Euro *electro-music* Klee

Panel and Daughterboard Kit Assembly Manual

Written by Tim Goslin (NV)

Revised June 2018

Please post any daughterboard related questions to the Euro Klee Daughterboard thread
http://www.muffwiggler.com/forum/viewtopic.php?t=79912

The electro-music.com Klee forum is the de facto source of information regarding the inner workings of the Klee and the analogue/digital Klee PCBs
http://electro-music.com/forum/forum-155.html

Scott Stites' official manuals can be found in his "Klee Documentation" thread
http://electro-music.com/forum/viewtopic.php?t=24821

Component kits for the electro-music Klee boards can be found at Synthcube's site
http://synthcube.com/cart/index.php?route=product/product&path=74_65&product_id=148

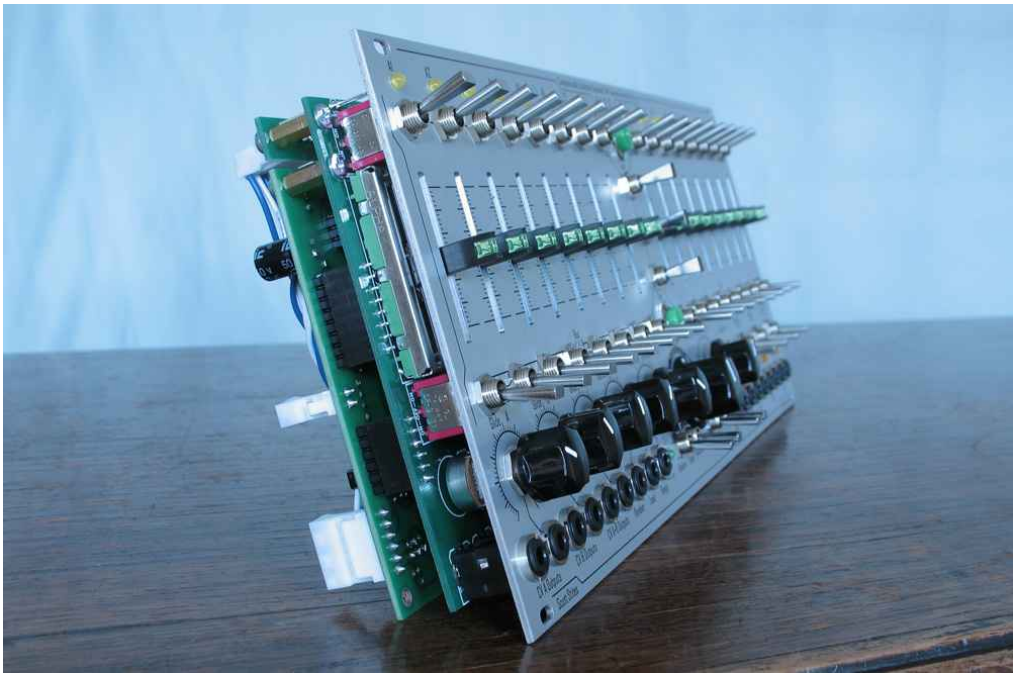
This is your down and dirty no-holds-barred guide for piecing together the Euro Klee daughterboard and panel kit. The daughterboard itself is not a difficult build, but there are a lot of components that need to line up with both the panel and the main Klee boards - getting it all to come out just right takes some patience and precision. Fortunately I've had the pleasure of experiencing nearly every *WRONG* way to do this, so now you get to do it the right way.

This guide is set up in the recommended order of progress. If you change up the order for whatever reason you might run into an annoying hassle that you didn't anticipate – in other words, I don't recommend it.

You'll need a few tools, some obvious others not so much:

- Soldering iron w/ solder
- A PCB vice or similar to hold the board and panel steady above your workspace (If you don't have access to a large vice capable of holding the boards, get two stacks of books or something that you can rest the board between)
- Lead cutters than can cut flush to the PCB – this is important
- Needle nose pliers
- Small flat-head screwdriver (for jack nuts)
- Small Phillips head screwdriver (for PCB standoffs)
- Socket drivers for panel hex nuts (optional, fingers or pliers work too)
  13/32" (10mm) for potentiometer nuts
  5/16" (8mm) for switch nuts
- Multimeter w/ continuity testing (for troubleshooting, if necessary)

So let's get started.



2015 Manual Edition

Before hitting anything else note that since the original manual was written a few major and some minor changes have been implemented. These changes impact any kit from runs in 2015 onward. It should be pretty obvious to spot which kit you have since the new kits don't include MTA cables (yay).

If you're building an older kit that includes the blue/white MTA cables, just press on through the manual. If you are building a kit *without* cables (from runs in 2015 or later), then you'll need to make the following changes to the manual ahead:

- ***Analogue/Digital boards now included –*** whereas formerly the Analogue/Digital boards needed to be purchased from electro-music they are now included in the kit as one continuous board rather than two separate pieces. Building up the Analogue/Digital boards is the same as detailed in Scott Stites manual - the layout, components, calibration, and all else is the same. The silkscreen is flipped for the digital board to make it easier to read but the locations are all the same. Following the official Klee build documentation (linked in the manual below) will guide you through the assembly of these boards.
- ***No cutting the sideboard off from the daughterboard*** - the sideboard has been eliminated and is now included in the redesigned Analogue/Digital board. All the components that used to go on the sideboard now go into the spaces on the A/D board which are labeled the same way (a few pin headers and the power header).
- ***3 screw/standoff sets instead of 6*** - placement for these should be easy to determine as there are now only 3 mounting holes in the daughterboard (the A/D board has 5 holes total but that's a "just in case" emergency mounting measure that no one using the daughterboard will ever need).
- ***No MTA cables*** - everything is now routed to the headers on the board, so ignore the MTA cables and MTA headers sections (the white headers that stick out above the board rather than below).
- ***4x extra pot nuts change*** – getting extra nuts to fit the pots became an exercise in frustration since they seemed to only sometimes fit the pots properly, so they've been eliminated from the kits. Fortunately this is a very minor aesthetic preference thing and doesn't affect the build except to make 4 of the smaller knobs about 1mm closer to the panel. If you still want to lower the knobs for those 4 pots this is easily remedied with pretty much any typical metal/nylon/rubber washer you may have lying around your house. Do note that because of this the small metal nubs must be removed from all 6 pots rather than just from 2.

