# Looping Delay

## Kit Builder's Guide for PCB v1.0

Guide v1.0a, June 26, 2025

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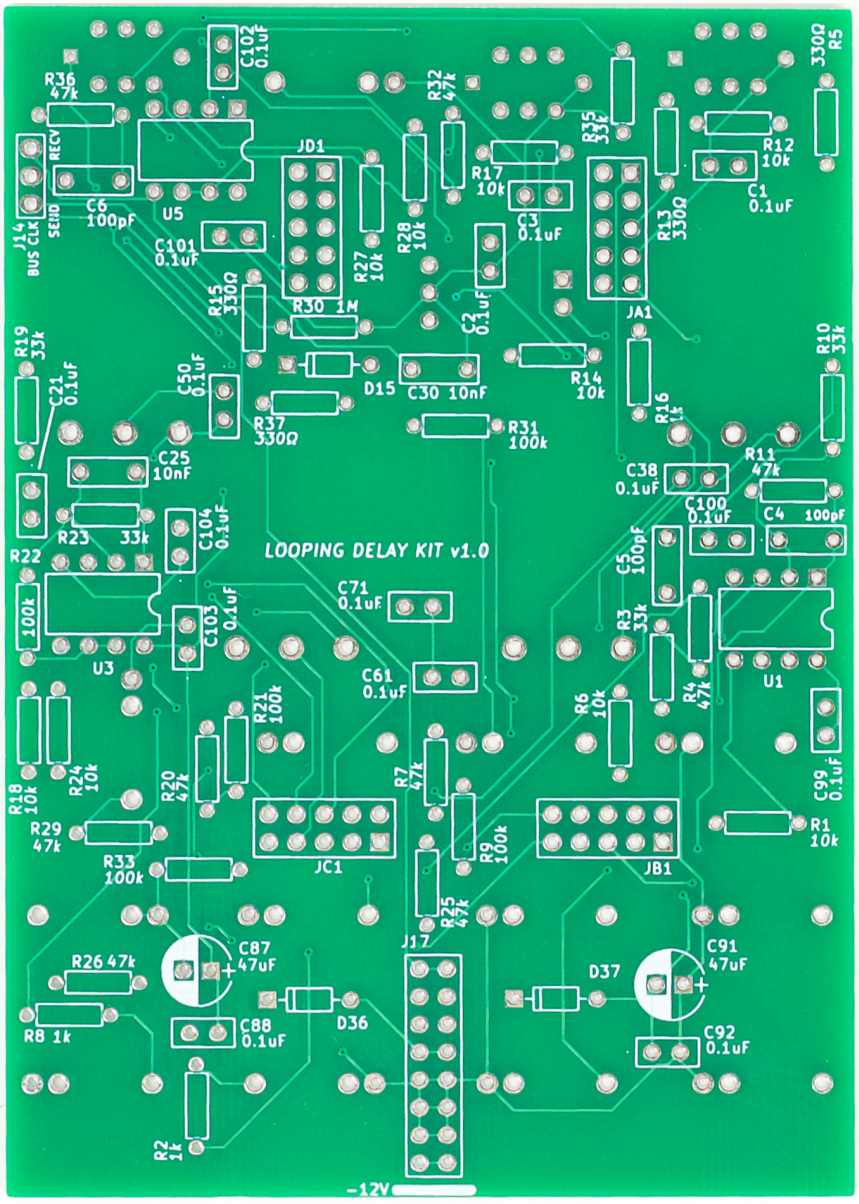



### LOOPING DELAY

This guide is for building a Looping Delay. You should have basic soldering skills and a basic familiarity with identifying electronics components.

### Tools Needed:

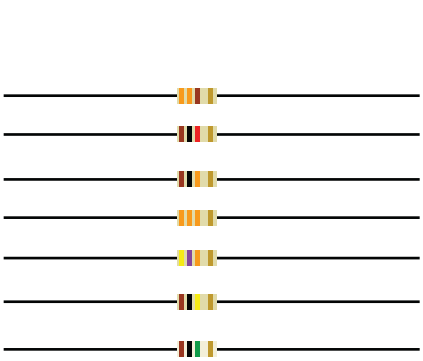
- Soldering iron, solder
- Flush cut snips (for snipping leads after soldering)
- Needlenose pliers (for removing a component if you make a mistake, and for pulling leads straight)
- 5/16" and 10mm socket drivers for pot and jack nuts (pliers will work, if you're careful not to scratch the faceplate)
- Multimeter (for reading resistor values if you don't know the resistor color code chart, or for locating shorts/solder bridges)
- Tape such as masking or painters tape (Optional: for holding down larger components while you solder)

## Step 1: Resistors

Insert and solder the 36 resistors and 3 diodes. Due to variations in components, you may find that some resistors are larger than others in your kit. The size is irrelevant, only the color bands matter. The orientation of the resistors does not matter. Be mindful not to confuse resistors that have the same quantities but different values. The diodes must go in with the grey band facing the line marked on the PCB.
After installing the components, you may want to splay the leads a bit so they don't start to fall out when you flip the board over to solder. Or, you can put a book or piece of cardboard over the components to hold them in place while you flip the board over. After soldering, snip the leads nearly flush to the PCB.

The 36 resistors :

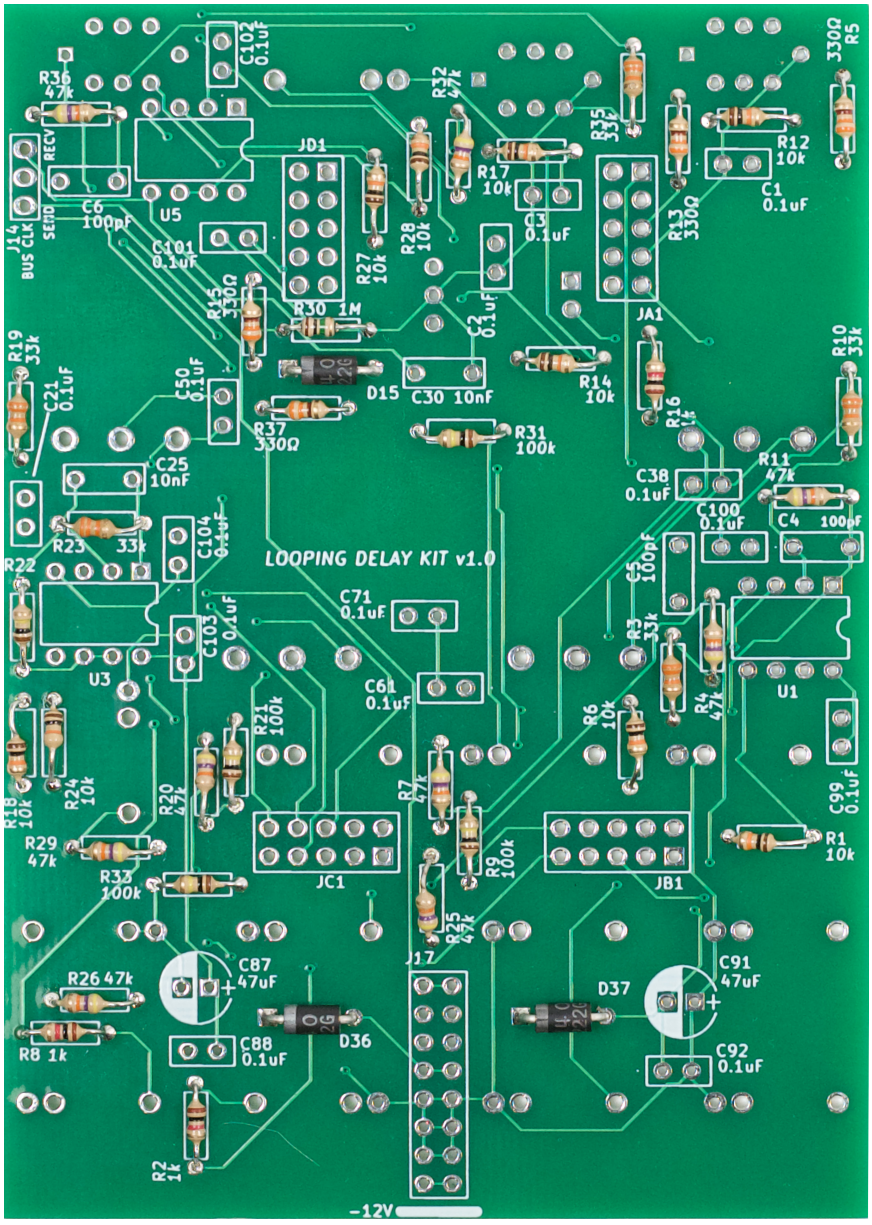
- *330 ohm x 4 (orange orange brown gold)*
- *1k x 3 (brown black red gold)*
- *10k x 9 (brown black orange gold)*
- *33k x 5 (orange orange orange gold)*
- *47k x 9 (yellow purple orange gold)*
- *100k x 5 (brown black yellow gold)*
- *1M x 1 (brown black green gold)*



The 3 diodes:

- *SB140 Schottky x 3 (black body)*

***Note orientation: band on diode = stripe on footprint***



### Step 2: Sockets:

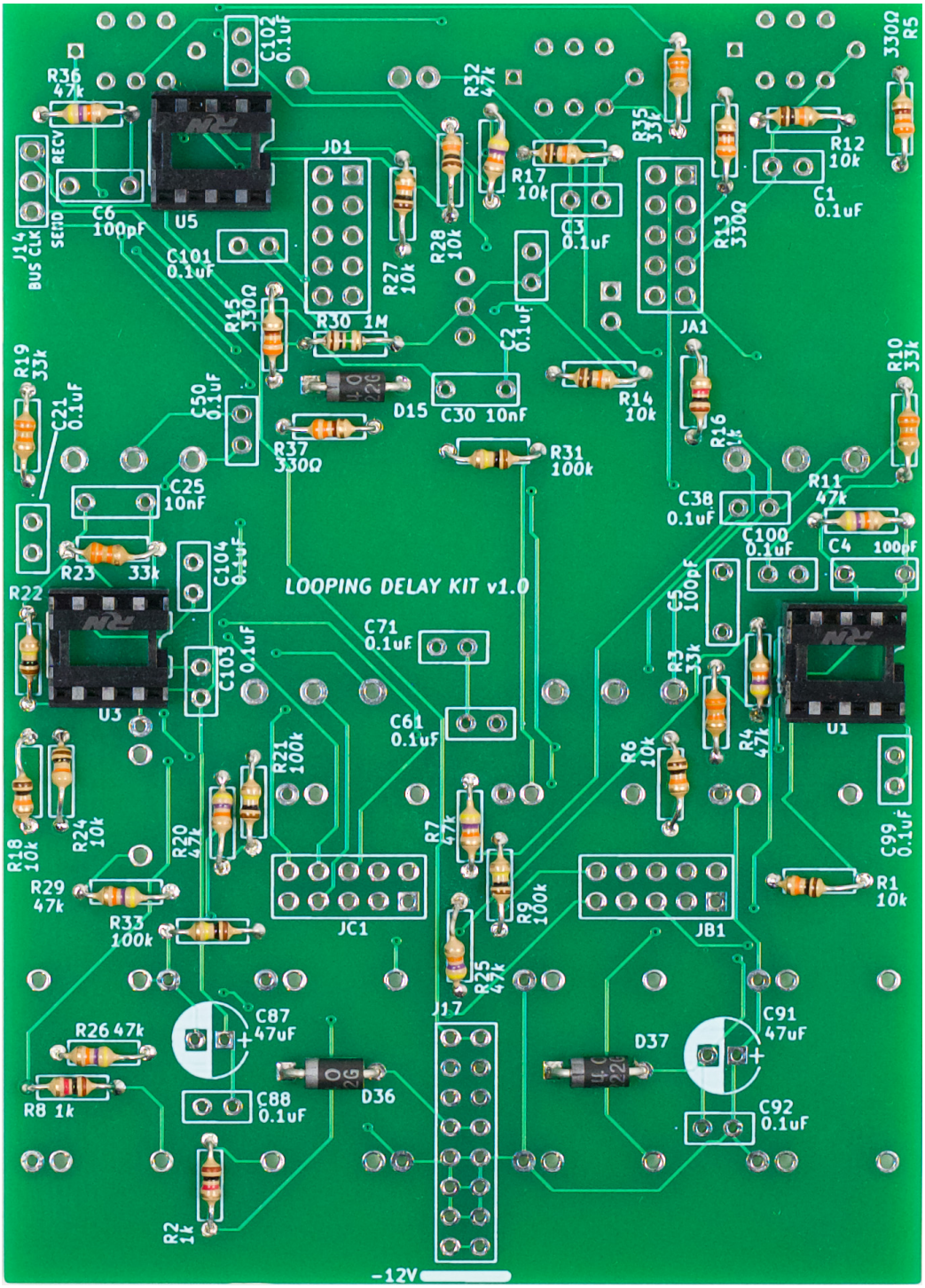
Insert and solder the IC sockets. The notch in the sockets should line up with a matching notch drawn on the PCB. All three of the sockets should have the notch facing to the right.

If you have trouble keeping the sockets installed while you solder them, you can bend the leads slightly, or try taping them down, or place a book or flat surface on top of them before flipping the PCB over to solder.

Make sure all 8 pins poke through the PCB. It's easy to bend a pin when installing the socket, and it will be difficult to fix this later.

Note that if you accidentally solder the sockets in backwards (with the notch facing the left), then do not remove them: removing sockets risks damaging your board. Instead, just wait until Step 9 and insert the ICs with the notch or dot facing the correct way.

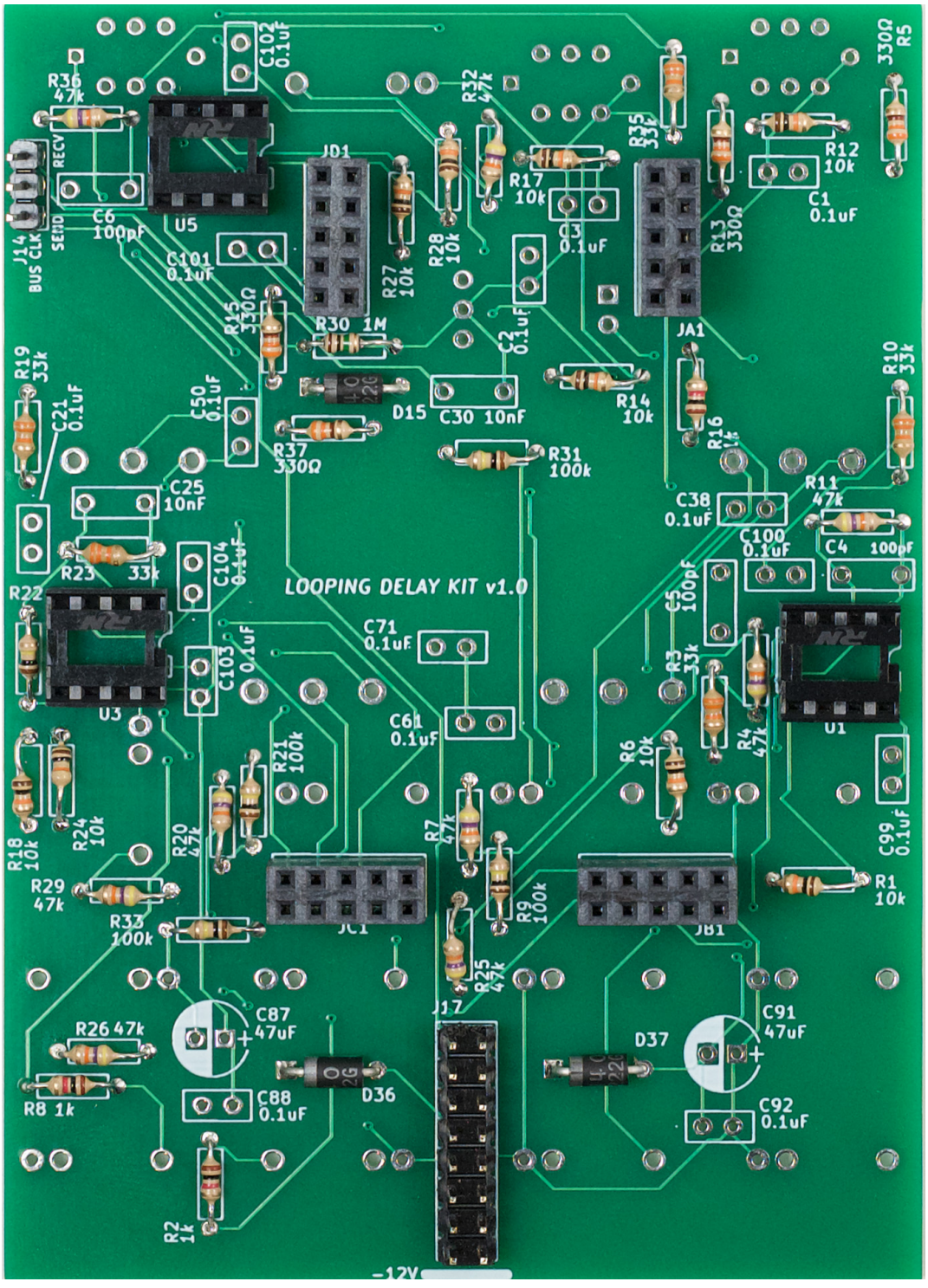
- *8 pin socket x 3*



### Step 3: Pin Headers and Socket Headers

Insert and solder the pin and socket headers. Since the headers fall out easily, it helps to put a piece of cardboard or a book over the PCB, then flip over the book and PCB together before soldering. Solder one or two pins per header, then flip the board back over and check to make sure they are lined up, flush to the PCB, with the pins at a perfect right angle to the PCB. It's important that the socket headers are vertical and not tilted or angled because the Brainboard will be installed into all four of these headers. After you verify this, flip the board back over and solder the rest of the pins.

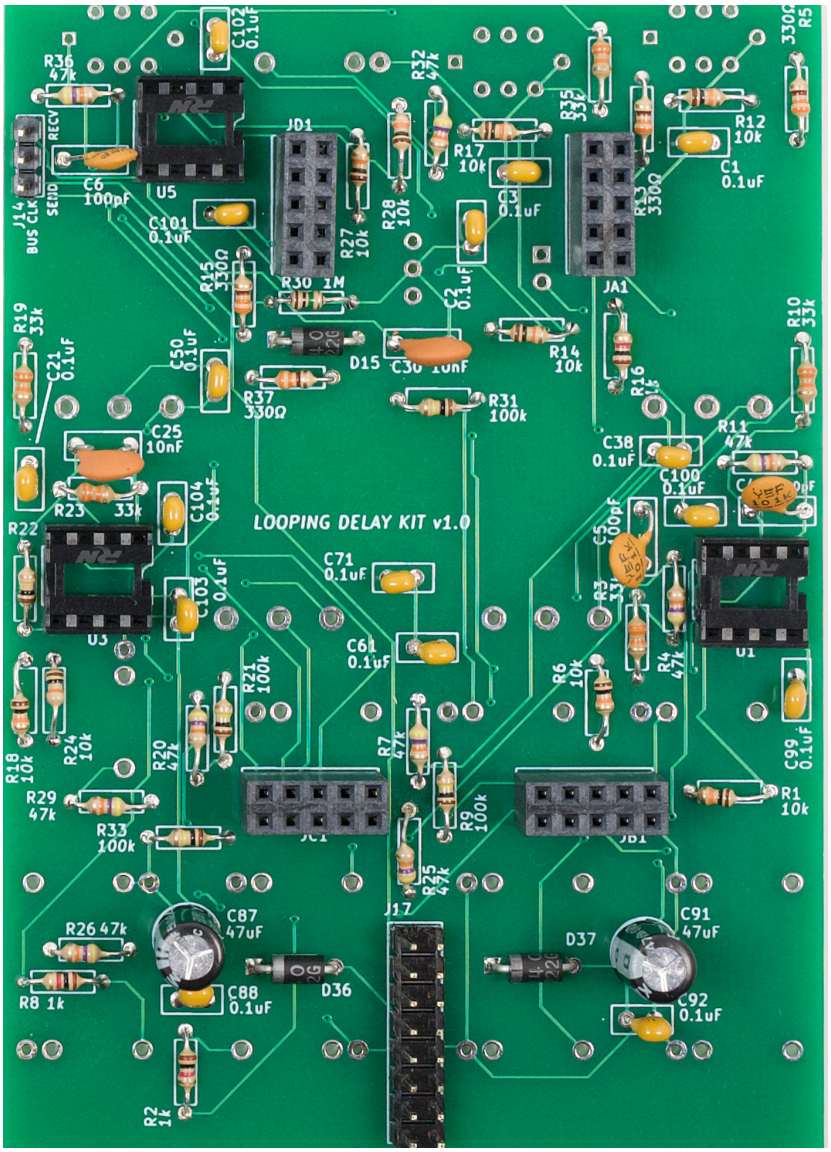
- *1x 3 pin header x 1*
- *2 x 8 pin header x 1*
- *2 x 5 socket header x 4*

