## PROJECT NAME
# ELYSIUM

**BASED ON**
Ibanez® EM5 Echomachine

**EFFECT TYPE**
Delay

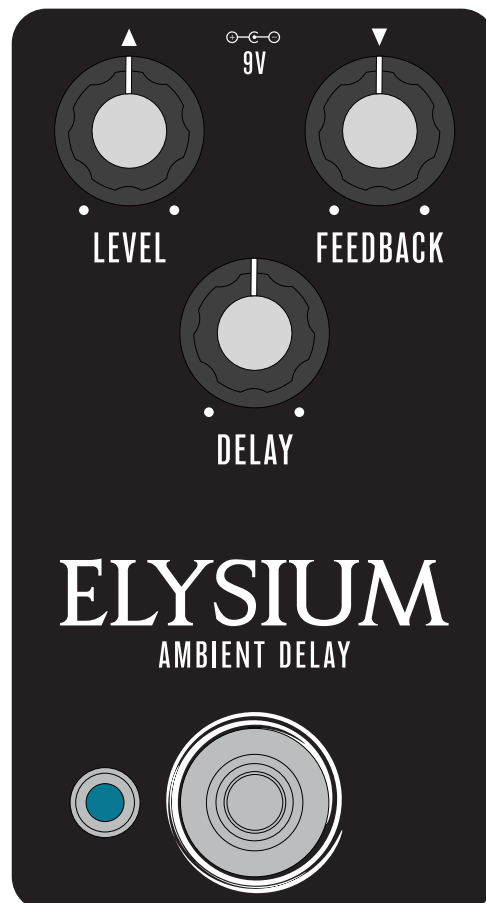**BUILD DIFFICULTY**
▌▌▌▌▌ Advanced

**DOCUMENT VERSION**
1.0.1 (2024-08-08)

**aion**
**DIY GUITAR EFFECTS**

**PROJECT SUMMARY**
An analog-voiced digital delay that emulates vintage tape echo units, with heavy filtering and a soft-clipping overdrive on the repeats.



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**IMPORTANT NOTE**
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This documentation is for the **kit** version of the project. If you purchased the PCB by itself, please use the PCB-only version of the documentation instead. The circuit is the same, but the instructions are completely different due to the specialized parts and assembly methods used in the kit.

Additionally, this is rated as an **advanced** project. Not only are there a lot of components packed closely together, it also requires calibration for proper operation. Read all the instructions, particularly the calibration step on pages 25-26, and make sure you know what skills are needed before you begin. If you've never built a pedal before, we recommend starting with a different kit.

# TABLE OF CONTENTS

# INTRODUCTION

If this is your first pedal, welcome to the hobby and thank you for choosing Aion FX. You've just joined a community of over 100,000 people around the world with a passion for building homemade noise machines using obsolete electronics technology, and we're glad to have you!

If you've done this before, it's great to see you again and we're confident you'll find this build experience an enjoyable one.

Aion FX kits are designed to empower anyone to build a high-quality pedal, no matter the skill level. The pedalbuilding hobby has traditionally had a steep learning curve, but don't be overwhelmed—we've done all the hard work for you. All you need to do is follow these instructions and you'll be on your way to transforming your tone.

There are a few things to go over before you get started.

- **You're going to have to get your hands dirty**—there's no way around it. Nothing here comes preassembled, and you'll have to learn the skills to put it all together. This document will walk you through everything you need, but be prepared to learn a few things along the way.

- **This will take time**. Plan on about two hours start to finish. It may take even longer if it's your first time building. Don't rush it. If you find yourself getting frustrated or overwhelmed, take a break and come back in a couple of hours or the next day.

- **No direct technical support is offered.** There are several DIY forums and Facebook groups with thousands of members who enjoy troubleshooting and teaching. But please be sensitive to the fact that the staff at Aion FX is minimal, and every minute spent helping individuals in private is time that can't be spent on new project development.

- **There is no implied guarantee of a final product.** Aion FX provides the ingredients and the recipe, but you are responsible for putting everything together to make it work. We've tried to make the process as clear and accessible as possible, but it must be expressly stated that purchasing the kit is not a guarantee that you will end up with a working pedal.

It's recommended to read through all of the instructions before you start, particularly if you've never built a pedal before. If you familiarize yourself with the entire process ahead of time and you know what the goal looks like, each step will make more sense.

Now, on to the fun stuff!

# PACKING LIST

This is a list of all the parts that are included with the kit, grouped by value. For a list of all the parts based on their PCB part numbers, please see page 25.

If you find that any parts are missing or damaged, please fill out the Missing Parts form.

## Film Capacitors

| NAME | QTY |
|---|---|
| 3n3 | 2 |
| 4n7 | 2 |
| 47n (0.047) | 1 |
| 68n (0.068) | 1 |
| 100n (0.1 or "µ1J100") | 3 |
| 1uF | 7 |

## Electrolytic Capacitors

| NAME | QTY |
|---|---|
| 10uF | 2 |
| 47uF | 4 |
| 100uF | 1 |

## MLCC Capacitors

| NAME | QTY |
|---|---|
| 5pF | 1 |
| 47pF | 2 |
| 470pF | 1 |
| 680pF | 1 |
| 100n (marked "104") | 4 |

## Transistors

| NAME | QTY |
|---|---|
| 2N5087 | 1 |
| 2N5088 | 2 |
| 78L05 regulator | 1 |

## Resistors

| NAME | QTY |
|---|---|
| 30R | 2 |
| 330R | 1 |
| 470R | 1 |
| 1k | 2 |
| 3k3 | 1 |
| 5k1 | 1 |
| 9k1 | 1 |
| 10k | 7 |
| 22k | 7 |
| 33k | 1 |
| 47k | 5 |
| 51k | 1 |
| 75k | 1 |
| 100k | 1 |
| 390k | 2 |
| 470k | 1 |
| 2M2 | 1 |

## Diodes

| NAME | QTY |
|---|---|
| 1N5817 | 1 |
| 1N914 | 2 |

## Trimmers

| NAME | QTY |
|---|---|
| 10k trimmer | 1 |
| 50k trimmer | 2 |

## ICs

| NAME | QTY |
| --- | --- |
| LM833 | 2 |
| M65831AP | 1 |
| SN74HCU04 | 1 |
| DIP-8 socket | 2 |
| DIP-14 socket | 1 |
| DIP-24 (wide) socket | 1 |

## Potentiometers

| NAME | QTY |
| --- | --- |
| 50kB | 1 |
| 100kB | 2 |
| Dust cover | 3 |
| Knob | 3 |
| Mounting nut, potentiometer, 0.44" | 3 |
| Lock washer, potentiometer, 0.5" | 3 |
| Outer washer, potentiometer, 0.475" | 3 |

## Other

| NAME | QTY |
| --- | --- |
| LED bezel | 1 |
| LED, blue | 1 |
| DC jack | 1 |
| Input/output jack | 2 |
| Mounting nut, jack, 0.54" | 4 |
| Outer washer, jack, 0.6" | 2 |
| Lock washer, jack, 0.5" (thin) | 2 |
| Enclosure | 1 |
| Enclosure screws | 4 |
| PCB, main circuit | 1 |
| PCB, footswitch | 1 |
| PCB, input/output/DC | 1 |

## Switches

| NAME | QTY |
| --- | --- |
| Stomp switch, 3PDT | 1 |
| Mounting nut, stomp switch, 0.6" | 2 |
| Lock washer, stomp switch, 0.6" | 1 |
| Dress nut, stomp switch, 0.77" | 1 |

## Wiring

| NAME | QTY |
| --- | --- |
| 3-strand wire assembly, 70mm | 2 |
| 4-strand wire assembly, 122mm | 1 |
| 3-pin wire assembly header | 2 |
| 4-pin wire assembly header | 1 |

# TOOLS NEEDED

### SOLDERING IRON

Temperature-adjustable is recommended. The optimum soldering temperature is 700-725° F (371-385° C) for leaded solder, or 750° F (400° C) for lead-free.
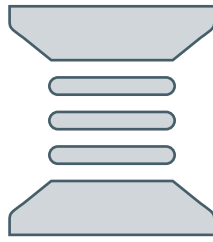
### SOLDER

Preferably 63/37 or 60/40 leaded solder. Lead-free is more difficult to use, so if that's the only type you can get, it's best to watch tutorials that are specific to lead-free solder.
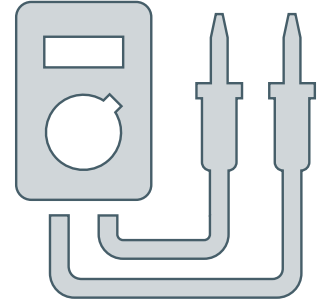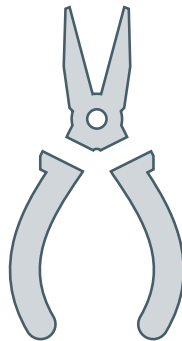
### DIGITAL MULTIMETER (DMM)

Most cheap ones in the $10-30 range are fine for what we're doing. Make sure it has audible continuity testing (i.e. it beeps at the lowest resistance) and transistor hFE measurement.

### WIRE SNIPPERS

Also called nippers or wire cutters. The Hakko CHP-170 is the best you can get for less than $10.

### FLAT-NOSE PLIERS

Many general-purpose uses, but particularly tightening the nuts of pots, switches and jacks. Quicker than changing out sockets on a ratchet.
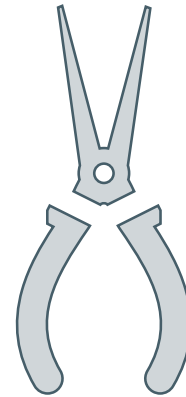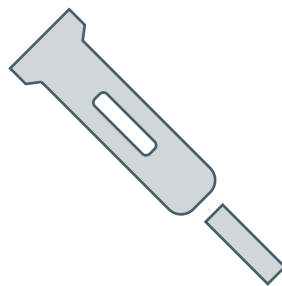
### NEEDLE-NOSE PLIERS

These are used for bending leads on components and other general uses. Use the smaller type with a tip that's approximately 0.05" (1.25mm) wide.
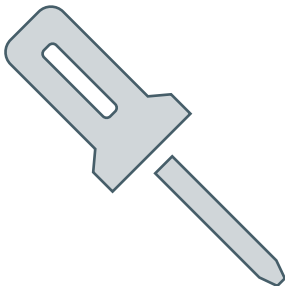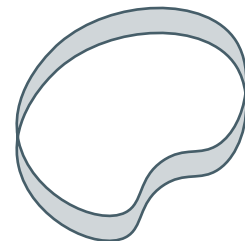
### SCREWDRIVER (PHILLIPS)

Used for the enclosure screws. Get a powered driver if you'll be building a lot of pedals!

