

GIZMO 808D MK2

BELT GIZMO & DAUGHTERBOARD KIT

INSTALLATION GUIDE & USER MANUAL

v1.0

ECTOLABS

Thanks for purchasing the **ECTOLABS GIZMO 808D MK2** kit - our flagship belt gizmo kit inspired by the Sanyo ICC-808D calculator circuit boards used in the original *Ghostbusters* movie.

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.

If you are new to soldering electronic components, we would recommend practicing a little with some online beginner guides before diving in. Bear in mind though, that only a smaller number of components are actually functional so don't worry too much in becoming a solder master!

We hope you enjoy building this kit as much as we have had designing it.

Have fun!

TOOLS REQUIRED

- **Soldering Iron**
- **Epoxy Glue** *(Rapid cure type recommended)*
- **Pliers** *(Narrow or needle-nose)*
- **Wire Cutters**
- **Wire Strippers** or **Craft/X-Acto Knife**
- **Small Phillips screwdriver** *(Suitable for M2.5 & M3 screws)*
- **Heat Source** *(Heat gun or lighter)*
- **1x 9V Battery**

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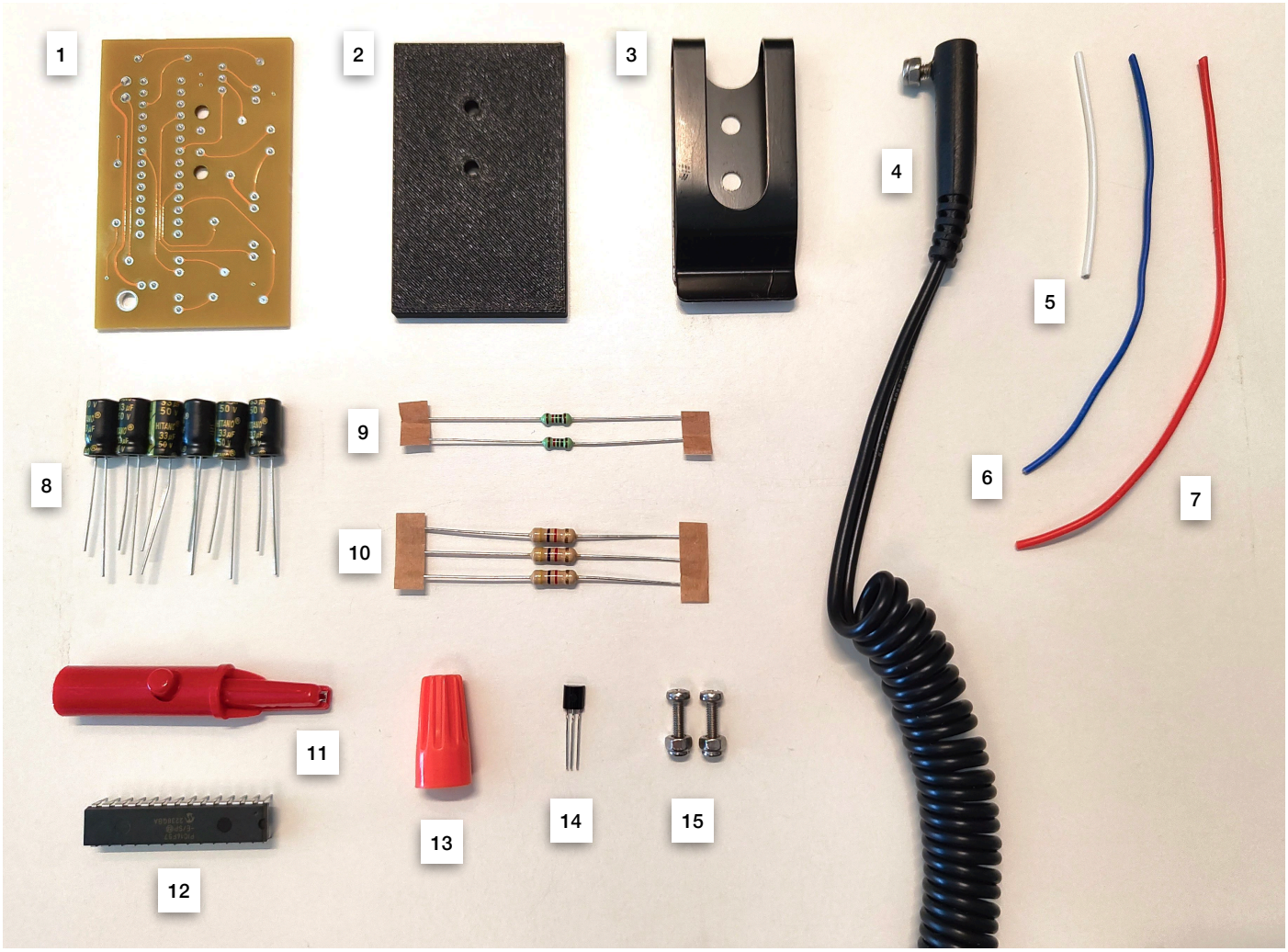
DAUGHTERBOARD ASSEMBLY

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

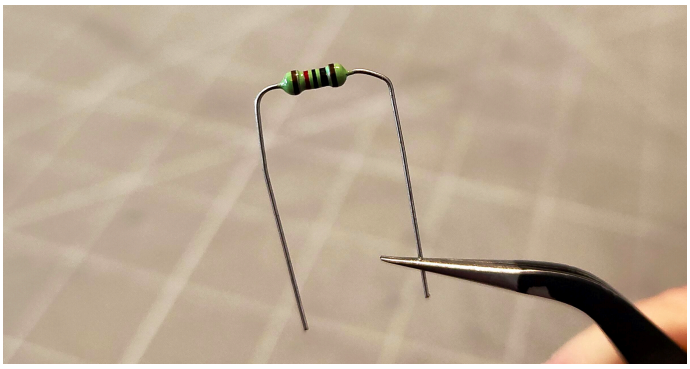
All the parts needed for the daughterboard assembly are contained in the bag labeled **GIZMO 808D MK2 - Daughterboard** - these are shown in the photo below. Using the following list, double-check you have all of the parts from the bag in your kit and set them out on your workbench:

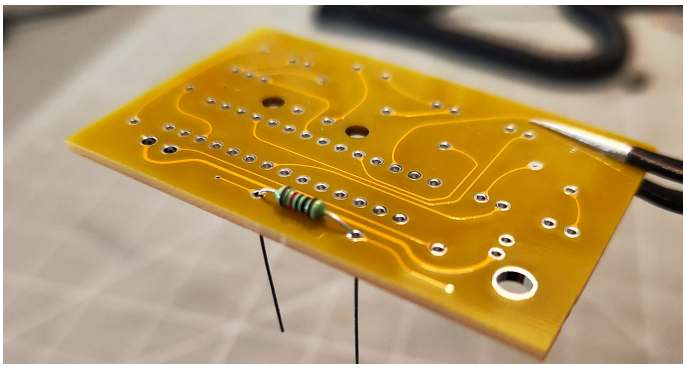


① 1x **Yellow daughterboard PCB**
② 1x **Back panel**
③ 1x **Belt clip**
④ 1x **Coiled cable (inc. bolt and lock nut)**
⑤ 1x **WHITE silicone wire**
⑥ 1x **BLUE silicone wire**
⑦ 1x **RED silicone wire**
⑧ 6x **Black/gold aluminium capacitors**
⑨ 2x **GREEN resistors**
⑩ 3x **30 Ω resistors [ORANGE-BLACK-BLACK-GOLD]**
⑪ 1x **Crocodile clip**
⑫ 1x **Black 28-pin controller chip**
⑬ 1x **Orange wire nut**
⑭ 1x **NPN transistor**
⑮ 2x **M2.5 10mm bolts + M2.5 lock nuts**

1. ATTACH THE RESISTORS, CHIP AND TRANSISTOR

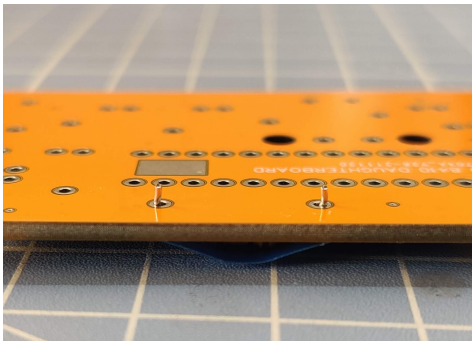
The resistors are the small tan or green coloured components fixed in the centre of a short length of silver wire. Each one has a four band colour code around the outside. Your kit contains various resistors in specific quantities (all with different colour codes) so make sure you select the right ones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

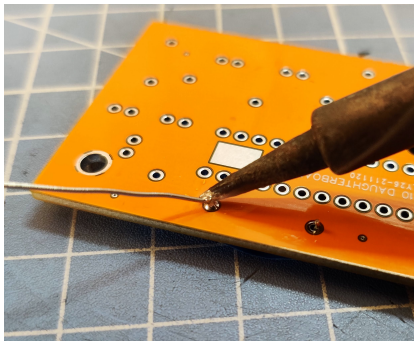


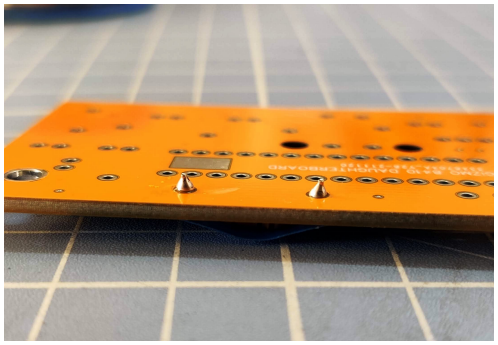


- Firstly, grab the daughterboard along with one of the small **green** resistors.
- Using pliers or your fingers, gently bend both ends of the resistor wire to a 90 degree angle.
- Thread both ends of the resistor through the two holes in the daughterboard as shown in the photo above. Be sure to double-check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

The orientation of resistors do 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. In the case of the tan coloured resistors, position the gold bands in the same position.

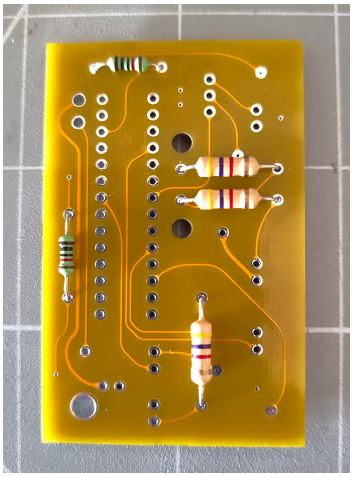


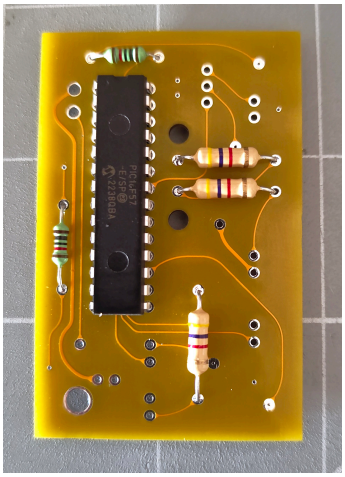


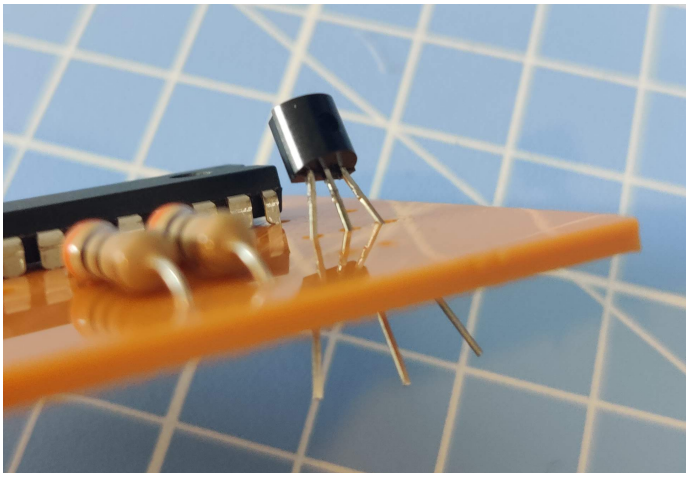


- Place some tape over the resistor to keep it in place and flip the board over.
- With your wire cutters, cut down each end of the wire leaving about 2-3mm.
- Use your soldering iron to apply solder around the ends of the wires. Make sure the solder flows all the way around the wire and over the surface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

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.

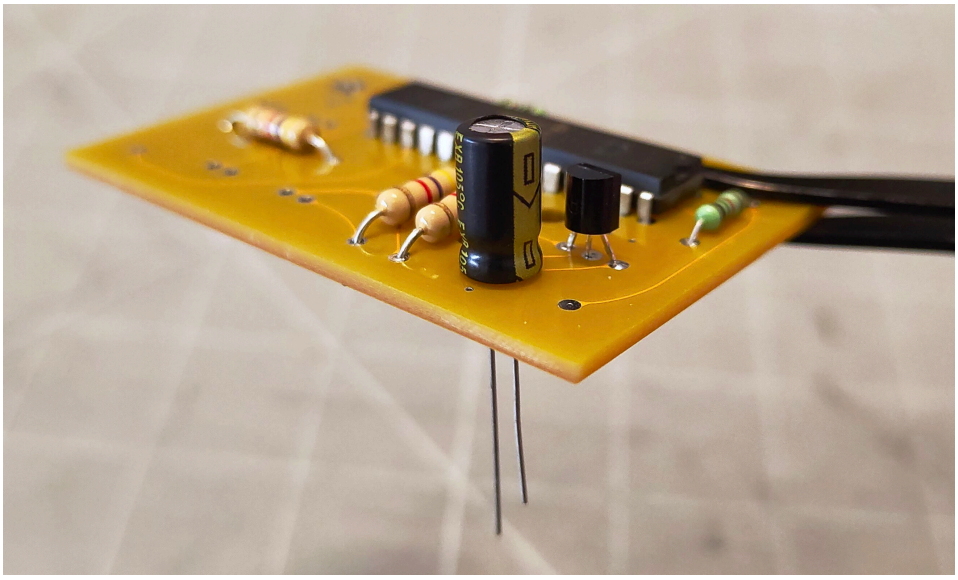


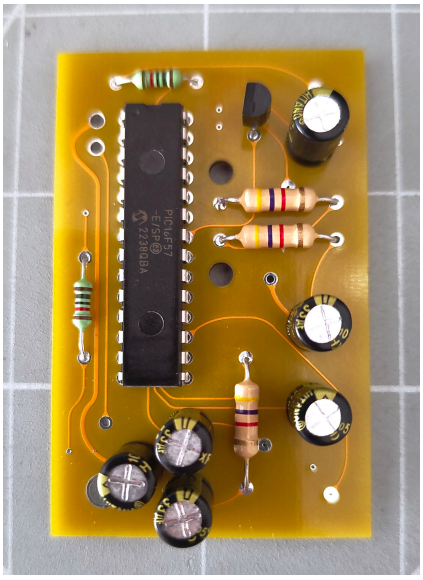




- Repeat this technique to attach the second **green** resistor and the three larger 30 Ω resistors **[ORANGE-BLACK-BLACK-GOLD]** as shown in the first photo above. Make sure to orientate them in a uniform way.
- Add the long black controller chip by inserting it into the two parallel 14-hole rows as 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 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 into place.

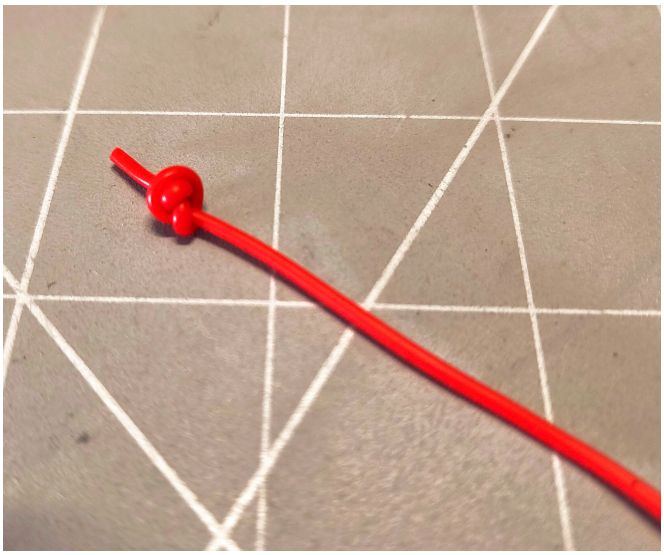
2. ATTACH THE ALUMINIUM CAPACITORS

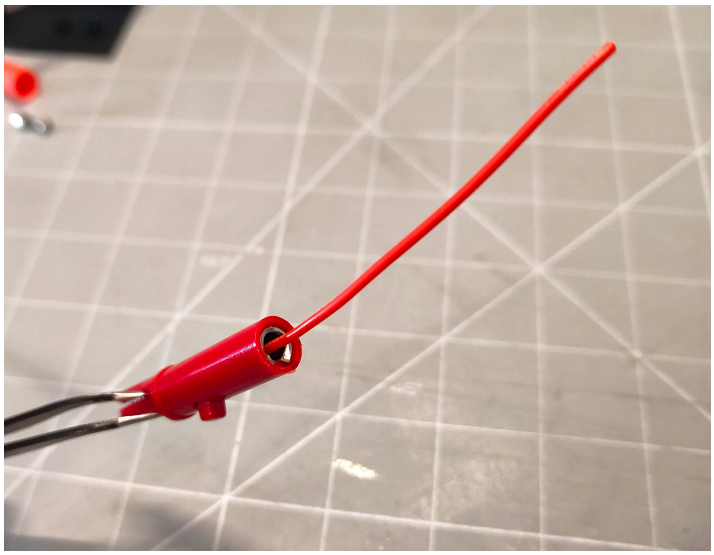




- Time to add the six black and gold cylindrical capacitors. If they are connected together in your kit, remove the paper and tape before continuing.
- Thread the wires through the holes next to the transistor we just added. Trim the wires and secure into place with solder. Notice the gold stripe along 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.

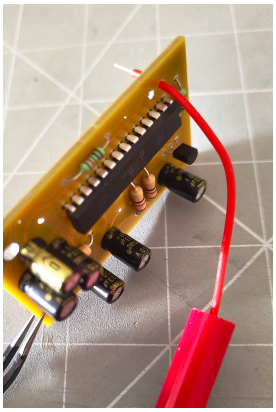
3. ASSEMBLE THE CROCODILE CLIP

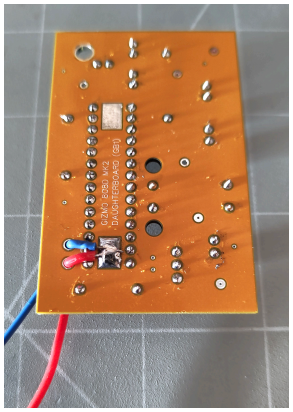


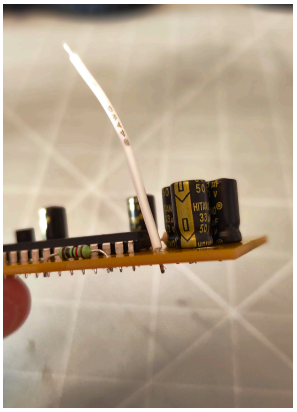


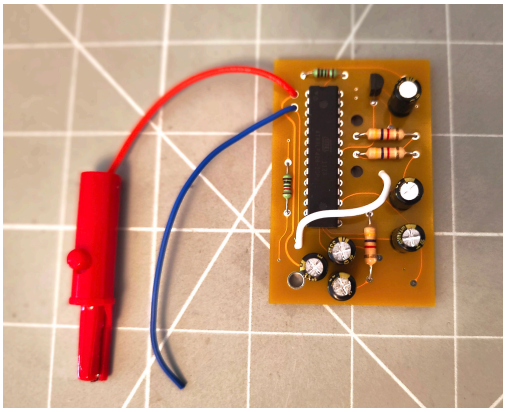
- Find the **RED** silicone wire and make two tight knots at one end.
- Use a small screwdriver or other thin implement to push the knotted end of the wire into the open hole in the crocodile clip. You may wish to fold the end of the wire over to make it a tighter fit so that the wire stays in place and will not pull back out easily.
- If you feel that the wire needs more security, add some epoxy or hot glue inside the hole to better hold the wire in place.