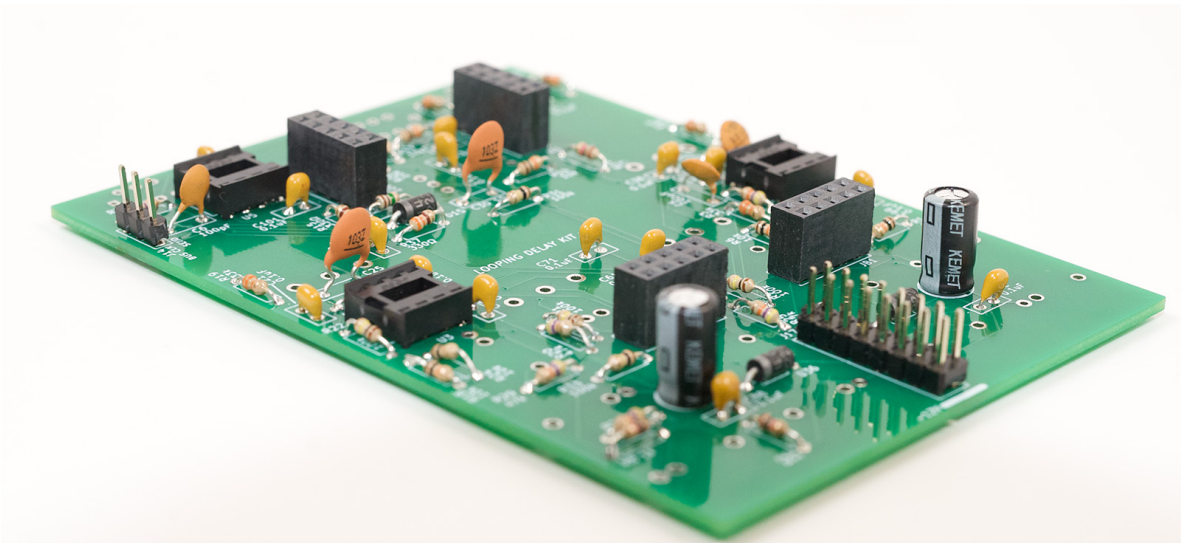


### Step 4: Capacitors:

Insert and solder the 23 capacitors. The 100pF, 0.1uF, and 10nF caps can be inserted either way, but the 47uF cylinder caps must go in with the long lead in the square hole. Both 47uF caps are orientated the same way, with the striped side to the left, matching the white half of the 47uF capacitor footprint on the PCB.

- *100pF x 3*
- *0.1uF x 16*
- *10nF x 2*
- *47uF x 2*



### Step 5: Check your work

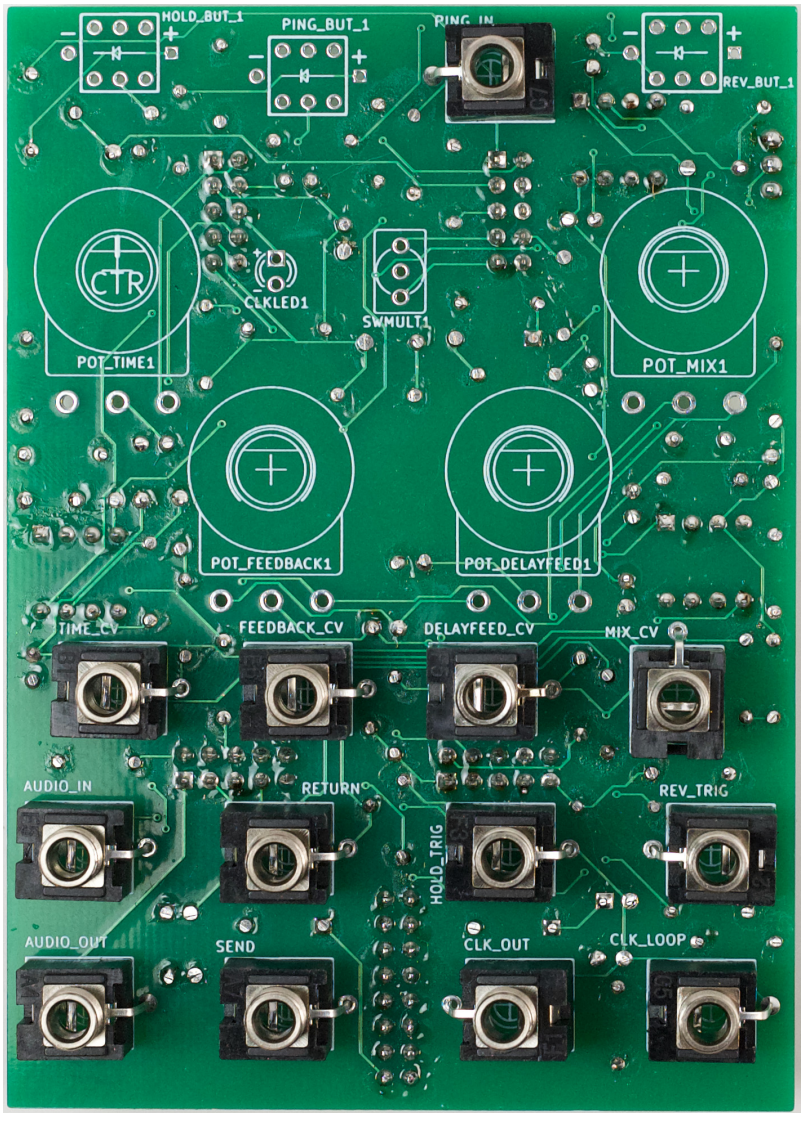
Before moving on to the mounting steps, look at the solder joints on the side opposite the components. Confirm that all solder joints are proper. Once we mount the hardware, and cover this side with a faceplate, it will be hard to check for mistakes.

Check for missed solder joints. Make sure all the leads have been trimmed flush to the board so that they don't short on anything. Make sure you have sufficient solder on each joint, your solder points should look like smooth, shiny cones. Look out for lumpy or oddly shaped joints, spots where the solder seems dull, or spots where the joint looks more like a sphere than a cone. These are all signs of bad solder joints. Before mounting the hardware and installing the panel, we recommend checking and reflowing / reheating every one of the solder points on the hardware side of the PCB. A poorly soldered joint is incredibly common and reflowing the solder before moving to the next step (whether you think you need to or not) might save you a lot of troubleshooting later.

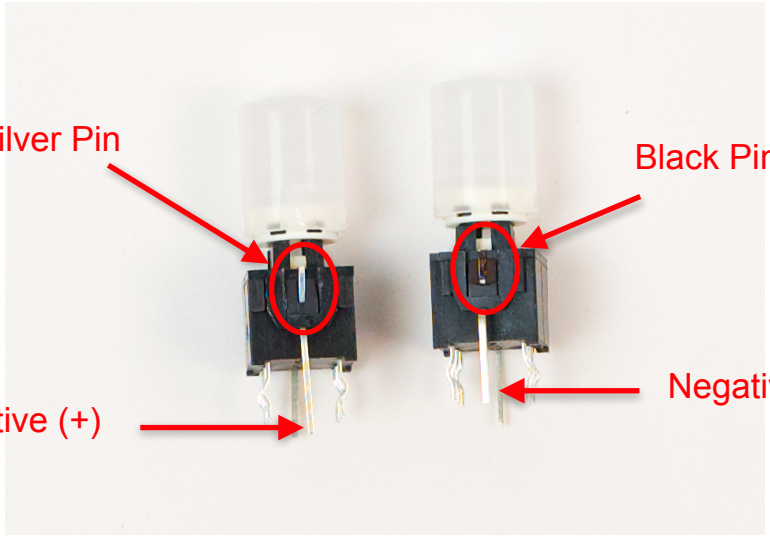
### Step 6: Prep mounting

For this step we will insert the jacks, buttons, pots, switch, and LED into the PCB, but we won't solder them until after we install the faceplate. This gives us a chance to align everything and catch mistakes before soldering.

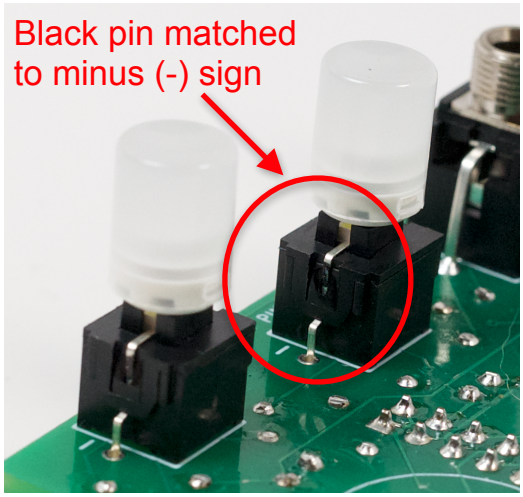
A. Insert the 13 jacks into the PCB. Do not solder yet.

