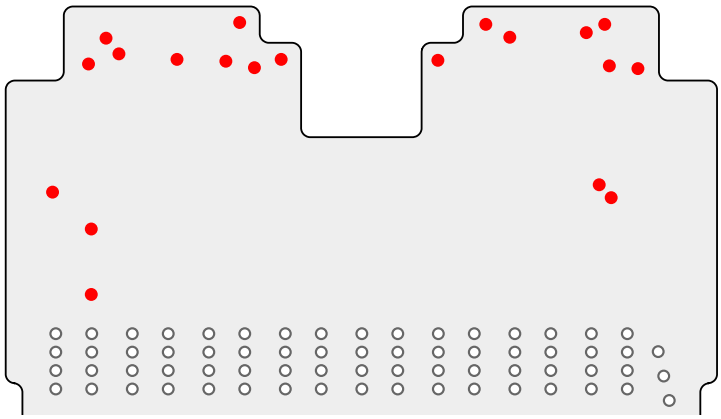
Be very careful when adding solder blobs and only cover the holes indicated in the diagram above. Adding solder to an incorrect hole will block that hole and make adding other components very difficult. Take this slowly and double check the hole positions before proceeding.





- Now move on to the 34 holes indicated in **red** in the diagram above. Be careful not to solder over the 5 holes positioned along the bottom right edge of the board - these will be required later.



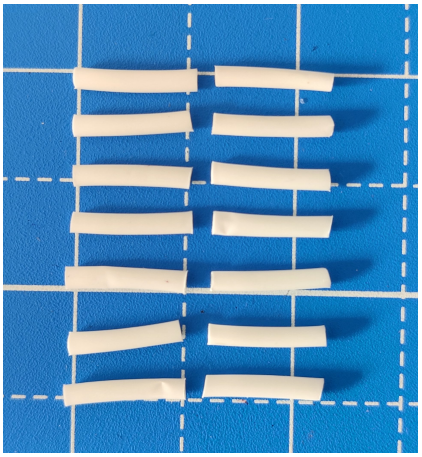


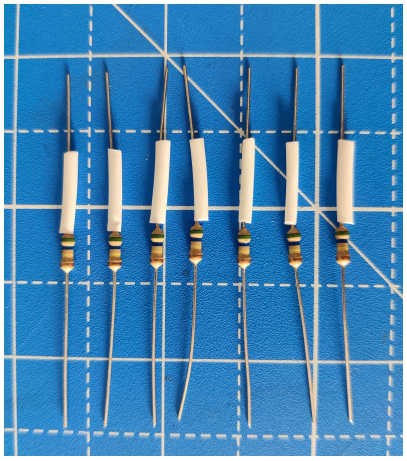
- Finish by adding blobs over the 20 holes located on the top of the board, as indicated in **red** above.

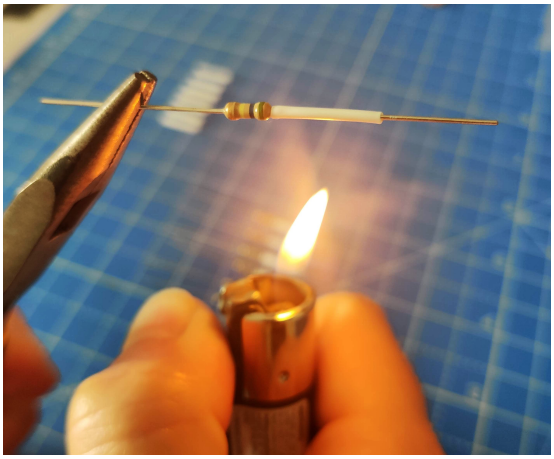
Be very careful when adding solder blobs and only cover the holes indicated in the diagram above. Adding solder to an incorrect hole will block that hole and make adding other components very difficult. Take this slowly and double check the hole positions before proceeding.

6. ADD THE UPRIGHT RESISTORS

We now need to add two sets of 7x resistors which sit upright on the board. Before we can attach these, each resistor needs a small piece of white heat shrink tubing added. Pay attention to the color bands and each set's position on the board.



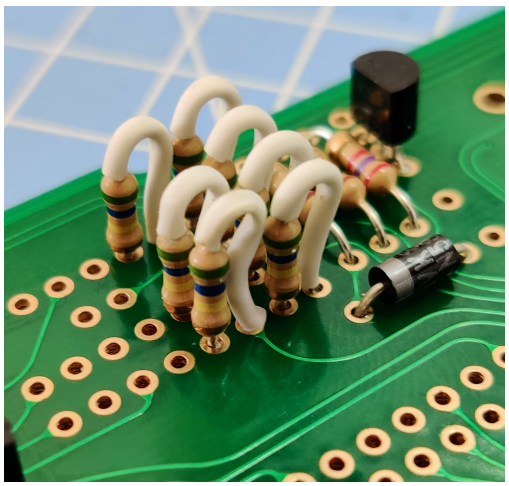


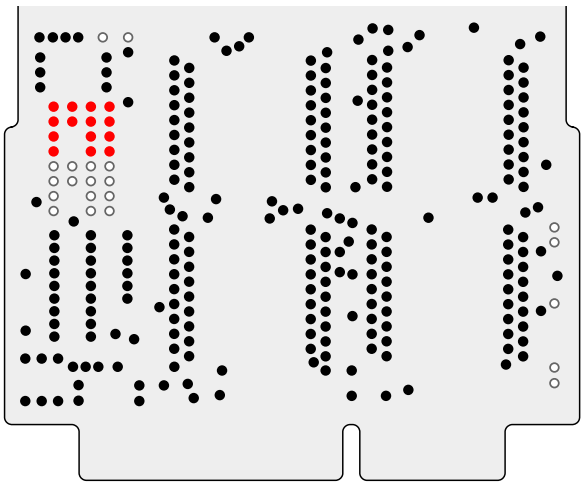


- Use scissors or your wire cutters to cut the white heat shrink tubing into **14** lengths of **13mm** each. There may be a little extra included in your kit, so expect to have some left over.
- Group together the 8x **GREEN**-**BLUE**-**YELLOW**-**GOLD** resistors and slip a length of tubing over one end of each resistor. Keep them all consistent by adding these to the same end as the **green** band, as shown above.
- Hold each resistor with pliers and gently apply heat to each section of tubing until it fully shrinks around the wire. A heat gun is the recommended tool for this job, but you can also use a lighter as shown above.

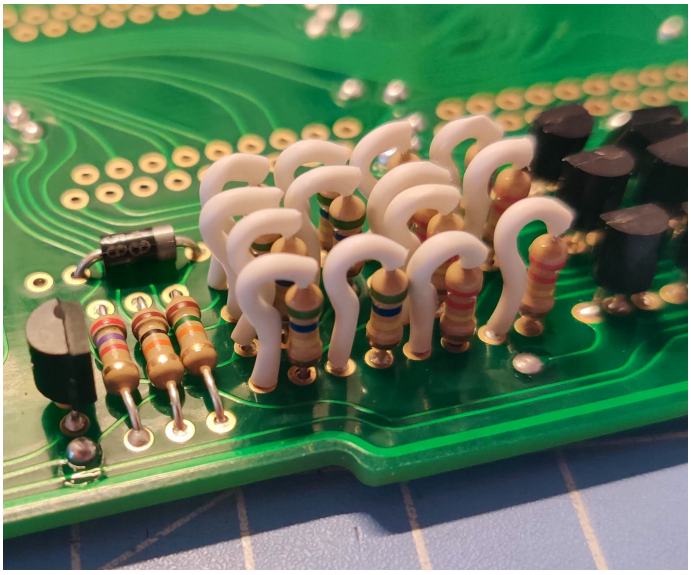
If using a lighter, make sure the flame does not touch the tubing - hold it a few centimetres away and allow the heat to rise until the tubing is fully shrunk. Moving the flame back and forth as you rotate the resistor can help create even shrinkage. Make sure to keep your hands away from the naked flame.

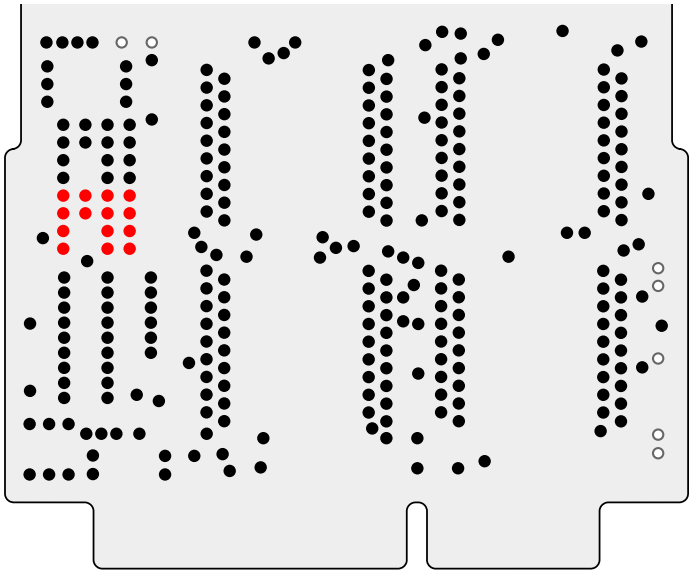






- Holding one of these resistors vertically, fold the end with the white tubing over until it faces in the opposite direction and both wires now run parallel. When folding over, make sure to create an arc at the top - it may help to fold over a small screwdriver to create a consistent curve. For added accuracy, add a kink in the middle of the white section to create an 'R' shape so it looks like the resistor in the first photo above.
- Repeat this for all 7 resistors and attach them to the motherboard using the holes indicated above. Each resistor will use two holes, so make sure the kinked white sections are facing the **top** of the board. As usual, cut the protruding wires short, and attach using your chosen method. If hot-glueing, you may wish to add a little superglue to the folded wires on the back of the board before the hot-glue to prevent the resistors from wobbling too much and coming free.

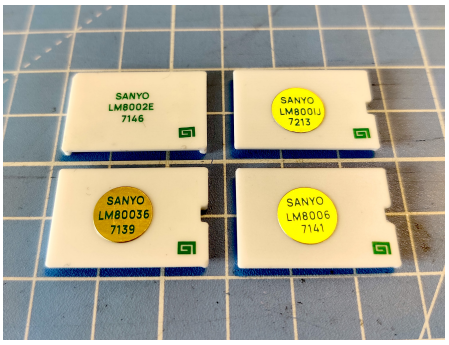


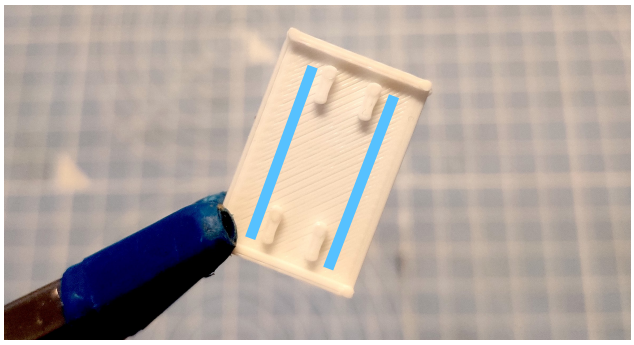


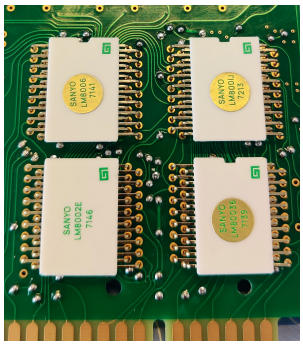
- Repeat the same process for the 7x **RED**-**RED**-**YELLOW**-**GOLD** resistors, using the remaining pieces of heat shrink tubing you cut earlier. Make sure to add the tubing to the same end as the **red** band.
- Attach these to the board using the second set of 14 holes as shown in the diagram above.
- Once all resistors are firmly in place, use pliers or a pair of tweezers to gently adjust them until they all line up with one another.