4. ATTACH THE WIRES AND CABLES





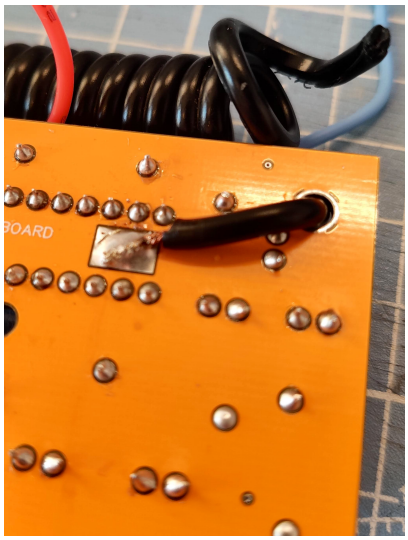


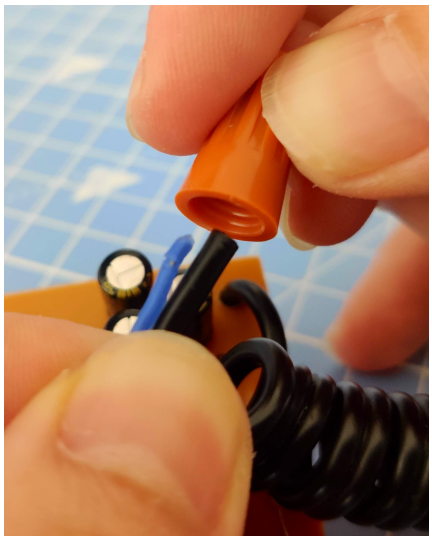


- Next, take the white wire, the **blue** wire and the **red** wire (now attached to the crocodile clip). Strip a small amount of the silicone insulation from ONE end of each wire.
- Push the **red** wire all the way through the hole as shown in the first photo above, and then do the same with the **blue** wire in the hole beneath.
- Fold both wires over and solder them directly to the silver pad as shown above.
- Now solder in the white wire to the hole beneath the green resistor.
- Strip the other end of the white wire and attach via the hole just below the two large resistors as shown in the fourth photo above. Manipulate the wire to create a wave shape
- Leave the **blue** wire as it is for the moment - we will secure that shortly.

5. ATTACH THE COILED CABLE



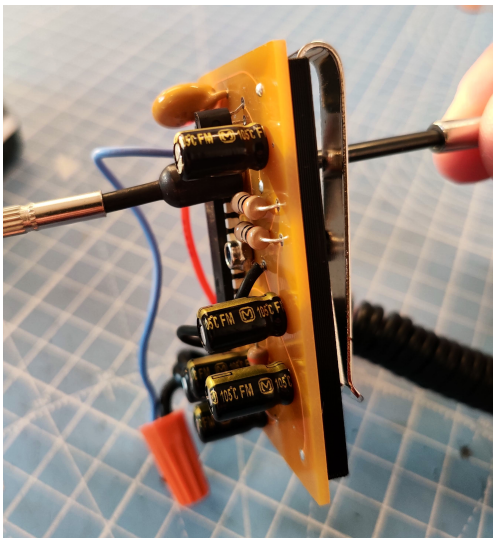


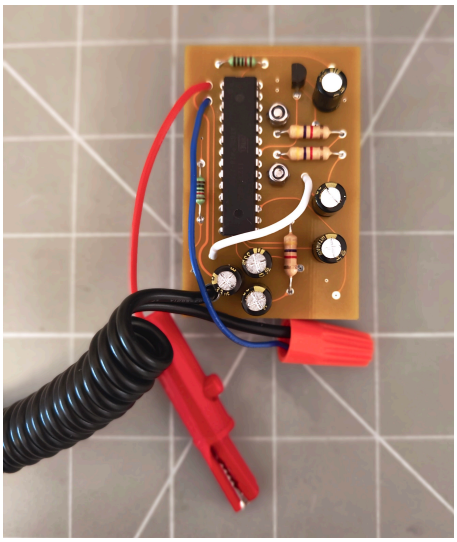


- The coiled cable actually consists of two individual wired moulded together with a short length separated at the end.
- Strip a good amount of insulation from the end of one of the loose ends and feed it through the large hole in the daughterboard. Pull this through until about an inch of cable is visible from the board to the beginning of the coil.
- Trim so that the end of the exposed wire overlaps the other 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.
- 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.

6. ADD THE BACK PANEL







- Align the two holes in the back panel with the two centre holes on the board.
- 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 'Motherboard Assembly' section…

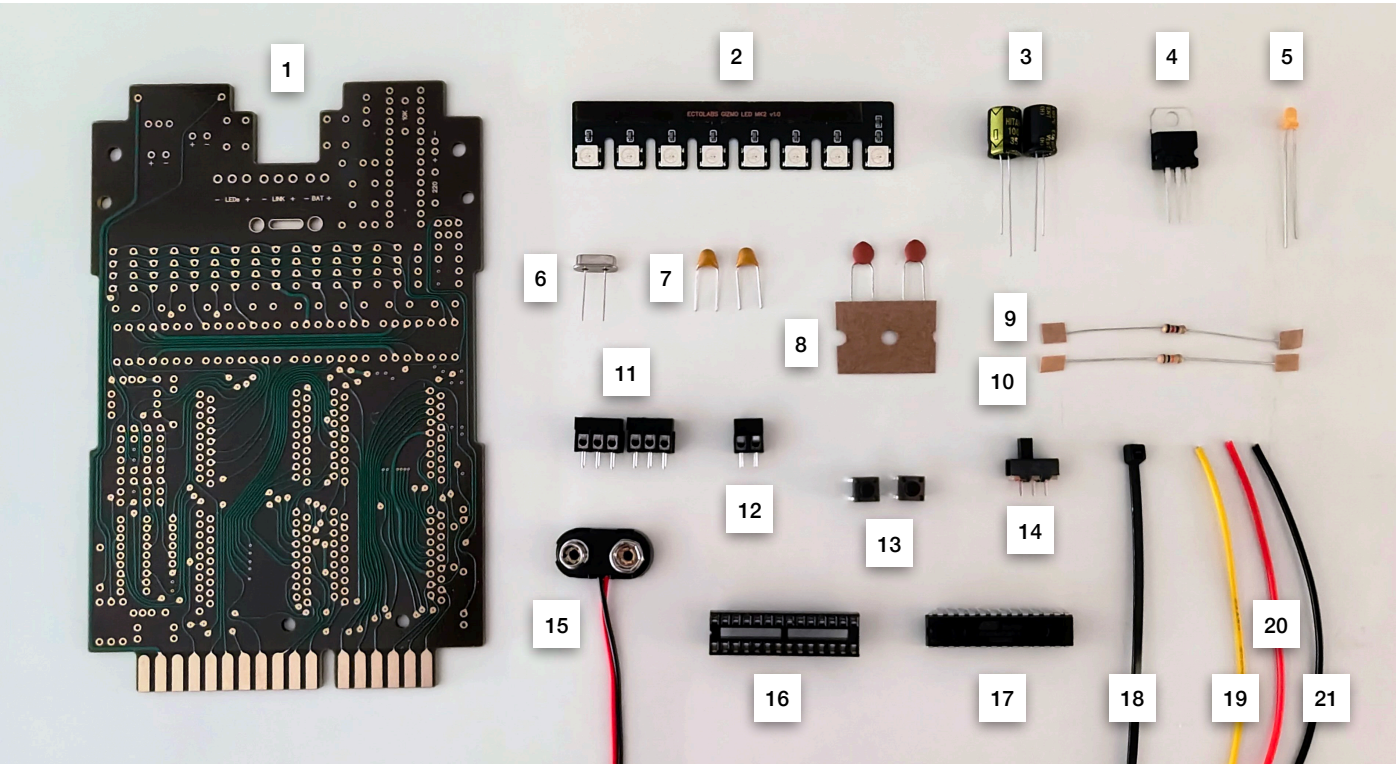
MOTHERBOARD ASSEMBLY

Attaching components to the main gizmo board uses the same technique we learned with the daughterboard. Remember that you will need to supply a 9V battery (not included) to power the electronics.

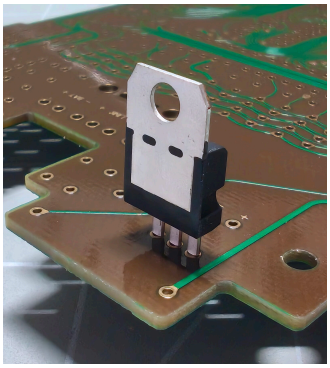
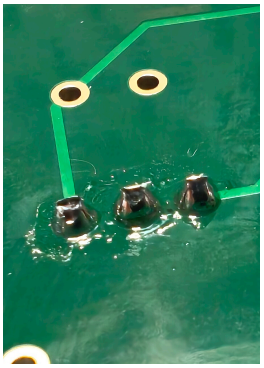
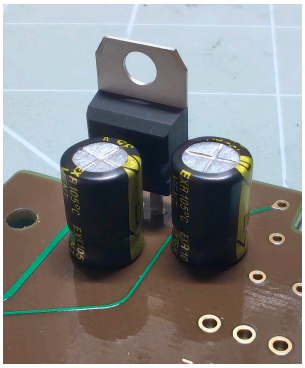
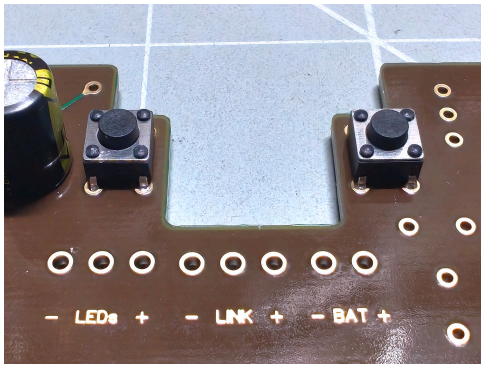
1. ATTACH THE FUNCTIONAL ELECTRONICS

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 808D MK2 - 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:



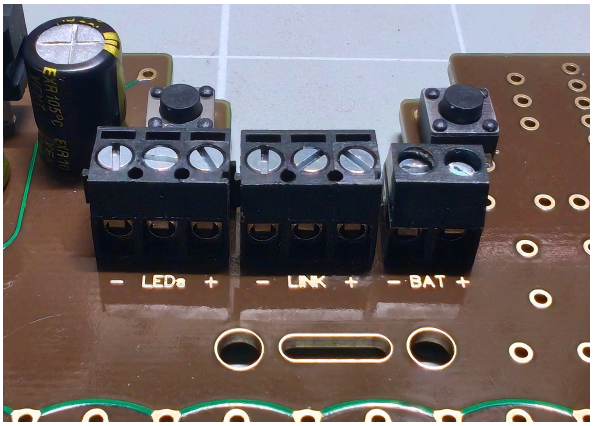
① 1x **Brown/green mainboard PCB**
② 1x **LED PCB**
③ 2x **100uF aluminium capacitors**
④ 1x **5V voltage regulator**
⑤ 1x **Orange LED**
⑥ 1x **Crystal resonator**
⑦ 2x **22pF tantalum capacitor**
⑧ 2x **0.1uF disc capacitor**
⑨ 1x **10K Ω resistor [BROWN-BLACK-ORANGE-GOLD]**
⑩ 1x **120 Ω resistor [BROWN-RED-BROWN-GOLD]**
⑪ 2x **3 pin screw terminal**
⑫ 1x **2 pin screw terminal**
⑬ 2x **Push buttons**
⑭ 1x **Slide switch**
⑮ 1x **9V battery cable/connector**
⑯ 1x **Microcontroller socket**
⑰ 1x **Microcontroller**
⑱ 1x **Cable tie**
⑲ 1x **YELLOW silicone wire**
⑳ 1x **RED silicone wire**
㉑ 1x **BLACK silicone wire**

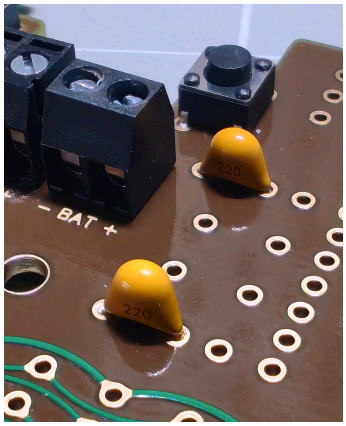





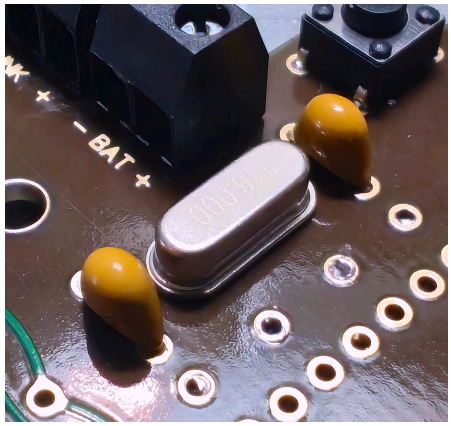
- Start by adding the voltage regulator to the three holes at the top-left of the mainboard as shown in the first photo above. **Make sure that the metal face of the regulator is facing the top of the board as it will not function correctly if mounted in the opposite direction.** The regulator can only 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.

It is essential that all functional electronics are soldered to the board correctly. The solder should completely surround each pin and fully cover its gold pad, forming a cone shape. Make sure that every pin is isolated and that no solder is bridging between the gaps, otherwise this may cause a short which may damage the electronics.

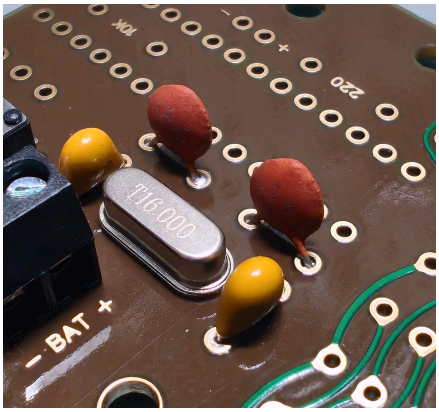
- Add the two aluminium capacitors next to the regulator as shown in the third photo above. Each capacitor has a gold stripe - **these stripes should be facing to the right of the mainboard in order to function correctly**. Solder the pins and trim.
- Now add the two mini push buttons as shown in the fourth 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.

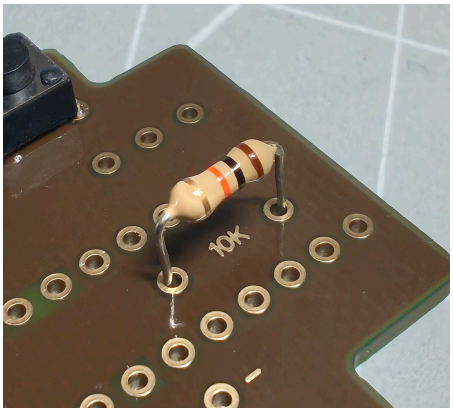


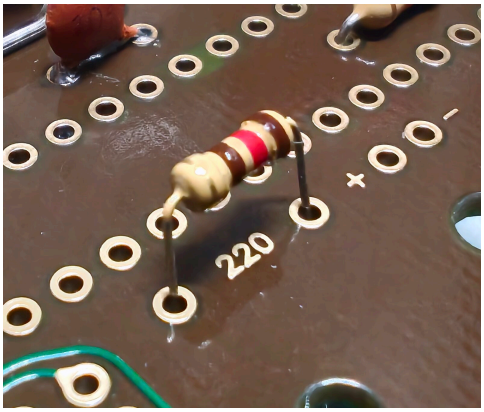




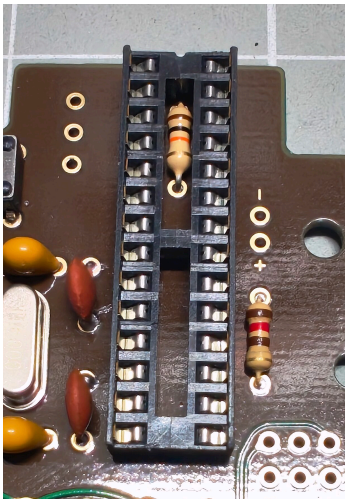
- Mount the three black screw terminals to the holes labeled ‘LEDs’, ‘LINK’ and ‘BAT’. Make sure the connection points are facing towards you so that we can attach wires to them later. You may need to tape them in place while you flip the board over to solder them in place.
- Add the two yellow tantalum capacitors 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.





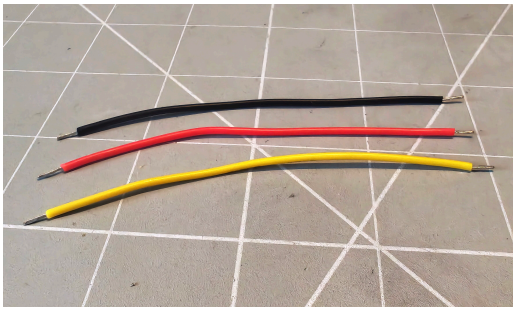


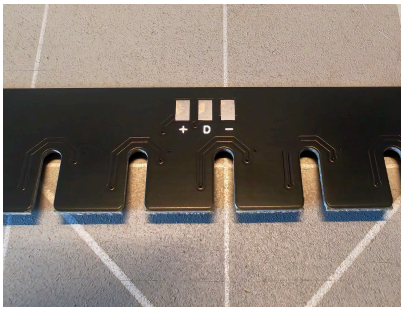
- Add the two orange disc capacitors to the two positions shown in the first photo above.
- The 10K Ω resistor **[**BROWN**-**BLACK**-**ORANGE**-**GOLD**]** now should be placed through the two holes labeled ‘10K’ on the board as shown in the second photo above. This can be inserted in either direction. 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 120 Ω resistor **[**BROWN**-**RED**-**BROWN**-**GOLD**]** to the holes labeled ‘220’ on the board as shown above. Please ignore the mislabelling of ‘220’ - the value of this resistor was changed after board production. This will be updated to ‘120’ for future runs.

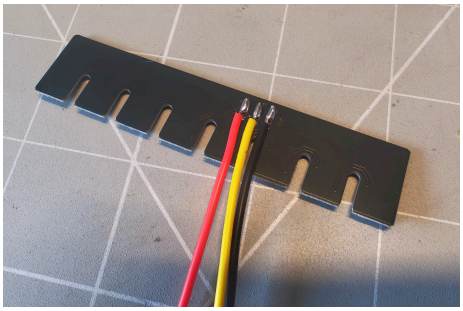




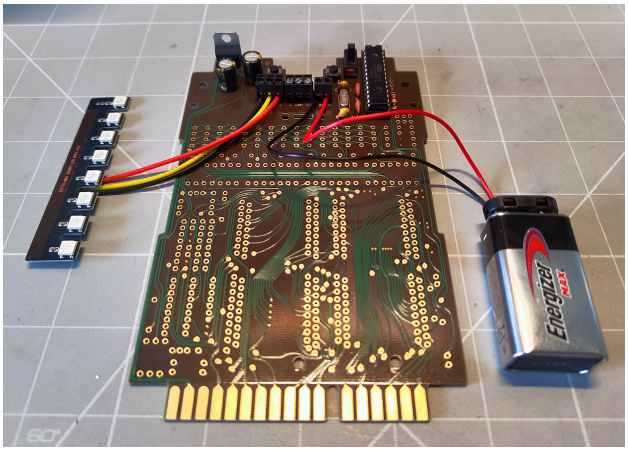
- Now add the 28-pin microcontroller socket as shown in the first photo above. You will see a small notch in one of the ends of the socket - this should be placed at the top. The resistor you added in the previous step should sit underneath the and within the cutout in the socket. Use tape to hold the socket in place while you flip the board over. Solder all 28 pins making sure that all the connections are sound.
- The slide switch can now be added beside the socket.
- Finally, insert the microcontroller into the socket. 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 (and may be damaged) 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.
- Carefully 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.