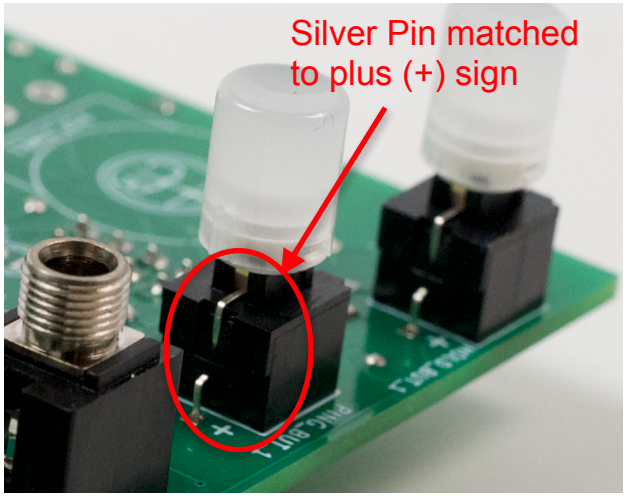


B. Look closely at the three buttons. One of their pins is marked with black. See the photo below. The side with the black mark is the negative pin. On the PCB, this side is marked with a minus sign (-). Insert the buttons into the PCB, they should snap into place with a firm push, being careful to ensure that they go in the right way, black pin facing the minus sign, and that no pins are bent.

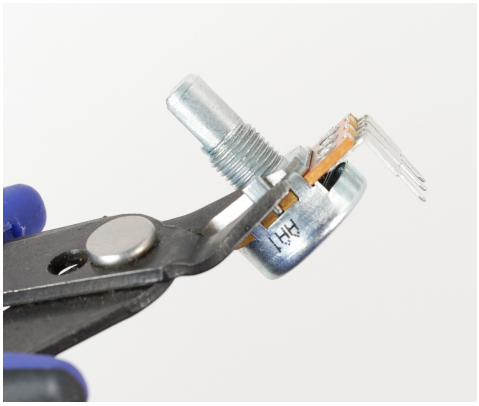


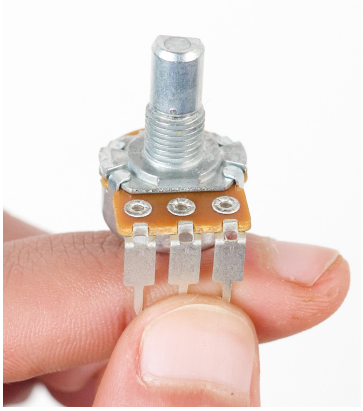

C. Verify your buttons are in correctly and that all eight of their pins are fully inserted through the holes in the PCB. The pins are very small and it is easy to bend one over as you place the button. It's also easy to place the button into the PCB the wrong way, since it's easy to miss the subtle coloring of pins. A bent pin or a backwards button is extremely hard to fix. When removing a button, you risk causing permanent damage to the thin copper traces on the PCB and/or button. On the other hand, it's very easy to double-check your work before soldering. Do this now, and check again before you solder the buttons. If you are unsure, take a break and look again later.



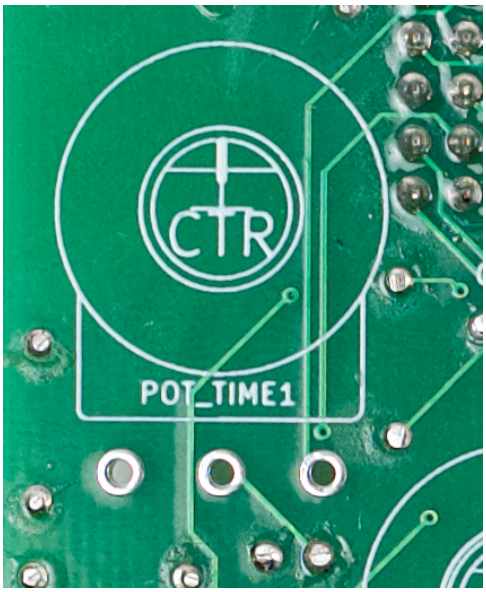
D. Take a look at the four pots. The three 100k pots come with a tab that must be removed before mounting (see photos below). You can do this using flush snips. Make sure to snip the tab as close to the base of the pot as possible. Insert the three 100k pots into the PCB. Do not solder yet; this will happen later.



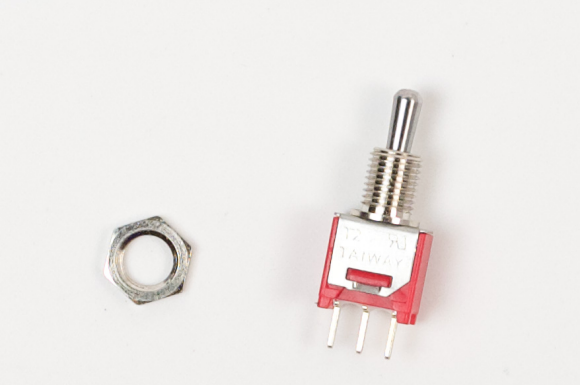


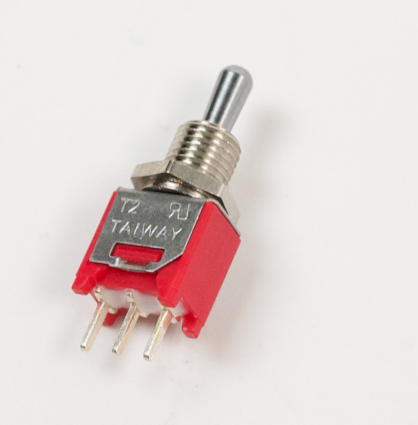
Note that the fourth pot does not have a tab to be removed. This is a center detent pot, marked with B10K. Insert it into the pot footprint on the lefthand side of the PCB, marked with the letters CTR. Do not solder yet.

- *10k center detent x 1*
- *100k no detent x 3*

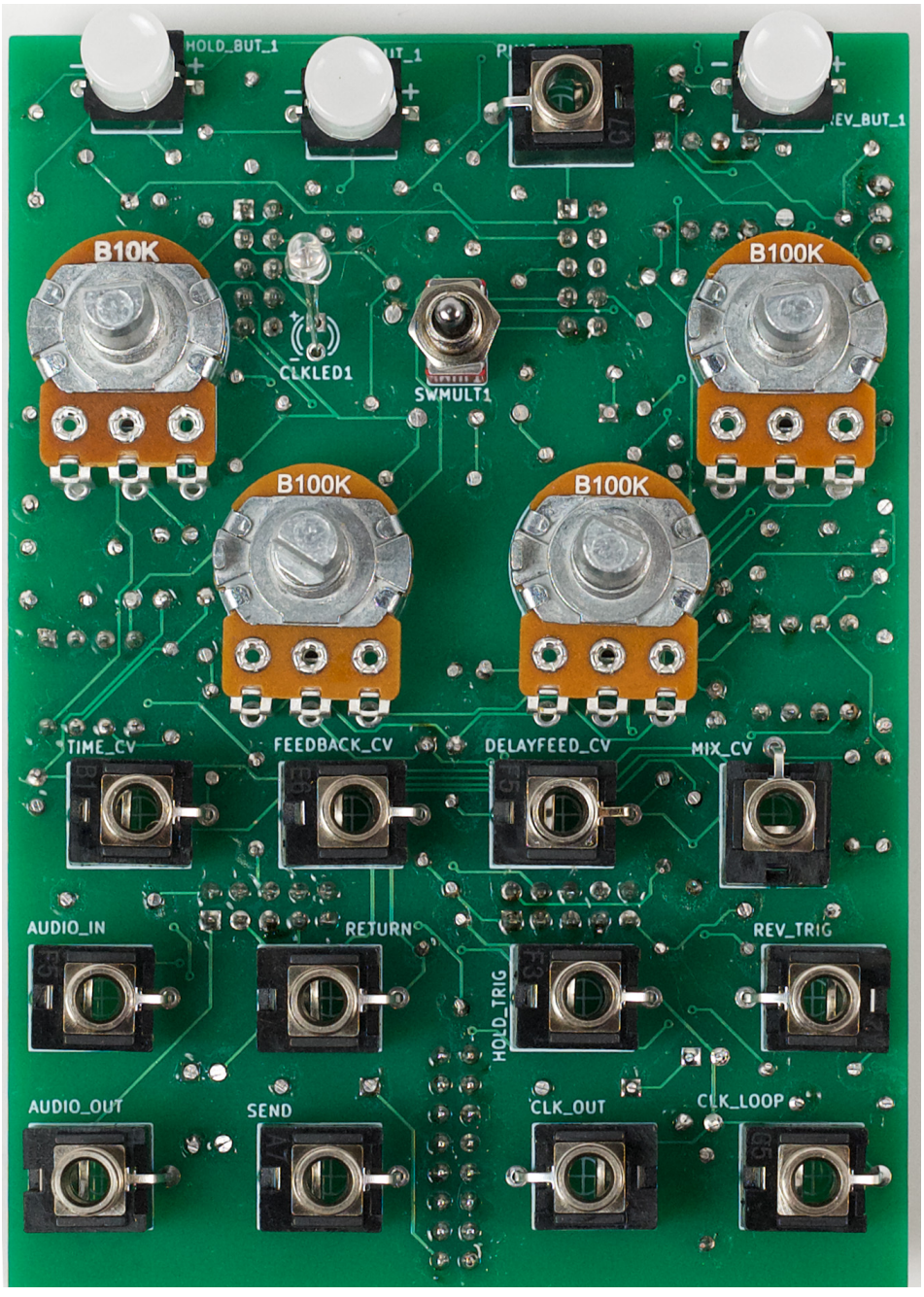


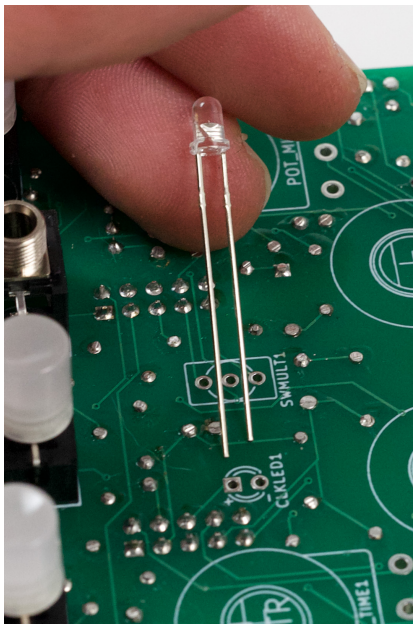

E. The kit comes with two mini hex nuts for the three-position switch (SWMULT1). Put one mini hex nut on the three-position switch. Finger-tighten the nut (don't use a driver) down to the base of the threaded bushing. Insert the switch into the PCB. Do not solder yet.