7. ADD THE WHITE CHIPS

The four pre-made white chips shown below which simply sit on top of the gold pins already soldered in place. Three of these chips feature a gold sticker and a notch in the right edge, while one is missing both the sticker and the notch. Each has their own unique identifying numbers.







- To add a chip, flip it over and run a small amount of **epoxy glue** along the inside lengths indicated by the **blue** lines above. Be careful not to apply glue too far to the edge of the chip to avoid any mess.

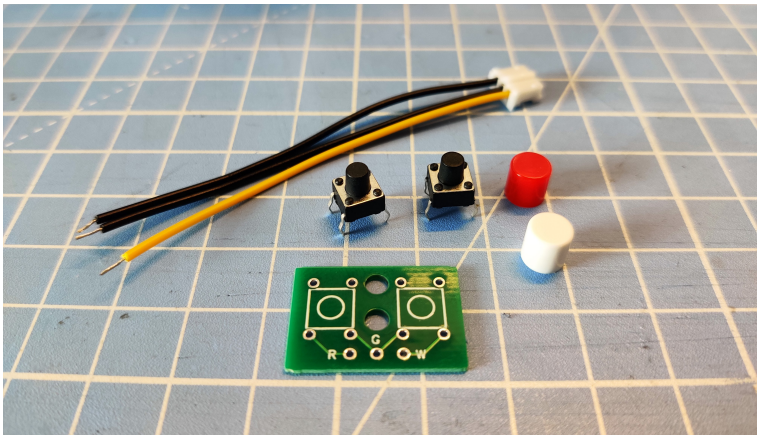
IMPORTANT - We no longer recommend the use of superglue (cyanoacrylate) for fixing the chips in place. It is possible that vapours can form during the glue drying process and settle on the surface of the board, creating a permanent white residue. Please only use epoxy for this.

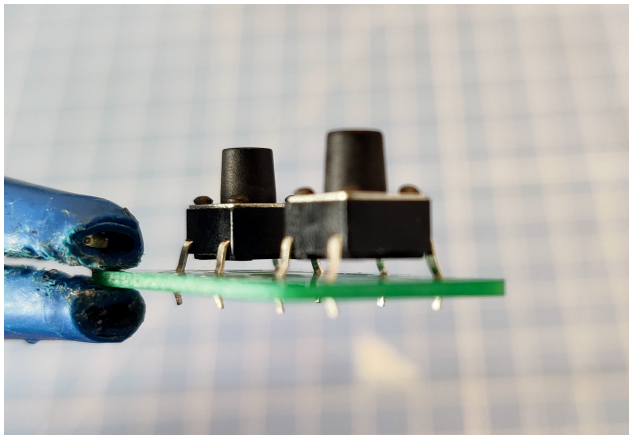
- Turn the chip back over and place it on top of the gold pins in its position as shown in the final photo above. Each chip should slot firmly into position with the four raised parts on the bottom of the chip sitting between the gap in the pins.
- Repeat for all four chips, making sure the green spiral logos are in the top right with the notches facing upwards.
- Whilst the chips can be arranged any way you like, the layout shown is based on our Sanyo reference photos with the sticker-less chip “7146” in the bottom left, “7141” top left, “7213” top right and “7139” bottom right.
- Leave the glue to fully cure before proceeding.

8. ASSEMBLE THE WORKING ELECTRONICS (Standard kits only)

In your kit you will find an anti-static bag labeled “Working Electronics”. This contains all of the functional components that make up the lighting effects system. This is simple to assemble, but be sure to read this part of the guide carefully, always refer to the photographs and double-check any soldering you do to ensure correct operation.

NOTE: In some cases, some or all of these components may have already been assembled for you. If this is the case, we still recommend reading through this section to check you have everything before continuing.

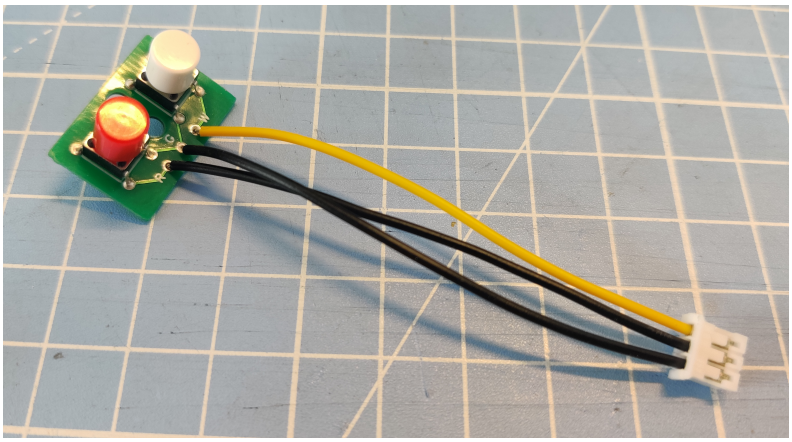




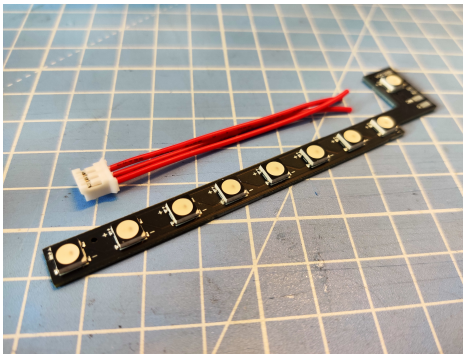
BUTTON ASSEMBLY:

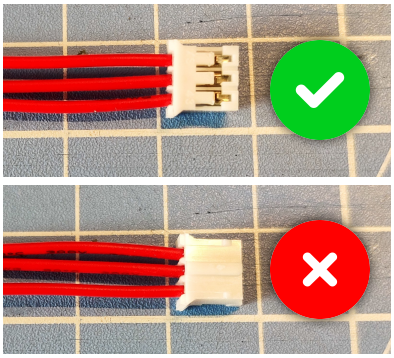
- Collect together the parts needed: Mini circuitboard, momentary buttons x2, **red** cap, white cap and 3-wire JST cable [**YELLOW-BLACK-BLACK]**
- Making sure that the markings on the circuitboard (white square and circle) are facing upwards, **i**nsert the pins from the buttons into the holes on the mini circuitboard as shown above - the orientation of the buttons does not matter.
- Align the buttons so they are as level as possible and flip the mini board over.

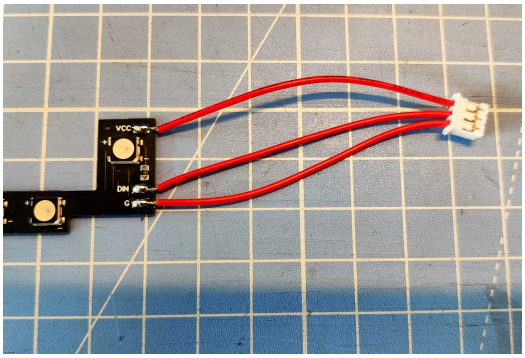




- Solder all eight pins on the back of the board and check your connections are sound and flip the board back over to the front.
- Push the two coloured caps firmly on to the buttons - **red** above the letter ‘R’ and white above ‘W’.
- Strip a little of the plastic shielding away from the end of each wire on the JST cable and solder in each wire as shown in the second photo above. This is as follows:
    - **YELLOW** wire: solder to hole labeled ‘W’
    - Centre **BLACK** wire: solder to hole labeled ‘R’
    - Outer **BLACK** wire: solder to hole labeled ‘G’
- Check that the wires are soldered to the correct positions (particularly the two **BLACK** wires which can be easily confused).

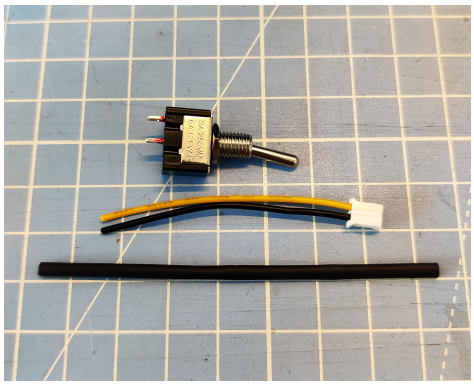


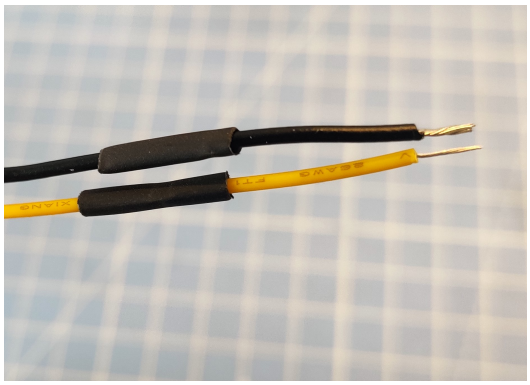


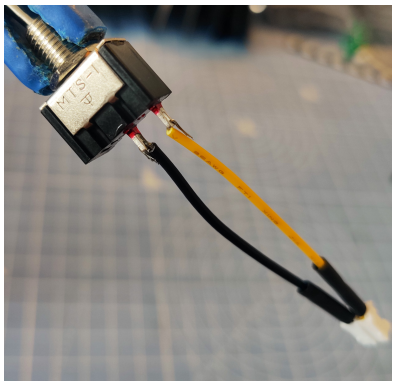


LED ASSEMBLY:

- Find the ‘GIZMO DISPLAY LEDS’ board from your kit, along with the 3-wire JST cable [**RED-RED-RED**]
- The LED board has three silver pads at one end which we will be using to attaching the cable wires.
- As each wire on this cable is the same colour, it is important that we know which way up the cable needs to be. To determine this, place the cable so that the connector plug looks like it does in the image above, next to the green tick. You should be able to see the silver connectors inside the the white plastic housing. This is the correct orientation - the three wires to the left of the connector plug are then our **top**, **middle** and **bottom**.
- With the LED board on your left and the cable in its correct orientation to the right, solder the three wires to the silver pads as shown above. This is as follows:
    - **Top** wire: solder to the pad labeled ‘VCC’
    - **Middle** wire: solder to the pad labeled ‘DIN’
    - **Bottom** wire: solder to the pad labeled ‘G’