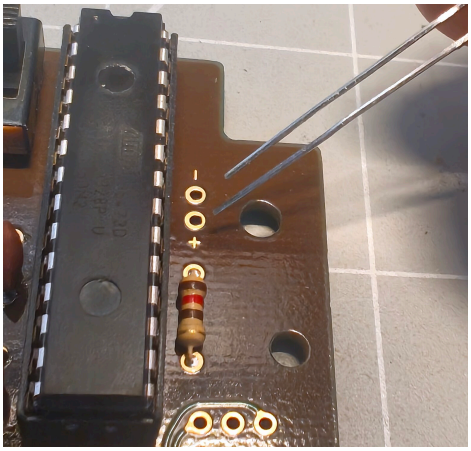




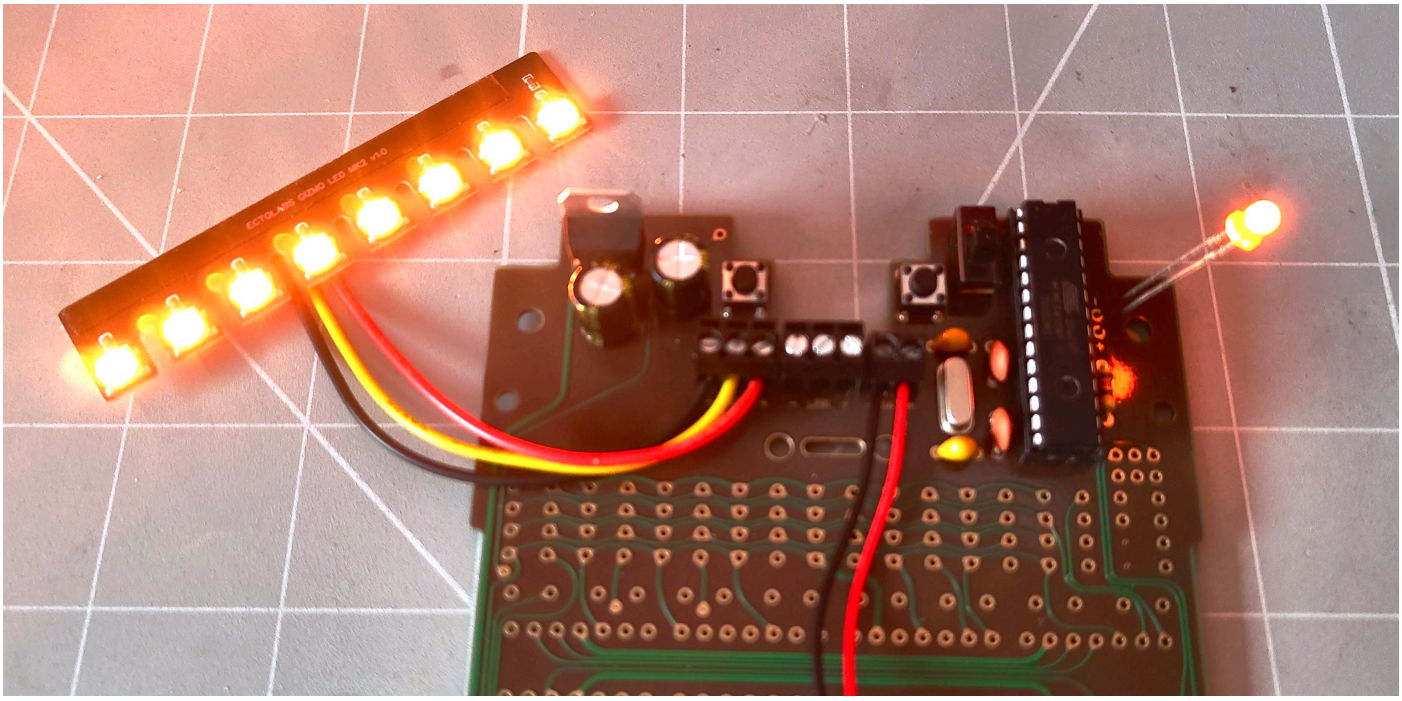
- In order to test the circuit we just assembled, we need to connect the LEDs to check everything is working.
- Strip away a small amount of silicone shielding from both ends of the **black**, **yellow** and **red** wires.
- Find the LED board and flip it to the back side to reveal the three silver pads.
- 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.
- Connect the 9V battery cable to the screw terminal labeled 'BAT' on the mainboard. The **black** negative wire to '-' and the **red** positive wire to '+'.
- Make sure the slide switch is in the up position and attach a fresh 9V battery to the cable connector. Be sure to use a new battery here as the lighting system can misbehave if not enough power is being supplied to the circuit.
- Find the single orange LED and make a note of the different length of its legs. Loosely place the LED through the two holes on the top right of the board. Insert the **longest** leg into the hole marked '+' and the **shortest** into '-'.
- **DO NOT SOLDER** the LED into place yet - just position it so the legs are touching the edges of the gold pads.



- Finally, slide the switch to the down position 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 the single orange LED on or flashing, 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, disconnect the cable and the LED board and set them aside along with the cable tie.
- Remove the orange LED from the holes and set it aside - we will permanently attach this LED later on in the build.

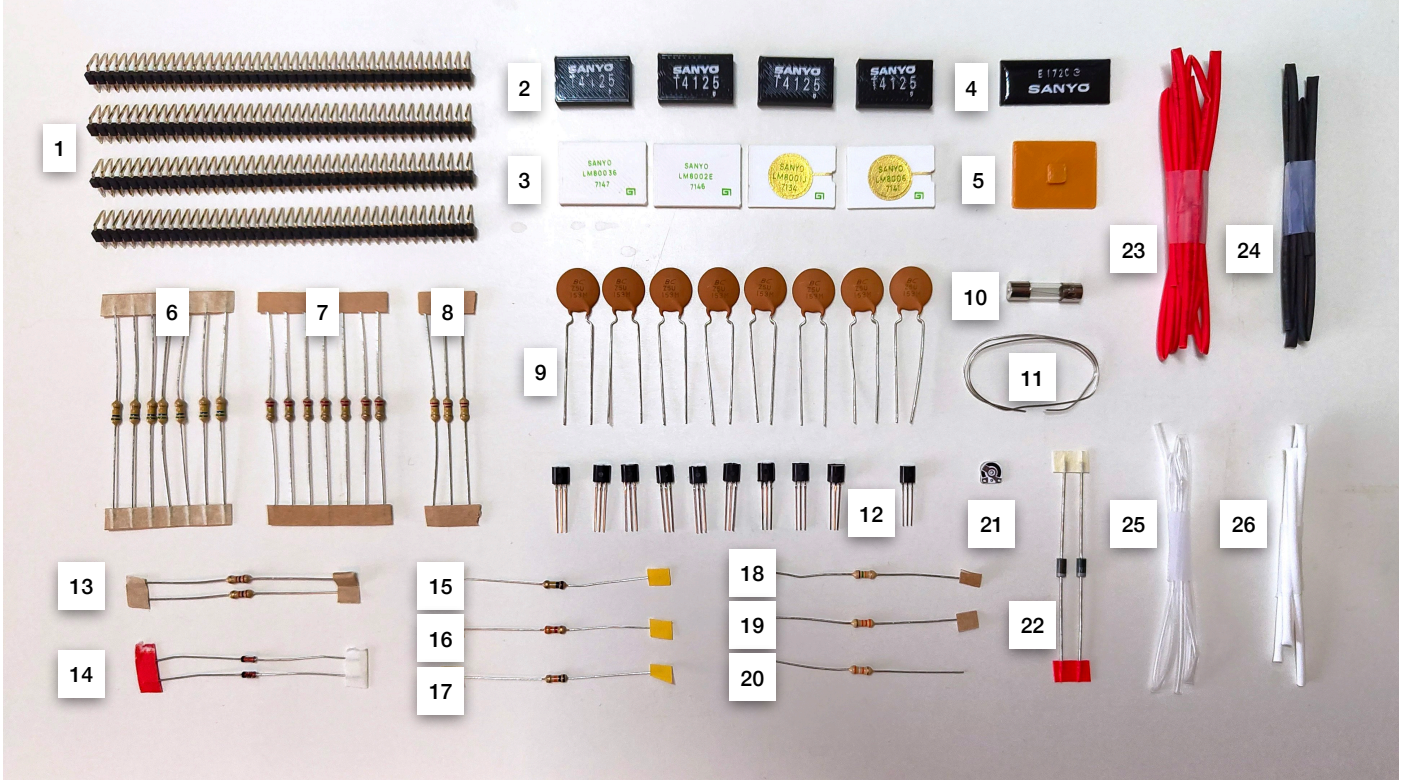
Congratulations! You have completed the most important part of the build. You can now take a break, safe in the knowledge that you have a fully functional gizmo. When you're ready, proceed to the next section to start making this baby look awesome!

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 808D MK2 - 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.

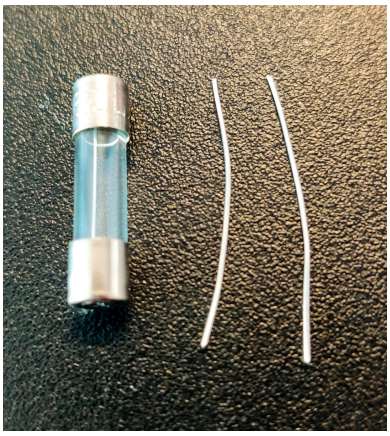
Using the following list, find each part in your kit bags and set them out on your workbench:

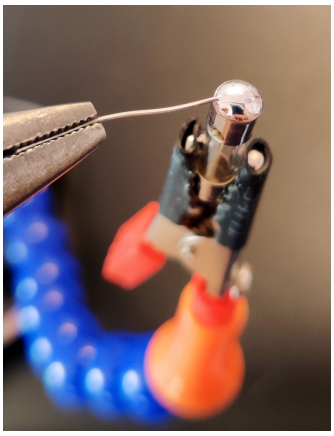
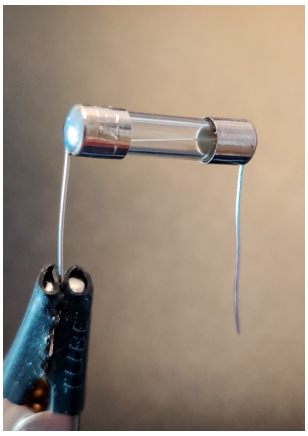


① 4x **40-pin right-angle header pins**
② 4x **Replica Sanyo T4125 black chips**
③ 4x **Replica Sanyo LM800 white chips**
④ 1x **Replica Sanyo E172C capacitor**
⑤ 1x **Chip installation tool**
⑥ 7x **560KΩ resistors [GREEN-BLUE-YELLOW-GOLD]**
⑦ 7x **220KΩ resistors [RED-RED-YELLOW-GOLD]**
⑧ 3x **270KΩ resistors [RED-VIOLET-YELLOW-GOLD]**
⑨ 8x **Disc capacitors**
⑩ 1x **Glass fuse**
⑪ 1x **Bare wire (180mm)**
⑫ 10x **NPN Transistors ***
⑬ 2x **2.7KΩ resistors [RED-VIOLET-RED-GOLD]**
⑭ 2x **Glass signal diodes (red/black)**
⑮ 1x **100KΩ resistor [BROWN-BLACK-YELLOW-GOLD]**
⑯ 1x **3.3KΩ resistor [ORANGE-ORANGE-RED-GOLD]**
⑰ 1x **10K Ω resistor [BROWN-BLACK-ORANGE-GOLD]**
⑱ 1x **15KΩ resistor [BROWN-GREEN-ORANGE-GOLD]**
⑲ 1x **33KΩ resistor [ORANGE-ORANGE-ORANGE-GLD]**
⑳ 1x **39KΩ resistor [ORANGE-WHITE-ORANGE-GOLD]**
㉑ 1x **Replica variable resistor**
㉒ 2x **Schottky diodes (black/silver)**
㉓ 1x **RED heat shrink tubing (1000mm)**
㉔ 1x **BLACK heat shrink tubing (400mm)**
㉕ 1x **CLEAR heat shrink tubing (350mm)**
㉖ 1x **WHITE heat shrink tubing (250mm)**

* Your kit may include one transistor that is slightly smaller than the rest. If so, keep this separate. Other kits will include 10x resistors all of the same size (depending on component availability).

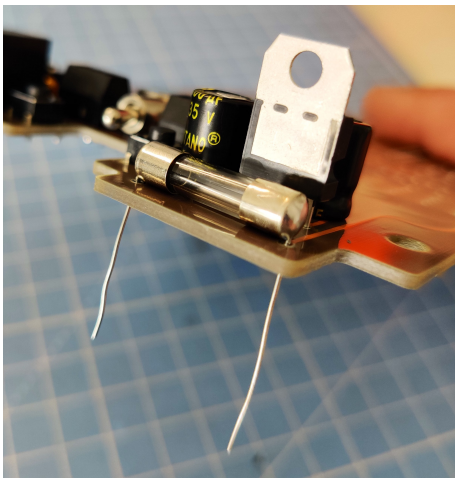
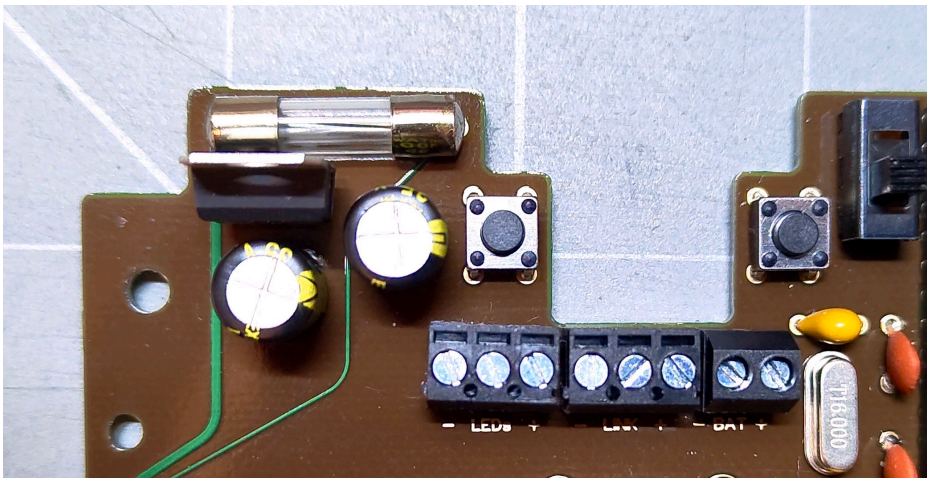
2.1. INSTALL THE GLASS FUSE



- Before we add the glass fuse, we need to modify it.
- Start by using your wire cutters to cut two **20mm** sections of bare wire. Put the rest of the wire aside as we will be needing that later.
- 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.

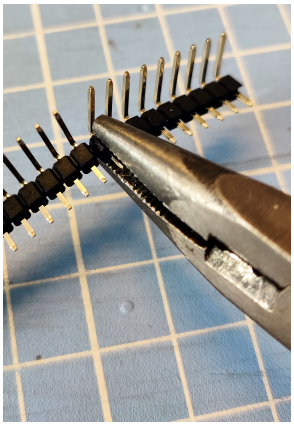
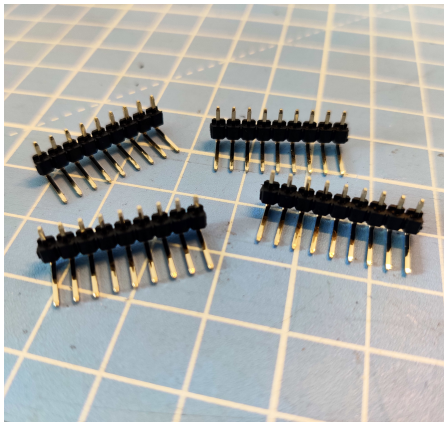
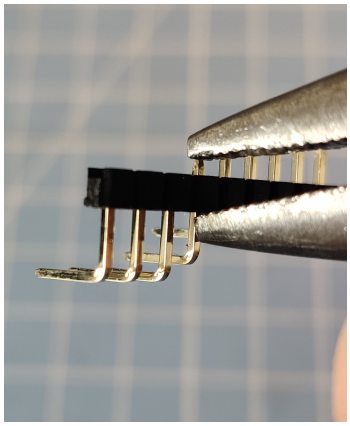
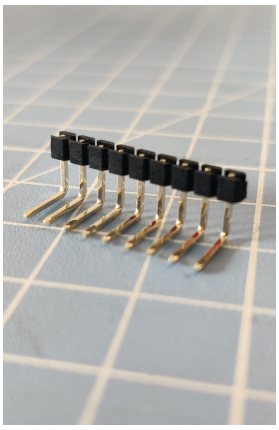
Do not handle the fuse with your hands when applying solder. The fuse will heat up very quickly which may cause injury.

- 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

2.2. PREPARE THE GOLD HEADER PINS

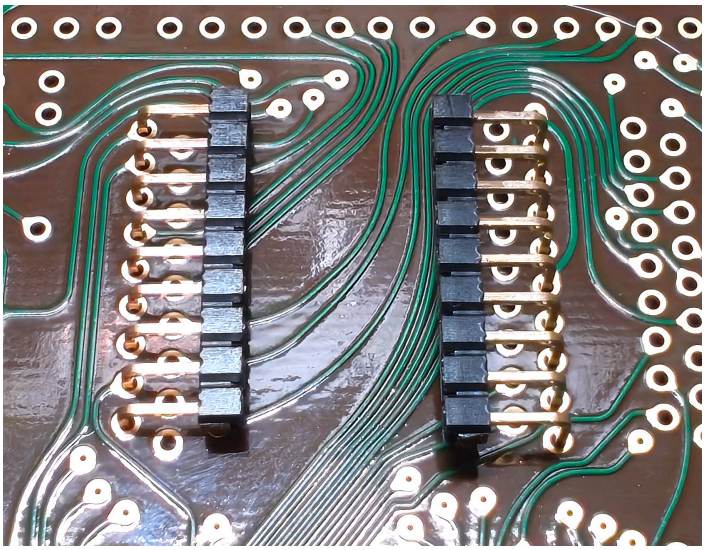
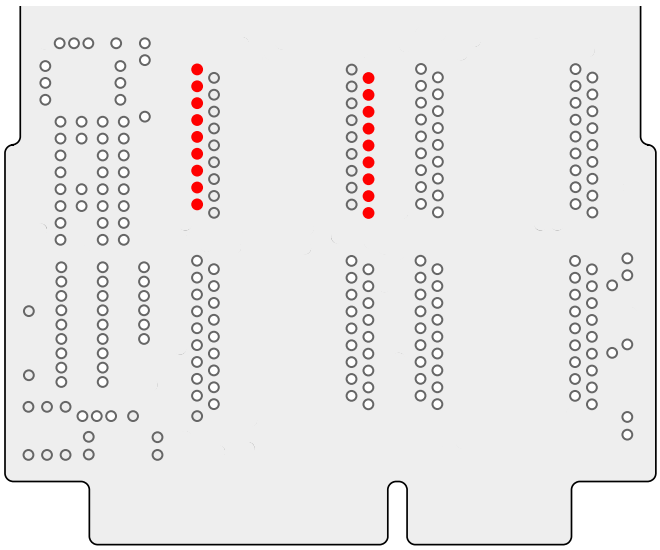
We will use the gold header pins to recreate the look of the four large white chips that float above the board. The pins in your kit will come as long strips, so we need to separate these into sections of nine pins.

- 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.

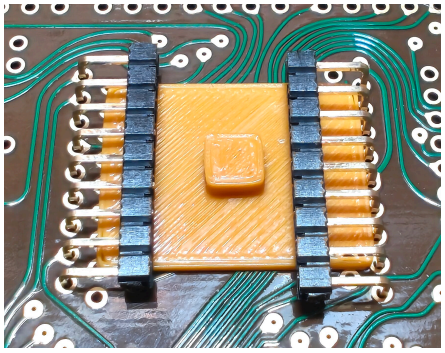
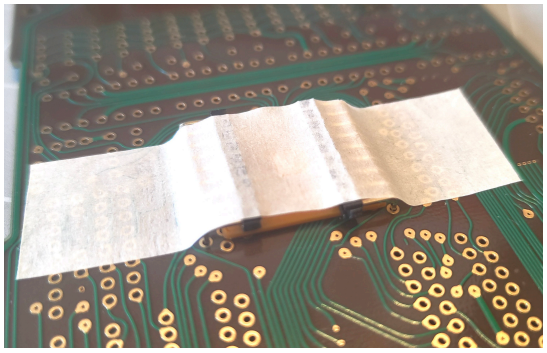
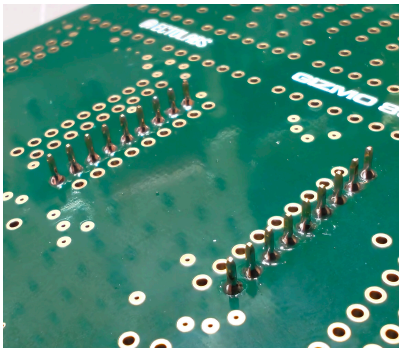
2.3. MOUNT THE GOLD HEADER PINS

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.

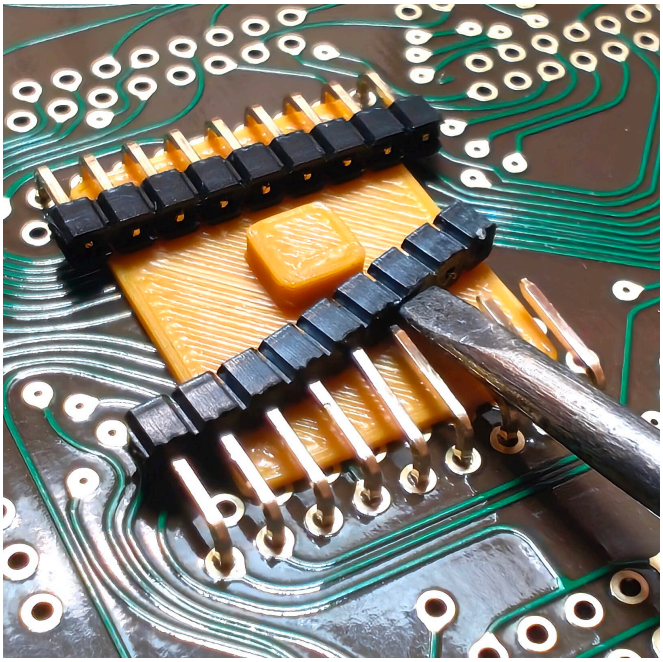
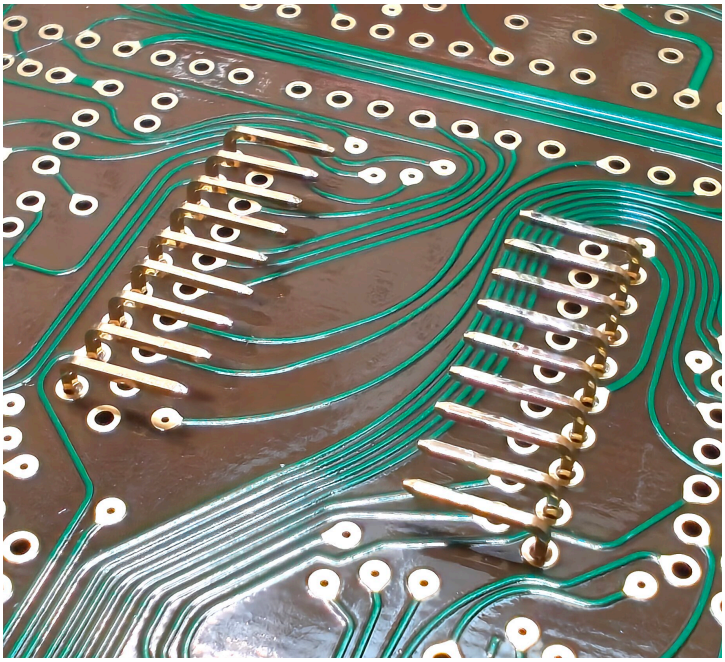



- Insert two of the 9-pin sections into the holes on the board as shown above. The pins should be angled so that the black plastic spacers are pointing towards each other.