Sections which are not applicable to builds from 2015 onward will be highlighted and italicized in red - ***like this.*** So as generally solid life advice, watch out for anything highlighted in red.

Part Options

The Synthcube kits (link at the beginning of the manual) include all of the LEDs and knobs you see in the completed build at the front of the manual, although you can of course customize things as you wish.

The knob dials allow for knob diameters of 17mm, 21mm, and 24mm, so anything at or below those sizes will fit. Knobs with set screws are needed for the included smooth shaft pots and the rotary. The knobs used in the pictured build can be found at Small Bear Electronics:

- Large knob - http://www.smallbearelec.com/servlet/Detail?no=104
- Medium knobs - http://www.smallbearelec.com/servlet/Detail?no=644
- Small knobs - http://www.smallbearelec.com/servlet/Detail?no=1037

The pushbuttons are available at Mouser in four different colors:

- Red (Part number 612-RP3502MA-RED)
- Green (Part number 612-RP3502MA-GRN)
- Yellow (Part number 612-RP3502MA-YEL)
- Black (Part number 612-RP3502MA-BLK)

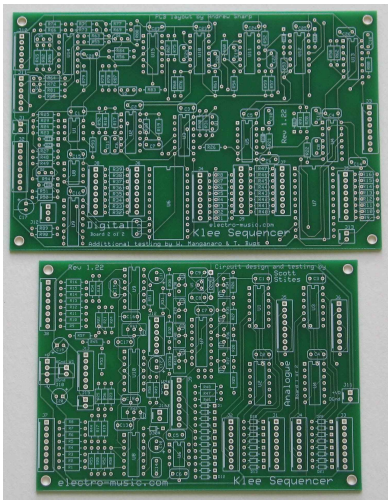
The sliders come with green LEDs fitted, although these can be swapped for other colors with a little work. The LEDs will slip out of the lever with a little force and you can fit any LED with a width of 3.2mm or less into the slot – it doesn't have to be square. Make sure that you orient the anode and cathode of the LED correctly into the lever, and trim the leads to match the length of the LED you just took out. If your new LED doesn't stay put, a small dab of glue at the bottom of the LED lens should be plenty to keep it in place.

Pick and choose whatever colors of LEDs you would like in the rest of the panel. The panel is drilled for standard T1 3mm LEDs. I recommend standard diffused LEDs - if you're going with something crazy then I leave it to you to figure out how to make it work with the Klee boards.

Here is a link to a Mouser BOM which includes all of the parts featured in the daughterboard kits: [https://www.mouser.com/ProjectManager/ProjectDetail.aspx?AccessID=a90d531b8f] Note that the jacks and sliders in the kits are customized variants – the jacks feature an additional switching contact and the sliders eliminate the center detent and have a longer lever. Synthcube's site offers the same jacks used in this build for purchase, and for less than Mouser charges - I spent a lot of time fiddling with jacks before settling on these for the kits and they are very high quality. As for the sliders, the eliminated center detent and longer lever are just for luxury – the sliders listed in the BOM will work just fine.

electro-music Klee Analogue/Digital PCBs

Before you start on the daughterboard you will need to complete your electro-music Klee boards. ***If you do not already have these they can be purchased at the electro-music store through the following link:***
http://www.electro-music.com/catalog/product_info.php/cPath/54/products_id/101

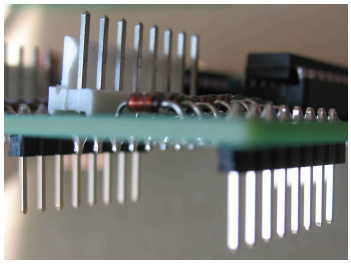


If you have purchased the Synthcube kit for this project his kit includes all of the parts that will be soldered onto these boards except for the SIL pin rows, which are included in the daughterboard kit.

The official Klee build documentation ("Build Doc" at http://electro-music.com/forum/viewtopic.php?t=24821) features incredible detail on the PCB build process. Be absolutely sure to reference it during your build, as this manual only features the modified aspects specific to the daughterboard construction.

electro-music PCB Headers

When building the electro-music boards you will need to place the included SIL pin rows in the majority of the header positions ***and MTA/Molex headers in the remaining positions***. I recommend doing this **before** soldering any other components in, although it's not a huge deal if not. ***Be careful to note that some of the headers remain as MTA headers and not as pins*** – here is a list of all the headers on the boards and the appropriate parts to place in them:

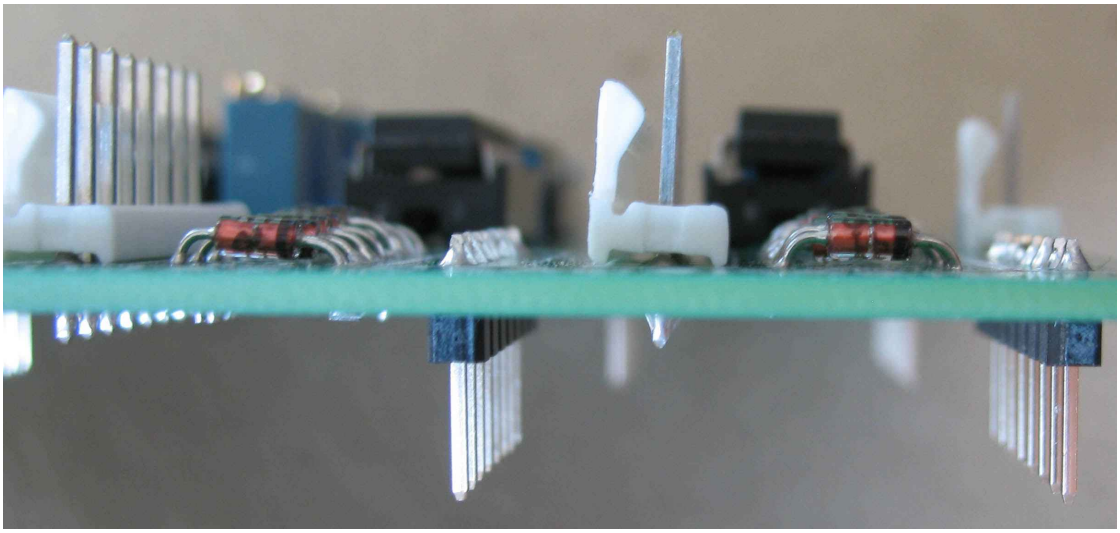


<u>Analogue Board:</u>
SIL Pin Rows --- J1, J3, J5, J6, J7, J8, J10, J12, J13, J15, J16
MTA Headers --- J2, J4, J9, J11 (not placed in 2015+)

<u>Digital Board:</u>
SIL Pin Rows --- J2, J4, J5, J8, J9, J11, J12, J13
MTA Headers --- J1, J3, J6, J7, J10 (not placed in 2015+)

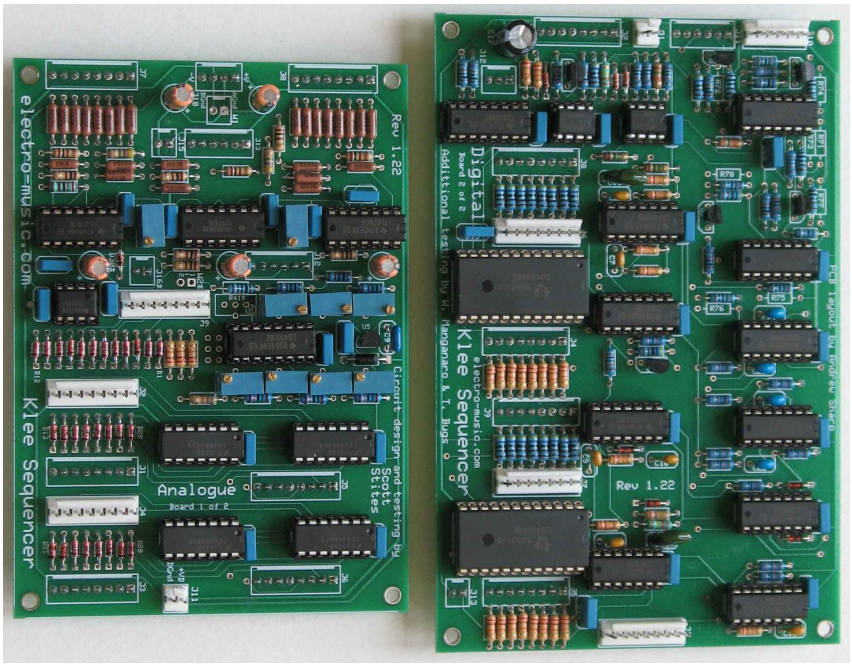
The pin rows arrive in long strips. These can be easily cut to size with any set of wire or lead cutters – just place both blades in the notches between the pins and cut. If you accidentally cut one too small don't worry, just cut an extra pin or two to fit alongside it. Once the pins are soldered in it won't matter how they were cut. The kits also include plenty of pins so there's some room for error.

When placing the headers and pins make sure you are orienting them correctly. ***The MTA headers must match the silkscreening on the Klee boards, with the flatted back of the header matching the bold edge of the silkscreen and with the pins facing up.*** The SIL pin rows are not orientation specific, but they must be facing **down** from the board – IE, they must be placed on the side opposite of the component silkscreen. Here is a profile of a completed board to illustrate the proper placement.



Make sure the pins are seated right up against the board before soldering – if they are crooked you will have a hell of a time fitting them into the sockets later. I recommend placing some pressure on the pins from below as you solder them in to make sure they fit snug – tack the two outside pins in place with some rough solder on the tip of your iron, make sure it's all lined up straight, then solder the middle pins. Don't forget to re-do your rough outside-pin solder job once the middle pins are soldered.

Once you've soldered all the rows and headers in you can move on to building up the rest of the boards.



If you have already built your Klee boards in the past entirely with MTA or Molex headers, you'll need to remove the headers that are listed as SIL pin rows above. Desoldering pin rows can be a pain, but fortunately I have experienced this and have my dumb little way of dealing with it using remedial tools. Here is my approach:

- ***Don't try to remove the entire header – do one pin at a time***
- ***Grip the pin you're removing on the component side with some needle nose pliers***
- ***Heat up the joint on the solder side with your iron***
- ***Pull the pin through with the pliers - it should slide right out of the header plastic with just a little effort***
- ***Repeat for all the pins of that header***
- ***Put the board on its side, heat up the solder still left in the joint, and use a solder sucker on the other side to suck it out***

electro-music PCB Part Considerations

The daughterboard is designed for the Eurorack format, hence these instructions are specific to building the Klee for +/-12V power and 10V gates/triggers. The official electro-music Klee build manual offers instructions for building the Klee to both 12V and 15V specifications as well as options for either 10V triggers/gates or 5V triggers/gates. Synthcube's kits also include all of the parts necessary to build under any of these choices. **When building in Euro my recommendation is to pursue 10V gates/triggers and, crazily enough, +/-12V power.** If you build it with 5V gates/triggers don't get mad when a finicky envelope decides not to play.