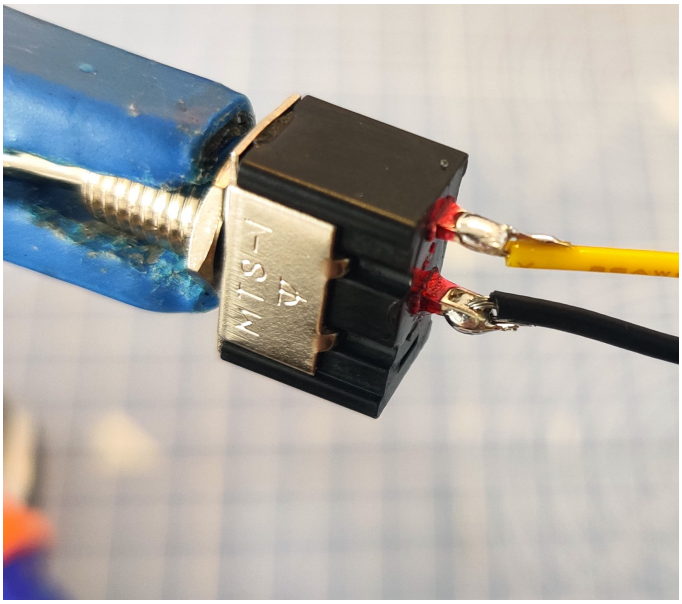


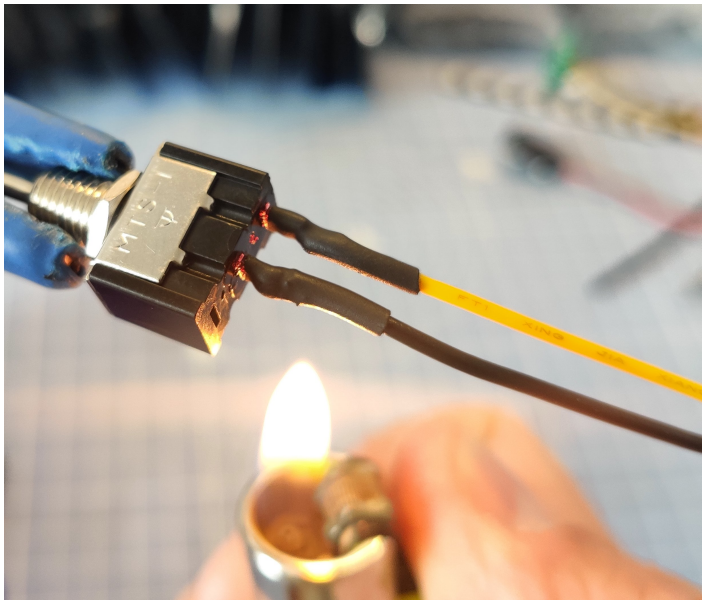




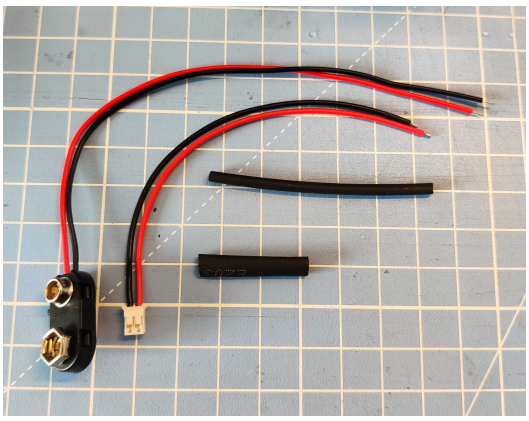
SWITCH ASSEMBLY:

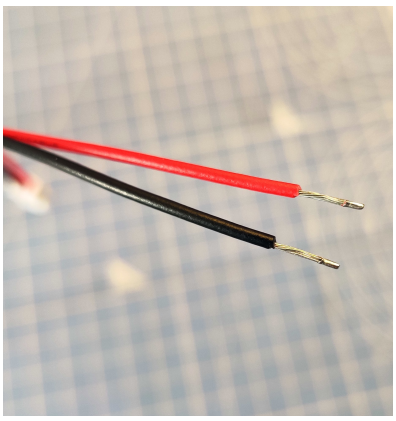
- You will now require the metal toggle switch, the 2-wire JST cable [**YELLOW-BLACK**] and the short length of black narrow heat shrink tubing.
- Firstly, strip a few millimetres from the shielding of both wires.
- Cut two **10mm** sections of heat shrink tubing and pass one over each wire.
- Thread each of the bare wires through the eyes in the switch’s pins and fold over as shown in the third photo above. As this is a simple on/off switch, it does not matter which wire you attach to which pin.

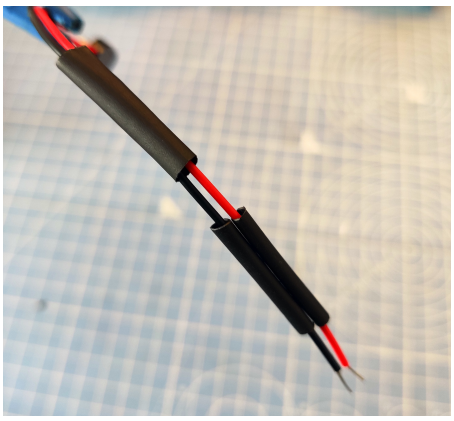




- Secure the wires by soldering them to the pins on the switch.
- Slide the two sections of heat shrink tubing over your soldered wires and apply your preferred heat source to shrink the tubing down and wrap tightly around the joints.





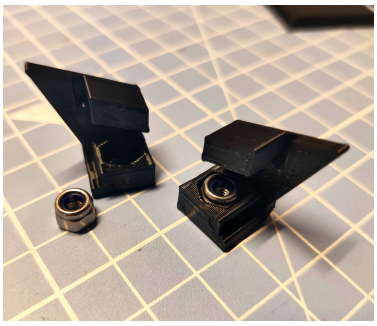


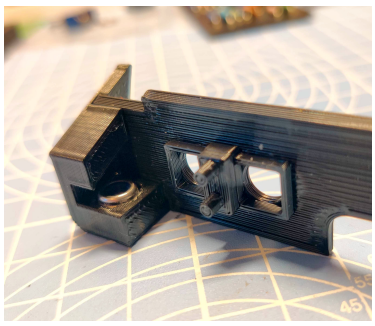
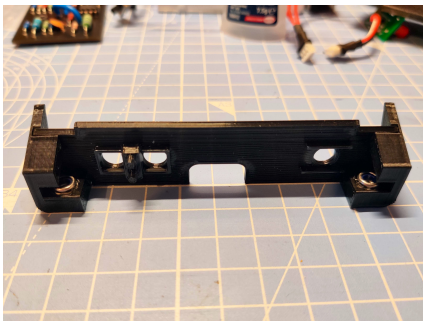
BATTERY CONNECTOR CABLE:

- The final component to assemble is the battery cable. For this, find the 9V battery snap, 2-wire JST cable [**RED-BLACK**], the small section of medium heat shrink tubing and the remaining amount of the narrow tubing.
- Strip at least 5mm of the shielding from each end of both the battery snap cable and the JST cable.
- Thread the medium section of heat shrink over **BOTH** wires on the battery snap cable.
- Cut two 25mm sections from the narrow heat shrink and place one on each individual wire as shown in the second photo above.
- Twist the bare ends of each wire together (**red->red** and **black->black**), apply solder and slide the two narrow sections of tubing over the joint and shrink down as shown above.
- Finally, slide the medium section of tubing over this and shrink down to secure the two wires together.

9. BUILD THE NIXIE SHELF AND CONTROL PANEL

Phew!! With the real electronics now assembled, it's time to get them working! For this, you need the 3D printed 'Nixie Shelf', 'Error Box' and shelf feet. You will also need the larger two pairs of nuts and bolts (M4).

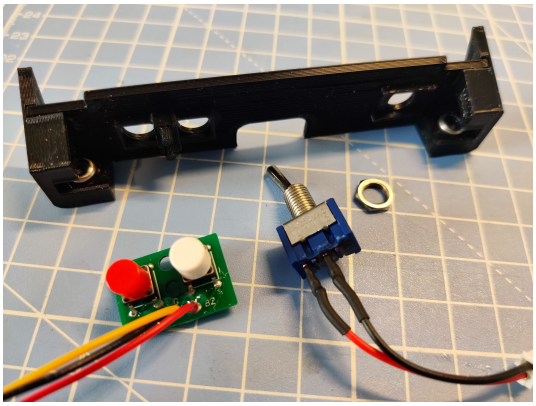
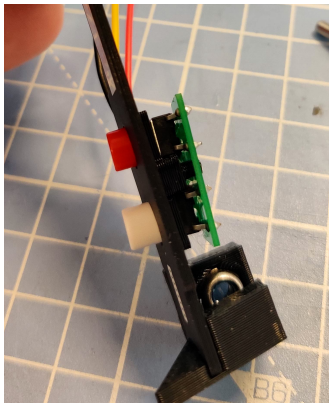
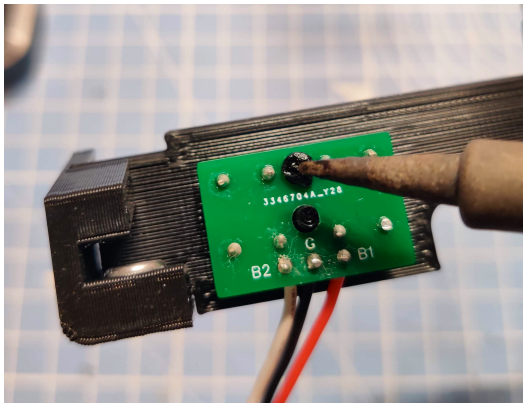


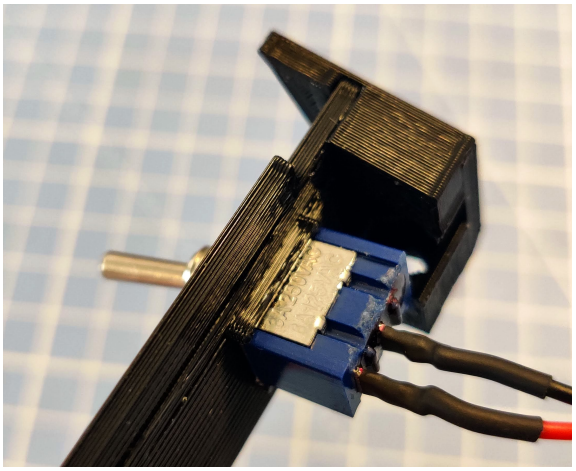
- First, take the the two shelf feet and seat the two nuts into the hexagonal holes. These 'lock nuts' contain a nylon ring which will prevent them from loosening over time, so make sure that the circular part of the nut is at the top.

In order to keep them in place when attaching the shelf to the board, it is recommended to add a drop or two of superglue to the outside of each nut as you place them into the holes.

- Apply some super glue to the flat inner sections of one foot as shown in the second photo above.
- Slot the edge of the control panel into the grooves in the foot. The smooth side of the panel (with DANGER label) should be facing outward. The bottom corners of the control panel should sit flush with the bottom of the foot.
- Hold the two parts together with one hand and apply superglue to the inside joins that have been formed. Be careful not to let any glue seep through to the smooth side of the back panel as this can cause permanent whitening of the plastic. You may wish to also add hot-glue here on top for added strength. This area will be hidden once assembled, so do not worry about the appearance of the glue here.
- Repeat for the foot at the other end of the control panel, making sure that the whole structure is as sturdy as possible.