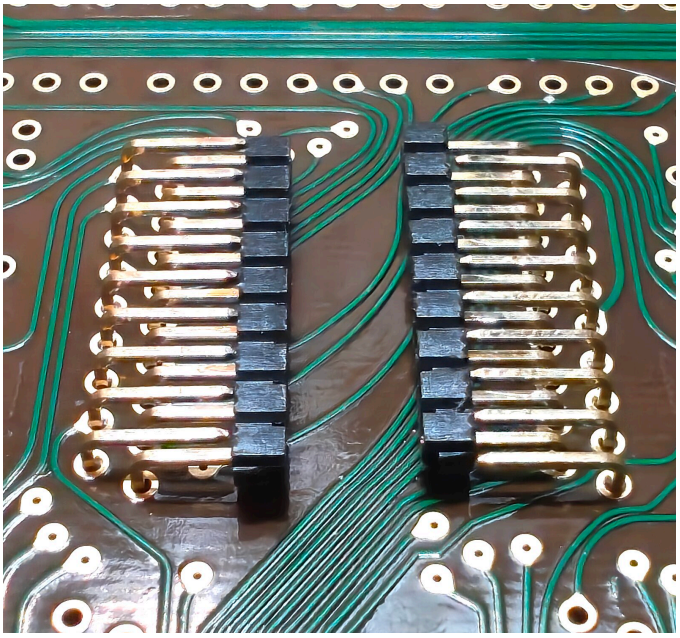
To install the pins in the correct position, you will need to use the orange chip installation tool found in your kit. This will raise the pins up so the four white chips float above the board at a consistent height.

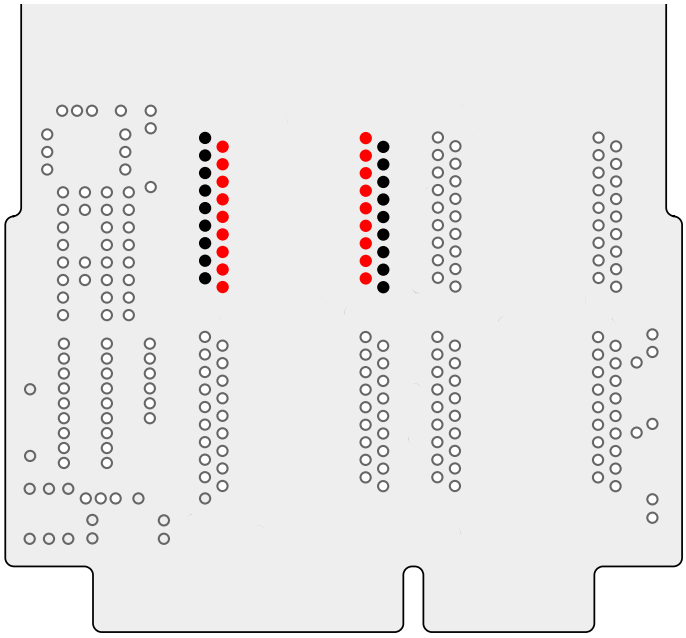




- Raise the pins up slightly and slide the installation tool underneath. Orient the tool landscape so the wider edges are horizontal as shown in the first photo above.
- Push the pins back down so black plastic spacers sit flush on top of the tool.
- Once you are happy the two pin sections are positioned correctly, place a strip of tape over the top to hold everything in place. Use low-tack tape here such as light masking tape so that you don't damage the glossy surface of the circuit board.
- Flip the board over and solder the protruding ends of all 18 pins to the copper pads as shown in the third photo above.

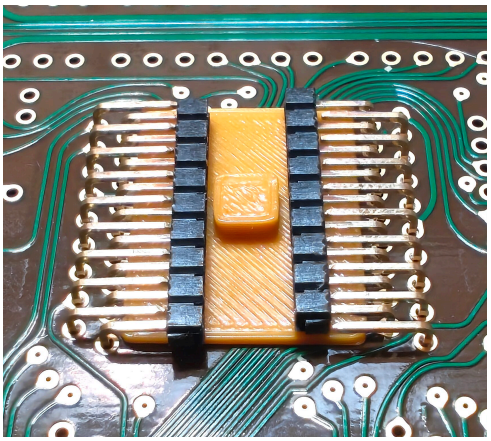



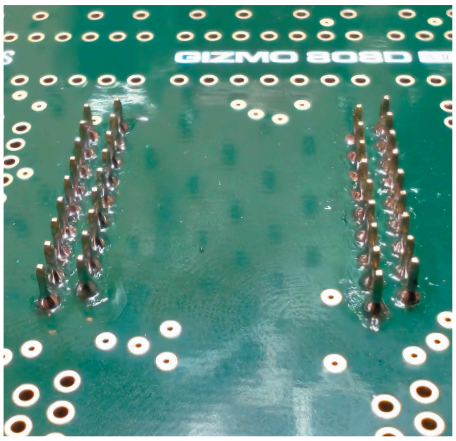
- Flip the board back over and use the end of a small screwdriver to gently force the black plastic spacers off the pins. There may be some resistance, so you may want to hold the board down securely with one hand as you push the spacers off with the other. Apply a little pressure to each end until the 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.

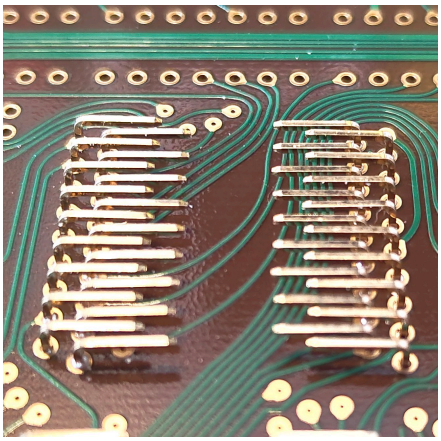




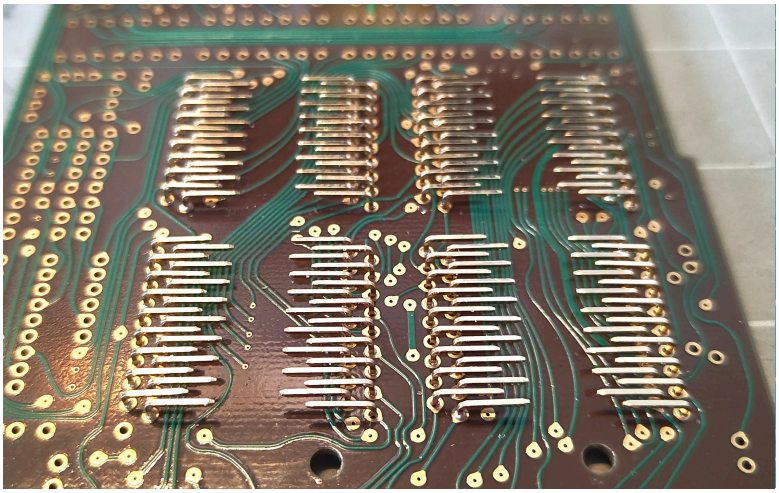
- Now repeat the process by adding the second two 9-pin sections to the holes in the board as indicated above.

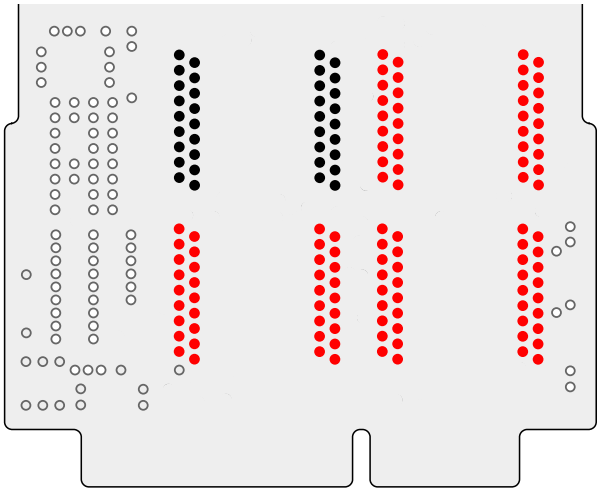






- Slide the installation tool underneath the pins (this time in a portrait orientation), then place tape to hold everything in place.
- Flip the board over and solder the remaining 18 pins to the copper pads.
- Remove the plastic spacers from the pins as before and remove the installation tool. You should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



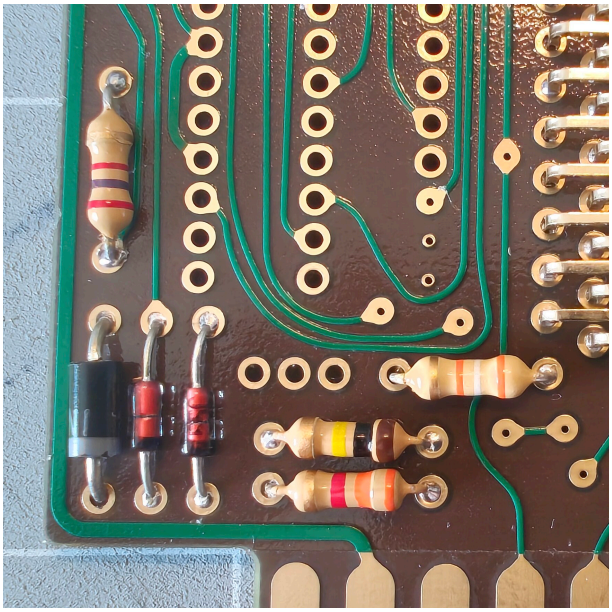


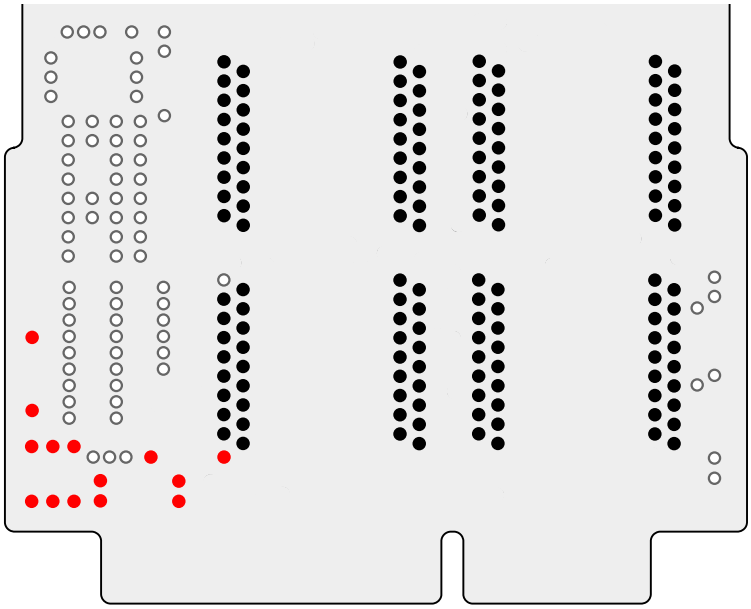
- Finally, repeat the entire process for rest of the 9-pin sections using the holes indicated above. Once finished, leave the pins as they are - we will add the replica white chips later.

2.4. ADD THE SMALL COMPONENTS

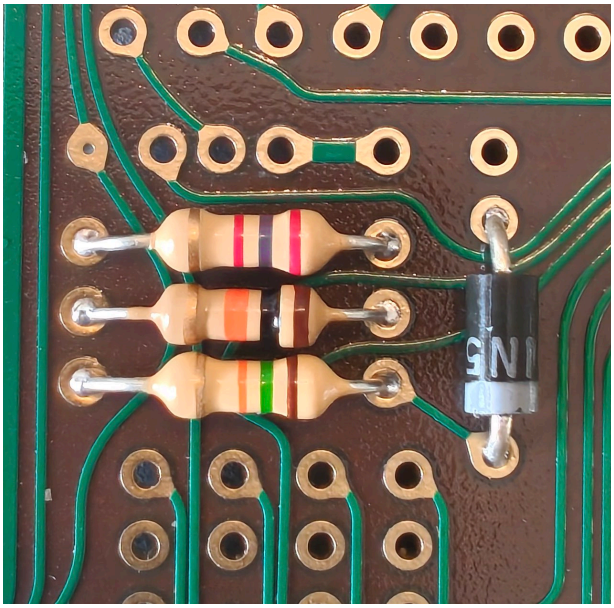
The following sections indicate where to add each component with the required holes. Each section has also been highlighted in the accompanying diagrams - **red** dots indicate the holes you need to use for the current step, solid **black** dots indicate the holes you have already used in previous steps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

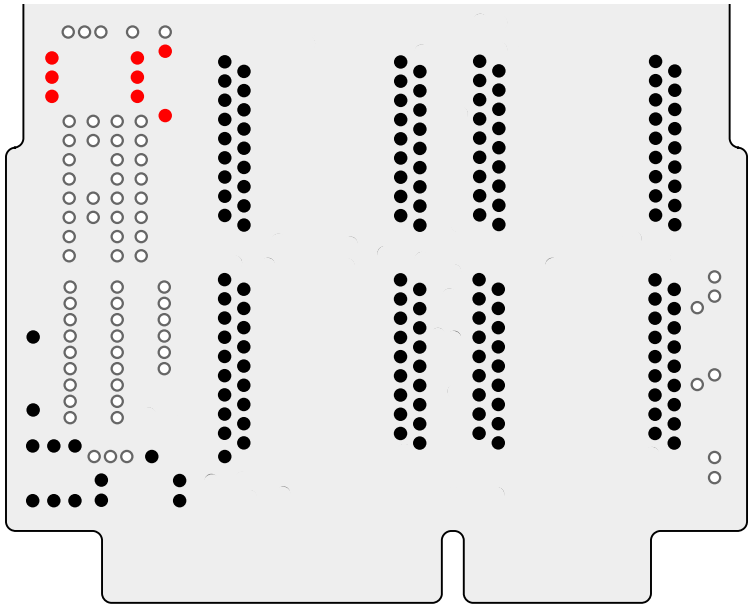
As with the daughterboard – feed the components through the holes, cut the wires according to your chosen mounting method and solder into place…



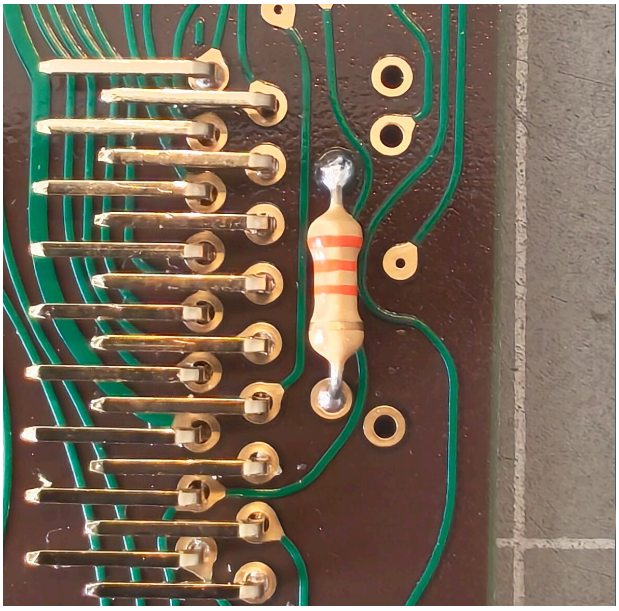


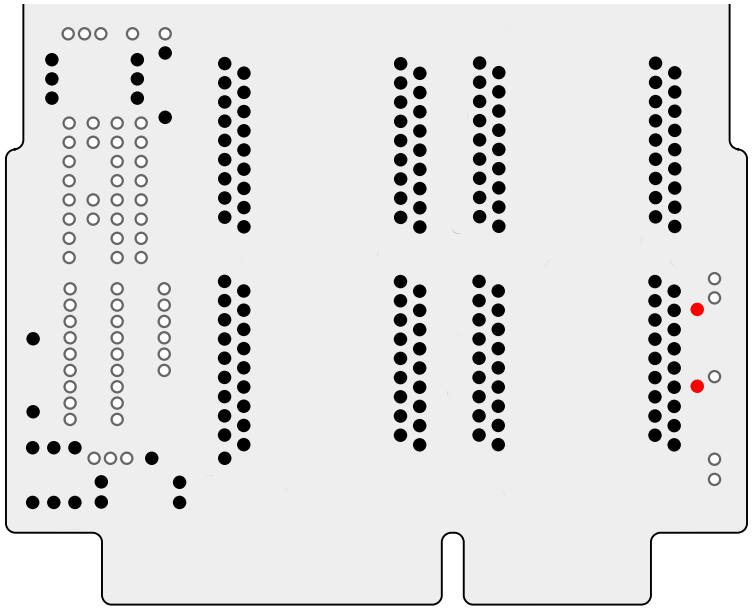
- Add the following components as shown above:
  - Resistors: 1x **RED-VIOLET-RED-GOLD**; 1x **ORANGE-WHITE-ORANGE-GOLD**; 1x **BROWN-BLACK-YELLOW-GOLD**; 1x **ORANGE-ORANGE-RED-GOLD**
  - 1x black/silver Schottky diode. Make sure the silver band is at the **bottom**.
  - 2x red/black glass signal diodes.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



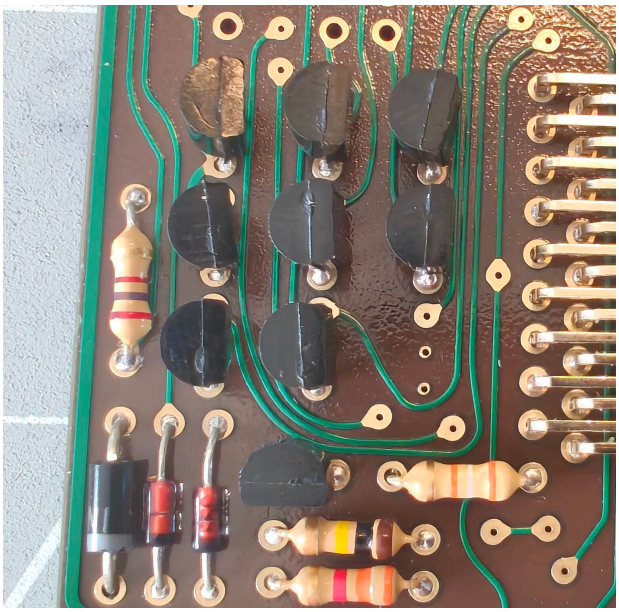


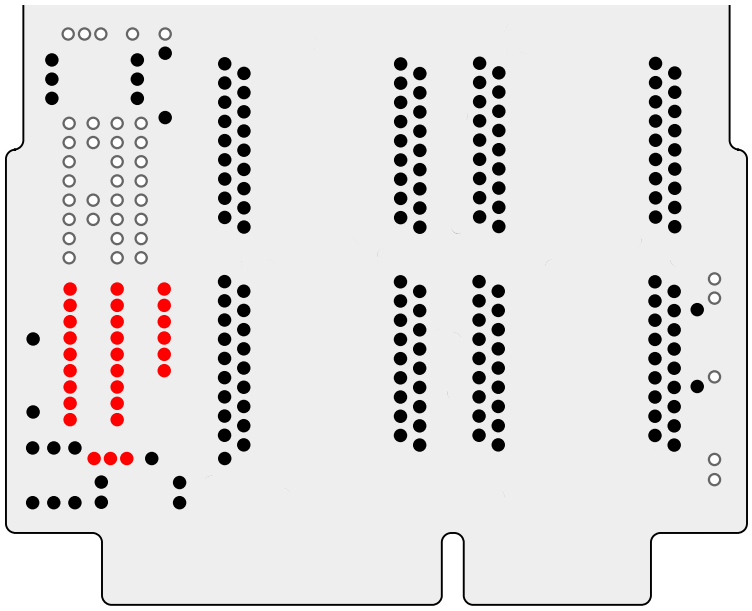
- Add the following components as shown above:
  - Resistors: 1x **RED-VIOLET-RED-GOLD**; 1x **BROWN-BLACK-ORANGE-GOLD**; 1x **BROWN-GREEN-ORANGE-GOLD**
  - 1x black/silver Schottky diode. The silver band should be at the **bottom**.