### FLAT SCREWDRIVER (SMALL)

This is used for tightening the set screws on the knobs. The tip should be no more than 0.1" (2.5mm) wide.
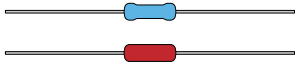
### RUBBER BAND

Yes, a plain old rubber band. This is used to tighten the dress nut to avoid scratching or denting it (which can happen with metal tools).
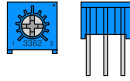
# COMPONENT IDENTIFICATION

If you've never built a pedal before, you'll need to know what all the components are. These are shown actual size. (Not all of these types of components may be part of this kit.)
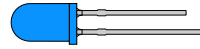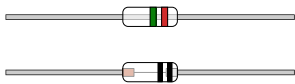
### RESISTOR

### TRIM POTENTIOMETER

### LED

### SILICON DIODE

### GERMANIUM DIODE

### RECTIFIER DIODE

### SCHOTTKY DIODE

### ZENER DIODE

*Some Schottky diodes also look like this.*

*These are very fragile, so be careful when handling them.*

### FILM CAPACITOR

### ELECTROLYTIC CAPACITOR

### MLCC

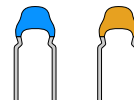### TANTALUM CAPACITOR
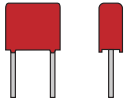
*Not polarized. Color may vary by brand and type.*

*Polarized. The negative side is marked.*

*Not polarized. MLCC stands for "multi-layer ceramic capacitor."*

*Polarized. The positive side is marked.*

### IC OR OP-AMP

### IC SOCKET

### TRANSISTOR OR JFET

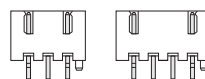*Charge pumps and delay chips also look like this. They may have more than 8 legs.*
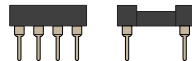
*Some voltage regulators also look like this.*

### WIRE ASSEMBLY

### WIRE ASSEMBLY HEADER
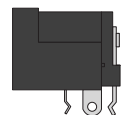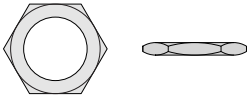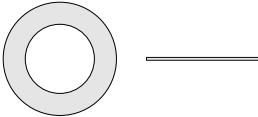
### DC JACK

### LED BEZEL
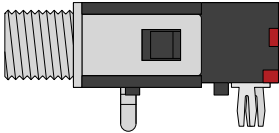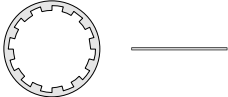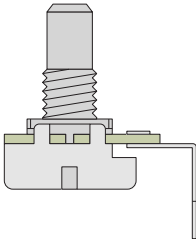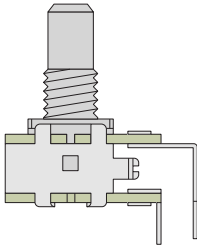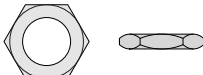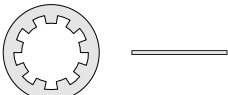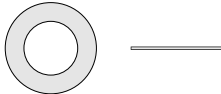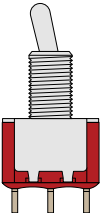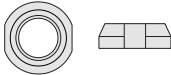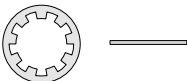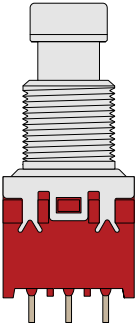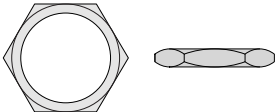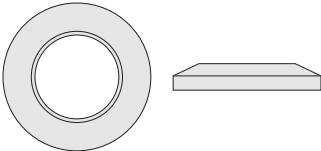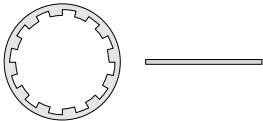
# HARDWARE IDENTIFICATION

The hardware comes unassembled, so you'll need to sort & identify each of the pieces. The diagrams below are actual size, so you can set them against the printed page to identify them if needed.

| I/O JACK | MOUNTING NUT | OUTER WASHER | LOCK WASHER |
|---|---|---|---|
| | **DIAMETER: 0.54" / 13.7mm** | **DIAMETER: 0.6" / 15.2mm** | **DIAMETER: 0.5" / 12.7mm** |

| POTENTIOMETER (SINGLE) | POTENTIOMETER (DUAL) | MOUNTING NUT | LOCK WASHER |
|---|---|---|---|
| | | **DIAMETER: 0.44" / 11.2mm** | **DIAMETER: 0.5" / 12.7mm** |
| | | OUTER WASHER | KNOB |
| | | **DIAMETER: 0.475" / 12mm** | |

| TOGGLE SWITCH | MOUNTING NUT | DRESS NUT | LOCK WASHER |
|---|---|---|---|
| | **DIAMETER: 0.36" / 9.1mm** | **DIAMETER: 0.375" / 9.5mm** | **DIAMETER: 0.4" / 10.1mm** |

| FOOTSWITCH | MOUNTING NUT | DRESS NUT | LOCK WASHER |
|---|---|---|---|
| | **DIAMETER: 0.6" / 15.2mm** | **DIAMETER: 0.77" / 19.6mm** | **DIAMETER: 0.6" / 15.2mm** |

# PCB ASSEMBLY OVERVIEW

Now it's time to start building!

Before you begin, separate the PCBs into individual boards and break off the tabs from each using needle-nose or flat-head pliers. You should be left with the three PCBs shown to the right.

The general principle for PCB population is that you want to work in layers from shortest components (i.e. lowest-profile) to tallest so that when the PCB is upside-down, everything is making contact with the work surface and is held in place.

Generally speaking, you should populate the components in this order:

1. Resistors
2. Diodes
3. IC sockets
4. MLCC capacitors
5. Film capacitors
6. Transistors
7. Electrolytic capacitors

Not all of these component types are included in each kit, so skip them if they aren't applicable. Some types of film capacitors are taller than electrolytics, so those can be done last.
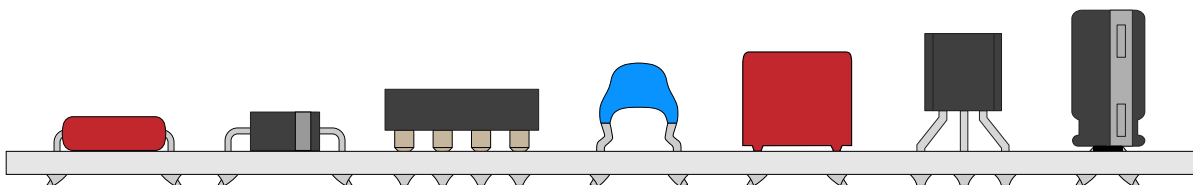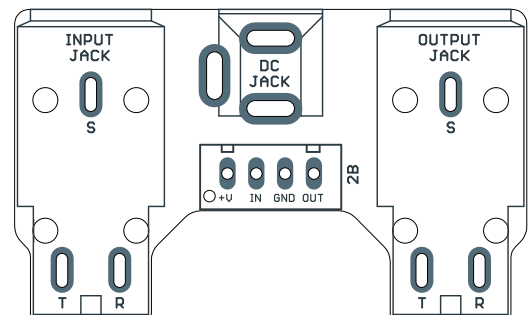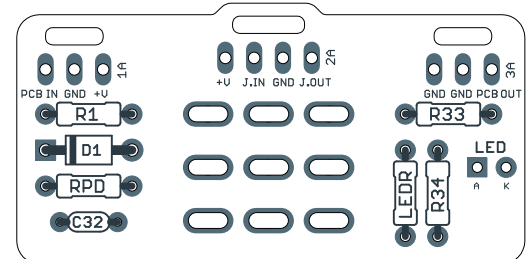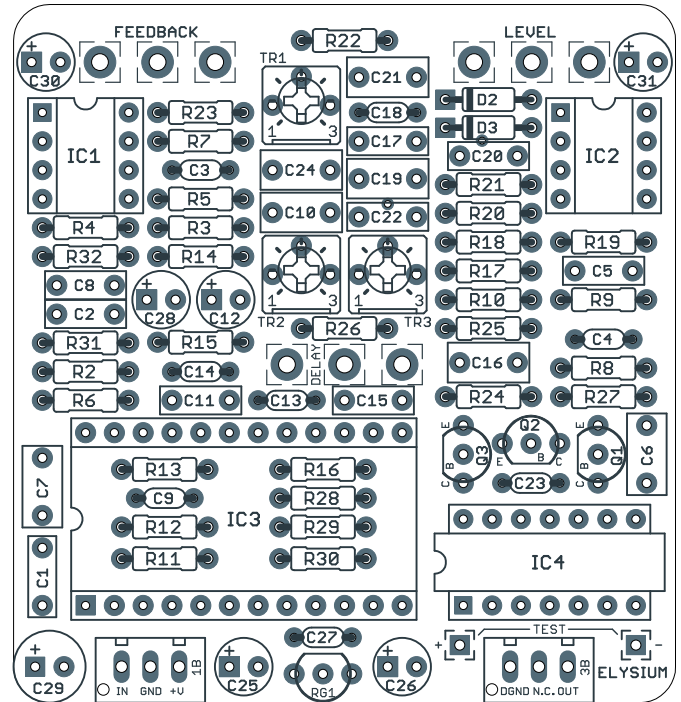
# RESISTORS