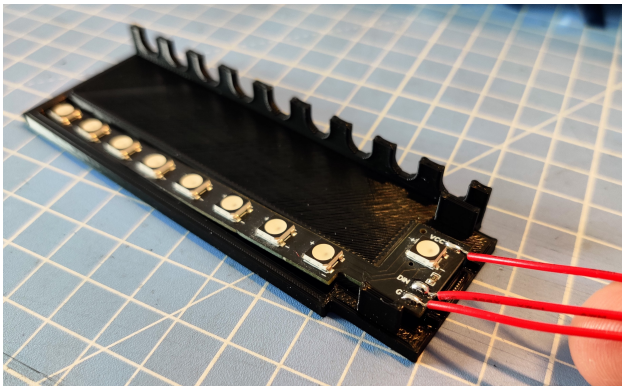




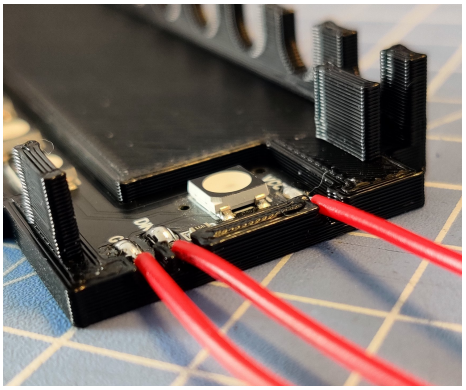
- Now take the button assembly we created earlier and slot the buttons into place by passing them through the two holes in the control panel - this will only fit one way.
- With a soldering iron, melt the top of the two plastic columns that pass through the holes in the small green circuit board. Melt enough so that, once cooled, they create rivets holding the board securely. Alternatively, you can hot glue or super glue the board into place. Just make sure that there is no wobble when pressing the buttons from the other side.

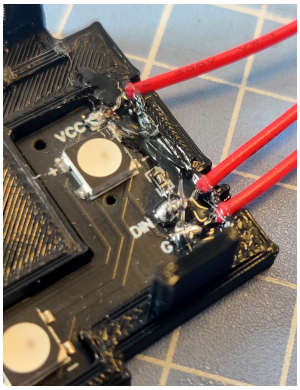




- Push the toggle switch through the remaining hole on the control panel. The main body of the switch will slot neatly between the raised bars to prevent the switch from rotating. Make sure the side of the switch marked “ON” and “OFF” is facing downwards.
- Replace the hexagonal nuts on the switch to secure it to the control panel. You can use pliers or socket wrenches to tighten the nut, but be careful not to scratch the panel as you do so. Tighten the nut and make sure that it is secure.

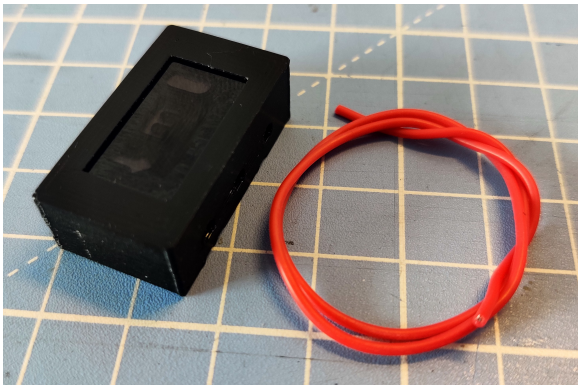
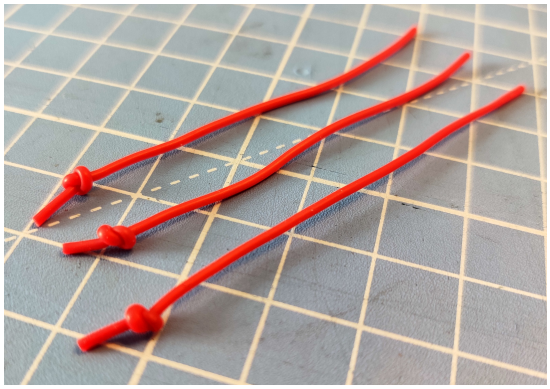
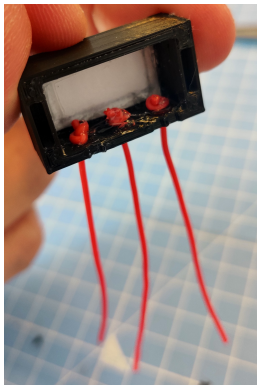




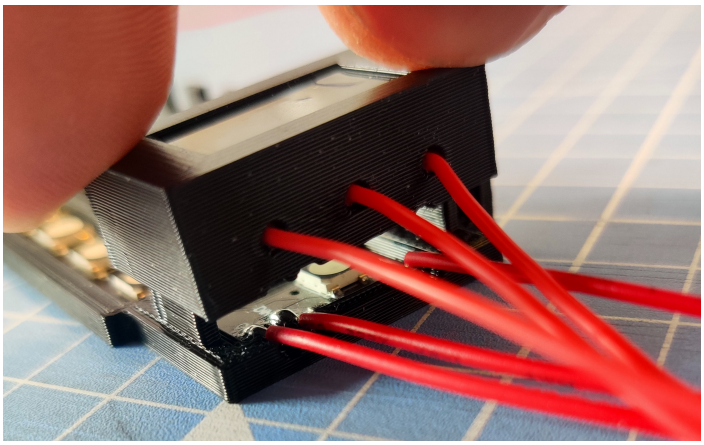
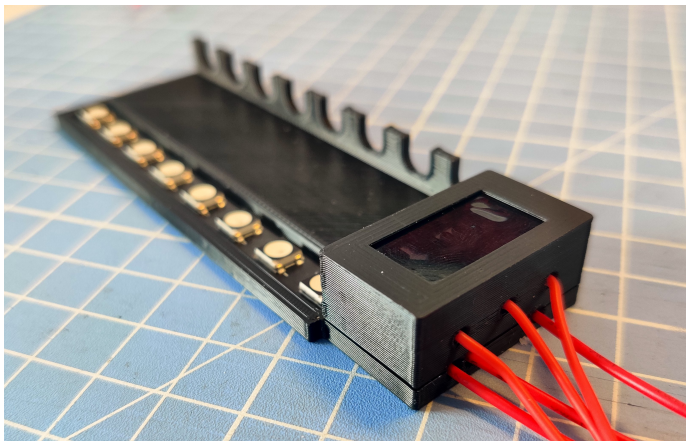


- Retrieve the LED assembly you completed earlier and place this into the recessed part of the ‘Nixie Shelf’. The black board should fit tightly and stay in place, however if you do find it is a little loose, try adding the little double-sided tape to the back of the board to prevent it from falling out.
- Make sure the three red wires attached to the board sit freely in the three cut outs in the side of the shelf.
- To help protect the wires from breaking, we recommend applying some hot glue over the ends of the each wire and the soldered pads, plus the inner edge of the shelf as shown in the third photo above.

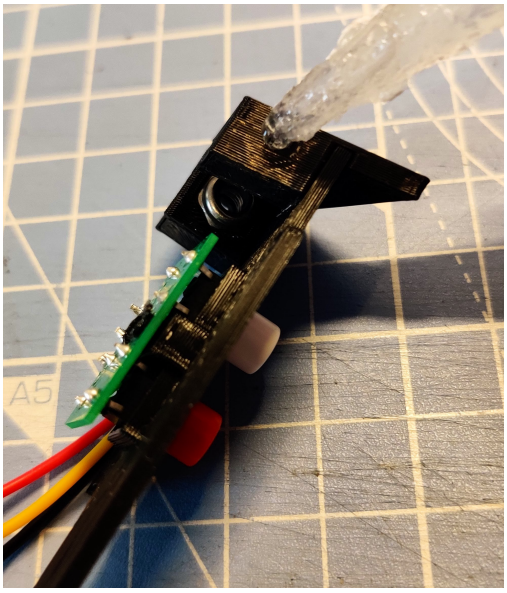
You will find that the ‘Error Box’ is partly assembled with the inner ‘E’ plate and light diffuser already in place. We just need to add three dummy wires to complete the look:

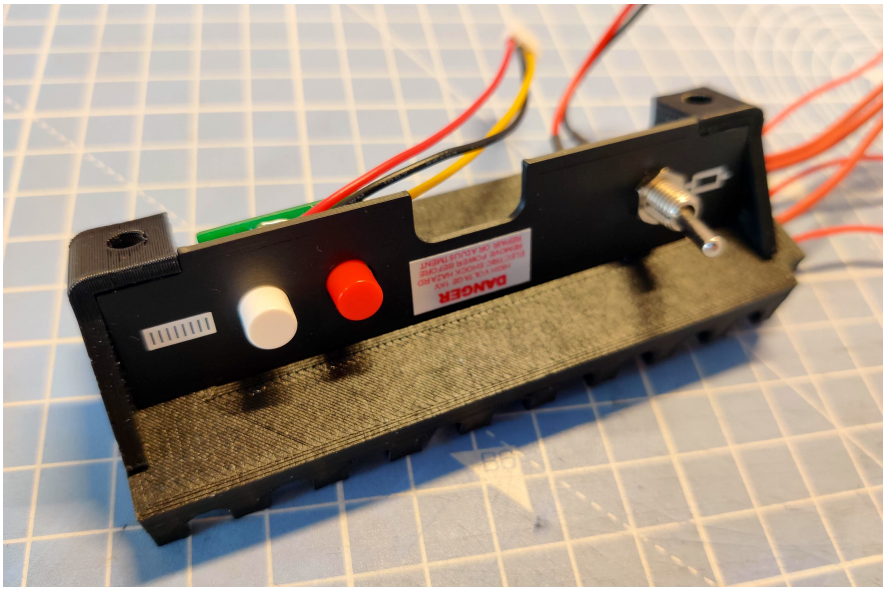




- Divide the 240mm length of red wire into three equal 80mm sections, then tie a single knot in the end of each one.
- Thread each wire through the holes in the side of the Error Box so that the knots sit along the inner edge as shown above.
- Cut any ends off from each knot and apply some hot-glue or superglue over each one to keep the wires from moving. This does not need to be tidy as it will be hidden once the Error Box is place.