All of the gate/trigger stuff is handled on the digital board. Under these recommendations you will need to place the following parts:

Digital Board:

R32-R47 --- 4.7k resistors
R63-R70 --- 1k resistors
R71-R78 --- do not install anything in these positions (leave them empty)

The analogue board features several options mentioned in the instructions for the Variable Range control. For this build:

Analogue Board:

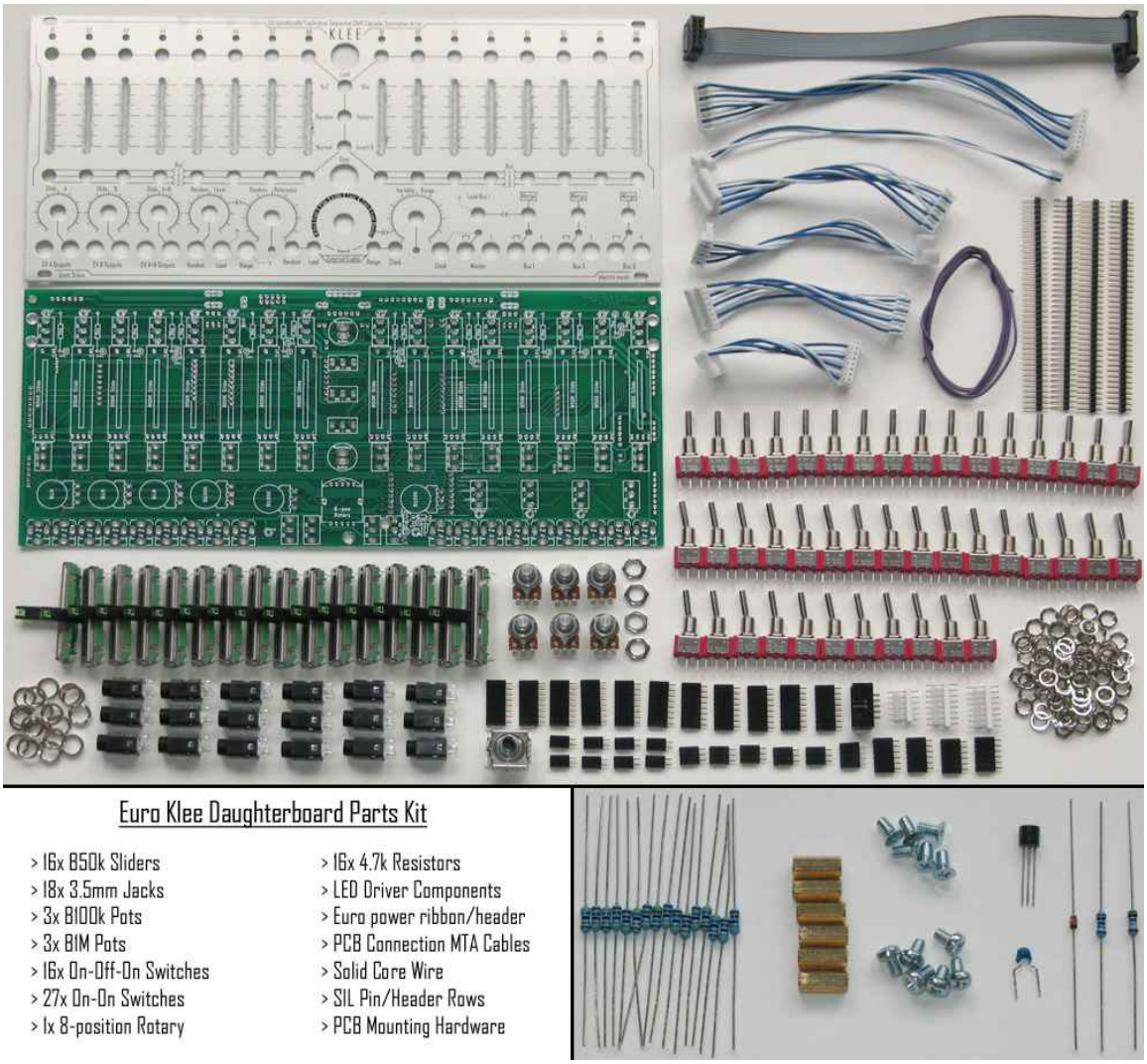
- Do **not** install trimpot R41
- Resistor R33 **will** be installed, and as **1k**. This sets the upper limit of the Range control at 8V – if you want to change that upper limit then you can read the official build instructions and figure it out
- Diode D30 **will** be installed

There are several jumper options mentioned in the electro-music Klee build manual. You do **not** need to install any of these jumpers – it's all taken care of on the daughterboard.