E. Look closely at the LED and note that one leg is longer than the other. Insert the LED into the PCB where marked, with the longer leg going into the square hole. After inserting the LED, verify that it was placed correctly. This is easy to mix up, and hard to fix later. Do not solder yet.

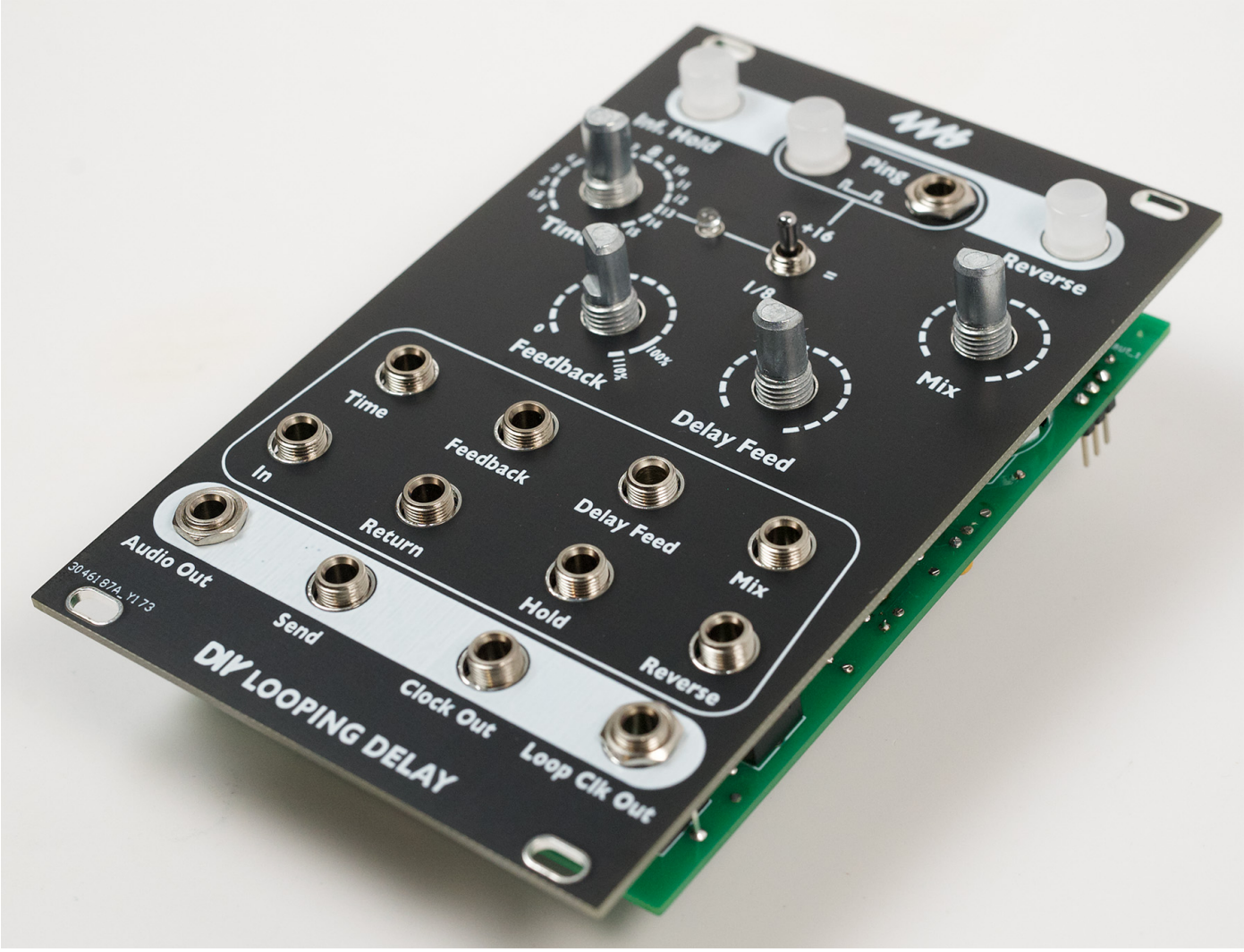


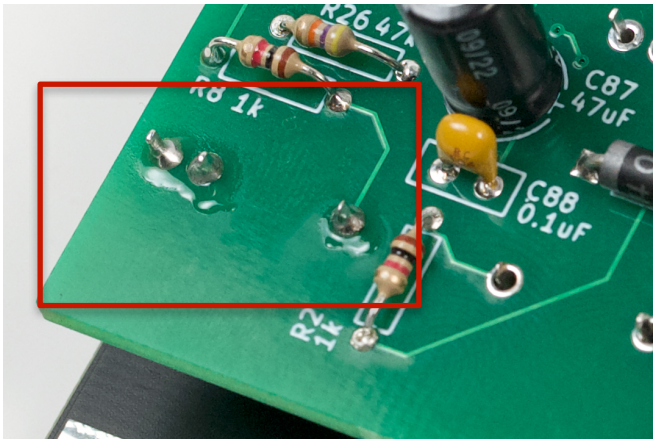
## Step 7: Mounting Part 1

A. Push the LED down close to the PCB. Take the panel and gently lower it down on the PCB. Wiggle it slightly so it fits over the pot shafts, the buttons, and the jacks.

B. Once the panel is on, anchor the PCB to the panel by placing nuts onto three jacks: Audio Out, Loop Clk Out, and Ping. Tighten the nuts down **slightly (1/8 turn)** with a 5/16" socket, pliers, or use your fingers to get them finger-tight. Be careful not the scratch the panel.



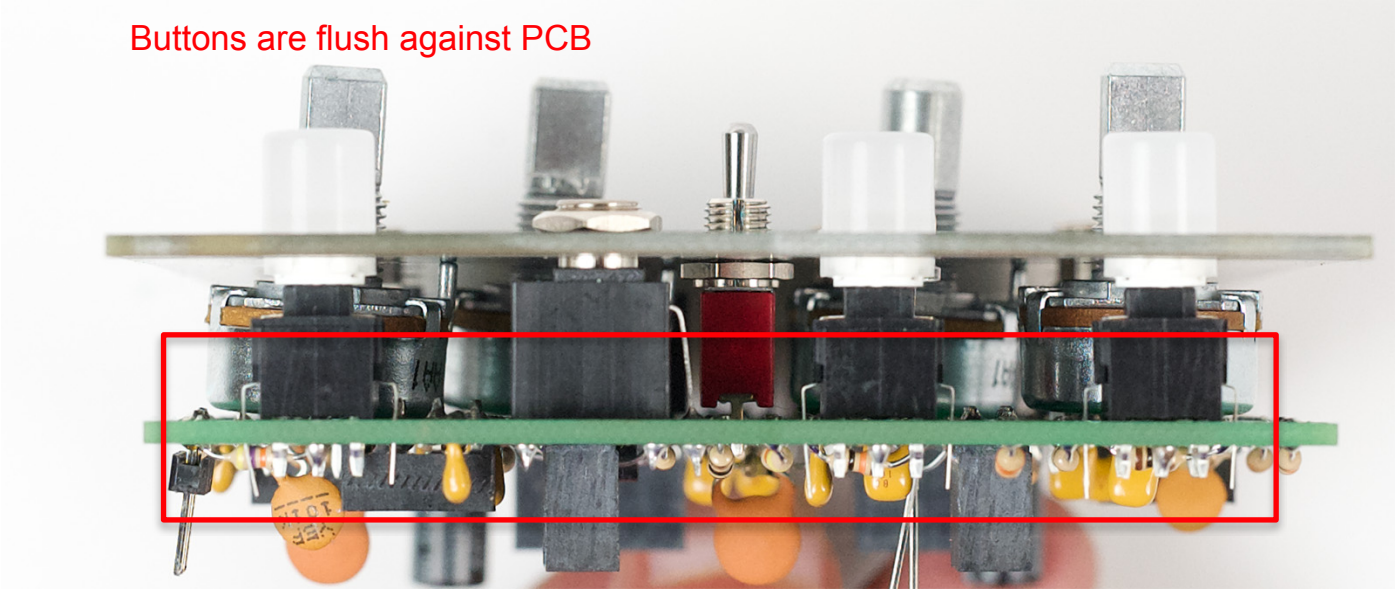

C. Carefully flip it over and solder all three pins on these three jacks. The photo on the right shows the three pins of the Loop Clk Out jack soldered. Repeat this for the Audio Out jack and the Ping jack.