- Flip the Error Box over and press it onto the shelf so the rectangular columns slide into the holes in the box.
- Press down until the box sits tightly on the top of the shelf as shown above. You may need to wiggle the box slightly until it sits flush.
- Now turn the shelf assembly face down so we can attach the control panel…



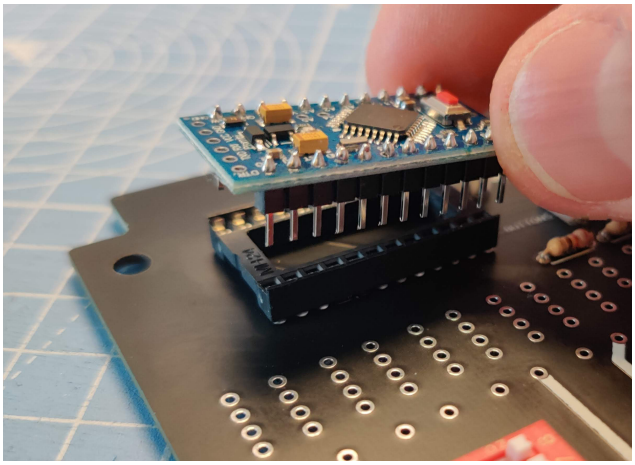


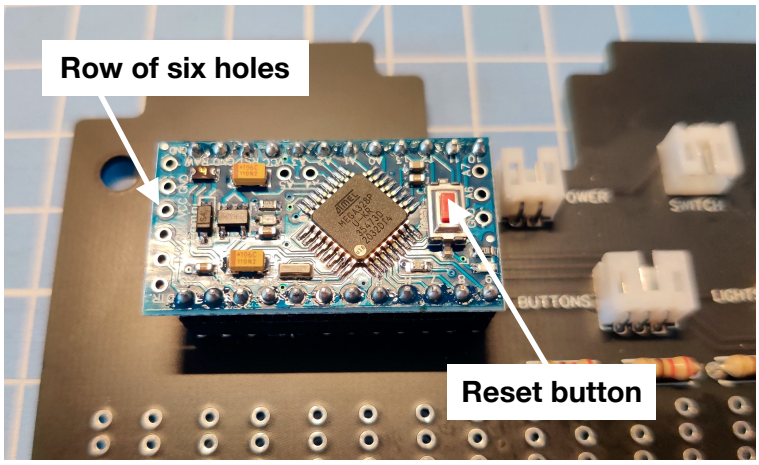
- Add some super glue to the flat area on each of the panel feet.
- Place the rear panel with connected feet on top of the Nixie Shelf assembly as shown. The edge of the control panel will slot into the groove in the shelf at an angle so the top of the feet sit flush against the sides.
- Apply glue if necessary to the inner joins. Again, there's no need to be neat as this will all be hidden, just make sure all parts are securely fixed in place.

10. CONNECT THE WORKING ELECTRONICS

The gizmo motherboard includes plug-in connectors for all working electronics. This means that no soldering is required for these parts. They can also be easily disconnected or replaced when needed.

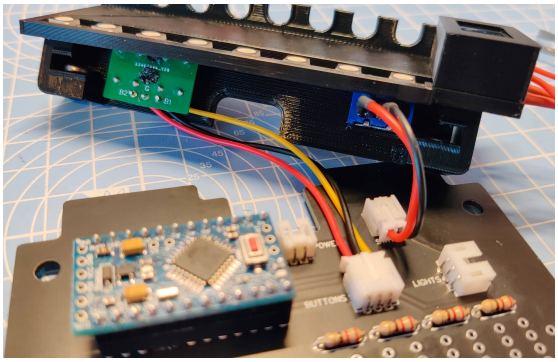
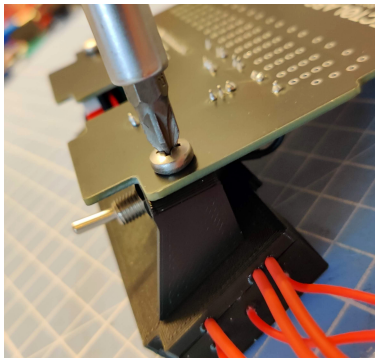
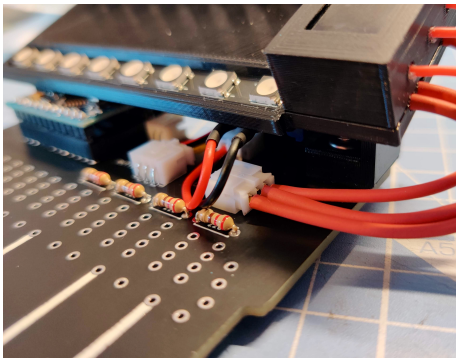
PLEASE NOTE: The photos in this section show our black GIZMO 8910 motherboard, however the connections and process is exactly the same for the GIZMO 8410.





- Firstly, plug the blue microcontroller into the black 24-pin socket on the top left of the motherboard. Press down firmly until it is fully seated.
- Double check that the microcontroller is inserted the correct way as shown above - the vertical row of six holes should be on the **left** hand side, and the red reset button should be on the **right**.

It is essential that the microcontroller is orientated correctly. Failure to do so may result in damage to the microcontroller when powered on.

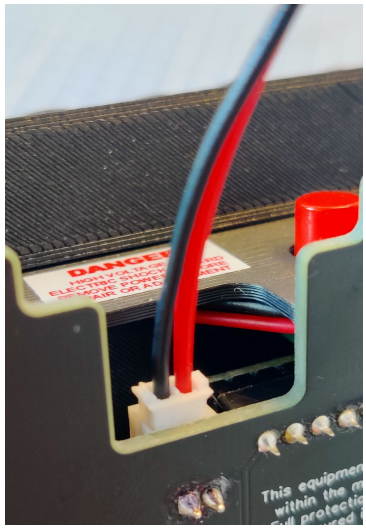




Now carefully insert the white plugs from the buttons and from the toggle switch into the connectors marked ‘BUTTONS’ and ‘SWITCH’ as shown in the first photo above.

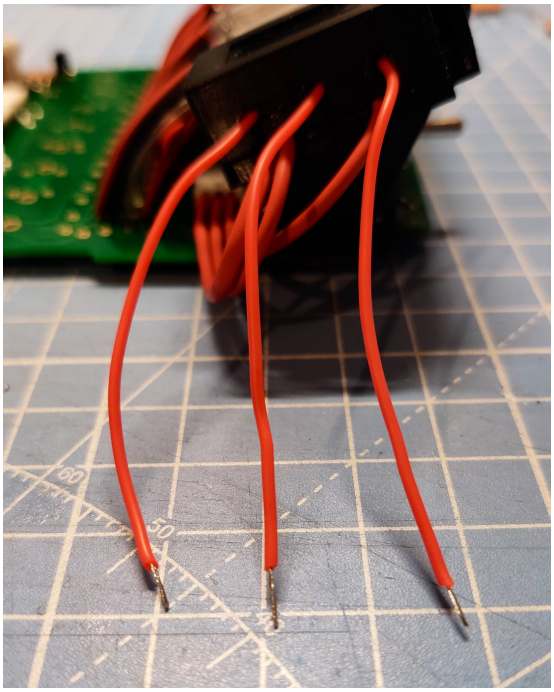
- Place the shelf at the top of the motherboard so that the large holes in the board line up with the holes in the feet. The **red**, **black** and **yellow** wires from the buttons should be tucked under the shelf so it loops over the cutout in the back panel.
- Flip everything over and screw the two bolts through the motherboard and into the lock nuts in the feet until tight.

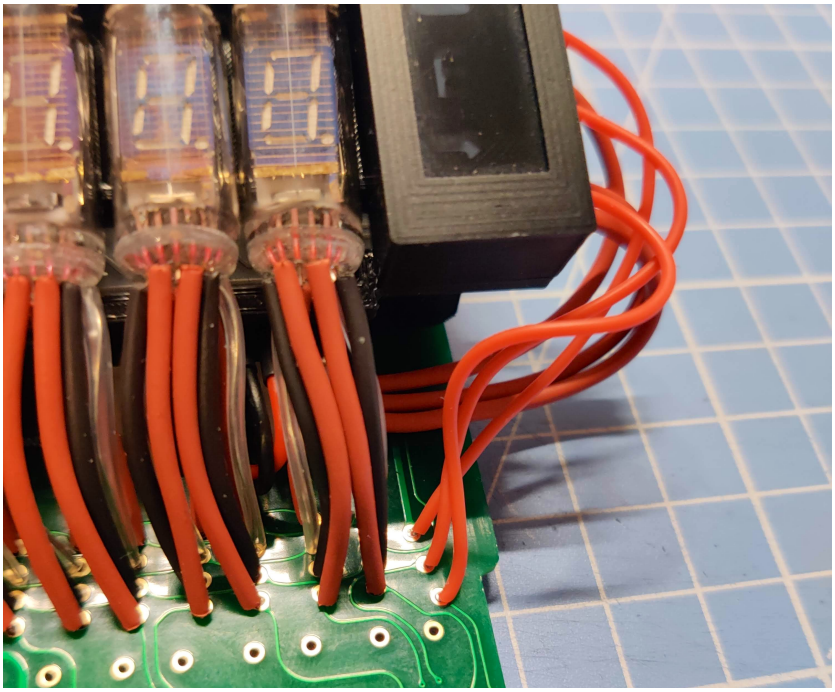
The nylon rings in the nuts will create some resistance when screwing in the bolts. Therefore, grip the corner of the back panel and the foot with your fingers as you slowly screw in each bolt. This will help prevent the shelf from coming apart in the glued areas.






- Once the shelf assembly is in place, connect the three lower red wires coming from the side of the error box into the connector underneath the shelf. The other three loose red wires are purely cosmetic and not part of the working lighting electronics. We will attach these to the board later, so leave them as they are for now.
- Plug-in the battery cable into the connector accessible at the top of the unit. Be very careful not to tug at the cables themselves as this may damage them - insert and remove the cable only by gripping as close to the plug as possible.
- It’s time for the moment of truth… Snap the battery connector onto your 9V battery and flick the toggle switch. If all is well, the eight main LEDs on the shelf, plus the error box, should begin to light up. The default lighting effect will display in a loop.
- Now let’s test the buttons on the control panel. Pressing the white button repeatedly will cycle through the light patterns, and the red button will cycle through the different colours. Full operating instructions, including information on all of the available modes are detailed at the end of this guide.
- Once you are happy that everything is working as it should, flick the toggle switch back to the off position, disconnect the battery and the battery cable and breath a sigh of relief!



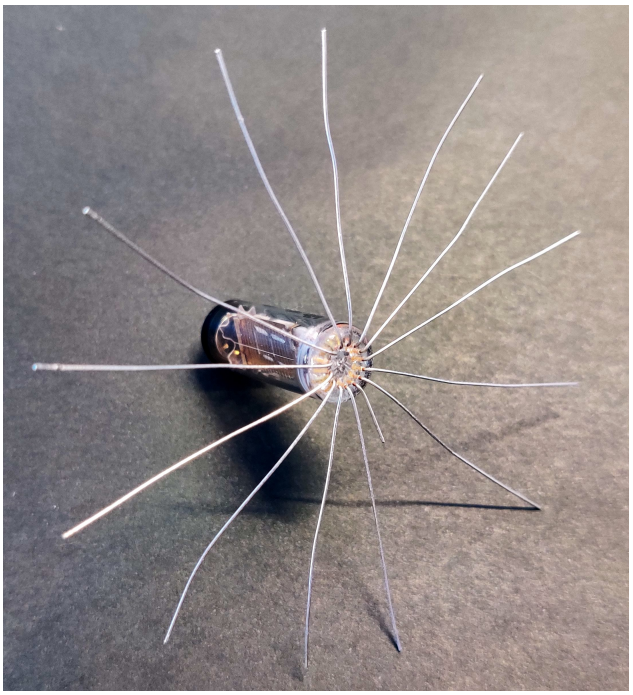


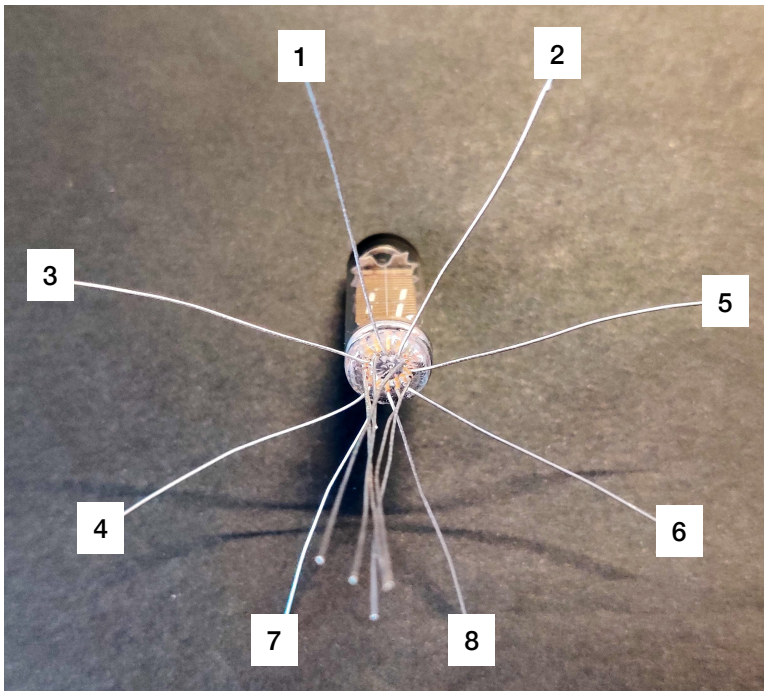
- Finally, strip a little of the red silicone away from the ends the three loose wires.
- Feed these bare wires through the three holes shown in the second photo above. As with the other components, solder into place or bend the wire over on the back of the motherboard and apply hot-glue.