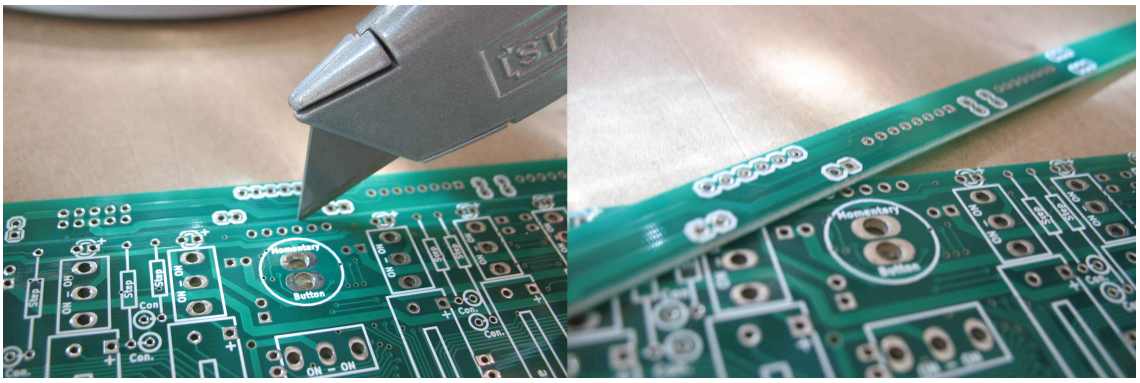
That concludes the changes to the main Klee boards for the daughterboard construction. From here on out, reference the electro-music Klee build manual for the construction of the analogue/digital PCBs. Once that's all done, let's move on to the daughterboard.

Daughterboard Construction

Before you start, it wouldn't hurt to make sure you have everything on hand. Here's a layout of all of the parts that were included in your daughterboard kit – it would be nice to have these out and ready rather than digging through a box every couple minutes. ***(2015+ kits do not include MTA cables/headers, don't have 4 extra pot nuts, have 3 standoff/screw sets, and include the Analogue/Digital boards in one additional PCB)***

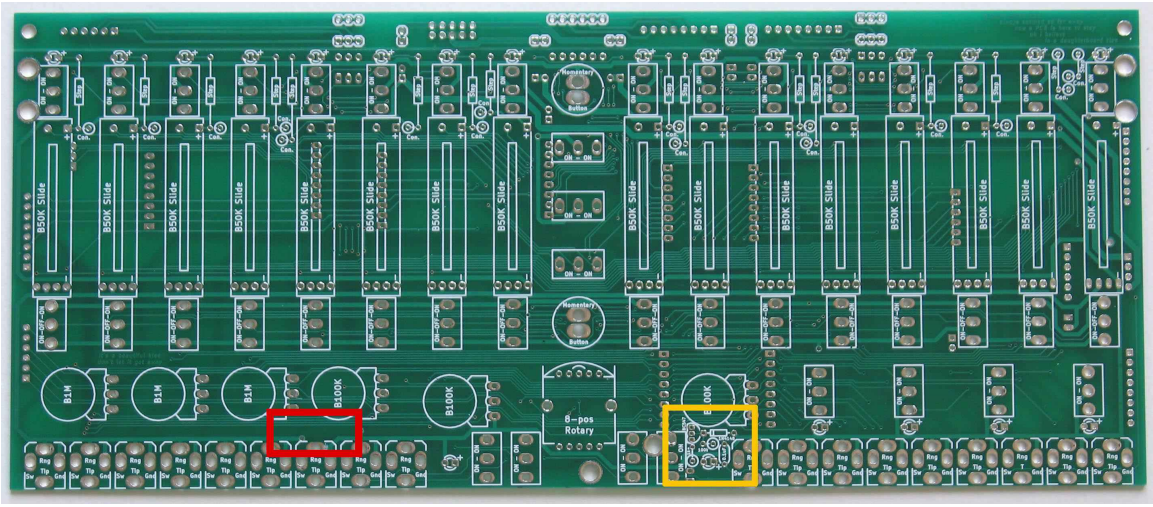


The first step before tossing things together is to separate the thin top section of the PCB from the main board. There is a v-score separating these two boards and since the top board is so thin I don't recommend trying to break it apart as is. Instead, take a sharp blade (a box cutter works great) and run it along the length of the v-score. Apply moderate pressure as you do but don't really dig into it. A few runs on each side of the board should be enough for the top section to pull off with minimal pressure. If it's not popping off easily give it a few more runs with the blade and try again. Set the thin board aside once it's off – we'll be calling this the "sideboard" from here on.



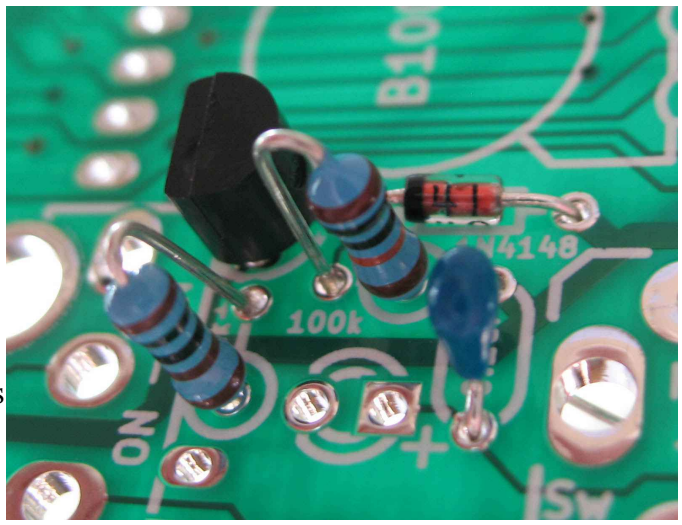
Resistors and Stuff

Now for components. First place a 1k resistor from the LED Driver bag in the "1k+" resistor space between the jacks and B1M/B100k pots on the mid-lower left of the board (*note: only 2018 and later builds*). Then on to the LED driver, in the lower center/right:



The 1k driver resistor is also labeled as "1k+" and determines the brightness of the Variable Range LED. 1k is the minimum value and allows a large range of illumination. However, it will also light up brighter than the other LEDs with 4.7k resistors. If you want to adjust the brightness of this LED feel free to adjust this resistor as needed – just don't go below 1k.