| PART | VALUE | PART | VALUE | PART | VALUE | PART | VALUE |
|------|-------|------|-------|------|-------|------|-------|
| R1 | 1k | R9 | 10k | R21 | 1k | R32 | 10k |
| R2 | 470k | R10 | 47k | R22 | 51k | R33 | 470R |
| R3 | 47k | R14 | 22k | R23 | 75k | R34 | 100k |
| R4 | 10k | R15 | 30R | R24 | 390k | RPD | 2M2 |
| R5 | 22k | R17 | 22k | R25 | 9k1 | LEDR | 10k |
| R6 | 47k | R18 | 22k | R26 | 390k | | |
| R7 | 47k | R19 | 33k | R27 | 3k3 | | |
| R8 | 47k | R20 | 10k | R31 | 10k | | |
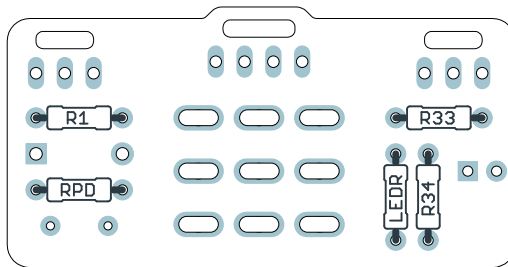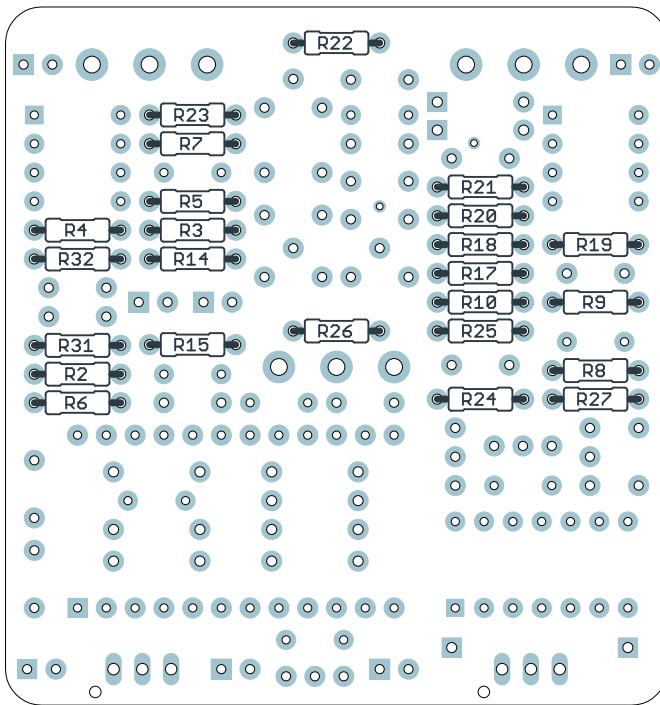


**Note:** *The resistors underneath the IC3 socket will be done in a later step. Leave them empty for now.*

Using the parts list above, populate the resistors by pushing them through the holes and bending the leads outward at an angle to hold them in place. Resistors are not polarized, so they will work in any direction. Turn the board upside-down to keep the components held in place while you solder.
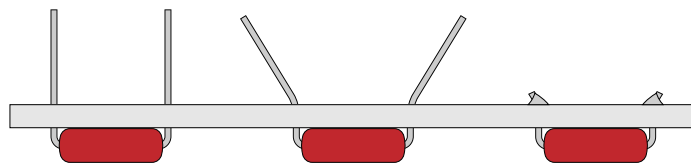


Don't try to do all of the resistors at once. You'll want to stop periodically flip the board and solder everything, then cut the leads using the wire snippers to make room for more.

# DIODES

| PART | VALUE |
| --- | --- |
| D1 | 1N5817 |
| D2 | 1N914 |
| D3 | 1N914 |
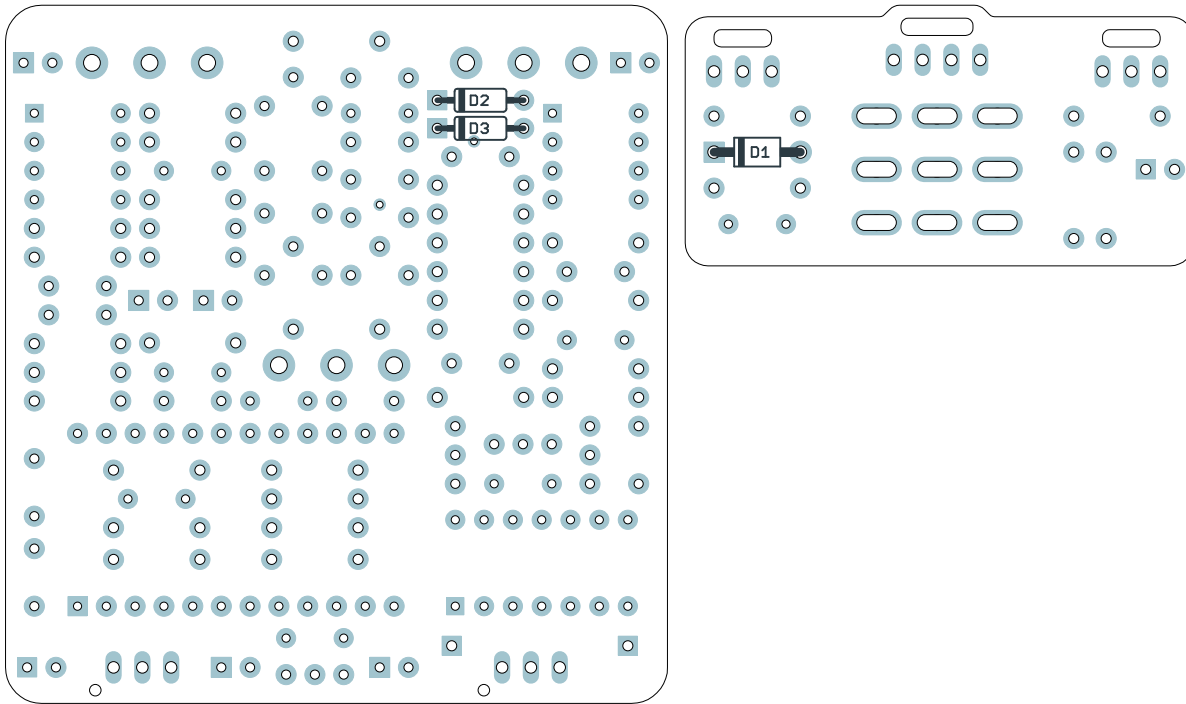
Next, you'll populate the diodes. Diodes are polarized, so make sure to identify the polarity band (which indicates the "cathode", or negative side) and match the band to the footprint on the PCB.

# SOCKETS & ICS

| PART | VALUE |
|------|-------|
| IC1 | LM833 with 8-pin socket |
| IC2 | LM833 with 8-pin socket |
| IC3 | M65831AP with 24-pin socket |
| IC4 | SN74HCU04 with 14-pin socket |



Next up are the sockets. You can't bend the leads of the sockets as with the other components, so they won't stay in on their own until they are soldered. Flip the PCB over and use gravity to hold them in place.

## Installing the ICs

Don't insert the ICs into the sockets just yet. We will do this in a later step, after we've finished soldering the tallest components (the polarized capacitors) as well as the components underneath IC3. This information is just listed here for reference.

The legs of the ICs are bent outward slightly during manufacturing, so they'll need to be bent back inward before they can be inserted into the sockets. It's easiest to do this by laying the IC legs against the table and bending the body itself so all the legs on the side are straightened out at once. Then, flip it and do the other side.
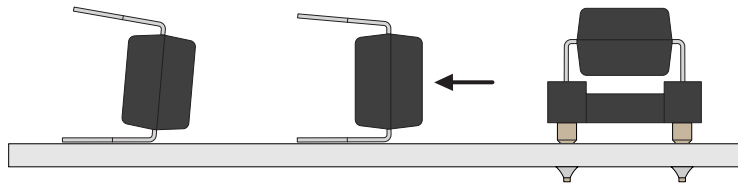


This is particularly tricky with IC3 (and to a lesser extent IC4) due to the number of legs. It may take a few tries to get them bent to the correct angle. Be very careful that every one of the legs is properly lined up with the socket before pressing down. If you encounter more than a small amount of resistance, check again to make sure none of them are misaligned.

ICs may have two different orientation marks: either a dot in the upper-left or a half-circle notch in the middle of the top side. Some ICs have both marks. This shows which way the IC should be rotated when inserting it into a socket (the socket also has a half-circle notch).
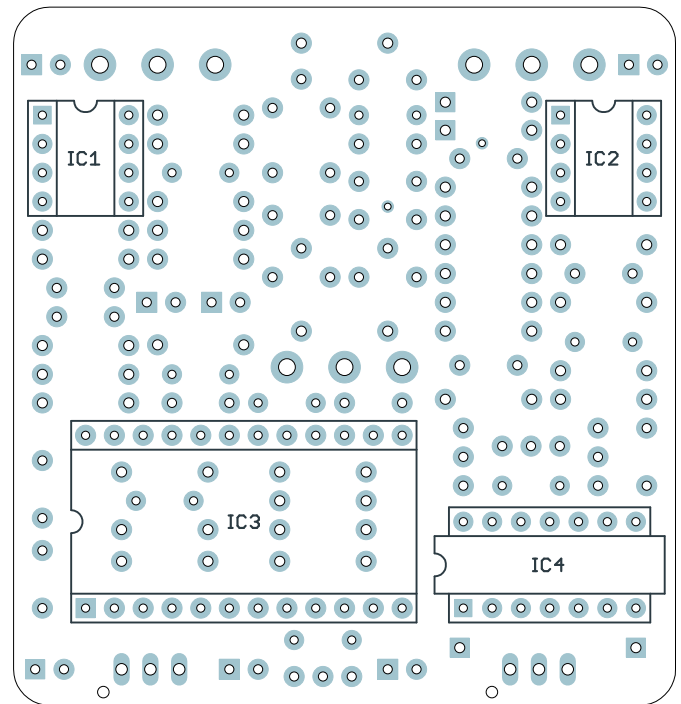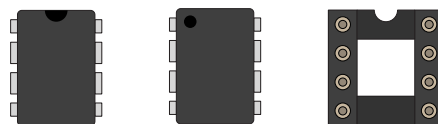
# RESISTORS (UNDER IC3 SOCKET)

| PART | VALUE |
|------|-------|
| R11 | 22k |
| R12 | 22k |
| R13 | 22k |
| R16 | 30R |
| R28 | 330R |
| R29 | 5k1 |
| R30 | 10k |
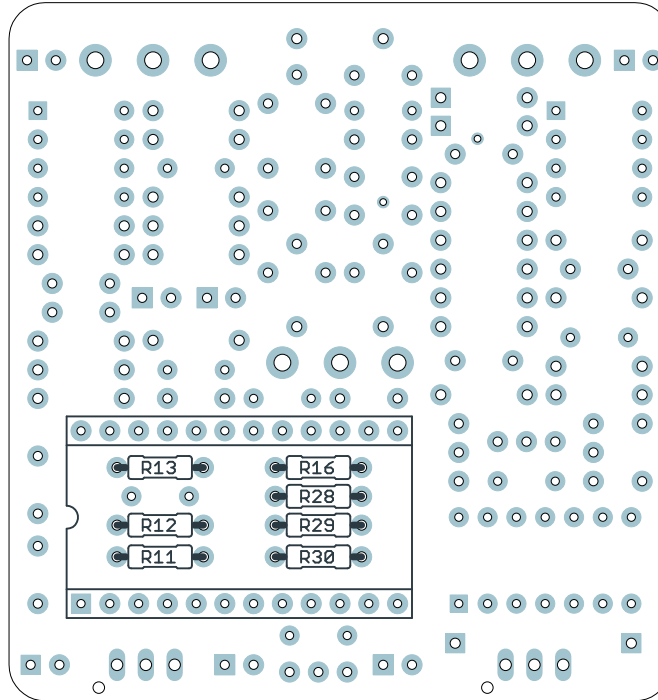
Populate the remaining resistors located underneath the IC3 socket.