11. PREPARE THE VFD TUBES

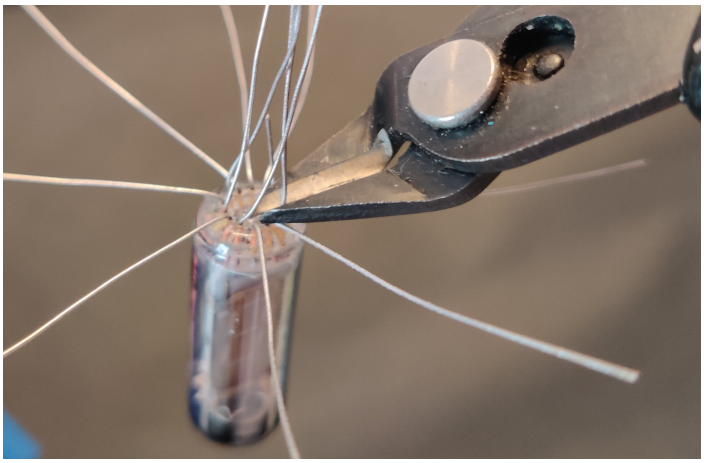
Your kit contains 8 genuine vintage glass VFD tubes. Although we won't be able to light the numbers up themselves, the glass tubes will reflect the light from the LEDs underneath to create an awesome looking effect.

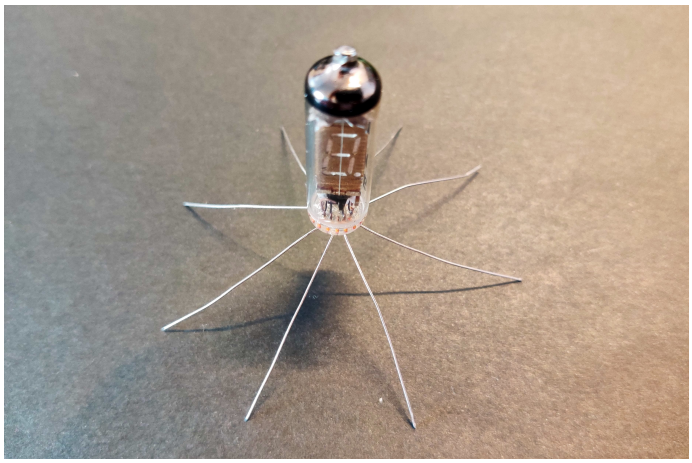
It's worth nothing that, depending on availability, the exact model of the nixie tubes can differ slightly from kit to kit. Their appearance may have minor differences to those shown in the following photos, but they will always be the correct size and will always be shipped together in a matching set 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.



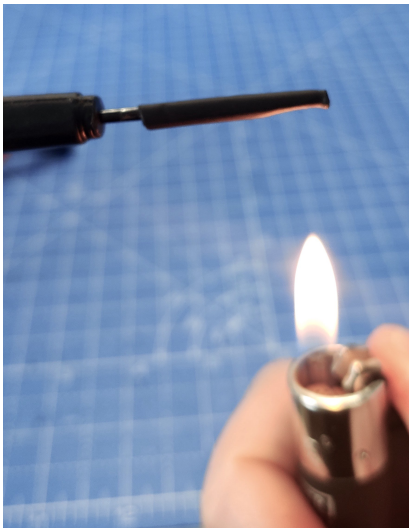


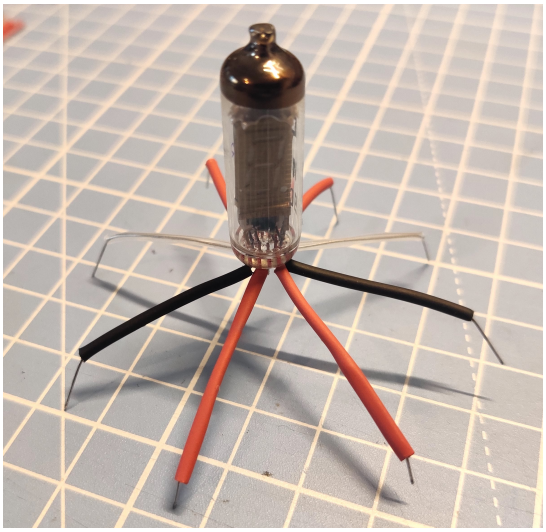
- With your wire cutters, snip off all the unwanted wires that you have bunched together. Be very careful not to remove any of the eight wires still fanned out as we will need these to attach to the motherboard.
- Once done, you should have a tube that looks like that in the second photo above with eight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

12. ADD THE COLOURED HEAT-SHRINK

Before we can mount the tubes to the shelf and attach them to the motherboard, we must mimic the look of the wire insulation the Sanyo calculator boards had. According to reference photos, there were different color in circulation, but we will recreate the bold black and red look to match the shelf wires.

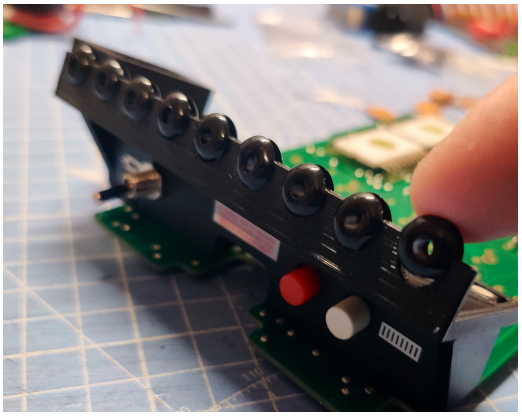
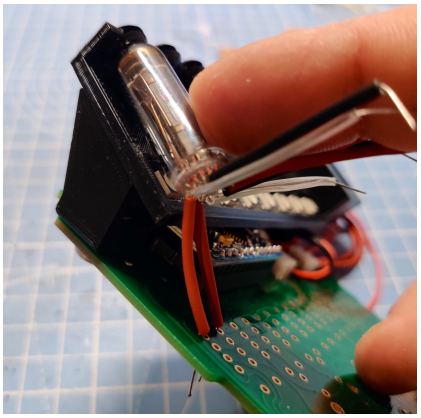
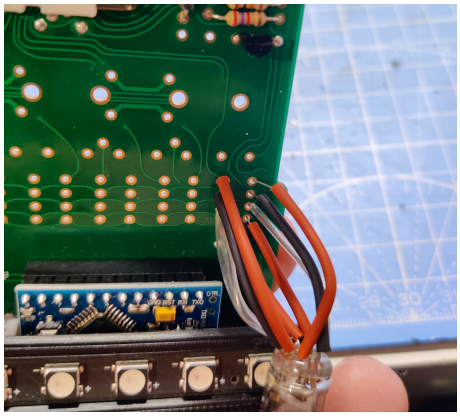




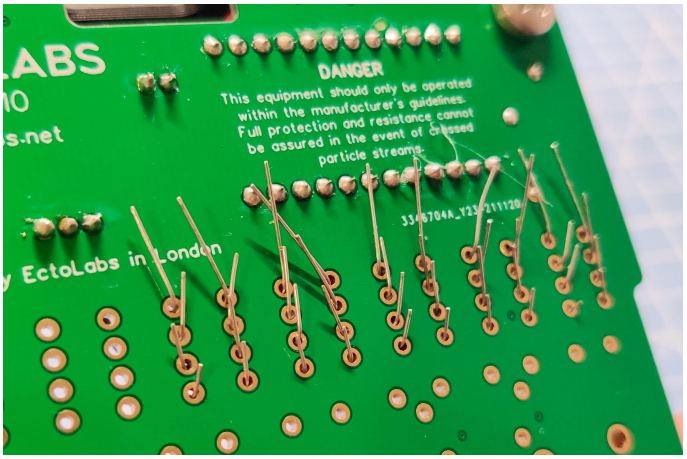


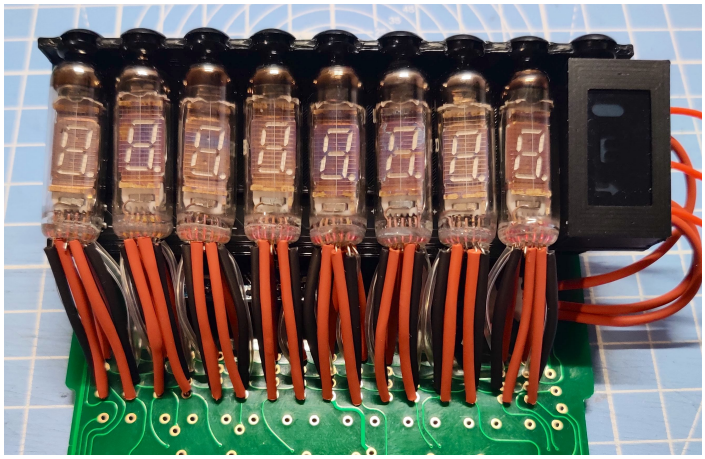
- From the **red**, **black** and clear lengths of heat shrink tubing, cut the following sections:
  - 2x 30mm **Red**; 2x 27mm **Black**; 2x 26mm Clear; 2x 22mm **Red**.
- Place a section of tubing over a wire or the end of a small screwdriver, and use a heat source to shrink it down. You can use a 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 **longer** 30mm **red** tubing over the front two wire strands.
- For the second two wires, repeat the process with the 27mm **black** tubing. For the third two wires, use the 26mm clear tubing, and for the final two use the shorter 22mm **red** tubing. The completed display tube should look like the third photo above.
- Repeat the process for the other seven VHD tubes.

13. MOUNT THE VFD TUBES

- Find the nine rubber grommets and press fit them into the notches in the nixie shelf.
- To attach the first tube to the motherboard, feed the **back two red** 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 clear wires into the next two holes, followed by the **black** wires into the next two, and finally the longer **red** wires into the front two holes.