Place all of the components according to the silkscreen. **Make sure you have oriented the diode and transistor correctly,** with the blackened end of the diode and flatted end of the transistor matching the silkscreen. The resistors will be standing on their sides as illustrated. In case you can't read band codes and don't have a multimeter handy, the 1k resistor has all black and brown bands and the 100k resistor has an orange band in the middle.

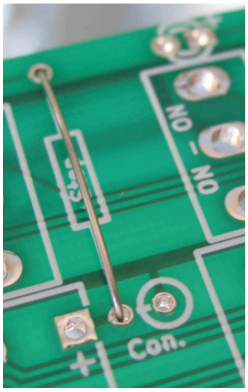


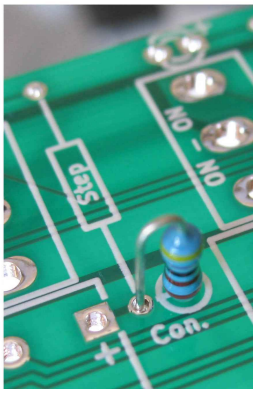
Now we'll place the slider LED resistors/jumpers, along the top of the board. There are two options to consider here – one where the LEDs on the sliders light in sync with the bit LEDs along the top of the module, and the other where the LEDs on the sliders remain constantly on.

Slider LED Options

Bit Synced

Constantly On





Slider LEDs in sync with bits:
Cut/strip the included purple wire into the appropriate lengths and place them into the **Step** spaces

Slider LEDs constantly on:
Solder the included 4.7k resistors into the **Con.** spaces

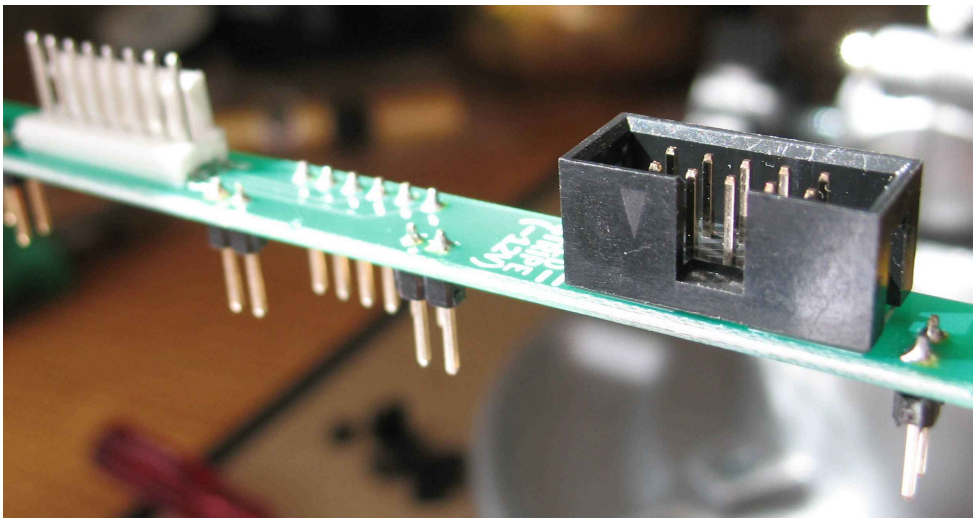
Note that the 4.7k and jumper choices are dependent upon your use of standard diffused LEDs. If you're going with waterclear-ultrabright-wow-bang LEDs you may need to adjust the "Step" jumper into a resistor in order to match the bit LED brightness. If you're not using the pre-installed green LEDs or a standard diffused LED in the sliders then I'll leave it up to you to figure out the proper resistance. Also note the Bit Synced option pulls twice the LED current so expect the LEDs to be slightly dimmer.

Place your choice in the appropriate spaces – make sure you have 16 of the resistors or jumpers in place to match the 16 sliders. Now flip the board and solder all of the components into place. Double check your soldering of the transistor – the three pads are close together and you don't want any solder bridges there.

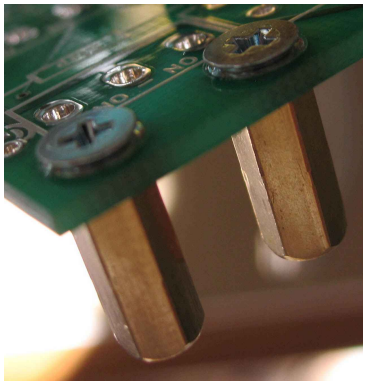
Daughterboard Sockets and Headers

The first phase here is to fill in the little sideboard you snapped off earlier ***(this board is built into the main board in 2015+ kits)***. This board contains a number of pin rows, ***three MTA headers,*** and the shrouded Euro power header. The same rules apply as when you were soldering the pins into the Klee boards – the MTA headers and power header all face up with their backsides matching the silkscreen, and the pin rows all face down. The board is silkscreened to illustrate this – place the components in the appropriate silkscreen designs and solder them in. **Make sure you orient the Euro power header correctly** – the notch in the header shroud should match the notch in the silkscreen.