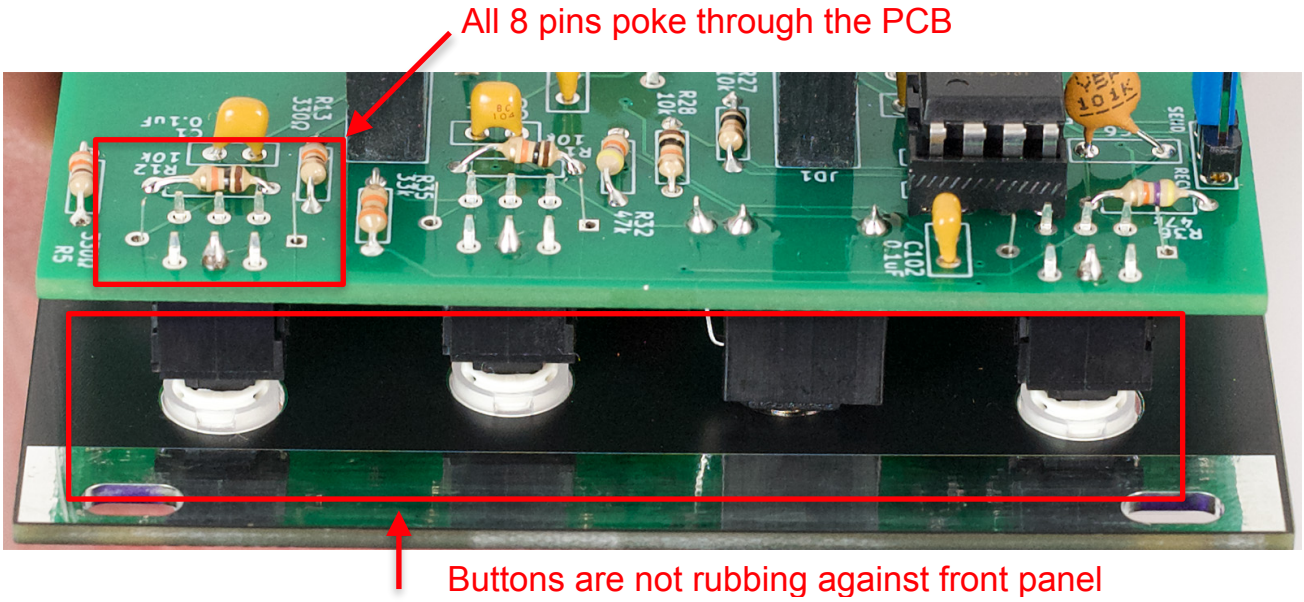


**Step 8: Mounting part 2**

A. Hold the unit so the panel is facing the floor. Gently guide the LED by its leads so the head fits flush into the hole in the panel. Once the LED is fitted in its hole, you may want to bend the leads so that it stays in place.

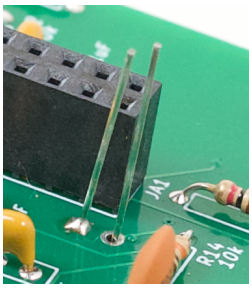
Push down on the heads of the 3 buttons to verify they are flat against the PCB, confirm that the buttons are not rubbing against the front panel, and that all 8 pins are passing through their holes. See photos below.



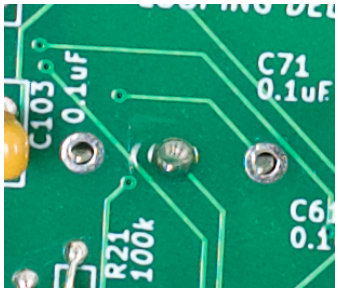



B. Now solder one joint on each component:

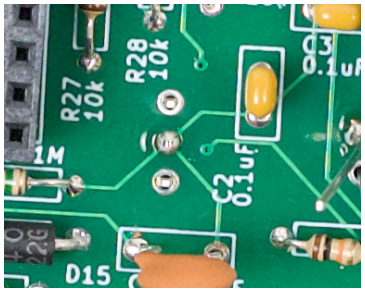
- One lead of the LED
- The center pin of each pot (see photo)
- The center pin of the switch
- One of the middle-ish pins of each button



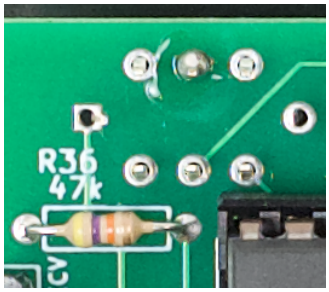
One leg of LED



Center pin of pot



Center pin of switch



Middle-ish pin of button

E. Verify that each button can be pressed without rubbing on the panel and that the LED is visible through the hole in the panel. If necessary, re-position a control by heating up the pin you soldered in the previous step.

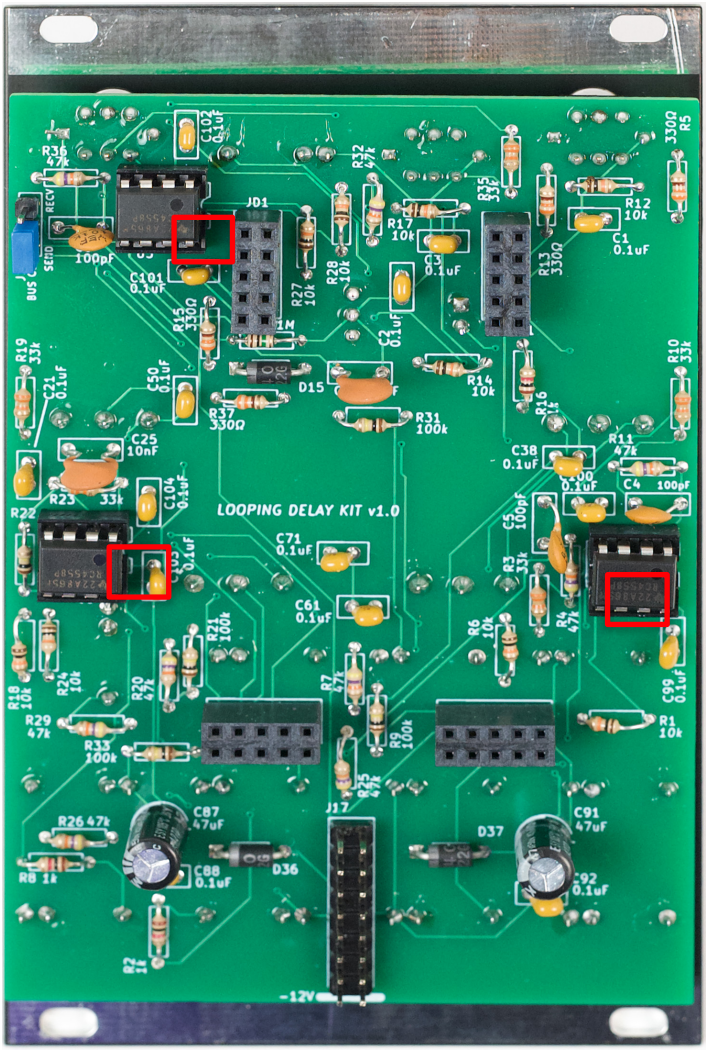
F. When you're sure all the pots, jacks, buttons, switch and LED are placed perfectly, install the rest of the jack nuts, pot nuts, and the switch nut. Go around and tighten all the nuts with a socket or pliers (careful not to scratch the panel!)

G. Check all the pots, buttons, switch and LED a third and final time. This is your last chance to verify none of the buttons are installed backwards (black pins should be facing minus sign). Flip the unit over and solder the rest of the PCB. Snip the LED leads short.

## Step 9: Insert ICs and jumpers

The three ICs have an orientation, the dot or notch should be pointed towards the notch in the IC socket. In this case, the dot/notch should be pointed toward the right. Verify you didn't put the IC socket in backwards by checking that the notch on the socket lines up with the notch drawn in white on the PCB. **Note: if you did happen to place the IC socket backwards, don't remove the socket!** Removing the socket once it has been soldered into place is difficult and can be quite destructive. The orientation of the socket is arbitrary, but the orientation of the IC is not. So, if you placed the socket backwards, it won't be a problem as long as you make sure to orient the IC correctly - with the dot/notch on the IC pointing toward the notch marked on the PCB (all ICs should be oriented with the dot/notch facing right). See photo below (the red boxes indicate the dot/notch).