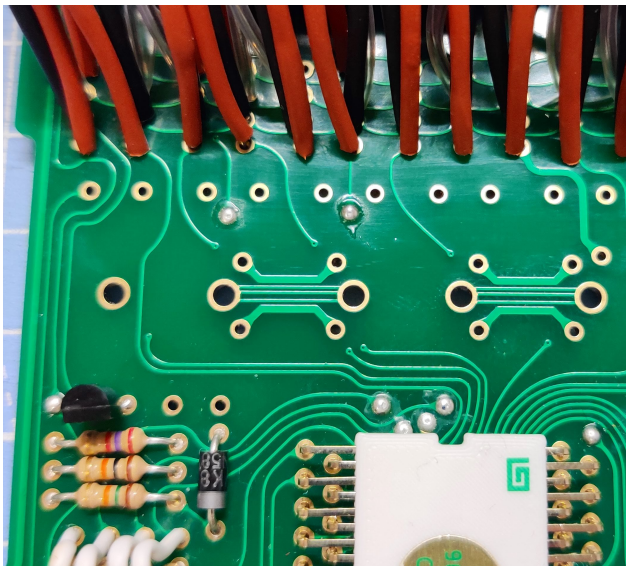


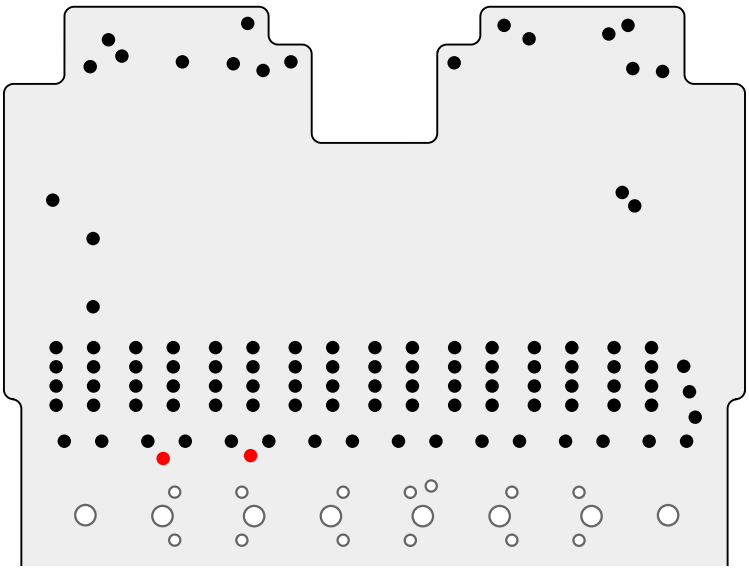
- Once all of the wires are in place, gently rotate the tube until the digit appears straight, facing directly upwards.
- You can now choose to either solder (or hot glue) the wires into place now, or attach the rest of the tubes first and secure them all in one go. If opting for the latter, bend the 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.

If any of the tubes are not staying in place on the shelf, slide the relevant grommet out of the notch and apply a drop of superglue inside the groove. Replace the grommet and allow the glue to set. Re-insert the top of the glass tube into the grommet to keep it firmly in position.

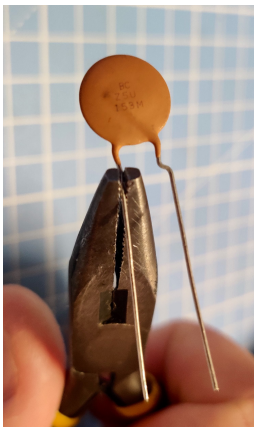
14. ADD THE FINAL SOLDER BLOBS (Optional)

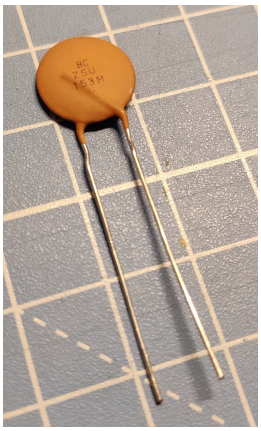
If you are using a soldering iron, add small blobs of solder over the 2 holes indicated in **red** below. If you are not soldering, then you may skip this step if you wish.

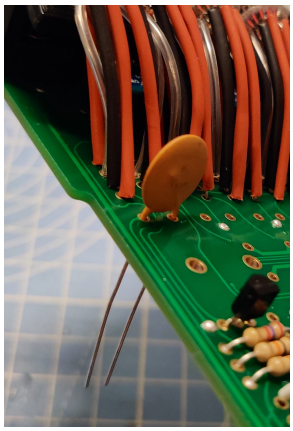


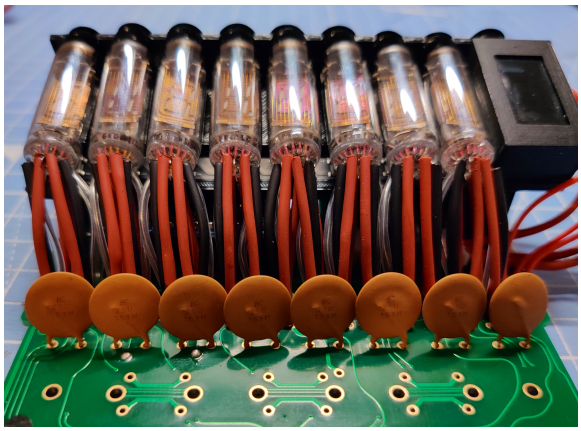


15. ATTACH THE DISC CAPACITORS









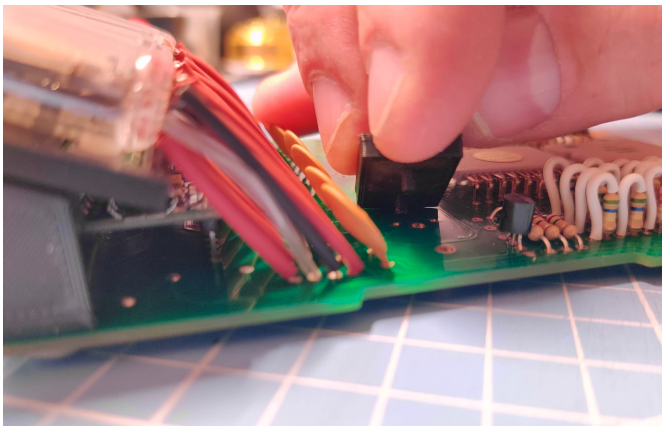
- Before adding the eight orange disc capacitors, we need to remove the kink in their wires. You can do this by bending the wires with a pair of pliers until they appear straight. This does not need to be neat - just enough so the wires slide through the holes unobstructed.
- Add each disc capacitors 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.

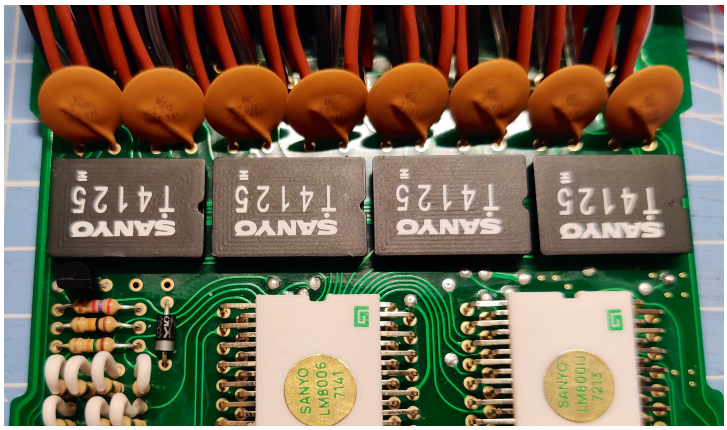
To help attach the disc capacitors and keep them lined up, you can push the body of each capacitor back so they rest on the tube wires. Use some tape to hold them in position as you flip the board over and solder or glue to the wires to the back.

16. ATTACH THE BLACK T4125 CHIPS

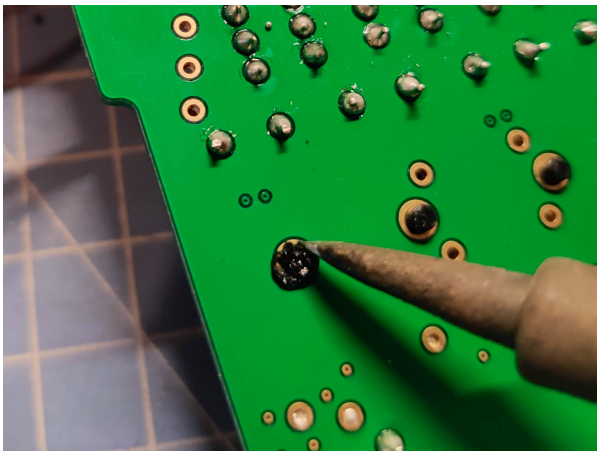
The four replica Sanyo chips are included in your kit and come pre-made with accurate logos and markings.

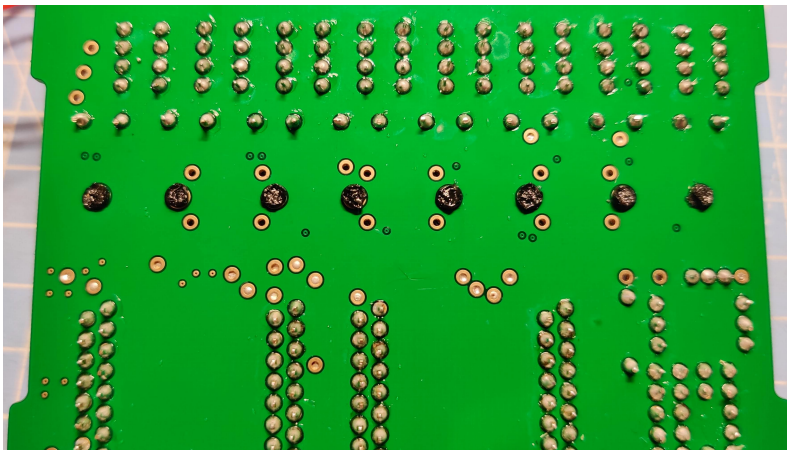
As was the case on the original Sanyo circuitboards, the T4125 chips should be mounted UPSIDE-DOWN with the small notches facing to the RIGHT.





- Simply press-fit each chip by pushing their two pins into the corresponding large holes on the board. Remember to mount them so the white text is **upside-down** and the notch is on the **right**.
- Flip the motherboard over and melt the ends of the plastic pins with your soldering iron. Using a circular motion,





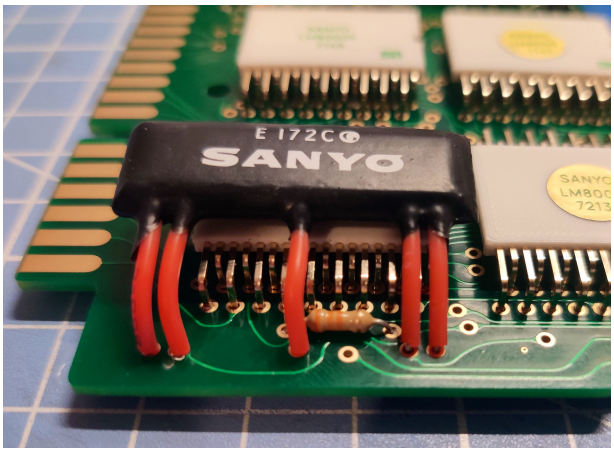
spread the melting plastic out flat over the pad to create a rivet.