These are saved until after the socket because there's not a lot of extra space, and it's possible to install them at a slight angle that could prevent the socket from fitting correctly if they go in first. However, if they're done after the socket then everything will fit in without any trouble.

# TRIMMERS

| PART | VALUE |
|------|-------|
| TR1 | 10k trimmer (marked "103") |
| TR2 | 50k trimmer (marked "503") |
| TR3 | 50k trimmer (marked "503") |
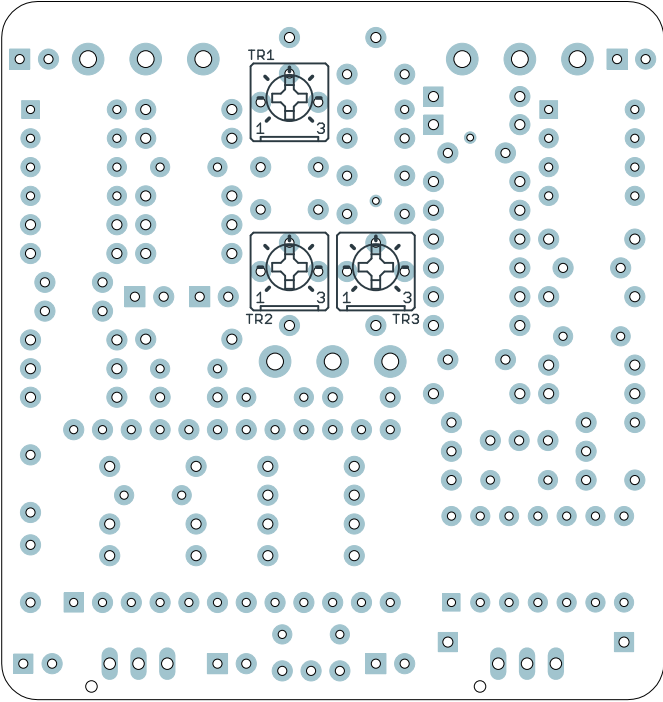
Next, we'll do the trimmers. The value code is located on the side. The 10k trimmer will say "103" and the two 50k trimmers will say "503". This code is etched or engraved rather than printed, so it's easier to read with direct light reflecting off the side.

## Setting the trimmers

These trimmers will be used for the calibration process on pages 25 and 26 and should not be adjusted once this is completed. For now, set all three of them them to the 50% position (12:00 noon).

# TRANSISTORS AND REGULATOR

| PART | VALUE |
|------|-------|
| Q1 | 2N5088 |
| Q2 | 2N5088 |
| Q3 | 2N5087 |
| RG1 | 78L05 |
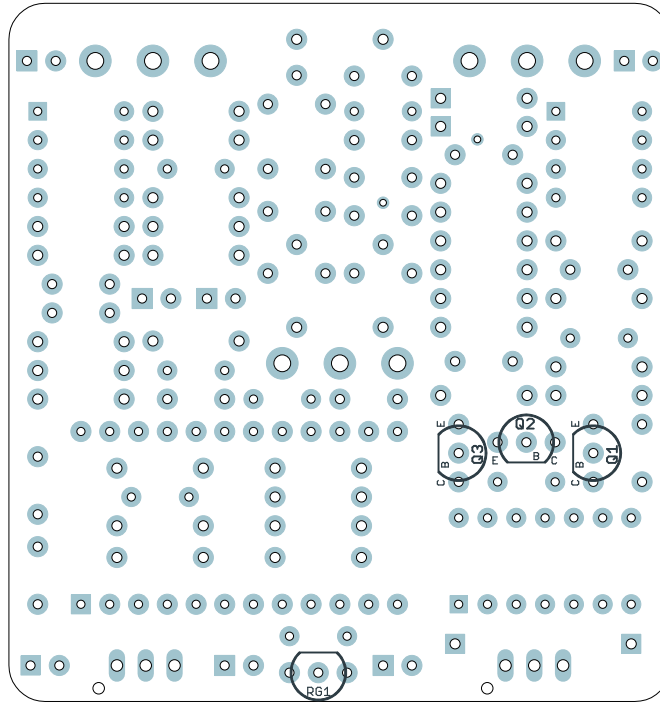


Now we'll do the transistors as well as the regulator, which is not a transistor but looks like one. For each, if the legs are not already bent into 0.1" spacing, use your needle-nose pliers to bend the outer two legs as shown.
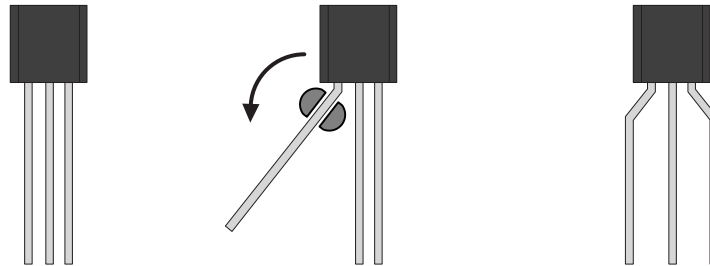


Once installed, bend the two outer legs to hold it in place on the board. Be very careful of the orientation since the four parts face in three different directions. Then, solder them in place and clip the leads.
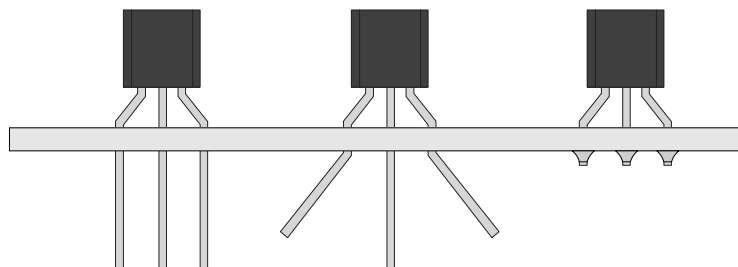
# CAPACITORS (NON-POLARIZED)

| PART | VALUE |
|------|-------|
| C1 | 47n (0.047) |
| C2 | 4n7 |
| C3 | 47pF MLCC |
| C4 | 47pF MLCC |
| C5 | 4n7 |
| C6 | 1uF |
| C7 | 1uF |

| PART | VALUE |
|------|-------|
| C8 | 3n3 |
| C9 | 470pF MLCC |
| C10 | 1uF |
| C11 | 100n (0.1) |
| C13 | 100n MLCC |
| C14 | 100n MLCC |
| C15 | 100n (0.1) |

| PART | VALUE |
|------|-------|
| C16 | 1uF |
| C17 | 3n3 |
| C18 | 680pF MLCC |
| C19 | 1uF |
| C20 | 68n (0.068) |
| C21 | 1uF |
| C22 | 100n (0.1) |

| PART | VALUE |
|------|-------|
| C23 | 5pF MLCC |
| C24 | 1uF |
| C27 | 100n MLCC |
| C32 | 100n MLCC |



*Be aware that IC3 will be installed above C9, so make sure the capacitor leads are inserted all the way and that it sits as close to the PCB as possible.*

After the sockets come the box film and MLCC capacitors. These are all several different heights, but there aren't as many, so just do them all at once. Bend the leads at an angle to hold them in place.

MLCCs and box capacitors are not polarized, so they will work in any direction, but to keep things neat, it's best to put them all facing the same way.

**Identification:** C2, C5, C8, and C17 are usually blue box-film capacitors. For these, the value is printed on the top rather than the side.

C11, C15 and C22 are usually red, but may read "µ1J100" on the top rather than the side.

C3, C4, C9, C18, and C23 are blue MLCCs taped to cardboard. The value is written on the cardboard.

C13, C14, C27 and C32 (100n MLCCs) are always yellow. It can be hard to read the code since it's so small, so it's easier to identify these by color.

# WIRE HEADERS
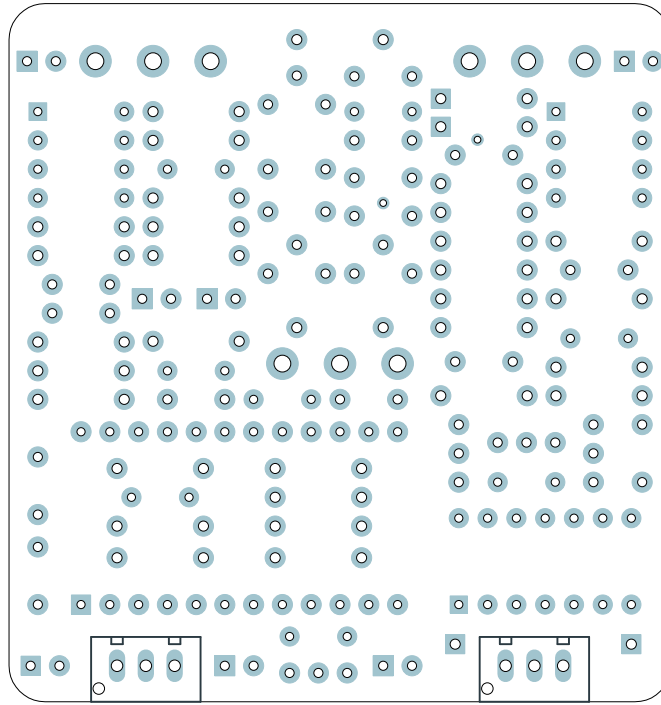


Install the two 3-pin headers (wire connectors) as shown above. These have a polarity pin, so as long as they are pressed all the way down, there's only one possible way to install them. They do fit pretty tightly in the holes, though, so press firmly.