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



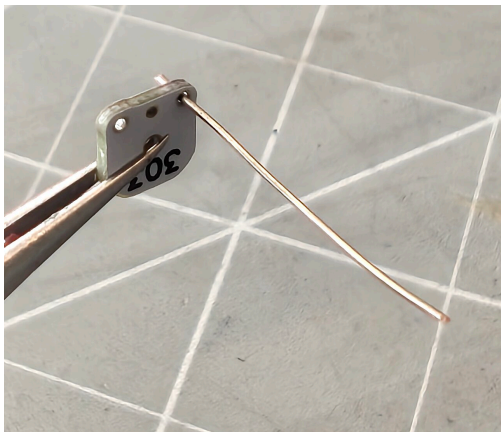


- Add the following components as shown above:
  - 9x transistors, with the flat edges facing to the **right**, except for the separate transistor at the bottom, which should have its flat edge facing **downwards**. As with the daughterboard, the body of the transistors should hover by a couple of millimetres.
  - If your kit has one slightly smaller transistor, only use the nine larger ones here.

2.5. ADD THE VARIABLE RESISTOR

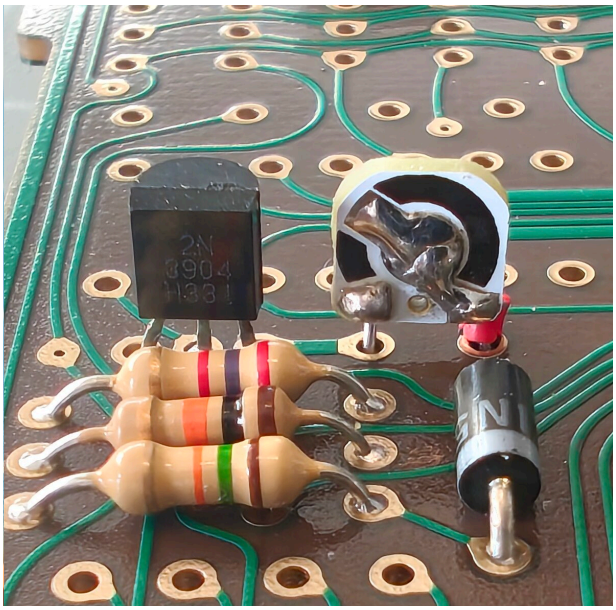
The variable resistor is our own replica of a long obsolete component found on many of the vintage Sanyo calculator boards and included for the first time in this MK2 kit. We will just need to add some wires to it so that it can be attached to the board…

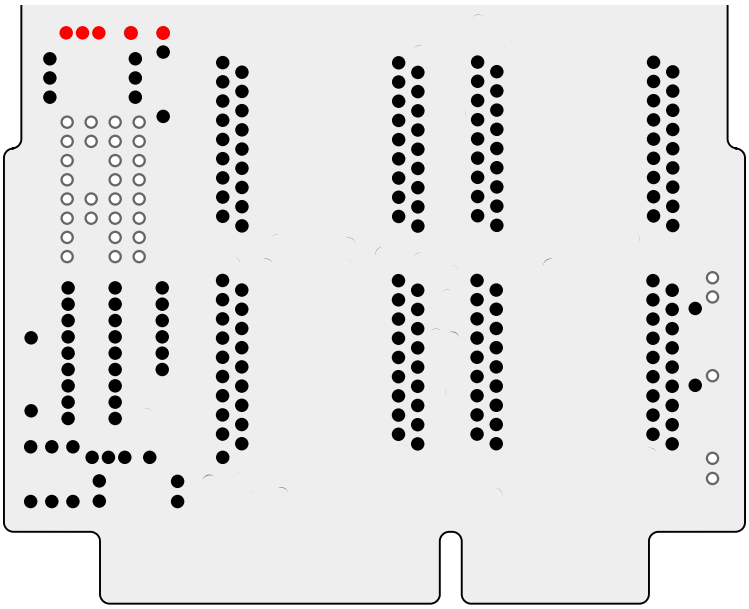






- Find the small black and white resistor board and use your wire cutters to cut two **20mm** sections from the bare wire we put aside earlier.
- From the back of the board (featuring the label ‘303’) Push each section of wire through the holes in the corners of the board and solder them into place on the front.
- Add a smooth blob of solder over the centre hole - for added accuracy, you could add a very small screw through the centre hole here instead, but some solder over the silver pad is generally good enough to replicate the look of this component.
- Cut a tiny 1mm section of **red** heat shrink and add it to the right wire. Use a heat gun or lighter to gently shrink it down in size. Note that this will still be loose on the wire, so be careful not to let it slip off.

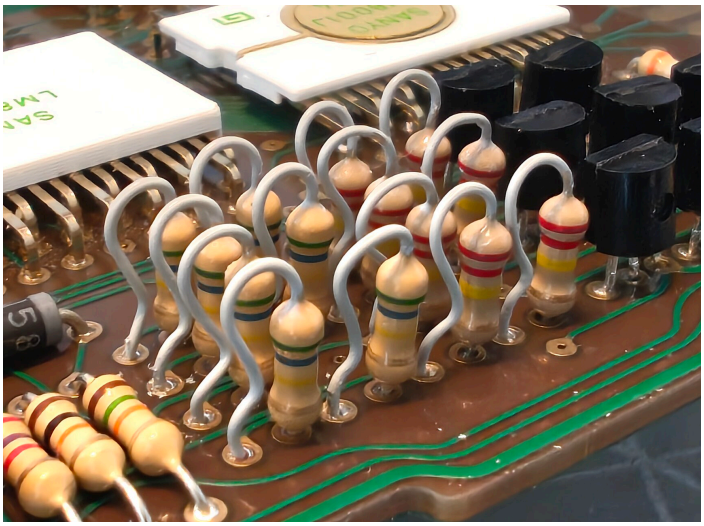


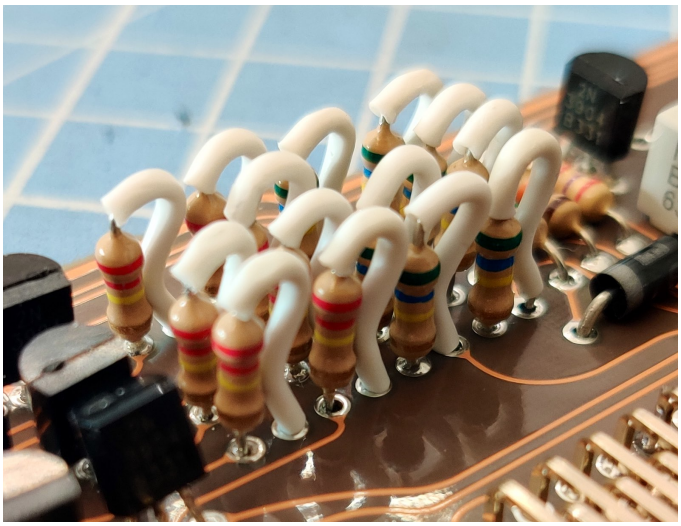


- Now add our completed component to the board. The heat shrink should allow the resistor to hover as shown above.
- Finally, solder in the last black transistor next to it. Make sure the flat edge is facing **downwards**.

2.6. ADD THE UPRIGHT RESISTORS

We now need to add the remaining 17 resistors which sit upright on the board. There are two methods you can use to do this, so make a choice depending on the level accuracy you want to achieve…

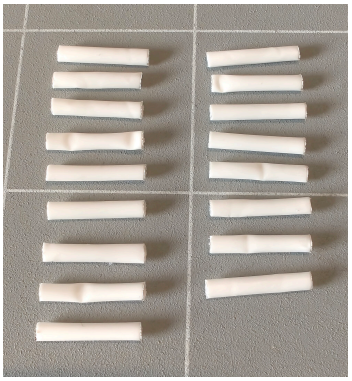


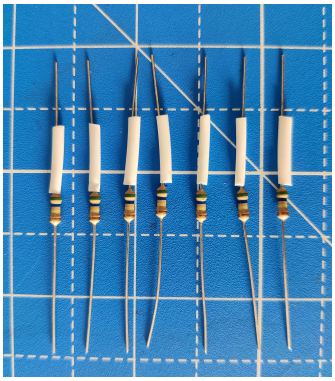


PAINTED METHOD: The upright resistors on the original Sanyo boards actually had a thin white coating over the wires, rather than heat shrink. Painting the wires simulates this look for better accuracy, but this method takes longer and requires additional primer and paint.

HEAT SHRINK METHOD: Instead of painting the wires, we use the white heat shrink included in your kit which is a quicker method but makes the wires look thicker and less accurate.

HEAT SHRINK METHOD



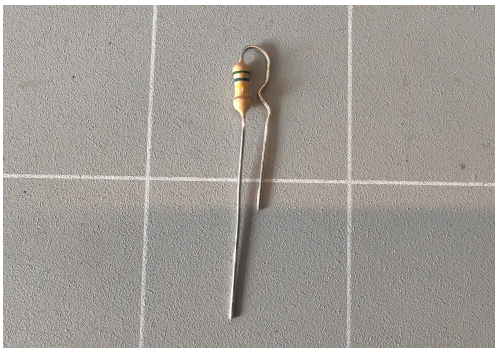






- Use scissors or your wire cutters to cut the white heat shrink tubing into **17** lengths of **13mm** each. There may be a little extra included in your kit, so expect to have some left over.
- Group together the 7x **GREEN**-**BLUE**-**YELLOW**-**GOLD**, the 7x **RED**-**RED**-**YELLOW**-**GOLD** and the 3x **RED**-**VIOLET**-**YELLOW**-**GOLD** resistors and slip a length of tubing over one end of each. Keep them all consistent by adding these to the same end as the **green** or **red** bands, 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.
- 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 last photo above.
- Repeat this for all 17 resistors.

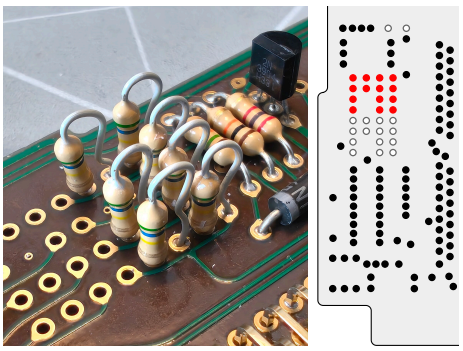
PAINTED METHOD

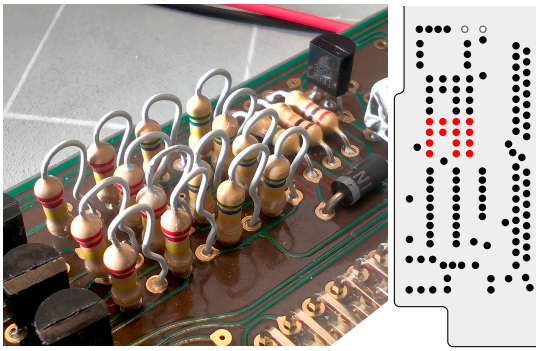


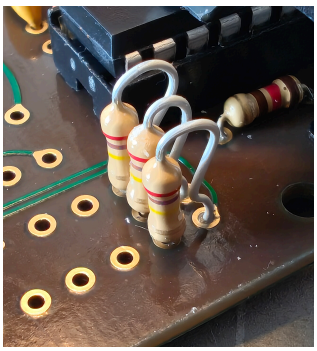


- Group together the 7x **GREEN-BLUE-YELLOW-GOLD**, the 7x **RED-RED-YELLOW-GOLD** and the 3x **RED-VIOLET-YELLOW-GOLD** resistors.
- Holding one of these resistors vertically, fold the wire nearest to the **green** or **red** bands over until it faces in the opposite direction and both wires now run 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 photo above (adding this kink can be quite fiddly and time consuming so this step can be skipped if you prefer). Repeat this process for the remaining resistors.
- We now need to paint the curved wires. As we do not want any paint on the body of the resistor, use masking tape so that only the curved wires on each resistor are exposed.
- As this is bare metal, we will need to use an **etch primer** first so that our paint can adhere better to the wires.
- Once the etch primer is fully dry, use a **white paint** or primer to achieve the final colour.

Now that we have our prepared resistors, we can add them to the board. 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 you are using the painted method, you will be soldering through a layer of paint so make sure to add enough heat so that the excess paint is removed from the end of the wire, and the resistor is fully attached.







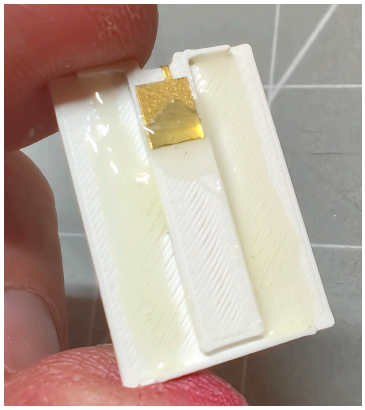
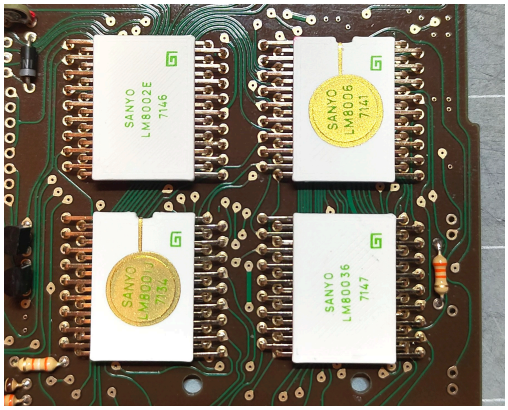
- Attach the 7x **GREEN-BLUE-YELLOW-GOLD** resistors to the board using the **upper** set of 14 holes as shown in the first photo and diagram above.
- Attach the 7x **RED-RED-YELLOW-GOLD** resistors to the board using the **lower** set of 14 holes as shown in the second photo and diagram above.
- Attach the 3x **RED-VIOLET-YELLOW-GOLD** resistors to the set of 6 holes directly underneath the error box as shown in the last photo 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.

2.7. 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. Two of these chips feature a gold sticker and a notch in the right edge, while the other two are missing both the sticker and the notch. Each has their own unique identifying numbers.

These chips can be arranged in any way you like - the original Sanyo boards had a seemingly random mixture of these chips in each unit. Remember that the bottom right chip will be partially obscured with another component when we finish the build, so you may want to place one of the plainer ones here.

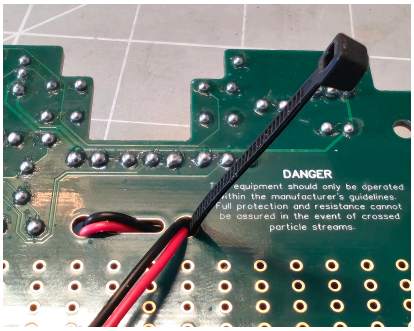


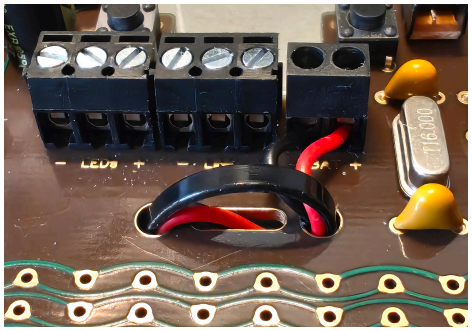
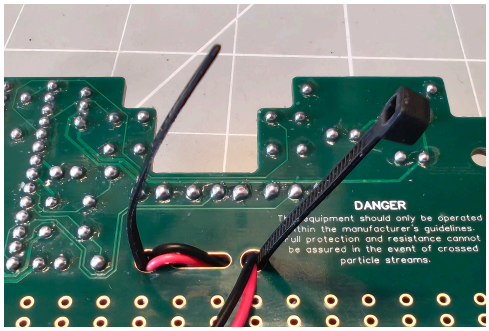



- To add a chip, flip it over and run a small amount of **epoxy glue** along the inside lengths as shown above. We recommend adding a little glue over the gold square to prevent this from becoming unstuck in the future. Be careful not to apply glue too far to the edge of the chip to avoid any mess.
- 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.
- Leave the glue to fully cure before proceeding.

2.8. ADD THE CABLE TIE (Optional)

If you are planning to mount your Gizmo in a leather holster, you may want to add the securing cable tie now. Adding this before mounting the display shelf will make things a little easier, although it is still perfectly possible to add this later, albeit rather more fiddly! Please see the dedicated section at the end of this guide for more information on mounting in a holster.



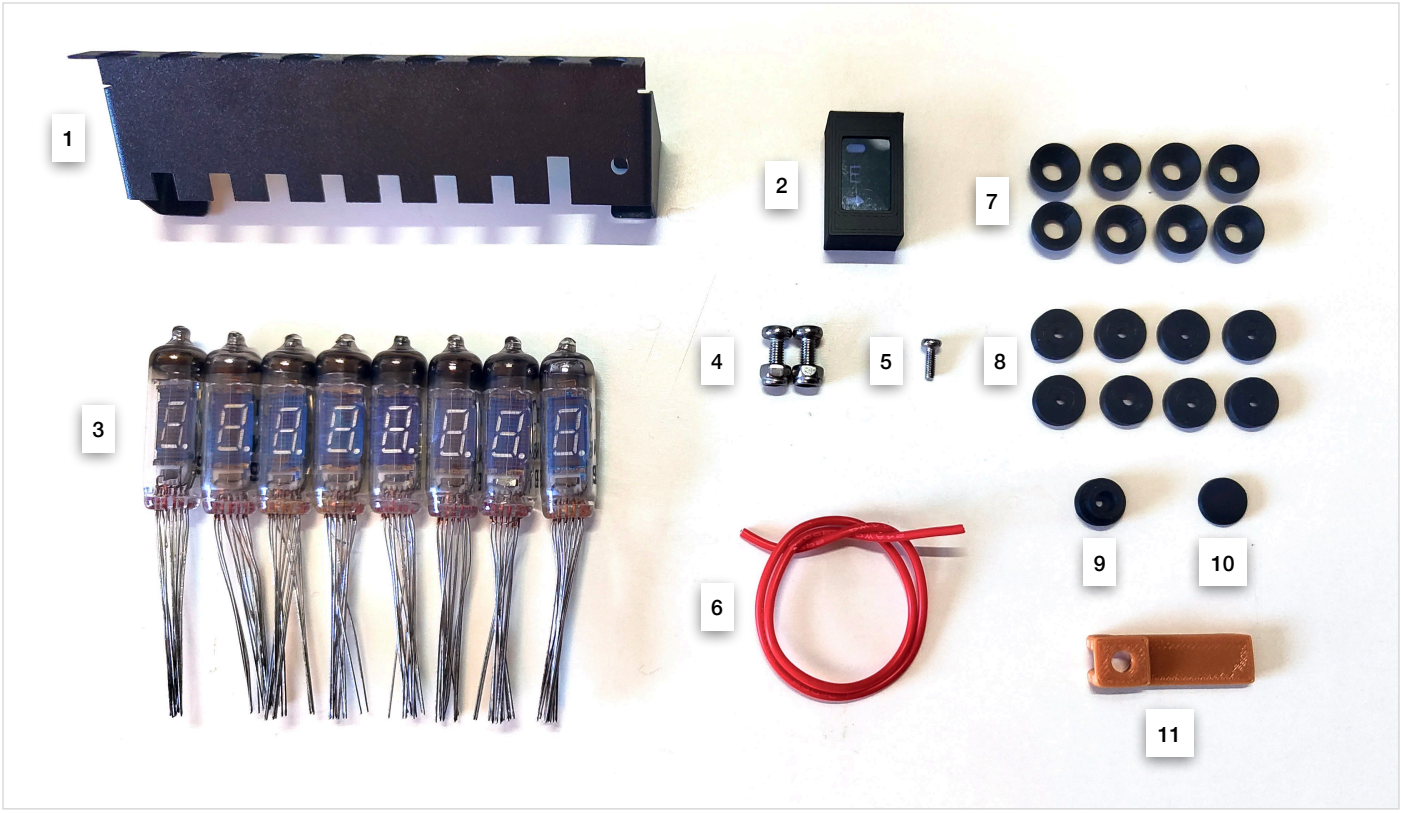



- Flip the main board over and push the end of the cable tie through the right hand mounting hole at the top of the board, past the battery cable. Make sure the tie is in the correct orientation as shown above.
- Fold the cable tie over the battery cable and pass it through the second hole
- We can now leave it like this until we secure the completed Gizmo to the holster.