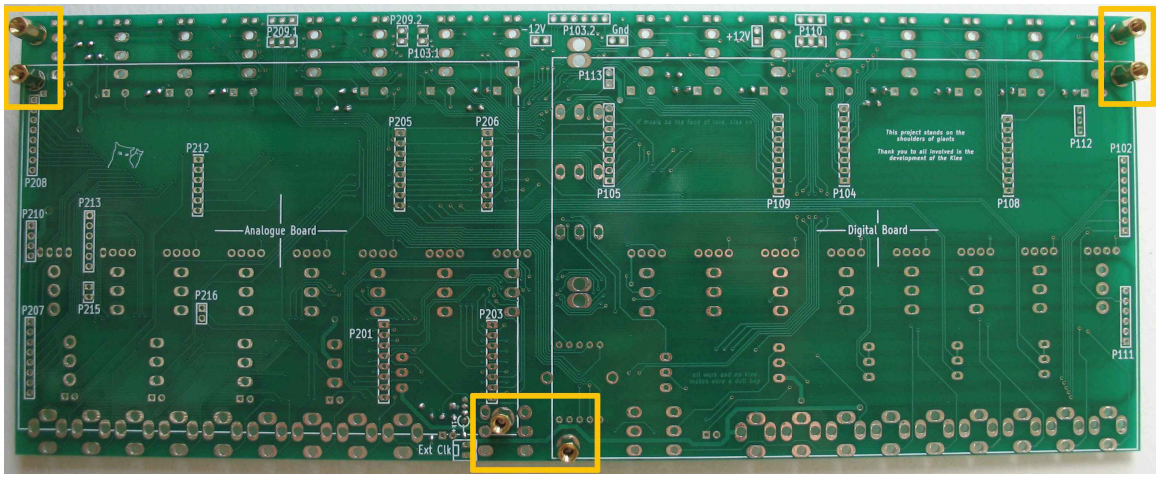
Once again make sure they sit nice and flat against the board before soldering all the pins.



The hex standoffs are going in next. There are 6 total ***(3 for 2015+)***, all mounted to the main daughterboard. Screw them in so that they are facing away from the component side of the boards, the same direction the sockets will soon be facing.



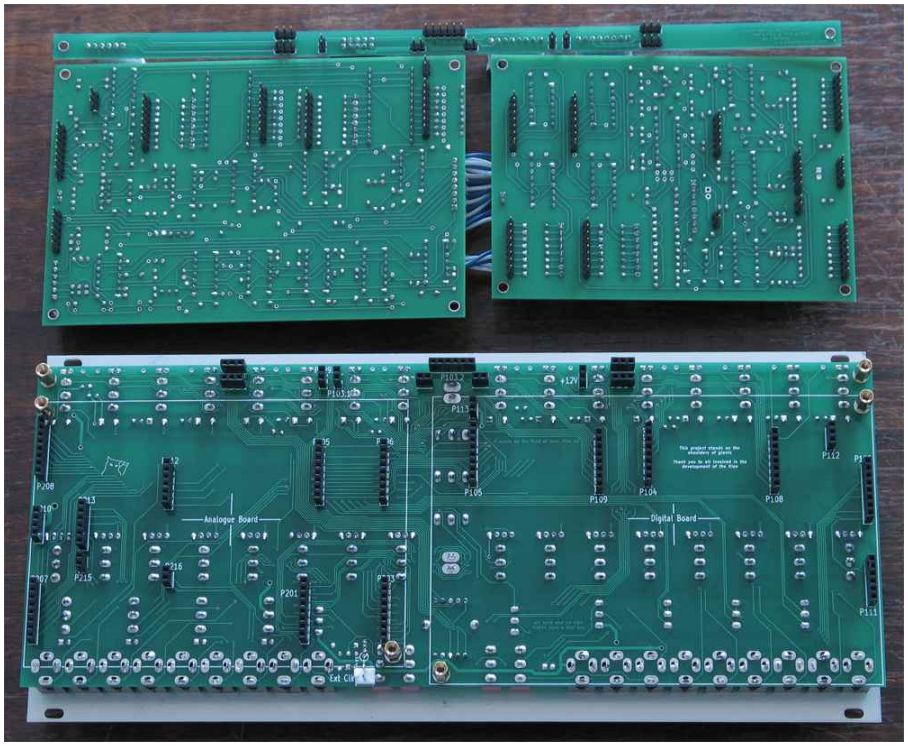
Note that when screwing these into the daughterboard you will be using the flat head screws and not the rounded head. This is to prevent the screws from pressing into any of the panel mounted parts. Screw each standoff in nice and snug, but don't muscle it – these will not be the only thing supporting the PCBs so there's no need to bury them into the boards. Additionally you may notice that the hole for the standoff in the corner of the analogue board silkscreen box is a bit larger than the others – this is intentional since it runs close to one of the sliders. Of all the screws be especially careful not to screw this one in too tight, or else you run the risk of pulling the standoff into the hole.
If your kit is from the 2nd run (shipped Aug./Sept. 2013) then the properly sized standoff/screws for this particular hole will be in a separate bag from the others.