There's also a 4-pin header on the I/O board that we will do in a later step.

# CAPACITORS (POLARIZED)

| PART | VALUE |
|------|-------|
| C12 | 47uF electro |
| C25 | 47uF electro |
| C26 | 47uF electro |
| C28 | 47uF electro |
| C29 | 100uF electro |
| C30 | 10uF electro |
| C31 | 10uF electro |
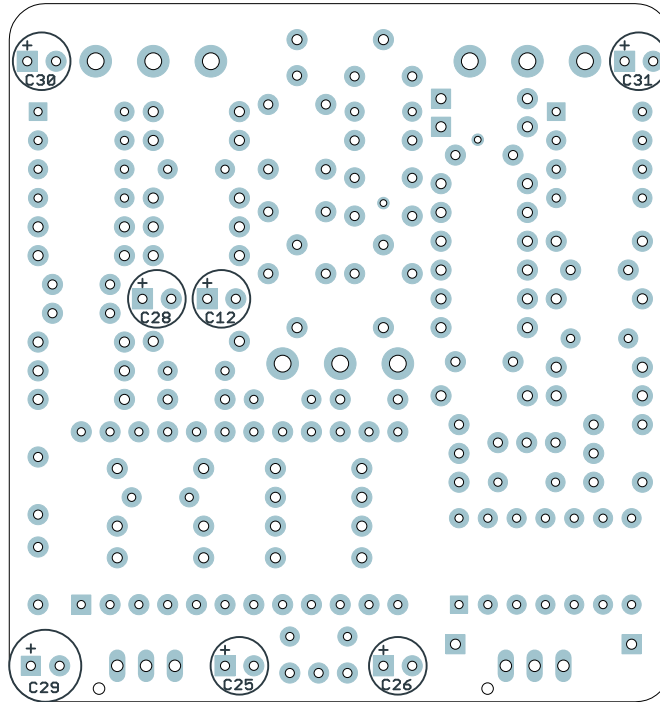


Populate the electrolytic capacitors. These are the tallest components, so we save them for last. They are polarized (i.e. they will only work in one direction), so note the vertical mark that indicates the negative side. The longer leg is positive and fits in the square pad.

These are the last of the on-board components. Now is the time to go back to page 12 and insert the ICs into the sockets.

# FOOTSWITCH PCB

### PARTS

3-strand wire assembly (2)

4-strand wire assembly
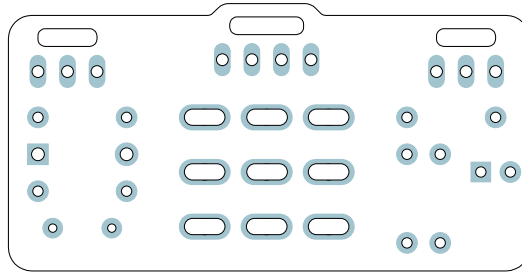
Next, it's time to finish up the footswitch board. You should have done most of the on-board components on this board in a previous step, but if not, go back and do those.

There will be one longer assembly with 4 wires and two shorter ones with 3 wires. The longer one goes in the middle and the shorter ones go on the left and right sides. The wire assemblies should then be soldered to the footswitch board as shown.

### STEP 1

First, thread the wire through the strain-relief slots, with the blue side facing outward and the PCB's previously-installed components facing up.

For now, pull it through as far as it can go.
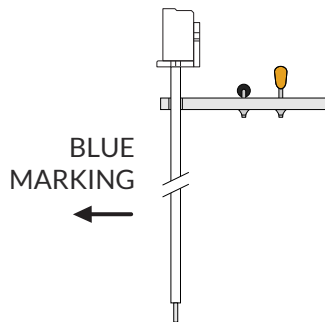
### STEP 2

Next, bend the wires back upward and fit the ends of the wires into the solder pads.

On the top side of the PCB, bend the exposed wires backward so it holds the wire in place. Pull the header back up through the slot partway.
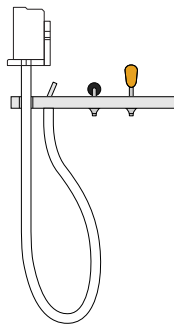
### STEP 3

Then, solder the wires from the top. This is the trickiest part of the whole build. You want to solder the pads without touching the iron to the wires themselves and risking burning through the insulation. It helps to use a sharp or narrow tip on the soldering iron.

BLUE
MARKING
←
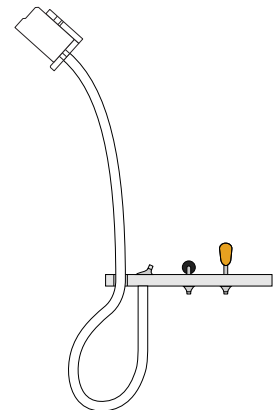
Once all three wire assemblies are soldered, set the footswitch PCB aside. We'll solder the actual footswitch and LED in a later step.

# INPUT/OUTPUT PCB

### PARTS

Input & output jacks

DC jack

Wire header
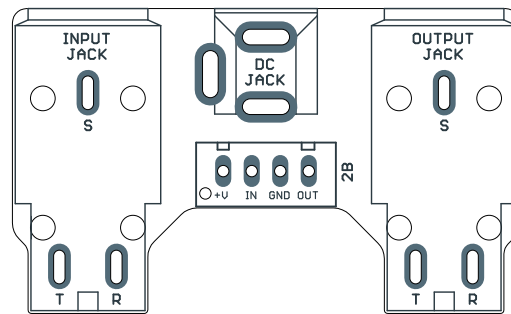


Almost done! Get the two input/output jacks, the DC jack and the wire header and snap them in place. The PCB is designed for them to fit securely, so you can do them all at once before flipping and soldering.
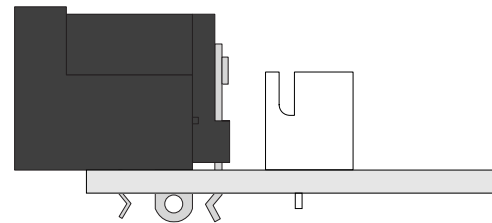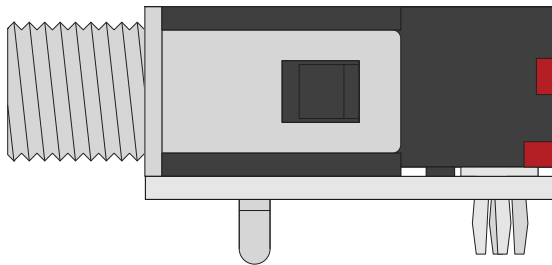


After you've soldered everything, make sure to **snip the leads on the I/O jacks as close as possible to the PCB**. There's not a lot of clearance between the bottom of this board and the top of the main PCB once everything is in place, and you don't want the pins to short against anything on accident.

# ENCLOSURE LAYOUT: PANEL MOUNTS

Attach the hardware to the enclosure as shown. (The I/O board is done in a later step.)

100kB  100kB

50kB

BEZEL & LED

FOOTSWITCH

125B

## FOOTSWITCH

MOUNTING NUT
LOCK WASHER
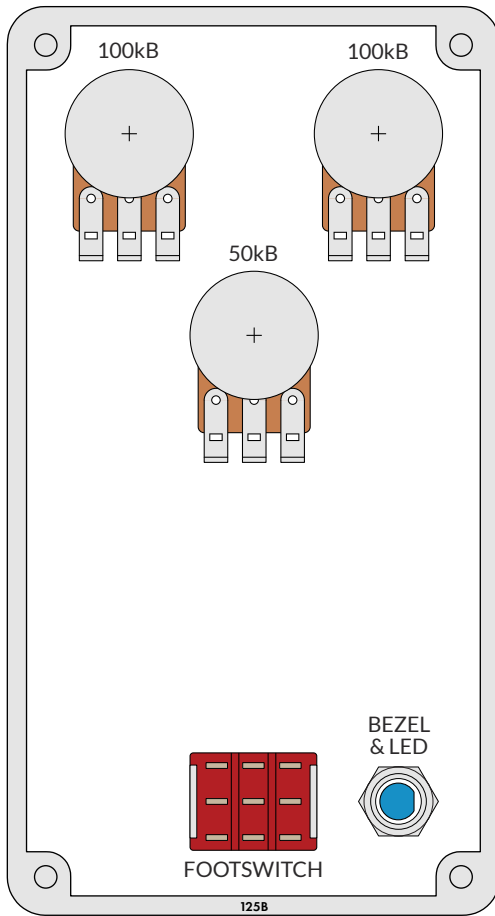
MOUNTING NUT
DRESS NUT
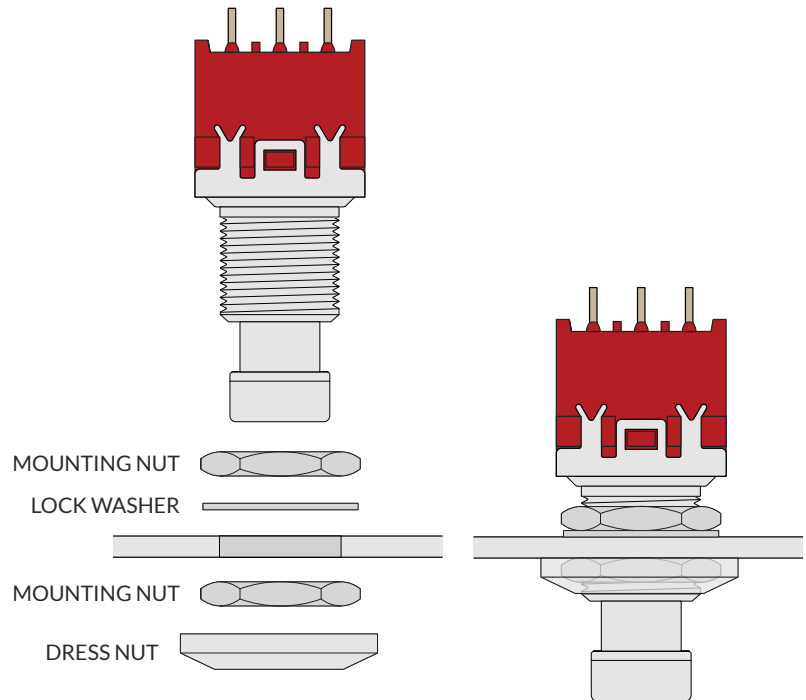
The dress nut fits over the top of the mounting nut and is for aesthetic purposes only. Wrap a rubber band around it to use as a grip when tightening. Avoid using metal tools on it or you run the risk of scratching or denting it.