3. ADD THE DISPLAY SHELF AND TUBES

PARTS REQUIRED FOR THIS SECTION

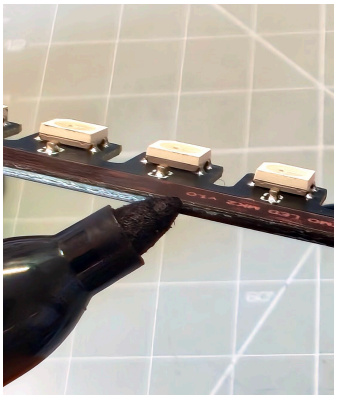
All the parts needed for this section are shown in the photos below. All the components you need can be found in the bag labeled **GIZMO - DISPLAY SHELF PARTS**. You will also need the separately wrapped **DISPLAY SHELF**, plus the **LED BOARD** with attached wires that we assembled earlier and the **ORANGE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

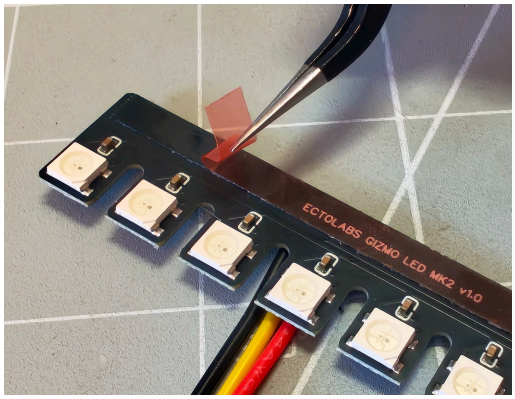


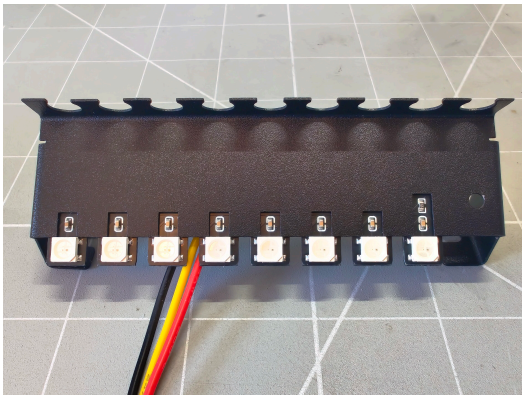
Using the following list, find each part in your kit bags and set them out on your workbench:

① 1x **Black powder coated aluminium display shelf**
② 1x **Error box**
③ 8x **Glass VFD tubes**
④ 2x **M3 Bolt (8mm) + Lock Nut**
⑤ 1x **M2 Bolt (6mm)**
⑥ 1x **RED silicone wire (320mm)**
⑦ 8x **Tube grommet**
⑧ 8x **Tube grommet cap**
⑨ 1x **Error box grommet**
⑩ 1x **Error box grommet cap**
⑪ 1x **Shelf installation tool**

3.1. ATTACH THE LED BOARD

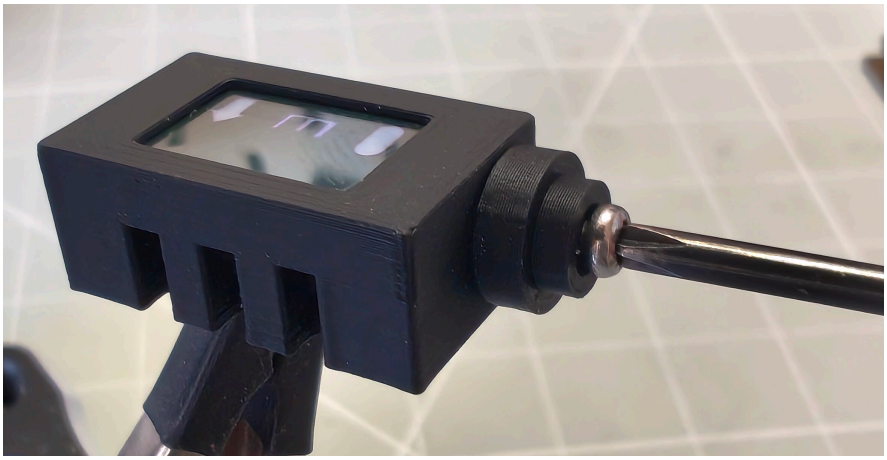






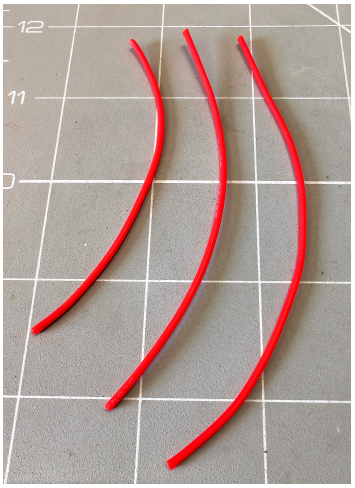
- Retrieve the LED board you assembled earlier. For aesthetics, you may wish to run a black sharpie around the edges of the board so that it blends in with the black coating of the shelf.
- You will see a pre-installed strip of high strength double sided tape on the top of the board. Remove the protective plastic with tweezers.
- Position the LED board on the underside of the shelf so that the square LEDs sit directly beneath each cut out as shown above. Make sure that the small components above each LED sit centrally inside the cut outs and do not touch the metal shelf itself.
- Once you are happy with the positioning, apply pressure to the LED board to stick it into place.

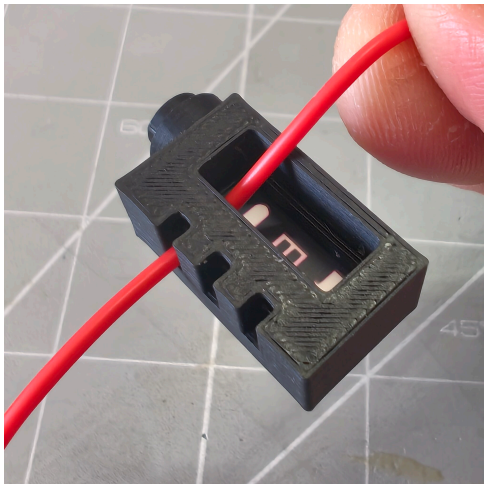
3.2. ATTACH THE ERROR BOX

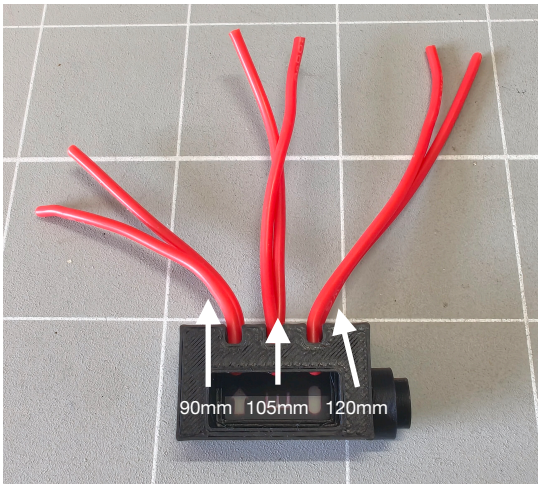




- Before we attach the error box to the shelf, add the error box grommet using the small M2 bolt. Screw the bolt through the grommet and into the box until the head of the bolt is fully inside the grommet until it is secure without over-tightening.

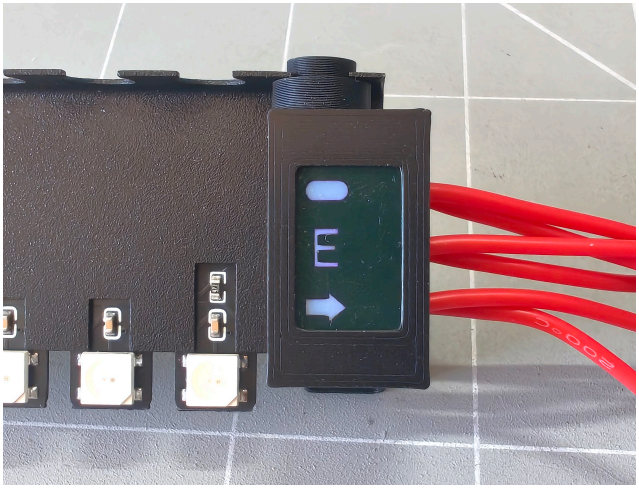






- Cut the red silicone wire into three sections. The first should be **120mm**, the second **105mm** and the third **90mm**.
- Thread the **longest 120mm** section of wire through the **first** two holes (closest to the grommet) in the error box as shown in the second photo above. Pull the wire through, double over the wire and thread the other end back through the second hole until both ends are sticking out the side of the box. Make sure each end is of equal length.
- Repeat for the **105mm** section through the **second** two holes, and then for the the **shortest 90mm** section through the **third** two holes as shown above.

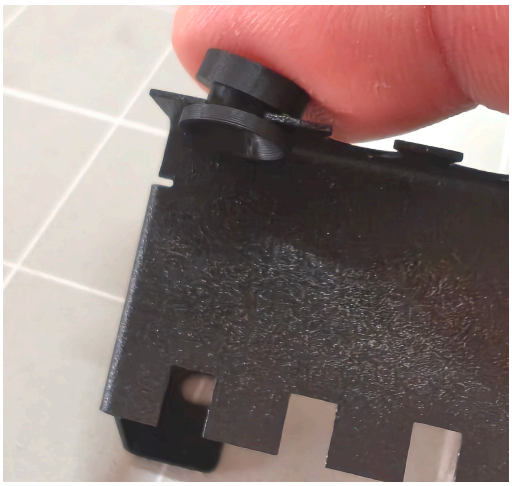


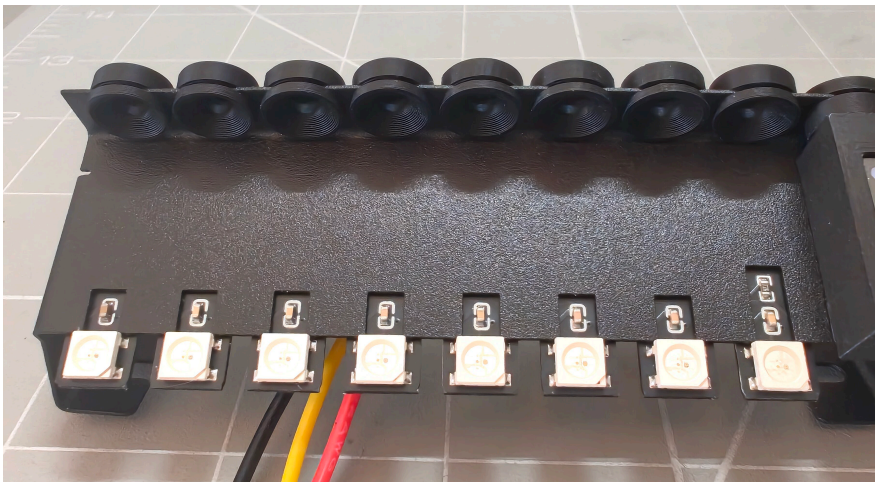




- Now add a small amount of epoxy glue underneath the circular hole in the shelf
- Add the error box to the help by pushing the end of the grommet through the last circular cutout in the shelf as shown above.
- Straighten the error box and apply light pressure so the underside contacts the epoxy glue. Let the epoxy fully cure before continuing so that the box is fixed firmly in place.
- Finish off by adding the cap to the protruding end of the grommet - this is designed to be a tight fit so press down formally until it is fully seated and is clamping the grommet to the shelf.

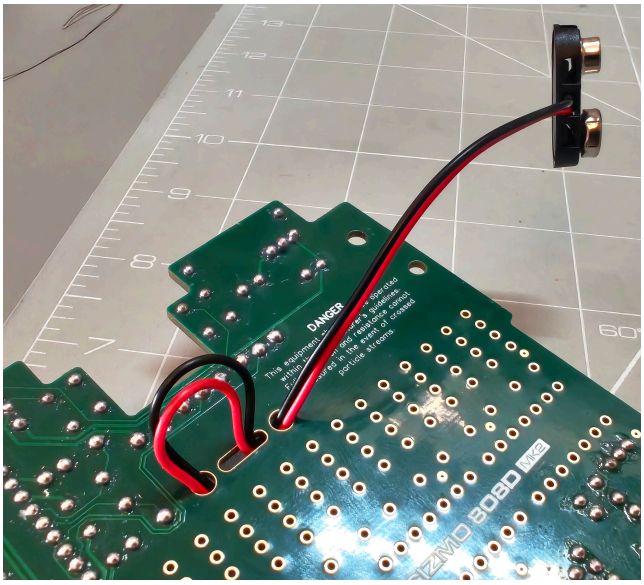
3.3. ATTACH THE TUBE GROMMETS

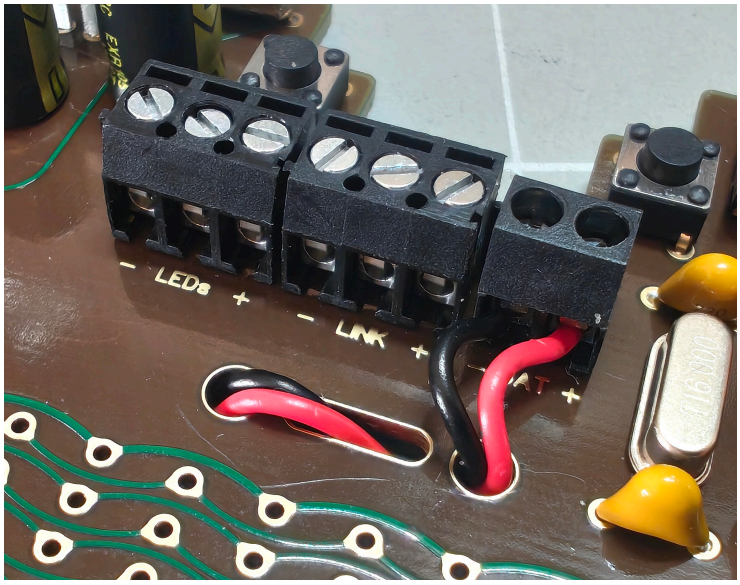




- Now we can add the rest of the grommets. Similar to the error box grommet push the narrowest part up through the circular cut out in the shelf as shown above.
- Add a cap to the protruding end of the grommet by pressing firmly. As before, these are designed to be a tight pressure fit, so pinch the two together with your thumb and forefinger until they snap into place and clamp securely to the shelf.
- Repeat this process until you have all eight tube grommets in place.

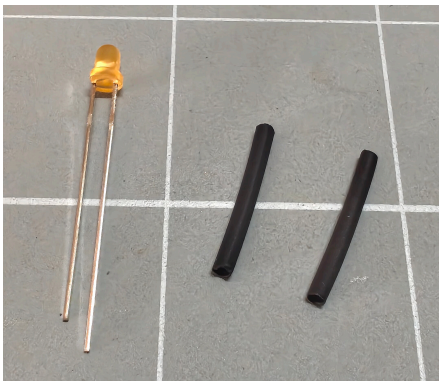
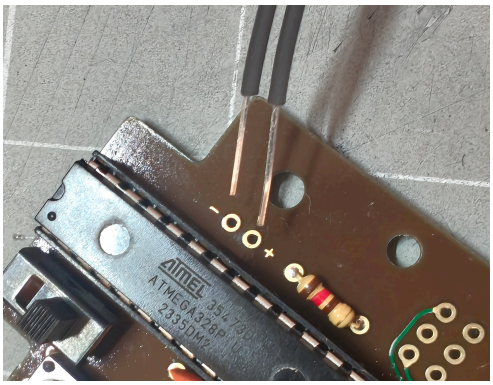
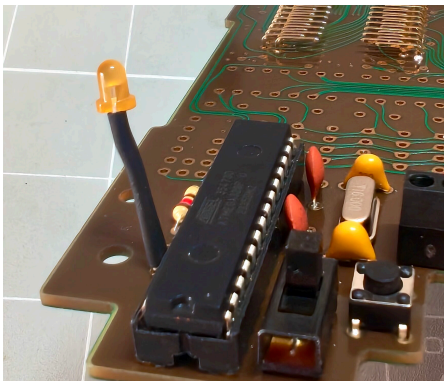
3.4. ATTACH THE BATTERY CABLE





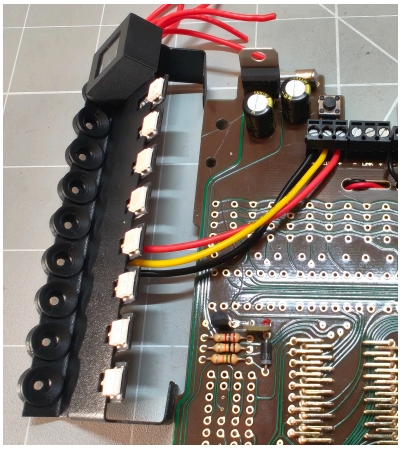
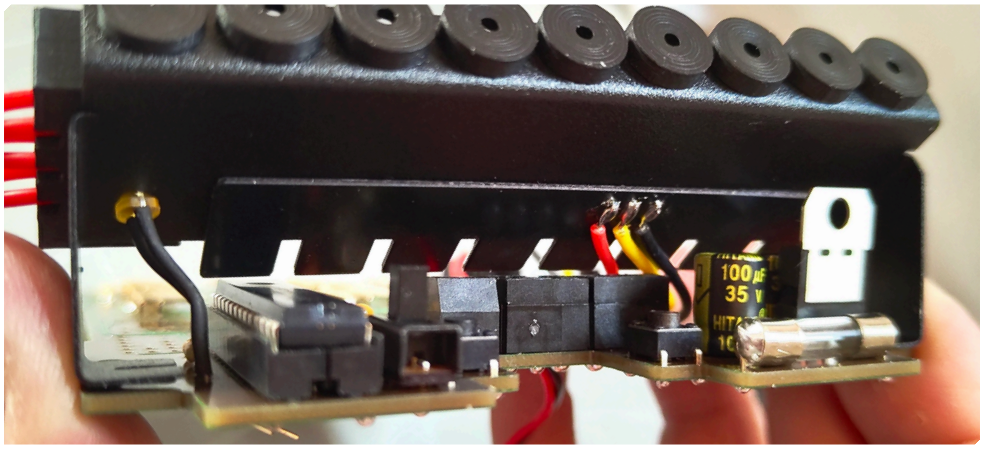
- Before adding the shelf to the mainboard, find the 9V battery cable and thread it through the slots in the board as shown above. This will provide some strain relief so the cable can not be easily pulled out.
- Connect and secure the wires to the screw terminal. The **black** negative wire to '-' and the **red** positive wire to '+'.
- We recommend leaving a little bit of give with the wires at the terminal, so that there is no unnecessary strain.

3.5. ATTACH THE ORANGE LED

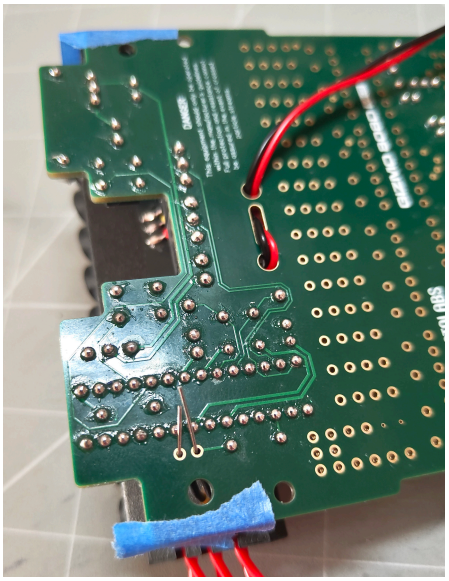




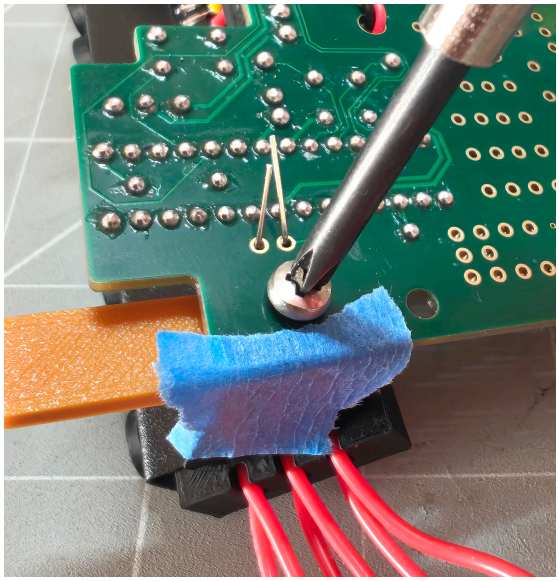
- Now find the orange LED we put aside earlier. Cut two **18mm** sections of black heat shrink and add them to the legs of the LED. Use a heat gun or lighter to shrink it to size.
- Insert the legs of the LED into the appropriate holes on the board. **Make sure this is done correctly** - The longest leg is the positive wire which goes to the hole labeled '+', and the shorter negative leg goes to '-'.
- Do not solder the LED just yet - we will do this ones the display shelf has been mounted.