- Allow the plastic to cool back down and become hard again, then check that each black chip is held firmly in place without any wobble.
- If you are not using a soldering iron, apply hot glue to the plastic pins where they protrude through the hole. If you need them to be more secure, you can apply a small amount of epoxy glue to the underside of each black chip to hold them permanently to the surface of the motherboard.

17. ATTACH THE E172C CAPACITOR

We're nearly there… Just one last thing to add! The final custom component is the long rubberised capacitor, again with accurate logo and markings:



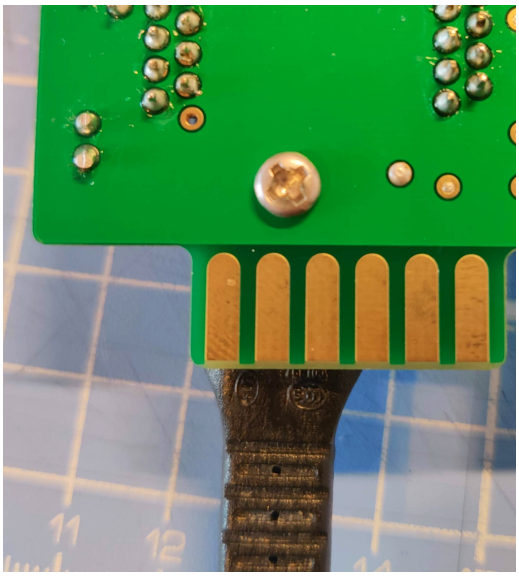


- Start by stripping a small amount of red insulation from each of the five wires. Twist the exposed wire so they will pass through the final holes on the bottom right of the motherboard.
- When attached, this replica capacitor should sit on top of the adjacent white chip as shown in the last photo above. If the capacitor sits a bit too far over, trim a little off the red wires and re-strip.
- Feed the bare wires through the five holes in the motherboard and solder into place. If hot-glueing, remove a little more of the insulation, bend the exposed wires over and apply the glue until secure. You may find it easiest to secure one wire at a time.

18. LINK THE DAUGHTERBOARD

This is it! This is definitely it!

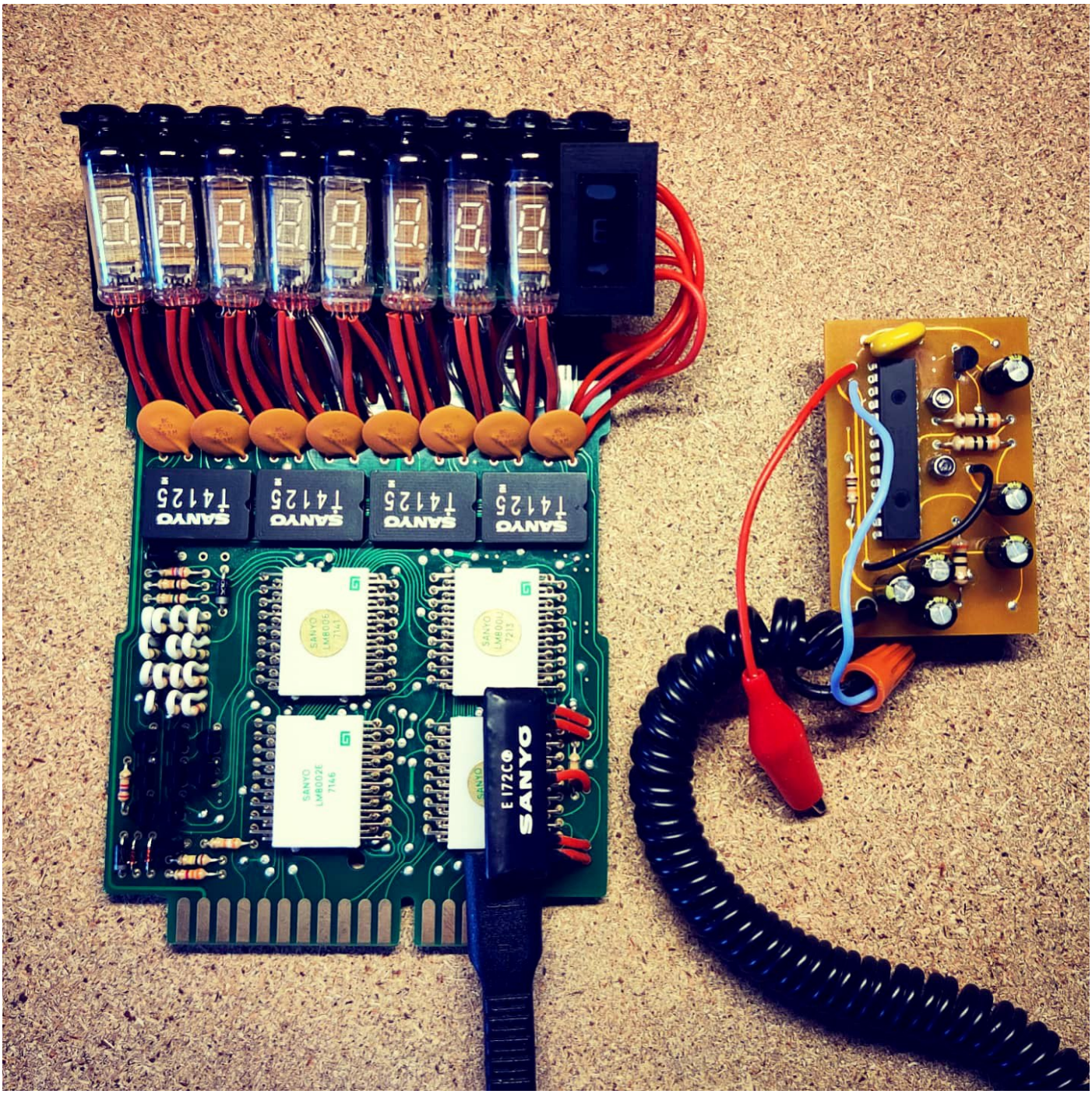




- Dust off the daughterboard you assembled earlier remove the small bolt and spacer from the 'shaver plug' at the end of the coiled cable.
- Pass the bolt (with spacer still attached) through the hole directly underneath the bottom-right white chip.
- Place the thread in the shaver plug over the bolt, flip the board over and tighten the bolt into the thread until the plug is firmly attached to the surface of the motherboard.
- If there is not enough clearance for the shaver plug to be attached correctly underneath the white chip, try cutting a small amount of the black rubber way from the plug until you are able to line up the bolt with the thread.

GIZMO 8400 COMPLETE!

Congratulations!!! You've done it! Your GIZMO 8410 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 on the control panel to change the lighting pattern or LED colour:

Pressing the WHITE 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. **“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.
8. **“RAINBOW”** — All nine LEDs display a continuously changing pattern in a full spectrum of colours. This mode overrides the currently selected colour.

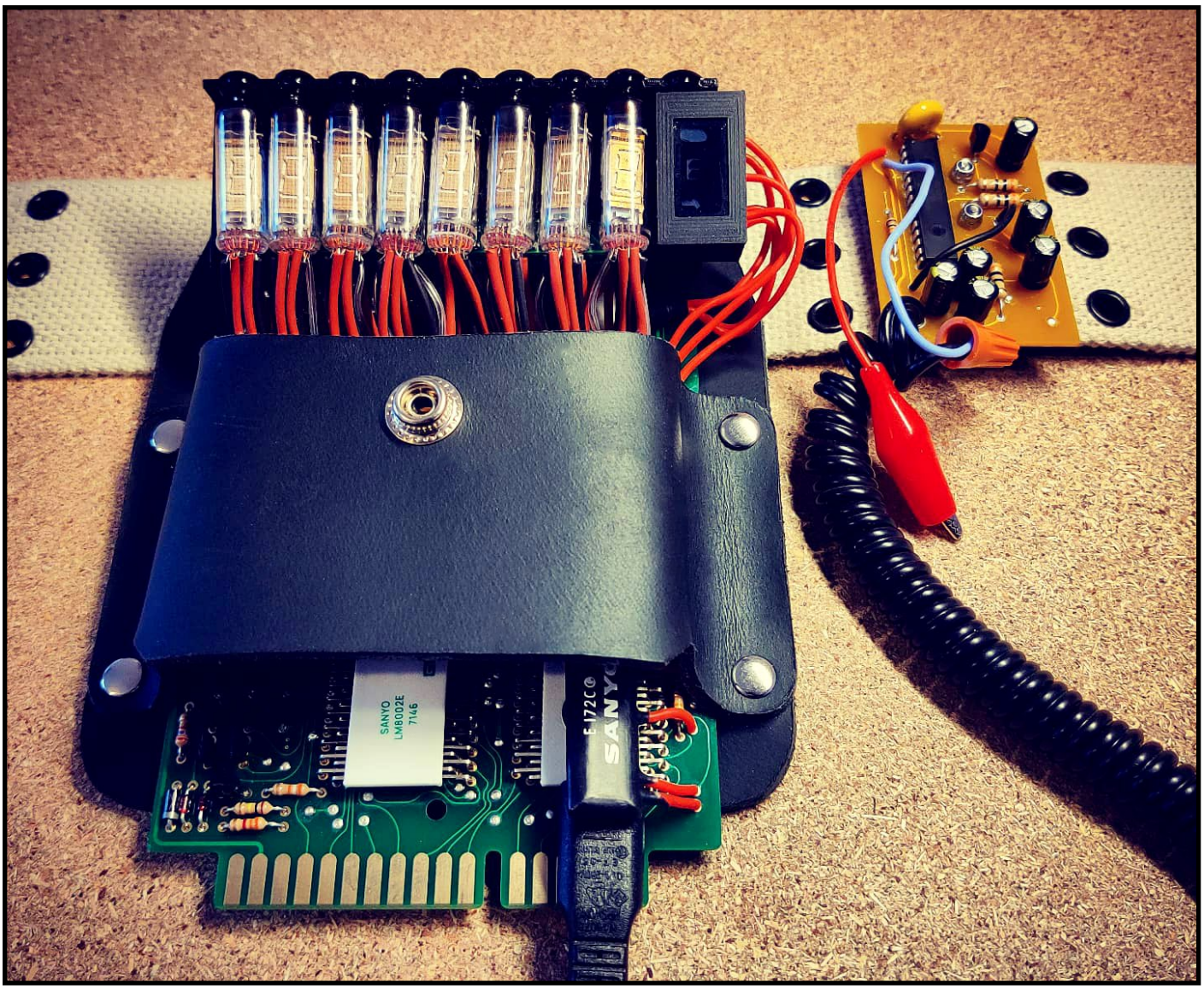
Pressing the **RED** button will cycle through all of the available colours. Changing the colour during a running pattern will restart that pattern. The pre-programmed colours are:

1. **RED**
2. **ORANGE**
3. **YELLOW**
4. **GREEN**
5. **TURQUOISE**
6. **BLUE**
7. **PURPLE**
8. **PINK**
9. **WHITE**

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

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 Tremaine, 2022

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