## POTENTIOMETERS

Feedback: 100kB

Delay: 50kB

Level: 100kB

DUST CAP

LOCK WASHER

OUTER WASHER

MOUNTING NUT
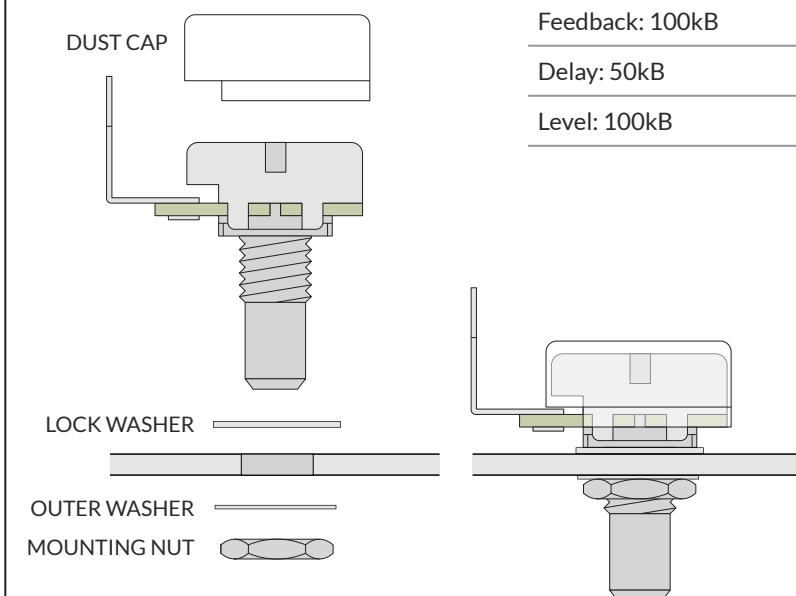
## BEZEL & LED

The LED will just sit loosely inside the bezel for now.

MOUNTING NUT
LOCK RING
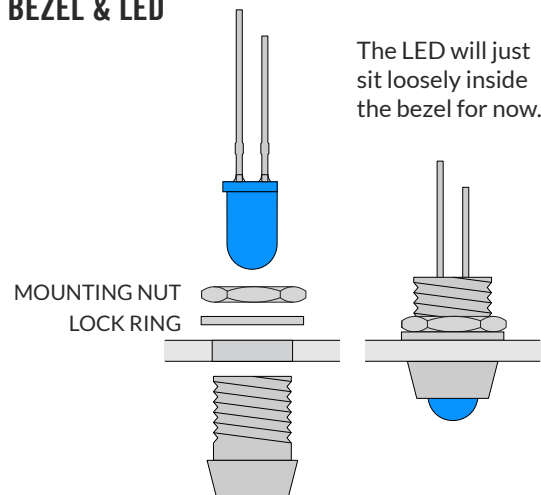
You'll need to hold the bezel in place when tightening the nut. Be aware that the bezel is fairly sharp. Try using a rubber band for grip instead of just pressing your finger against the bottom.

# ENCLOSURE LAYOUT: MAIN & FOOTSWITCH PCBS
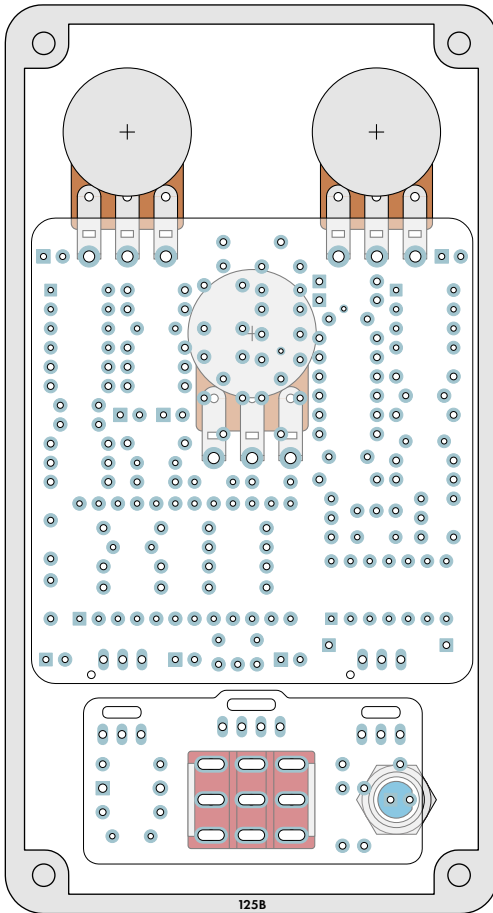


After all the components are affixed to the enclosure as shown on the previous page, place the main PCB on top of the potentiometers as in the diagram to the left.

You may need to adjust the position of the potentiometers slightly if they are not aligned straight.

Once all of the pins are through and the PCB is laying flat, solder each of the pins from the top, being careful not to touch any of the surrounding components with the soldering iron.

After you've finished soldering the pots, **clip the leads as close as you can to the main PCB**. This is important because the input/output PCB overlaps them and you need to avoid any of the components shorting.

Next, do the same thing with the footswitch board—the 3PDT footswitch and the LED.

Before soldering, double-check to **make sure the flat side of the LED is facing to the right**, as shown in the diagram, and that the short leg is coming through the pad on the right. It won't work if it's turned the other way.

## Why solder everything inside the enclosure before testing it?

"Rock it before you box it" is conventional wisdom in pedalbuilding, and you'll often hear it recommended that builders should test the circuit before putting everything inside the enclosure.

However, Aion FX projects are designed to be extremely easy to remove from the enclosure for troubleshooting, with no desoldering required—so with these kits, it's actually much easier to "box it before you rock it".

If you've read the documentation carefully and followed all the instructions, there's a good chance you will get it right the first time.

# ENCLOSURE LAYOUT: INPUT/OUTPUT PCB

Affix the input/output PCB to the north-facing panel of the enclosure as shown.

Note the use of two mounting nuts on each of the jacks, one inside and one outside. The inner nut acts as a spacer to set the DC jack flush with the outside of the enclosure. The inner nuts should be threaded as far down as they can go.



MOUNTING NUT

OUTER WASHER

LOCK WASHER

MOUNTING NUT

125B
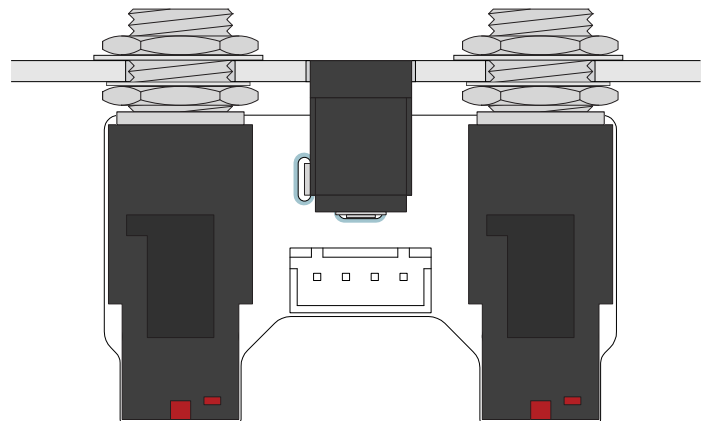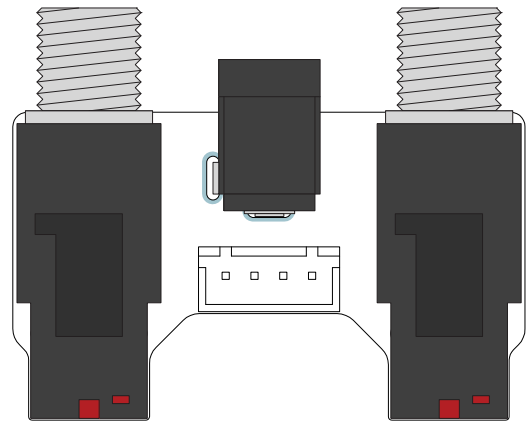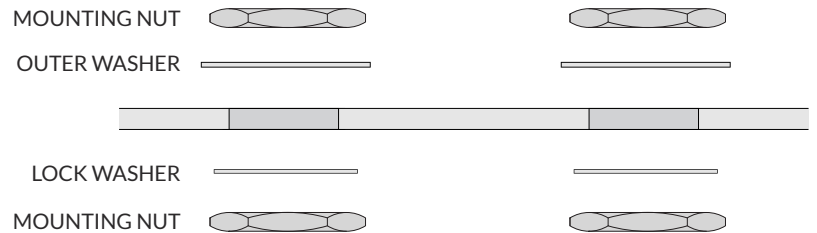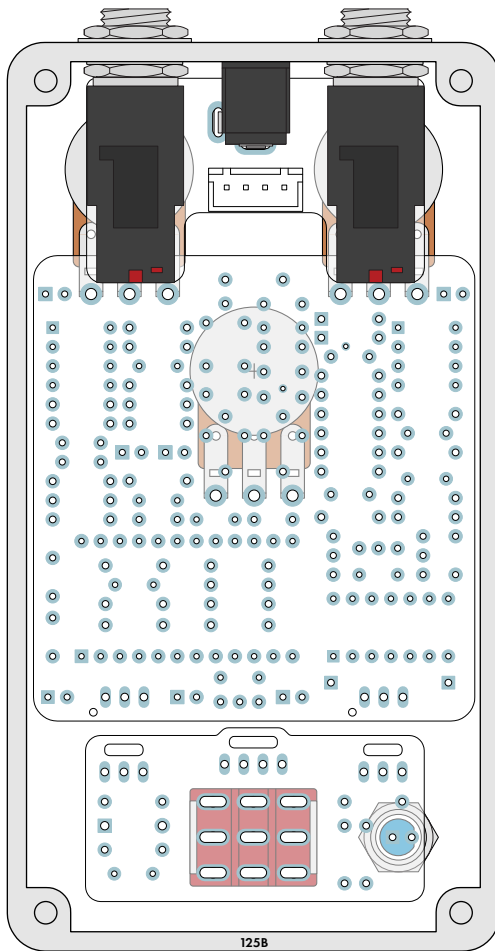
# TESTING & ASSEMBLY