3.6. MOUNT THE DISPLAY SHELF

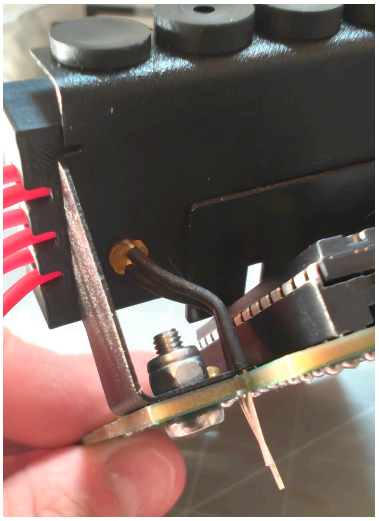
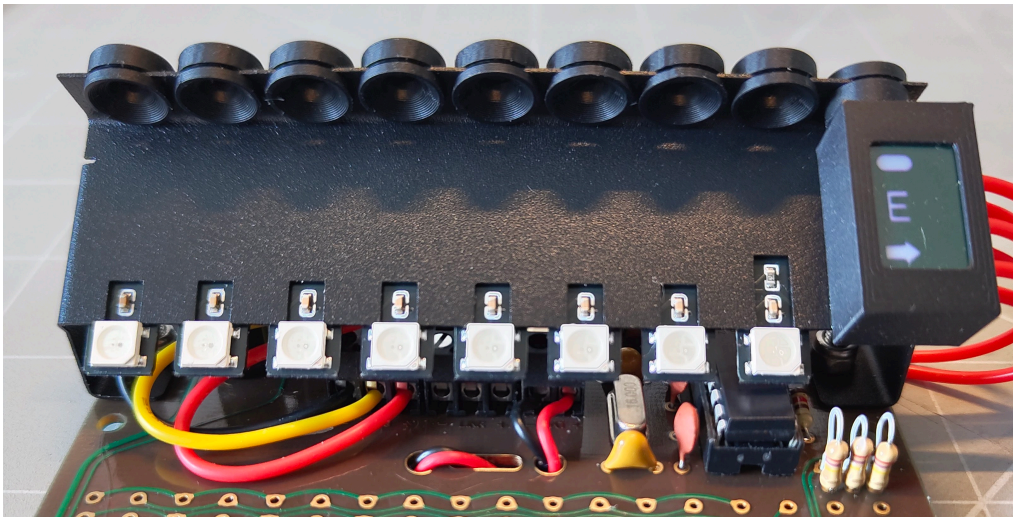



- Start by connecting the wires from the LED board to the screw terminal labeled 'LEDs' on the mainboard. The **black** negative wire goes to '-', the **yellow** data wire to the centre, and the **red** positive wire to '+' as shown above.
- Now place the holes in the feet of the display shelf over the top holes in the mainboard.
- Pay attention to the orange LED and manoeuvre the wires so that the lens slots into the circular hole in the shelf.



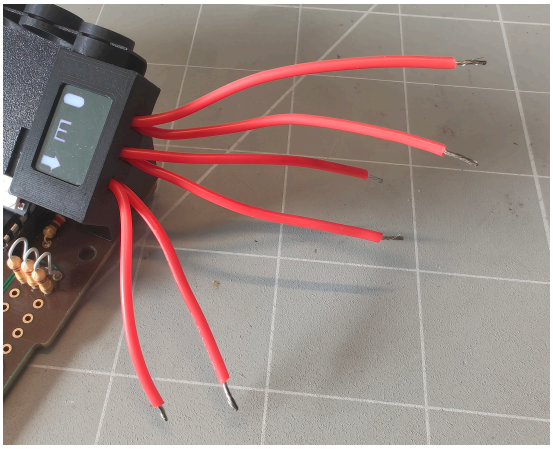


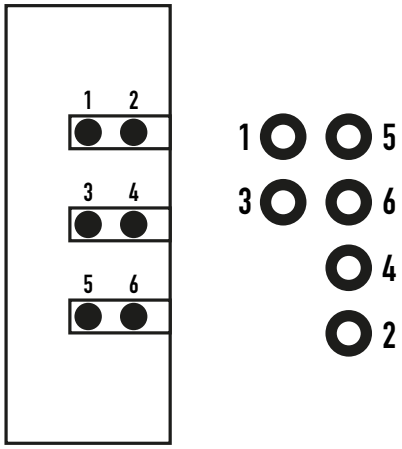
- Use some tape to hold the legs of the shelf into place and flip the board over to the green side.
- To make installing the shelf easier, we have included a 3D printed installation tool. Place one of the M3 lock nuts into the tool. Be sure that the circular side of the nut with the inner nylon ring faces downwards as shown above.
- Insert the tool into the space beneath the holes so that the nut is in alignment and screw one of the M3 bolts through the hole and into the nut. Tighten the bolt with a screwdriver while gripping the 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 these steps with the second nut and bolt so that the shelf is securely fastened to the box

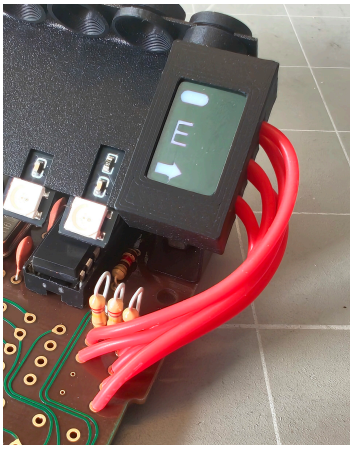



- Now push the orange LED up into the hole in the shelf as far as it will go and solder it to the board in the usual way.

Now we have our completed shelf assembly in place, you may want to test the electronics are working again by attaching the battery and sliding the power switch to the on position. If no lights come on, check for any loose wiring or wires in the incorrect positions.





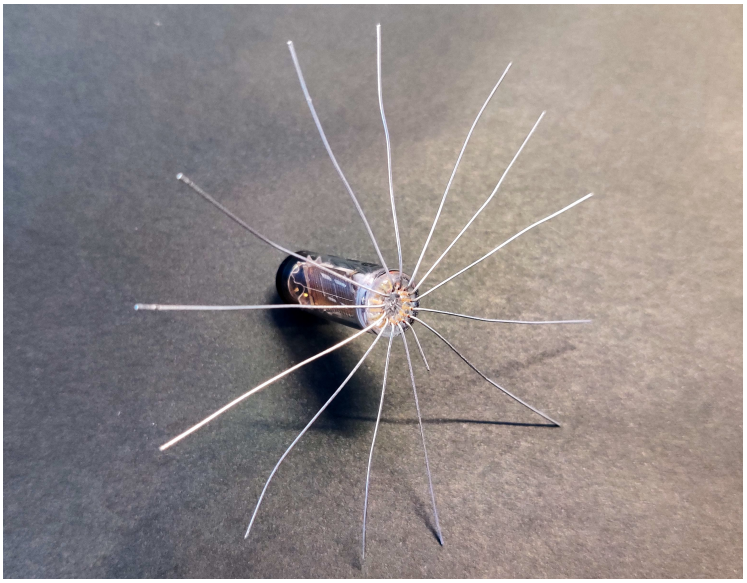


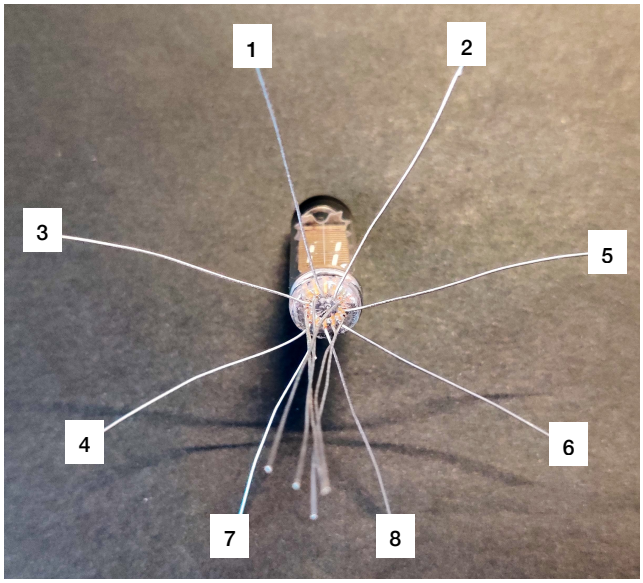
- Strip about 2mm of shielding from each of the Error Box's silicone wires.
- Use the diagram above to solder each of the red wires to the board. For instance wire 1 (indicated on the left) should soldered to hole 1 (indicated on the right). This arrangement is based on a real Sanyo ICC-808D, so this will give us an accurate look.

3.7. PREPARE THE VFD TUBES

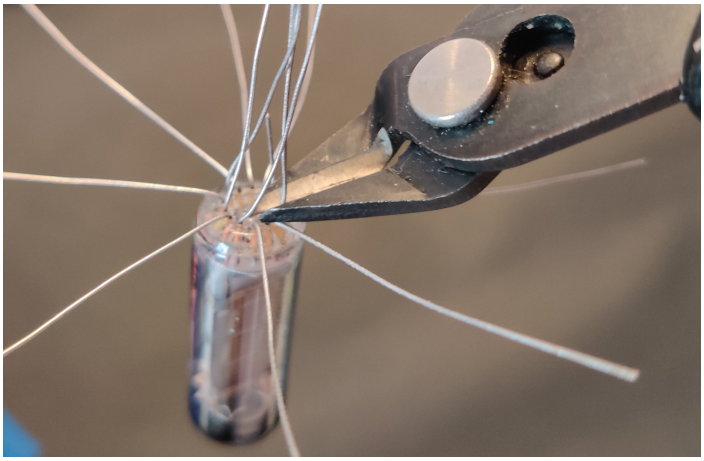
Your kit contains 8 genuine vintage glass VFD tubes. Although we won't be able to light the numbers up themselves, the glass tubes will reflect the light from the LEDs underneath to create an awesome looking effect.

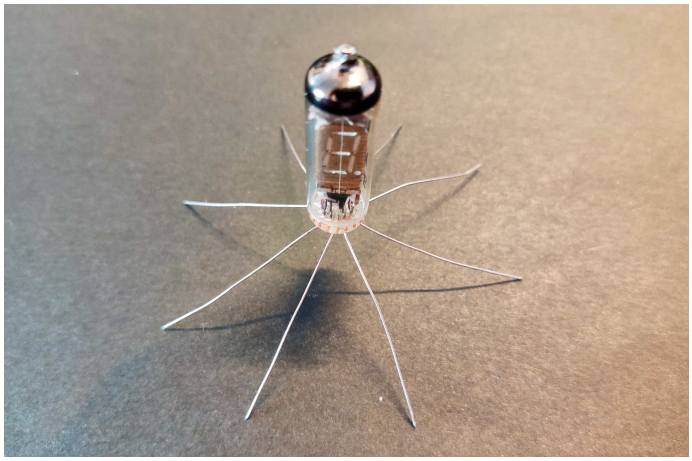
It's worth nothing that, depending on availability, the exact model of the nixie tubes can differ slightly from kit to kit. Their appearance may have minor differences to those shown in the following photos, but they will always be the correct size and will always be shipped together in a matching set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



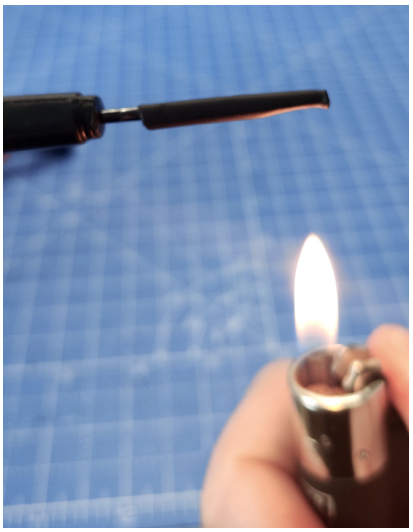


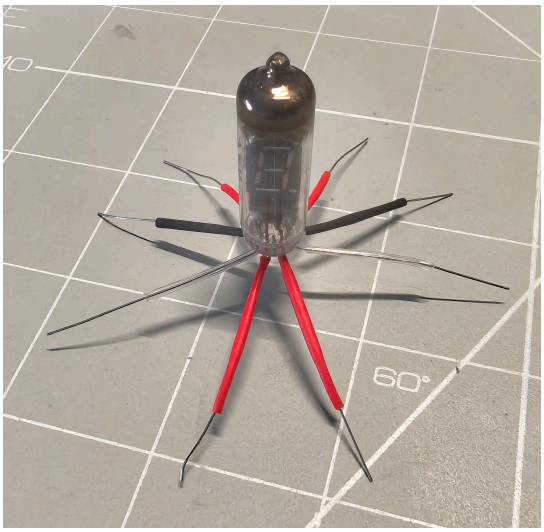
- With your wire cutters, snip off all the unwanted wires that you have bunched together. Be very careful not to remove any of the eight wires still fanned out as we will need these to attach to the motherboard.
- Once done, you should have a tube that looks like that in the second photo above with eight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

3.8. 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.

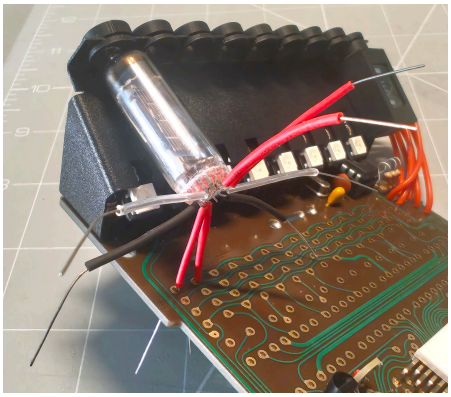
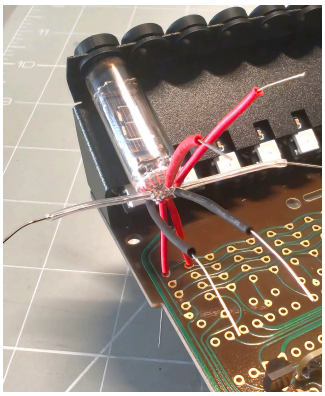
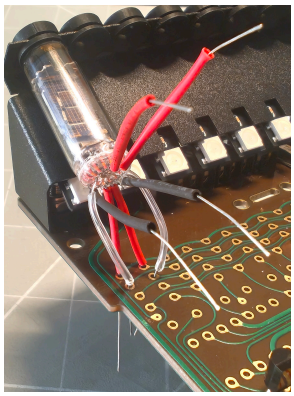
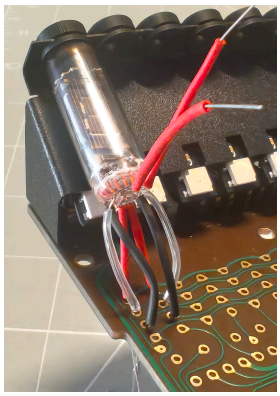




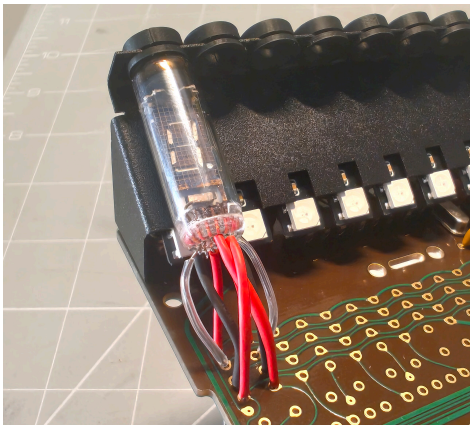
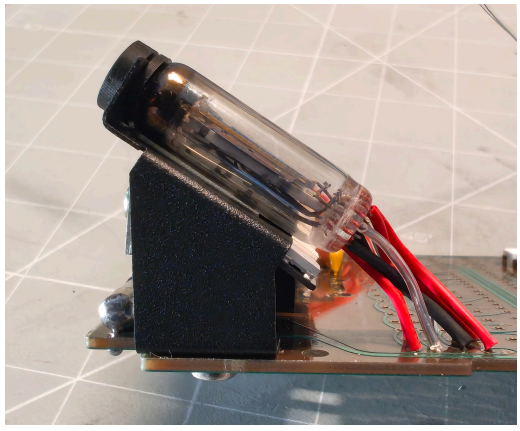
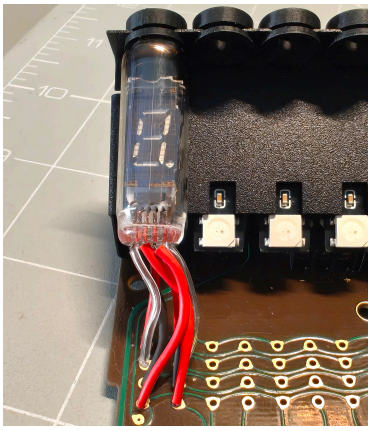


- From the **red**, **black** and clear lengths of heat shrink tubing, cut the following sections:
  - 2x 25mm **Red**; 2x 21mm **Black**; 2x 19mm Clear; 2x 17mm **Red**.
- Place a section of tubing over a wire or the end of a small screwdriver, and use a heat source to shrink it down. You can use a 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** 25mm **red** tubing over the front two wire strands.
- For the second two wires, repeat the process with the 19mm clear tubing. For the third two wires, use the 21mm **black** tubing, and for the final two use the shorter 17mm **red** tubing. The completed display tube should look like the third photo above.
- Repeat the process for the other seven VHD tubes.

3.9. MOUNT THE VFD TUBES

- 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 first photo above. As you do so, push the top of the glass tube into the first tube grommet - this will help keep the tube in place as you insert the other wires.
- Instead of inserting the **black** wires next, just bed them so they point directly forwards.
- Take the clear wires and insert them into the second two holes in the board. They should be wrapped around the **black** wires.
- Now insert the **black** wires through the next two holes.

- Finally, criss-cross the **red** wires (the wire on the left feeds underneath the right) and thread them both into the final two holes in the board so it looks like the second photo above.
- With all the wires in place, flip the board over and solder them into place and trim any excess wire.
- Gently push the glass tube downwards until it sits at the same angle as the metal shelf. Push the wires to the right so they curve as in the final photo above - this will help the tube to sit flat and give us an accurate look.



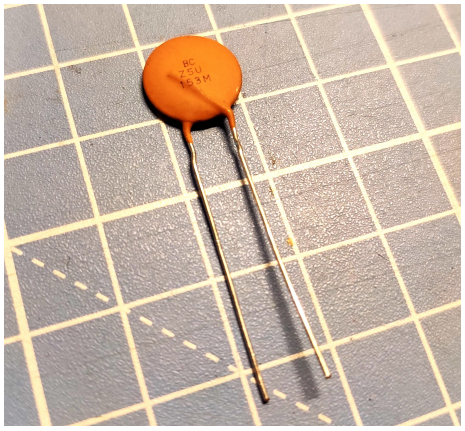
Repeat this process until all eight tube are fully secured on the shelf. You may need to gently rotate the tubes so all the digits are aligned and facing directly upwards and manipulate the wires so they look consistent.

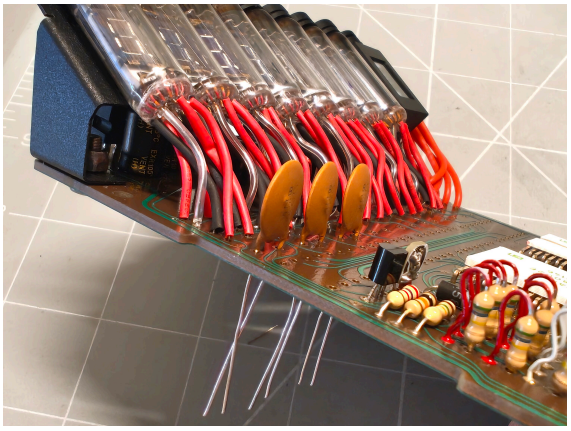
4. ADD THE FINAL COMPONENTS

We're now on the home straight. Just a few more components to add. For this you will need the eight **orange disc capacitors**, the four replica black Sanyo T4125 chips, the replica Sanyo E172C capacitor and, of course, your completed daughterboard assembly. Let's do it!

4.1. ATTACH THE DISC CAPACITORS



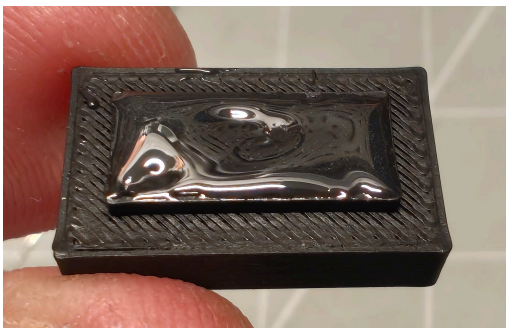


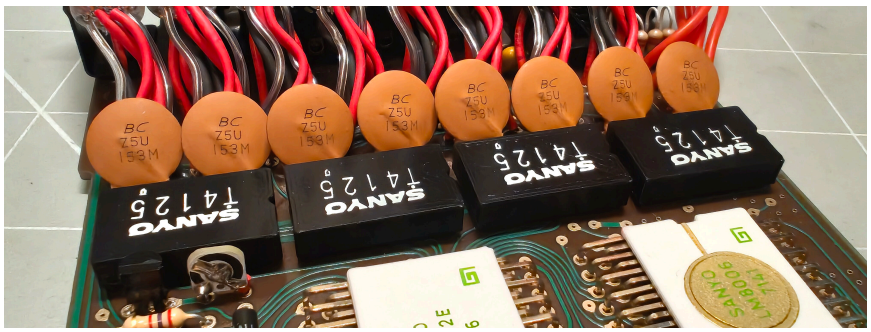


- Before adding the eight orange disc capacitors, we need to remove the kink in their wires. You can do this by bending the wires with a pair of pliers until they appear straight. This does not need to be neat - just enough so the wires slide through the holes unobstructed.
- Add each disc capacitors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

4.2. ATTACH THE BLACK T4125 CHIPS



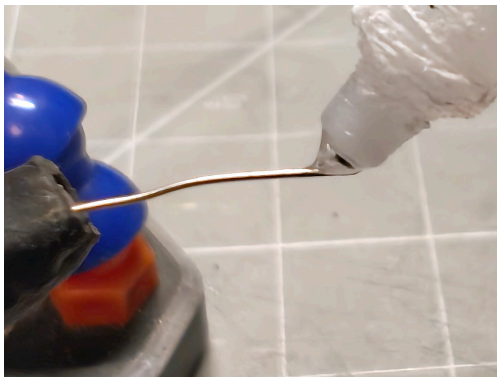
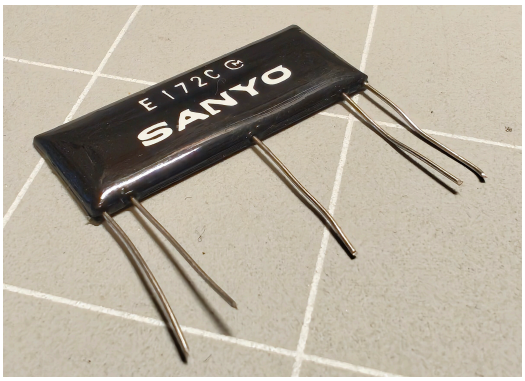


- Apply a small amount of epoxy glue to the raised section on the underside of one black chip. Don't add too much otherwise it may ooze out and glue will be visible on the board itself.
- Position the chip **upside-down** on the board, using the two rows of seven holes as an alignment reference.
- Repeat for the remaining three chips and realign them as necessary before the glue fully cures.