- *Opamp x 3: notch or dot facing right*

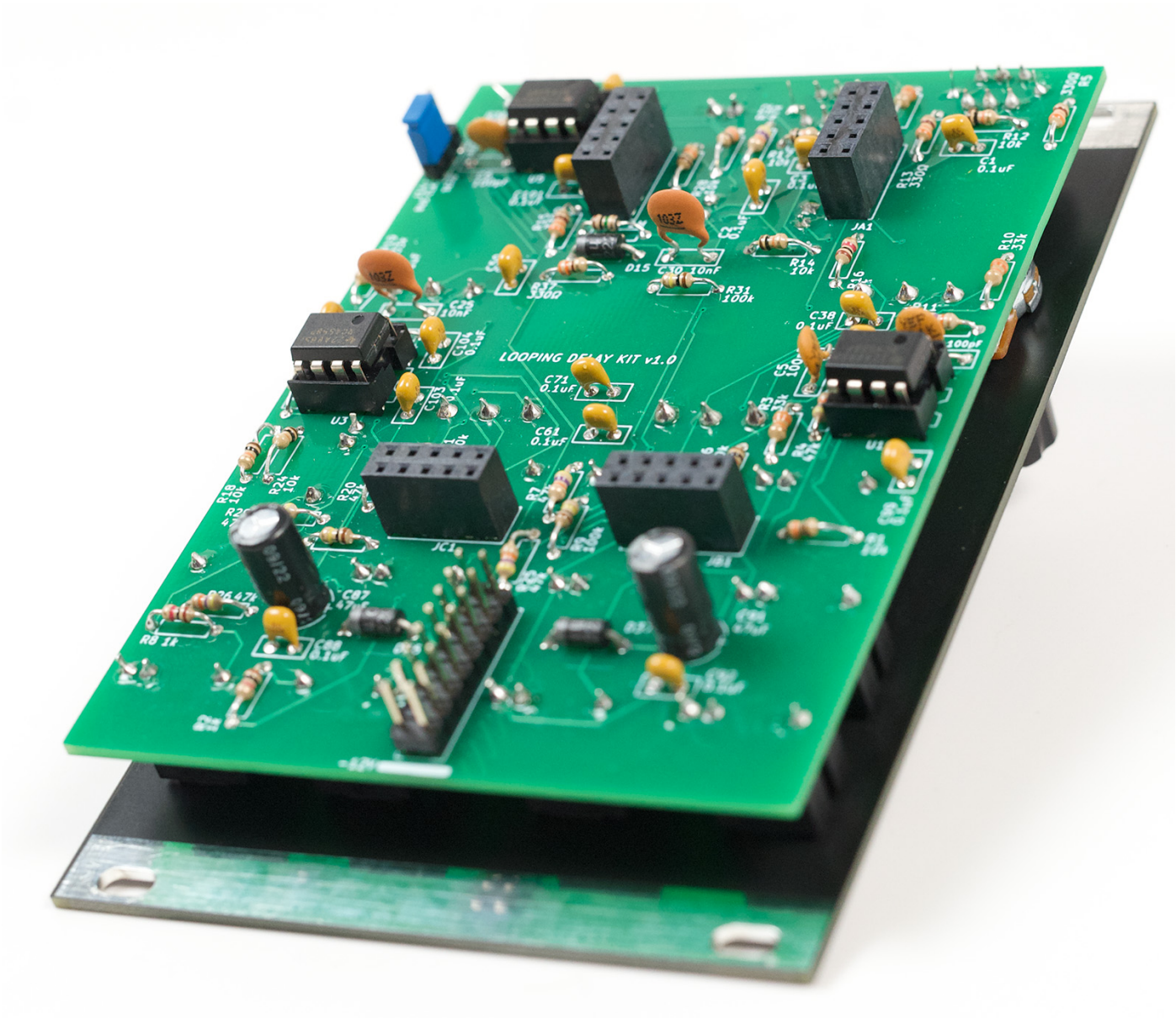


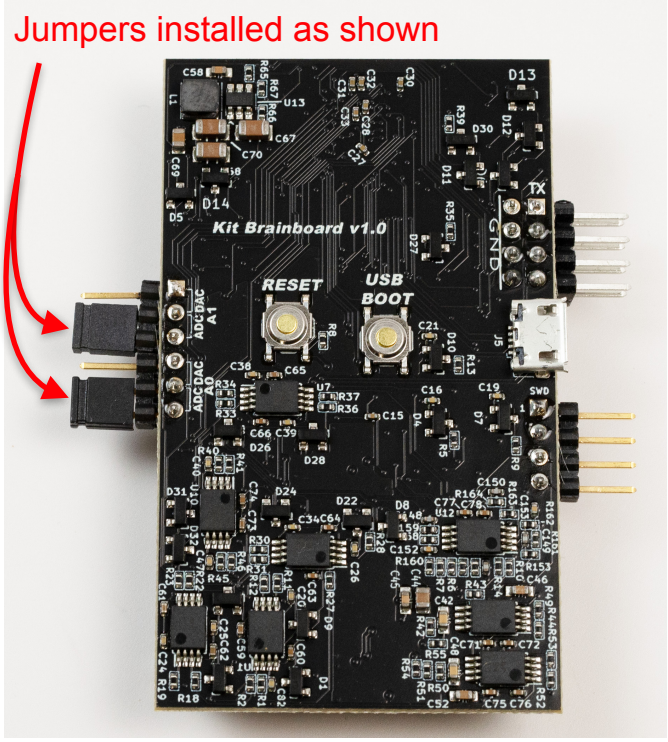

The blue jumper is intended for use on the 3-pin header located at the left side of the PCB, near the top ("BUS CLK"). Install the jumper between the top two pins (marked RECV) if you want the Looping Delay to receive a master clock signal through the bus board, or on the bottom two pins (marked SEND) if you want the Looping Delay to send a master clock signal through the bus board. If you omit the jumper altogether, the Looping Delay will neither send nor receive clock signals through the main bus board. If you aren't sure what this means, or if you don't know what you want, we suggest omitting the jumper and referring to the user manual for more information.

### Step 10: Take a break.

That's right, walk away and do something else. This is a critical step **especially if you are an advanced kit builder or electronics person** (beginners tend to check their work with more skepticism!). There are many things you can do wrong in building a kit that causes it to smoke and destroy components. So don't rush, have a clear head, and check your work. Come back refreshed. Look over everything:

- Check all the solder joints, it's easy to miss one
- Check for shorts or solder bridges
- Verify the ICs are not in backwards
- Verify the diodes have the band pointing to the line on the PCB
- Verify the 47uF caps are not in backwards (stripe to the left).
- Verify the header pins are not bent.
- Verify no components are sticking up and potentially able to short out to something