After everything is in place, just plug the 3 wire assemblies into their respective headers and make sure they're secure. Here is a cross-section of the inside of the completed pedal.
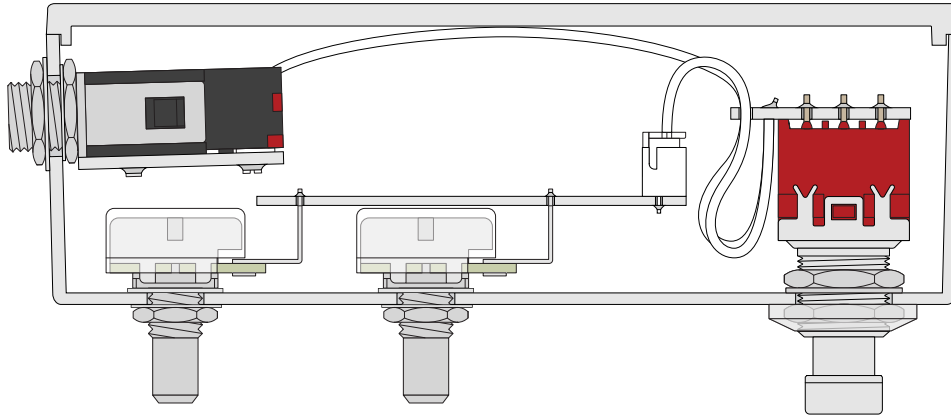


At this point, you have completed the full circuit as far as the electrons are concerned. Plug in a 9-volt supply and test it out with a guitar and an amplifier.

Test the bypass switch a few times, then start turning the knobs and see if everything sounds OK. Note that it has not been calibrated yet, so we're only testing to make sure it passes signal (both dry and delayed) so we can proceed to the next step. We'll evaluate the sound as part of the calibration process.

## Installing the knobs

Even though we're not finished, it's helpful to have the knobs installed for the calibration process. Turn the potentiometer shafts all fully counter-clockwise, then put on the knob and rotate until the indicator line is aligned with the dot on the enclosure that shows the zero point. Affix the knobs to each of the potentiometer shafts as shown in the diagram below.

Using a small flat-head screwdriver (no more than 0.1" / 2.5mm in diameter), firmly tighten the set screw until it presses against the shaft of the potentiometer and holds the knob in place.

Be careful not to over-tighten or you may damage the set screw. But if it's not tight enough, the knob will be more likely to fall off or lose its alignment with the markings on the enclosure.
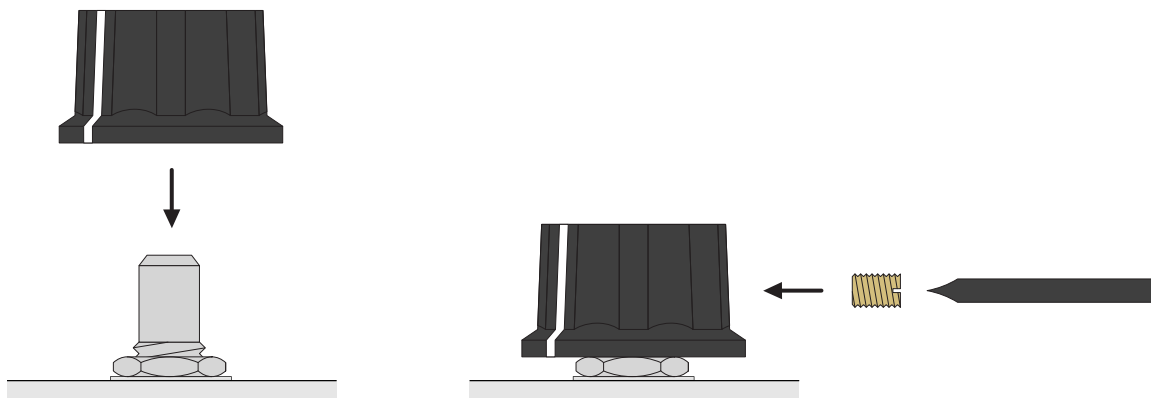
# CALIBRATION

Once we've verified that it passes signal, we're ready to calibrate. First we'll start with the delay range.

## Calibrating the delay range

TR2 and TR3 allow the low and high end of the delay range to be tuned for optimal performance. This is best done with test equipment that can measure frequency (e.g. an oscilloscope, frequency counter, or some multimeters), but it can be done by ear as well and the results are not noticeably different.

For either method, start with both trimmers at the 50% (noon) position. Set Level at full up and Feedback at 50%.

### Calibrating by ear

Set the Delay knob to minimum (shortest delay time, or fastest repeats). Adjust the trimmer labeled TR2 to preference. You can set it for a quick 30-50ms slapback delay, or go even shorter and get pseudo-reverb sounds with the Feedback knob turned up.

Next, set Delay to maximum (longest delay time, or slowest repeats). Adjust trimmer TR3 to preference. The target is around 800-1000ms of delay time. At some point glitches or artifacts will start to appear in the repeats, so if you hear those then back off slightly until they go away—although if you like the sound of these artifacts, they won't cause any harm.

The two trimmers are somewhat interactive, so after adjusting TR3, turn the delay all the way down again and see if TR2 needs to be adjusted. If you do adjust TR2 a second time, then go back and do TR3 a second time as well.

Typically, the 50% setting is pretty near the optimal range for both trimmers, so don't be surprised if it sounds pretty good before you adjust anything.

### Calibrating by frequency measurement

Directly below IC4, there are two test pads marked "+" and "-". It's recommended to solder wires to these pads so you can easily clip probes or test leads to them. Short resistor leads will work fine.

Set Delay to minimum (shortest delay time, or fastest repeats). Adjust TR2 until the frequency on the + test point reads 4MHz. This is the factory setting for the original EM5, but it's reported that the chip works well up to 8MHz if you want a faster delay available, approaching reverb territory.

Next, set Delay to maximum (longest delay time, or slowest repeats). Adjust TR3 until the frequency reads 650kHz. Again, this is the factory setting for the original EM5, but you can go down to 450-500kHz for even longer repeats. If you hear artifacts or noise in the delay signal, turn the frequency up slightly until they go away.

Note that the frequency will likely drop slightly after the unit has been powered on for a few minutes. When we measured an original EM5, it measured 650kHz to 4 MHz across the delay range, but dropped to 625kHz and 3.8 MHz when we took a second set of measurements a bit later.

These are both well within normal operating range, so this behavior won't normally make a difference. But if you've just barely trimmed out the artifacts and you notice they reappear once the unit warms up, then just trim them out again and they should stay out this time.

# CALIBRATION, CONT.

## Setting the feedback (repeats) range

The maximum range of the feedback control is set by the TR1 trimmer. Begin by setting it to the 50% (noon) position, and set the Feedback knob to maximum.

On the original EM5, the repeats knob was set to maximize feedback without reaching self-oscillation or infinite repeats. So to match this, turn TR1 while listening for the point of self-oscillation, and then turn the trimmer down slightly once you get there.

Some people like infinite repeats in a delay, so if you want this sound available at the upper end of the range, feel free to set the trimmer a little higher. It won't cause any problems.

## FINAL ASSEMBLY

If everything calibrated OK, you're all done! Affix the back panel with the four screws provided and make some music.

If doesn't work, or doesn't sound quite right after calibration didn't work, don't be discouraged.

## USAGE

The Elysium has three controls:

- **Delay** (called "Speed" on the EM5) sets the delay time, going from short to long as you turn it up.
- **Feedback** (called "Repeat" on the EM5) sets the number of repeats. Due to the heavy filtering in the delay path, each repeat has degraded sound quality, especially the treble content, resulting in an ambient wash that doesn't conflict with the dry signal. Depending on how the unit is calibrated, the upper end of the Feedback range can get into self-oscillation or infinite repeats.
- **Level** sets the volume level of the delay signal. The dry signal is unaffected and always unity gain.