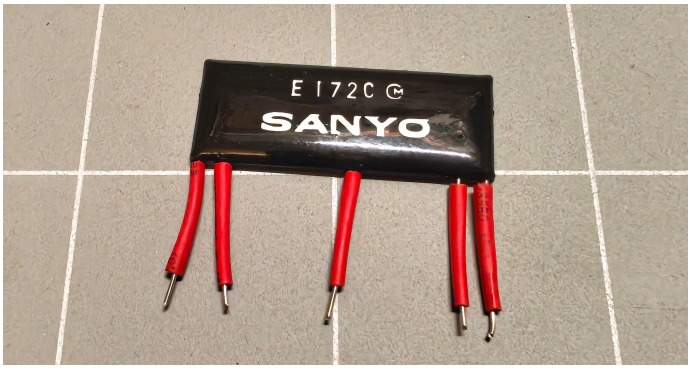
As was the case on the original Sanyo circuitboards, the T4125 chips should be mounted UPSIDE-DOWN with the small notches facing to the RIGHT.

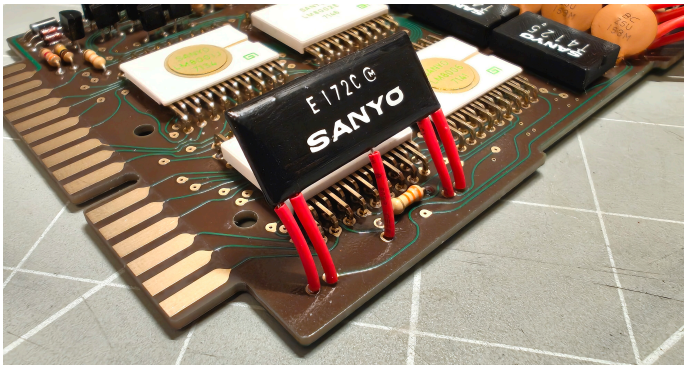
4.3. ATTACH THE E172C CAPACITOR



- Find the rest of the bare wire we put aside earlier and cut 5x lengths of **20mm**.
- Add a small amount of super glue to the end of each wire and insert them into the pre-made holes in the bottom of replica capacitor. If any of the holes appear to be blocked, try clearing them with a needle.



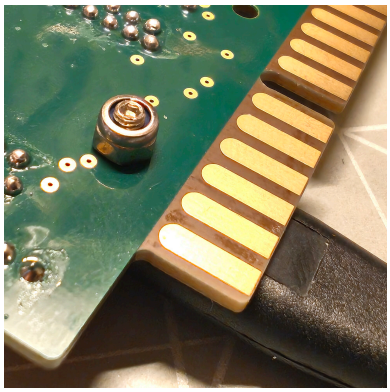


- Once the glue has set, find the remainder of your red heat shrink and cut 5x **13mm** sections. We recommend shrinking these sections of a separate piece of wire so that the heat does not damage the 3D printed part and its coating.
- Add the replica capacitor to the board by inserting the wires into the five holes on the bottom right side of the board and solder into place. The capacitor should fold down and sit on the adjacent white chip.

4.4. LINK THE DAUGHTERBOARD

This is it! This is definitely it!

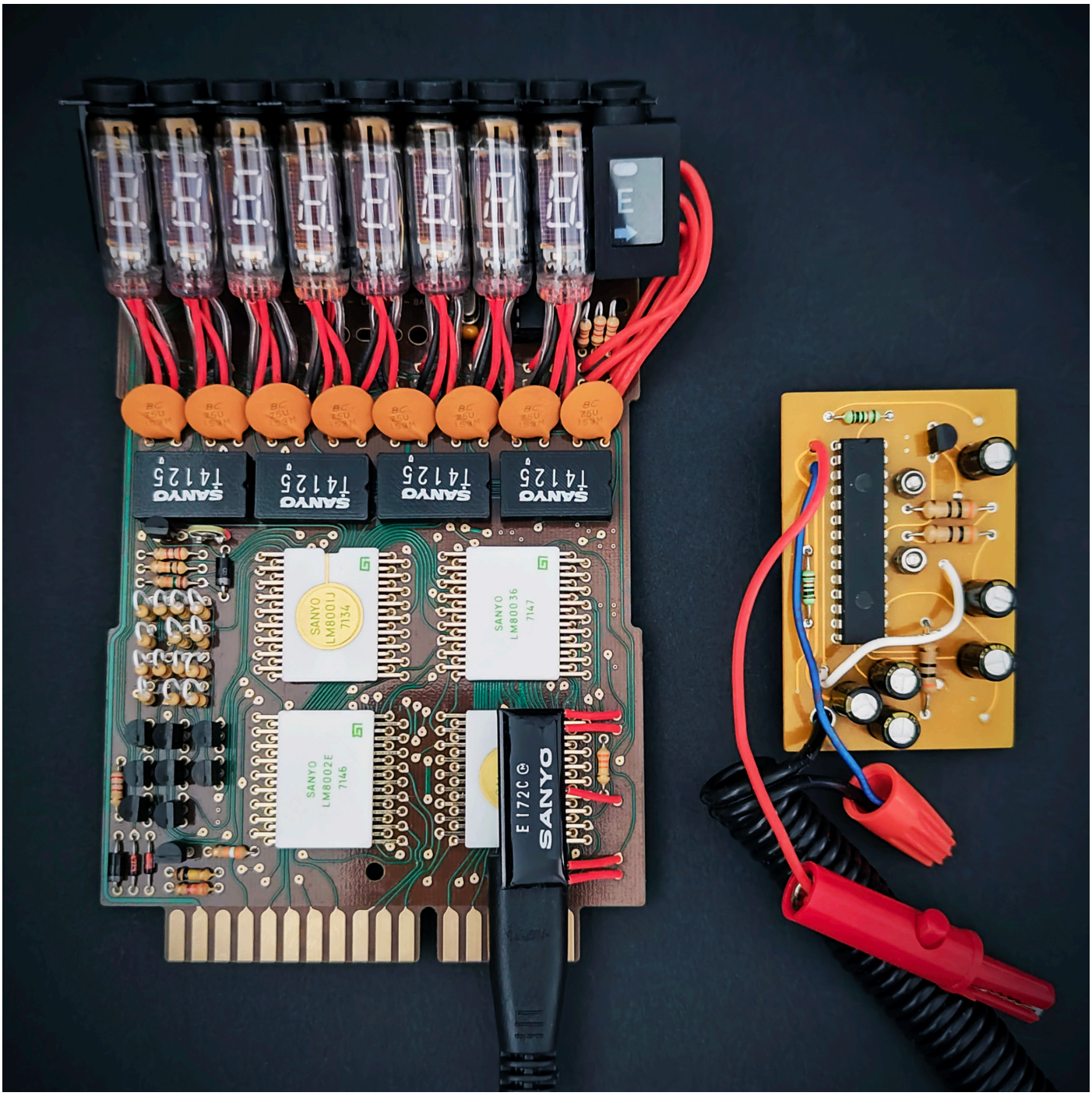




- Dust off the daughterboard you assembled earlier and remove the lock nut from the ‘shaver plug’ at the end of the coiled cable.
- Pass the bolt through the hole directly underneath the bottom-right white chip.
- Add the lock nut and tighten until the plug is firmly attached to the surface of the motherboard.

YOUR GIZMO 808D MK2 IS COMPLETE!

Congratulations!!! You've done it! Your GIZMO 808D MK2 is finished! Give yourself a pat on the back for all your hard work and bask in the glory of your brand new toy!



Continue to the next section for the full operating instructions, plus information on how to attach to a leather holster…

OPERATING INSTRUCTIONS

Using the Gizmo lighting effects is simple. Once you have connected a 9V battery to the snap, slide the 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 then use the two buttons underneath the display shelf to change the lighting pattern and LED colour:

LIGHT PATTERNS

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, followed by a quick flash of the Error Box.
2. **“WIPE”** — Each tube is illuminated - one-by-one from left to right and immediately turned off one-by-one in the same way. The Error Box lights up for a full second.
3. **“BOUNCE”** — Each tube is illuminated - 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 quickly after every five cycles.
4. **“PULSE”** — A pulsating fade-in and fade-out of all tubes and the Error Box together.
5. **“RANDOM PULSE”** — A pulsating fade-in and fade-out a single tube in a random sequence. The Error Box remains on.
6. **“SPARKLE”** — Individual tubes flash quickly at random. The Error Box remains on.
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.
8. **“CENTRE FAN”** — Illuminated tubes fan out from the centre. The Error Box remains on.
9. **“PKE”** — Tubes are illuminated one by one from left to right with a random interval between each one suggesting a slowly strengthening PKE level. Each tube blinks fast before remaining on. Once all eight tubes are illuminated, the Error Box is illuminated and all lights flash 10 times before the sequence resets.
10. **“STEADY ON”** — All tubes and Error box are turned on at full brightness. There is no motion effect in this mode.
11. **“RAINBOW”** — All eight tubes display a continuously changing pattern in a full spectrum of colours. This mode overrides the currently selected colour. The Error Box stays off in this mode.

COLOUR MODES

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

1. **NIXIE ORANGE** - matches the glow of the original Sanyo nixie tubes found on the ICC-808D calculators.
2. **WARM WHITE** - a warmer white to simulate the look of incandescent bulbs.
3. **CUSTOM COLOUR** - displays the custom colour you have saved in memory. See the next section on how to change this.

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

SETTING A CUSTOM COLOUR

Your MK2 GIXMO includes a brand feature that allows you to save a custom colour to the on-board memory. This can be any colour of the RGB spectrum.

- To enter color selection mode, **double-click** the **left** button. You will see the lights underneath the tubes switch to the last saved colour (this will be bright white by default). No lighting pattern will be displayed and all LEDs will be steady on.
- Once in selection mode, hold down the left button. You will now see the tube lights slowly cycle through the colour spectrum. When you reach the colour that you would like to save, release the button to stop the cycle.
- To save your custom colour, press the **right** button. This will save your colour to memory, exit selection mode and return you to the light patterns.

POWERING OFF YOUR GIZMO

To power off, slide the switch back to the off position. The microcontroller will remember your last selections, so whatever pattern and colour you used previously will illuminate immediately when powering back on. Any custom color selection will also be remembered and be available as one of the colour modes.

USING A DIFFERENT POWER SOURCE

If you wish to use a power source other than a 9V battery, this is possible but it is essential that you don't overload the board. The functional circuitry expects an input voltage of 6-12V. The onboard regulator steps this voltage down to a steady 5V to power the lights. Therefore, the input voltage must be at least 6V for the system to work correctly.

TROUBLESHOOTING

If the lighting effects are behaving erratically or don't display at all, this is almost always down to battery issues. It is important to always use fresh batteries before operating your Gizmo for an extended time. Bear in mind, 9V batteries are not designed for extended power usage so they will deplete relatively quickly. We use these by default simply for their pocketable size.

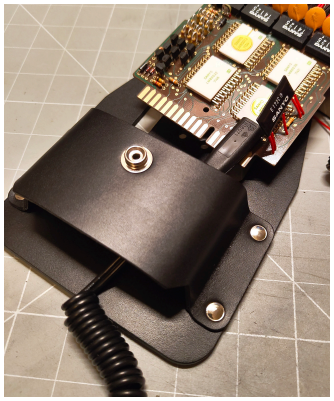
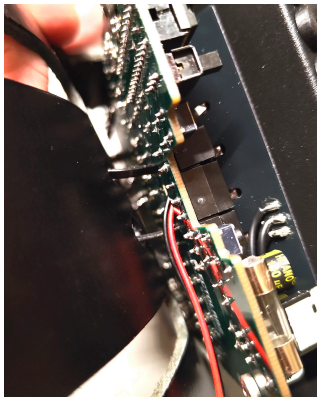
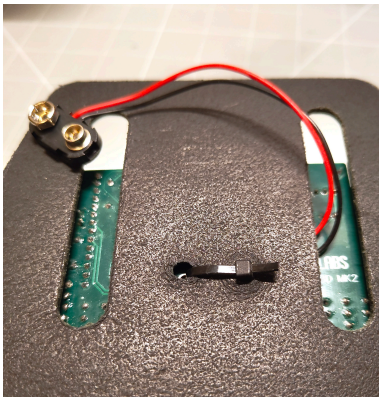
If changing batteries does not solve your issue, then check your connections to rule out any loose wiring. If none of the above resolve the problem and you think there may be a problem with the supplied electronics, please contact us and we will do what we can to help.

Always remember that your GIZMO 808 MK2 is an unprotected and exposed circuitboard so be careful not to expose it to liquids or wear it outside in bad weather.

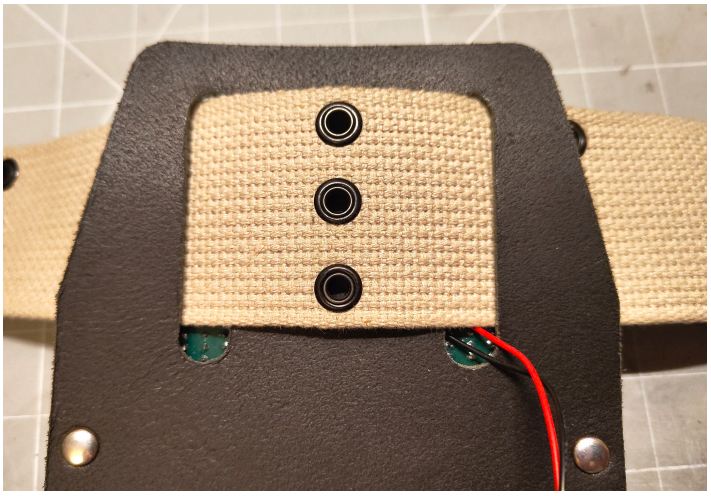
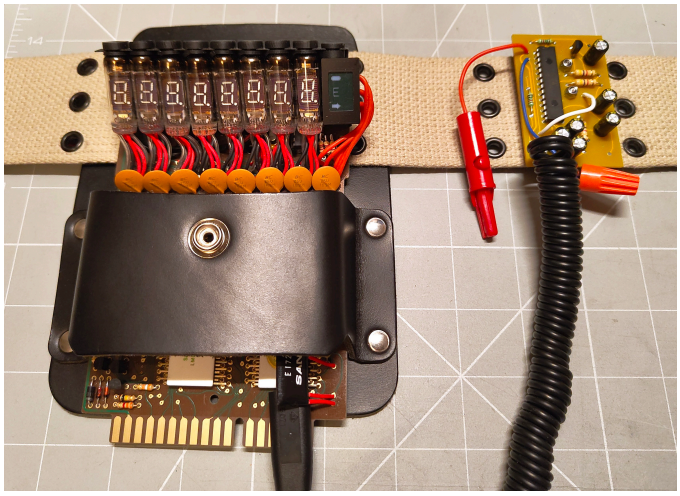
ATTACHING TO A HOLSTER

The GIZMO 808D MK2 includes mounting holes in the board that can be used to secure it to a holster. If you added the EctoLabs holster to your MK2 order, you will find two holes in the leather to use for this purpose. If you have not already added the cable tie supplied in your kit, please see section 2.8 of this guide for photos of where this should go. If you plan to regularly remove your Gizmo from the holster, you may prefer to use a basic wire tie that you can easily twist together and untwist later.

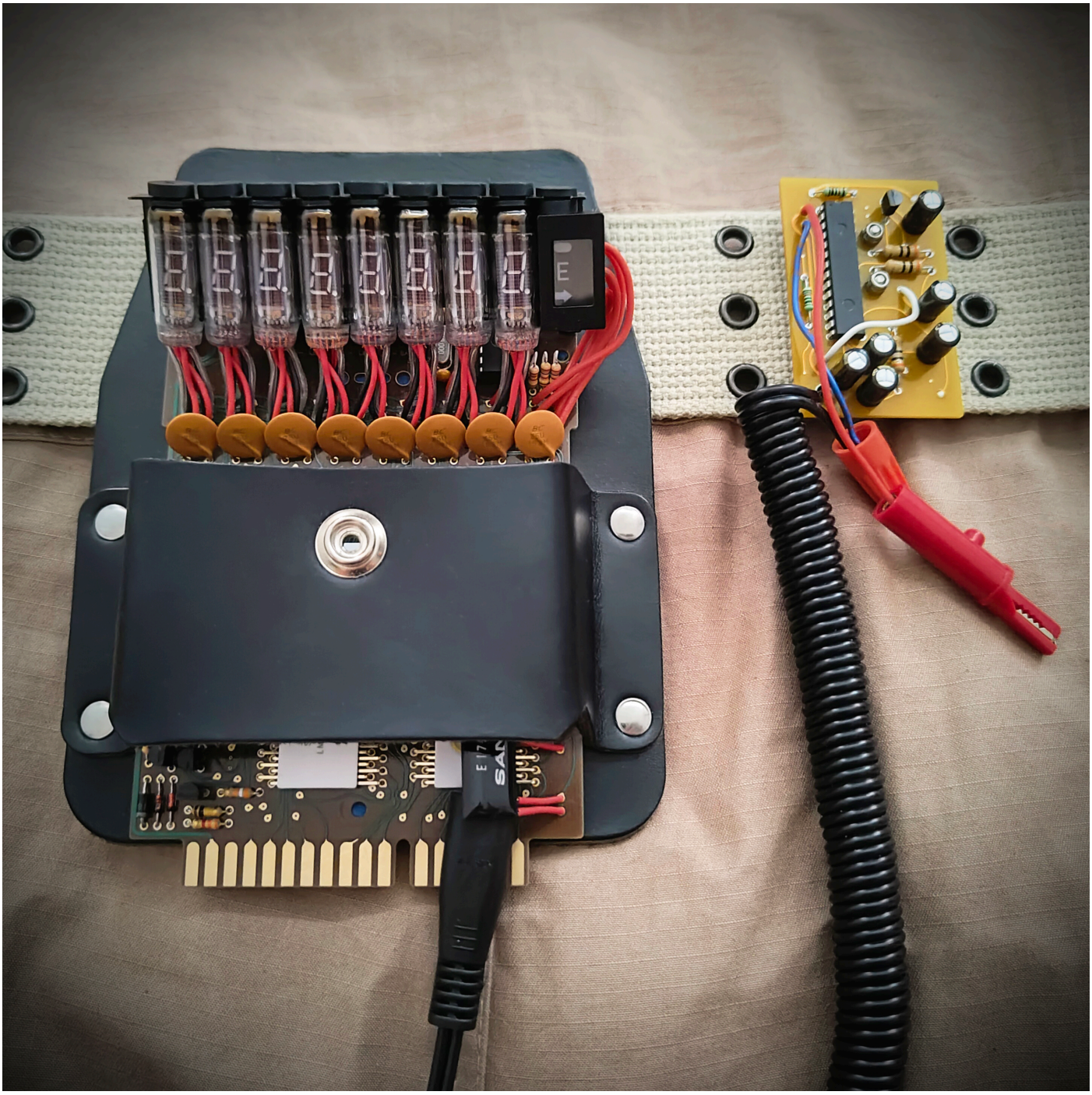
Any sharp solder joints on the back of the board are likely to scratch the leather, so you may wish to cover these joints with masking/electrical tape before inserting into the holster.

- The mounting holes in the EctoLabs holster are located between the two belt slots. These are designed so that the Gizmo remains secured at the optimum position.
- Start by feeding the daughterboard through the holster from the top, followed by the main board itself until the holes line up with the ends of the cable tie.
- Feed both ends of the cable tie through the holes and the battery cable through one of the belt slots. Fasten the cable tie and trim the excess from the end.

- You can now feed a standard sized pistol belt through the slots in the holster as shown above.
- Finish off by clipping the daughterboard to your belt.



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

Designed and assembled in London, 2026

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