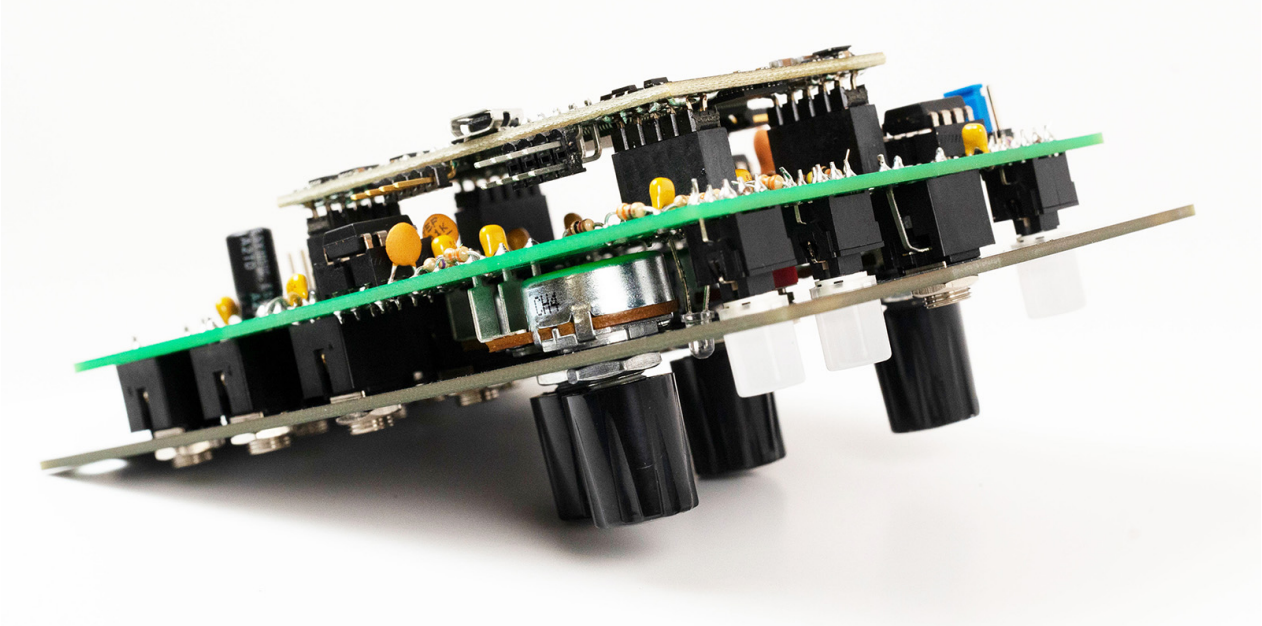


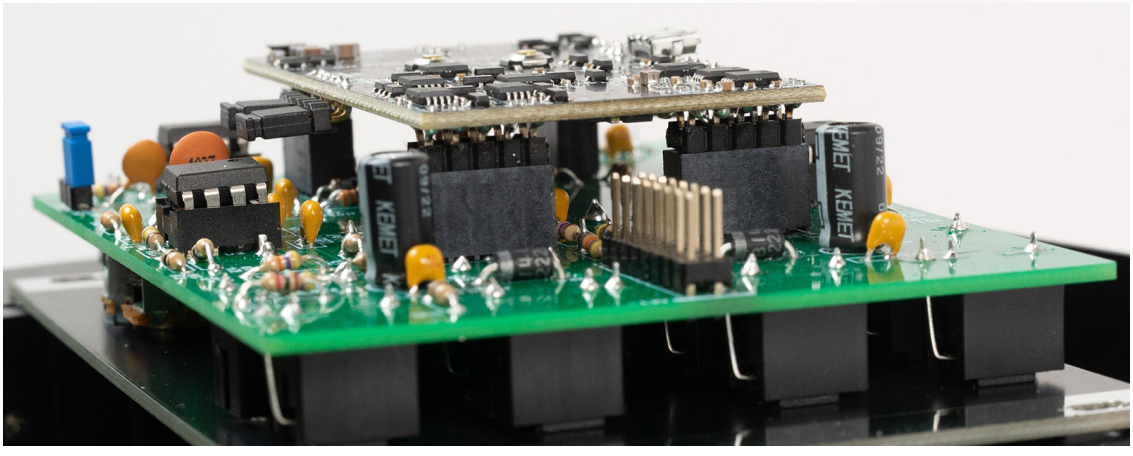

### Step 11: Prepare Brainboard

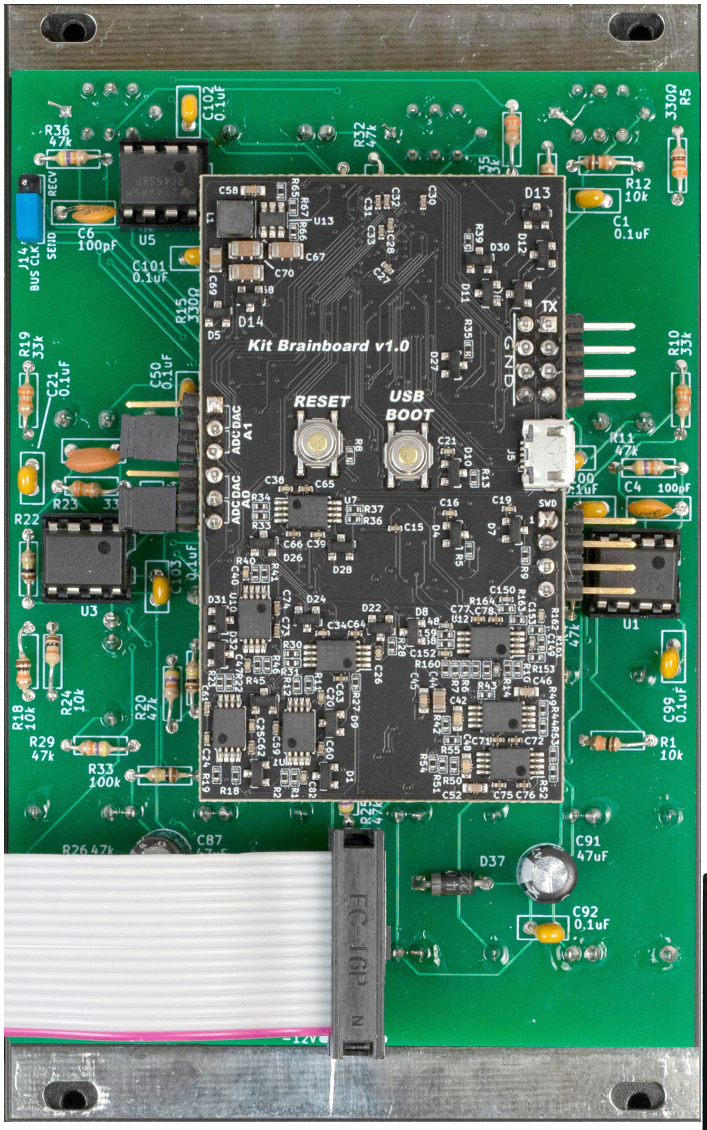
Take a look at the Brainboard that came with your kit, it should have arrived with two black or blue jumpers that have been installed at the factory. One jumper should be attached between the 2nd and 3rd pins (marked ADC), and the other jumper should be attached between the 5th and 6th pins (also marked ADC). Verify that these jumpers are present, and that they are placed correctly (see photo). If a jumper is missing or placed on a different set of pins, the Brainboard will not be damaged, but the Looping Delay will not behave normally (some knobs and CV jacks will not work).

### Step 12: Knobs and Finishing Touches

Connect the Brainboard to your Looping Delay. Line up the four 10-pin headers on the Brainboard with the four 10-hole socket headers on the Looping Delay. Push firmly so that the pins go all the way into the sockets and no metal is exposed. View each header from two different angles to verify you didn't miss a row or column of pins.








## Step 13: Ribbon Cable and Knobs

Install the 16-pin ribbon cable with the red stripe at the bottom, oriented toward the white line marked on the PCB (-12V).

Flip your unit over and attach the four knobs by lining up the flat side of each pot shaft with the notches inside the knob, and pushing firmly downwards.

## Step 12: Power up

Power up the Looping Delay and be ready to turn it off if something goes wrong. You should immediately see Ping illuminate and the red Time LED blinking (at a rate determined by the positions of the Time knob and switch). If no lights turn on within one second, unplug your Looping Delay and check around for errors, especially near the power connector. Consider removing the faceplate and making sure everything around the power header is soldered properly. Check that the diodes and 47uF capacitors are oriented correctly.

Once you have confirmed that the unit powers up, turn it on and leave it on for about 10 seconds. This is long enough so that the ICs will get hot if something is wrong, but not so long that they get damaged. Now turn the unit off, flip it over, and touch the ICs with your finger tip. The IC should be warm, you should be able to hold your finger there with no trouble, it should not hurt. If the IC has overheated it will be obvious, holding your finger on it will be unambiguously painful. If this is the case, check that the ICs are oriented correctly. Check for shorts, check your solder joints, check that the values of nearby components are correct. Note: If you have a volt meter and you understand DIP-8 IC pinouts, then check that pin 8 of each opamp has about 11.6V, and pin 4 has about -11.6V. Ground can be taken from the threaded portion of any jack.

## Step 13: Run Hardware Test

Now that you have successfully powered up your Looping Delay for the first time, we recommend running a complete Hardware Test. This test checks that all the hardware on your Looping Delay is functioning properly, and can be a useful troubleshooting tool when trying to diagnose an issue.

**1) Enter Hardware Test**
Power up your Looping Delay while holding down the Ping and Reverse buttons. Ping will flash rapidly.

**2) LED Test**
This test checks that all LEDs are working properly. Press Ping to step forward through the test. With each press of Ping, the buttons will illuminate one at a time in the following order: Inf Hold, Ping, Reverse. The final push of Ping will turn on the red Time LED. Pushing Ping while the Time LED is lit will begin the Button Test.

Fail: If any lights do not turn on, or if one is significantly dimmer or brighter than the rest. In this case, check for shorted pins, and that the correct resistor values were installed. Check for unsoldered or shorted header pins.
For Inf. Hold check R5, R12
For Ping check R13, R14
For Reverse check R15, R17
For Time LED check R16

**3) Button Test**
In this test you will push each button as it lights up to test for mechanical functionality. The test begins with Inf. Hold illuminated. Press Inf. Hold, then Ping will illuminate. Now press Ping, and Reverse will turn on. Once you press Reverse, all three of the buttons will illuminate to indicate the start of the Switch Test.

Fail: If one of the buttons lights up but pressing it does not advance the test. In this case, make sure that the button is oriented correctly. Check that none of the pins are bent, all eight are poking out of the PCB. Make sure none of the pins are shorting onto anything. Check for unsoldered or shorted header pins.

**4) Switch Test**
This test begins with all three buttons lit. Flip the switch to all three positions. Each time you flip it to a new position, a light will turn off. When all three positions have been hit, the test will automatically advance.

Fail: If any of the three lights fail to turn off as you flip the switch. In this case, check that the switch is soldered properly, look for shorts.

**5) Output Test**
During this test, Ping will be flashing rapidly and the Inf. Hold light will be on. Patch your mixer or headphones into the Audio Out jack. You should hear a loud tone. If you have a tuner, it should read as A4 or 440Hz. If you have an oscilloscope you should measure an amplitude of about 20Vpp (anywhere between 19.6V and 20.4V is OK).

Now plug into the Send jack. You should hear a tone of the same volume (same amplitude), but at two octaves plus a fifth up (E7, or 2637Hz).

Next, patch into Clock Out. You should hear a tone that is quieter than the others, with a lower frequency than the previous two pitches. A tuner will read somewhere between F#4 and G4. On an oscilloscope, look for a pulse wave at about 375kHz, 25% duty cycle, 0V to +8V in amplitude. **Note:** if you are testing a pre-built (SMT) Looping Delay with a black PCB marked v1.0, then the waveform will be curvy, resembling more of a shark-fin than a pulse wave (about 350us rise/fall time).

Finally, plug into the Loop Clk Out jack. You will hear a tone that is an octave higher in pitch than the Clock Out jack. On an oscilloscope you should see a square wave at 750Hz, same amplitude as Clock Out. **Note:** if you are testing a pre-built (SMT) Looping Delay with a black PCB marked v1.0, then the waveform will have a curve on the rise and fall (about 10us rise/fall time).

When you complete the test, press Ping to continue.

Fail: If any of the tones are missing, if the pitch (frequency) is off, or if their loudness / amplitude varies drastically. In this case, check that your jacks and headers are soldered properly.

**6) Audio Input Test**
During this portion of the test, Ping will be flashing rapidly and Reverse will be on. Patch your mixer or headphones into the Audio Out jack. You should hear silence. Some 377Hz background bleed is OK.

Now patch Send into Return. You should hear a 377Hz sine wave (somewhere between F#4 and G4). If using an oscilloscope, you should measure the amplitude at roughly 8Vpp. Now, keeping the cable from Send to Return patched, patch a new cable from Clock Out into Audio In. You should now hear a harsh waveform with a beat frequency of 2Hz. That is, there should be two subtle beats, pulses, or swells every second. If using an oscilloscope, you should see the 2Hz beat frequency manifested as the overall amplitude reaching a minimum every 500ms.

Fail: If any of the tones is missing or appearing where it shouldn't be, if the pitch (frequency) is off drastically (small difference may be due to variations in measurement), or if the loudness / amplitude varies drastically from what is described. In this case, check that your jacks and headers are soldered properly.

**7) Knob and CV Test**
This test begins with all three buttons illuminated. One of the lights might be off depending on the position of the Time knob. This is ok. The purpose of this test is to confirm that the Knob and CV controls are hitting their peak values. Start by turning the Time knob all the way down, the Inf. Hold light should turn off. Now turn Time all the way up and the Reverse light will turn off. Next, center the Time knob and Ping will turn off. Once all three lights are off, the buttons will flash a few times (this is called the "success animation") and the test will immediately go to the next knob. Repeat the procedure for each knob in the following

order: Time, Feedback, Delay Feed, Mix.
After the Mix knob has passed, the test will automatically proceed to the CV jacks. Patch Audio Out into the Time jack. You will see the lights blink off, and then the success animation. Remove the cable and patch Send into Feedback. Once you see the success animation, unpatch the cable from Feedback and into the Delay Feed Jack. Watch for the success animation and then do the same for the Mix jack. Once Mix has passed, the test will automatically move on to the Trigger Input Test.

Fail: If at any point when testing a knob or jack the lights do not turn off and the success animation does not occur, this means that the particular knob or jack you are on has failed the test. If this is the case, check that the control is soldered properly, look for shorts. In the case of CV jack failure, check that associated resistors are the correct values:
Time CV: R22, R23, R24, R18, R19
Feedback CV: R20, R21
Delay Feed CV: R9, R7
Mix CV: R29, R33

**8) Trigger Input Test**
This test begins with Inf. Hold illuminated. Begin by patching Clock Out into the Hold jack. The Inf. Hold light will turn off, and Ping will illuminate. Unpatch the cable from Hold, and move it to the Ping jack. Ping will turn off and Reverse will light. Unpatch the cable from Ping and into the Reverse Jack. The Reverse light will turn off and the RAM test will begin automatically.

Fail: If patching into a trigger input does not advance the test. In this case, check that the jacks in question have been soldered properly, look for shorts, check the values of R25 for Hold, R32 for Ping, and R26 for Reverse.

**9) RAM Test**
This is an automatic test and requires no action on your part. When the Trigger Input Test is complete, Inf. Hold will light momentarily. The light should turn off within about 5 seconds and the Looping Delay will automatically reboot and start operating in normal play mode. If not, the RAM has failed, indicating a problem with the Brainboard. If this occurs, please email us at 4ms (at) 4mscompany (dot) com, or send us a message through our website https://4mscompany.com.