# SCHEMATIC
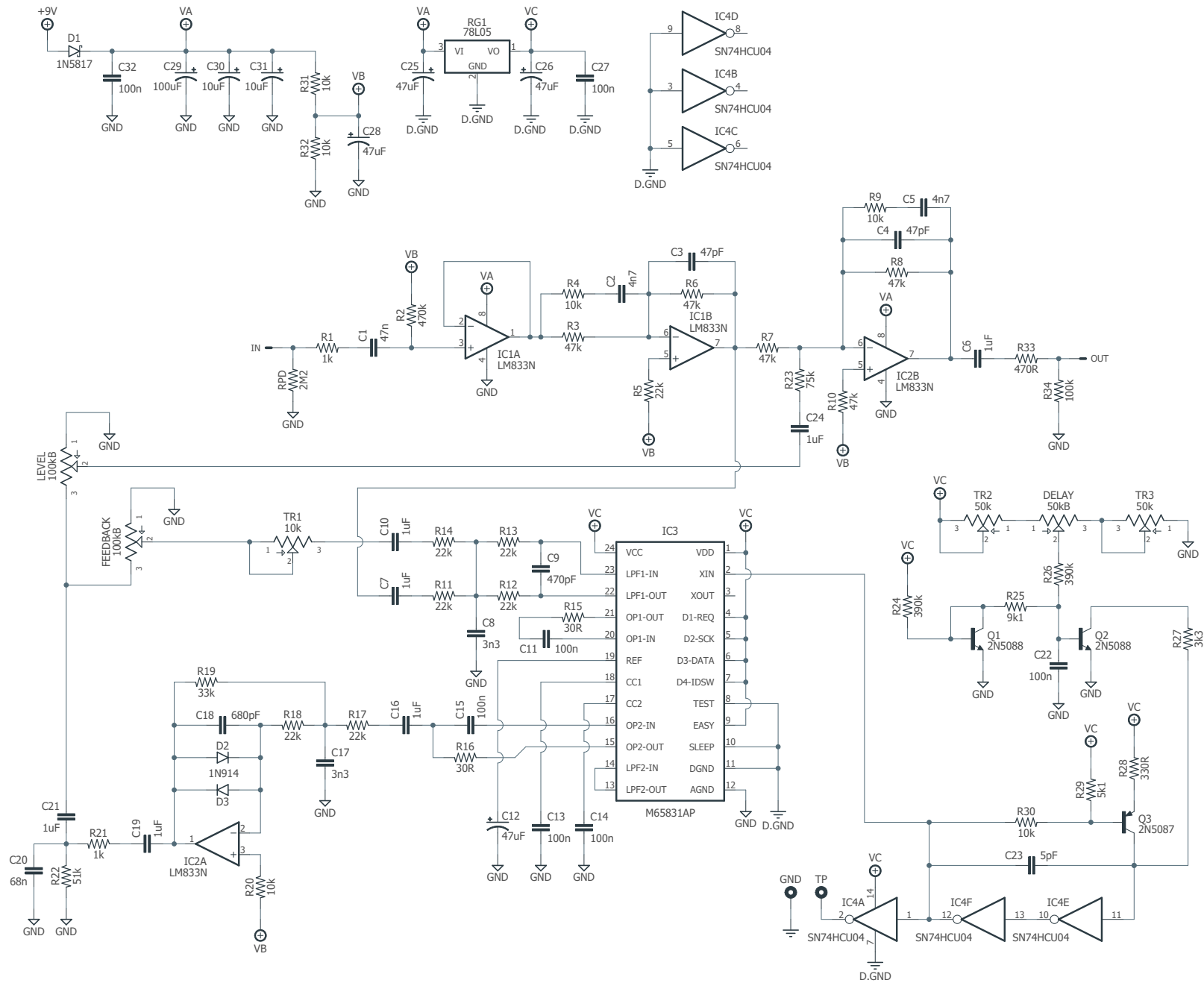
# FULL PARTS LIST

## Resistors

| PART | VALUE | PART | VALUE | PART | VALUE | PART | VALUE |
|------|-------|------|-------|------|-------|------|-------|
| R1 | 1k | R10 | 47k | R19 | 33k | R28 | 330R |
| R2 | 470k | R11 | 22k | R20 | 10k | R29 | 5k1 |
| R3 | 47k | R12 | 22k | R21 | 1k | R30 | 10k |
| R4 | 10k | R13 | 22k | R22 | 51k | R31 | 10k |
| R5 | 22k | R14 | 22k | R23 | 75k | R32 | 10k |
| R6 | 47k | R15 | 30R | R24 | 390k | R33 | 470R |
| R7 | 47k | R16 | 30R | R25 | 9k1 | R34 | 100k |
| R8 | 47k | R17 | 22k | R26 | 390k | RPD | 2M2 |
| R9 | 10k | R18 | 22k | R27 | 3k3 | LEDR | 10k |

## Capacitors

| PART | VALUE | PART | VALUE | PART | VALUE |
|------|-------|------|-------|------|-------|
| C1 | 47n film | C12 | 47uF electro | C23 | 5pF MLCC |
| C2 | 4n7 film | C13 | 100n MLCC | C24 | 1uF film |
| C3 | 47pF MLCC | C14 | 100n MLCC | C25 | 47uF electro |
| C4 | 47pF MLCC | C15 | 100n film | C26 | 47uF electro |
| C5 | 4n7 film | C16 | 1uF film | C27 | 100n MLCC |
| C6 | 1uF film | C17 | 3n3 film | C28 | 47uF electro |
| C7 | 1uF film | C18 | 680pF MLCC | C29 | 100uF electro |
| C8 | 3n3 film | C19 | 1uF film | C30 | 10uF electro |
| C9 | 470pF MLCC | C20 | 68n film | C31 | 10uF electro |
| C10 | 1uF film | C21 | 1uF film | C32 | 100n MLCC |
| C11 | 100n film | C22 | 100n film | | |

## ICs

| PART | VALUE |
|------|-------|
| IC1 | LM833 |
| IC2 | LM833 |
| IC3 | M65831AP |
| IC4 | SN74HCU04 |

## Sockets

| PART | VALUE |
|------|-------|
| IC1-S | DIP-8 socket |
| IC2-S | DIP-8 socket |
| IC3-S | DIP-24 socket |
| IC4-S | DIP-14 socket |

## Diodes

| PART | VALUE |
|------|-------|
| D1 | 1N5817 |
| D2 | 1N914 |
| D3 | 1N914 |

## Transistors

| PART | VALUE |
|------|-------|
| Q1 | 2N5088 |
| Q2 | 2N5089 |
| Q3 | 2N5089 |
| RG1 | 78L05 |

## Potentiometers

| PART | VALUE |
|------|-------|
| Feedback | 100kB |
| Delay | 50kB |
| Level | 100kB |

## Trimmers

| PART | VALUE |
|------|-------|
| TR1 | 10k trimmer |
| TR2 | 50k trimmer |
| TR3 | 50k trimmer |

# TROUBLESHOOTING INFORMATION

If you finish building the kit and find that it doesn't work right, we've written a separate in-depth Troubleshooting Guide that applies to all of our kits. The main troubleshooting process is covered there. Here you will find information specific to this kit that will help with that process.

## Voltages

The following voltages are taken from our prototype unit using a **9.60V** supply. Your measured voltages won't be exactly the same due to variance in power supplies and component tolerances.

Note that IC pins are labeled counter-clockwise from the upper-left, as shown in the diagrams to the right. Voltages taken with Delay control at maximum.
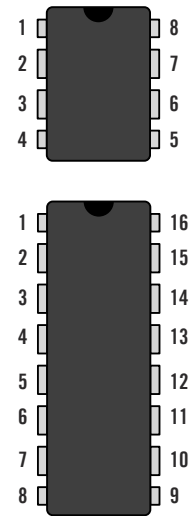
## IC1

| PIN | VOLTAGE |
| --- | --- |
| 1 | 4.79 |
| 2 | 4.79 |
| 3 | 4.58 |
| 4 | 0 |
| 5 | 4.65 |
| 6 | 4.66 |
| 7 | 4.52 |
| 8 | 9.31 |

## IC2

| PIN | VOLTAGE |
| --- | --- |
| 1 | 4.64 |
| 2 | 4.66 |
| 3 | 4.65 |
| 4 | 0 |
| 5 | 4.64 |
| 6 | 4.67 |
| 7 | 4.80 |
| 8 | 9.31 |

## IC4

| PIN | VOLTAGE | | PIN | VOLTAGE |
| --- | --- | --- | --- | --- |
| 1 | 4.88 | | 8 | 5.04 |
| 2 | 0.14 | | 9 | 0 |
| 3 | 0 | | 10 | 0.47 |
| 4 | 5.05 | | 11 | 2.73 |
| 5 | 0 | | 12 | 4.88 |
| 6 | 5.05 | | 13 | 0.48 |
| 7 | 0 | | 14 | 5.05 |

## IC3

| PIN | VOLTAGE | | PIN | VOLTAGE |
| --- | --- | --- | --- | --- |
| 1 | 5.05 | | 13 | 2.53 |
| 2 | 4.88 | | 14 | 2.53 |
| 3 | 0.10 | | 15 | 2.53 |
| 4 | 5.05 | | 16 | 2.53 |
| 5 | 5.05 | | 17 | 0.86 |
| 6 | 5.05 | | 18 | 0.81 |
| 7 | 5.05 | | 19 | 2.53 |
| 8 | 0 | | 20 | 2.54 |
| 9 | 5.05 | | 21 | 2.53 |
| 10 | 0 | | 22 | 2.53 |
| 11 | 0 | | 23 | 2.53 |
| 12 | 0 | | 24 | 5.05 |

## RG1

| PIN | VOLTAGE |
| --- | --- |
| 1 | 9.31 |
| 2 | 0 |
| 3 | 5.05 |

## Q2

| PIN | VOLTAGE |
| --- | --- |
| E | 0 |
| B | 0.50 |
| C | 2.67 |

## Q1

| PIN | VOLTAGE |
| --- | --- |
| E | 0 |
| B | 0.50 |
| C | 0.50 |

## Q3

| PIN | VOLTAGE |
| --- | --- |
| E | 5.04 |
| B | 4.89 |
| C | 2.73 |

# SUPPORT

**Aion FX does not offer direct support for these projects beyond the provided documentation.** Replacements and refunds cannot be offered unless it can be shown that the circuit or documentation are in error or that the included components are non-functional.

## Where to get help

The three best places to ask for help are the DIY Stompboxes forum, the DIY Stompboxes Facebook group, and the r/diypedals subreddit. These communities have more than 150,000 members between them and they are very accommodating to new builders.

When posting a troubleshooting request, always include the following:

1. A thorough description of the problem you are experiencing

2. A photo of the inside of the pedal

3. A list of all the measured voltages of each of the pins, described on the previous page

While we cannot offer direct, private support, you may send a link to your public troubleshooting thread to Aion FX using the contact form on the website. There is no guarantee that we will be able to join the discussion and help solve your problem, but this improves the chances.

It benefits the whole community if the troubleshooting process is public because then people who have the same issue in the future may come across it when searching. And if you do get help, remember to pay it forward! The best way to learn new skills is to help others. Even if you've only built one pedal, you have more experience than someone who is brand new, so you have something to offer.

# RESALE TERMS

These kits may be used for commercial endeavors in any quantity unless otherwise noted. It's okay to sell individual builds locally or online, or even to offer a service to build pedals based on these kits.

No direct attribution is necessary, though a link back is always greatly appreciated. The only usage restriction is that you cannot "goop" the PCB or otherwise obscure the source. In other words: you don't have to go out of your way to advertise the fact that you use Aion FX kits, but please don't go out of your way to hide it. The guitar effects industry needs more transparency, not less!

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# DOCUMENT REVISIONS

**1.0.1 (2024-08-08)**
Added link to troubleshooting guide on page 29.

**1.0.0 (2024-01-26)**
Initial release.