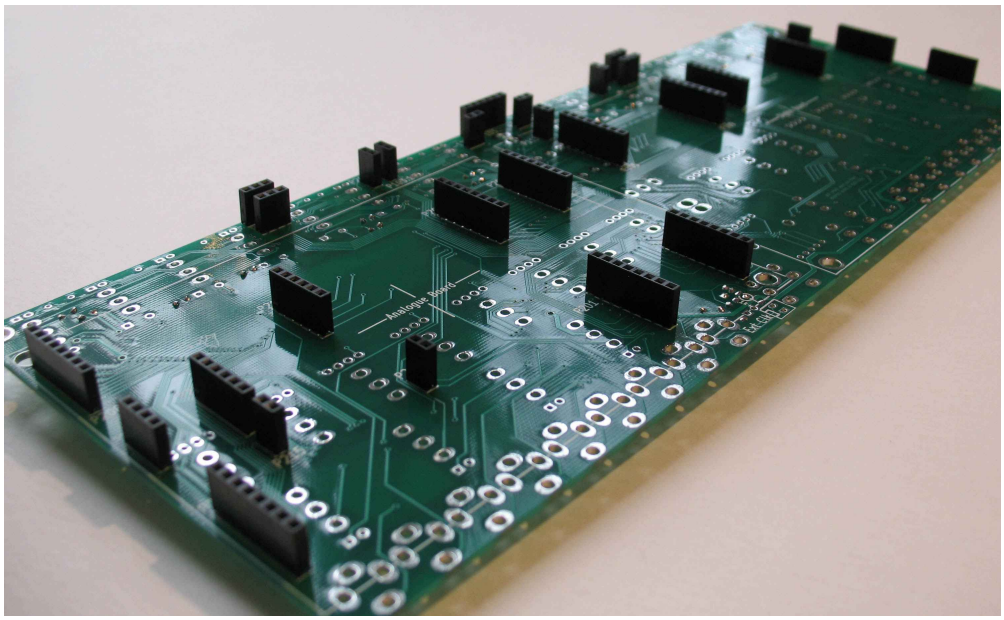
Since you've already installed the pin rows into the main Klee boards (right…?) the next step will be much easier. Install the appropriately sized sockets onto the underside pin headers of every board including the sideboard we just finished. Once all the sockets have been fitted, lower the boards onto the panel, fitting the socket pins into their holes. The electro-music boards are each placed over the silkscreened squares labeled "Analogue Board" and "Digital Board." The thin side board goes along the top. Some of the sockets may need a bit of a wiggle to get them to slip into their holes – you should be able to tell which ones are dodging the holes by peeking between the boards. Gently nudge them into place with a pencil or creepily long pinky finger.

Once every socket has slipped into the holes allotted for them the standoffs should line up with the mounting holes of the boards. Take your rounded screws and lightly screw the boards in – no need to tighten them too much, they're coming right back out in a minute.

Once all the boards are secured, flip the assembly and solder in all of the sockets. As you do, apply pressure on the boards from below to make sure the sockets are seated nice and snug against the board as you solder them in, particularly with the long side board.



Unscrew the standoffs and pull the boards free. The pins should fit pretty tight into the sockets, so you may need to do a little pulling on one side and then the other to work it free. Be especially careful with the side board – it's long and thin and not exactly up to the task of being pulled by the hair.



Make sure you didn't miss any headers – there should be 11 headers in the Analogue section, 8 headers in the Digital section, and 10 headers up above.

You may notice that there is a small header at the bottom of the board labeled "Ext. Clk" – this is a bonus header that allows you to connect an external clock signal to the switching lug of the clock input. This is only useful if you like normaling your sequencers to an internal master clock behind the panel. The top pad is the clock input and the pad closest to the edge is ground. Chances are no one will use this (and a header for it is not included in the kits), but that's what it does.

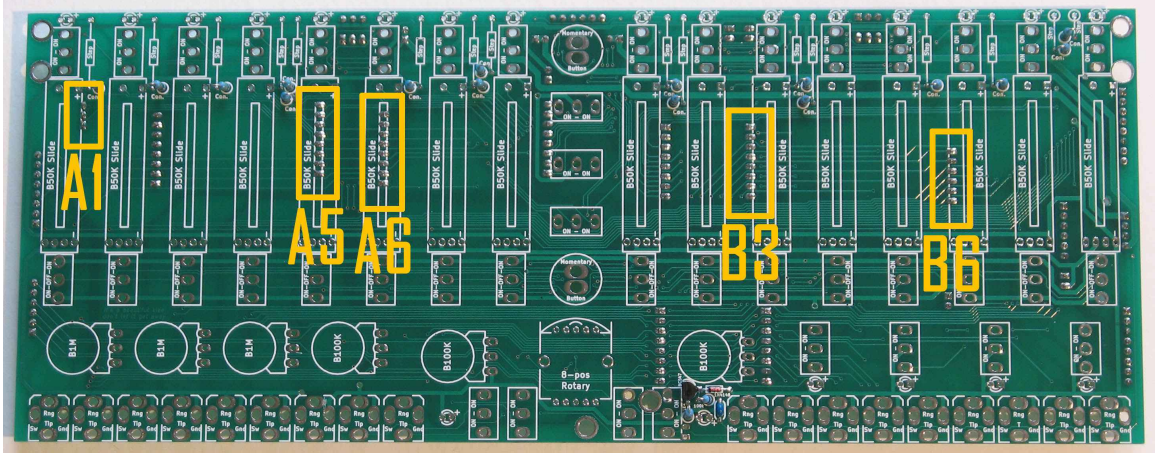
If you're using water-soluble flux solder now would be the time to clean the board and switch to no-clean or standard rosin flux. If you have no idea what that means you're probably using standard rosin flux, so don't worry about it.

Now that you've soldered (and cleaned, if necessary) every socket you're going to need to trim the leads of a few of them very close to the board – preferably as close as you can get them. Here's where the flush cutters are necessary. Some of these you'll be fine trimming down fairly close to the board, but there are some you're going to need to spend some time really shaving down as close to flat as possible. Follow the illustration and instructions on the next page for this step. Don't worry about damaging the board – these are plated through-holes, and once the part is soldered in it won't care what you do to the lead.

Socket Pin Shaving Time

From left to right...

- In A1 cut the 3 solder joints along the silkscreen edge down
- In A5 and A6 cut the solder joints that are within the slider silkscreen down as low as possible
- In B3 cut the 8 solder joints along the silkscreen edge down
- In B6 cut the 6 solder joints for the socket as close as you can to the PCB. You're going to need to shave these down as flat as you can get them, more so than the others.



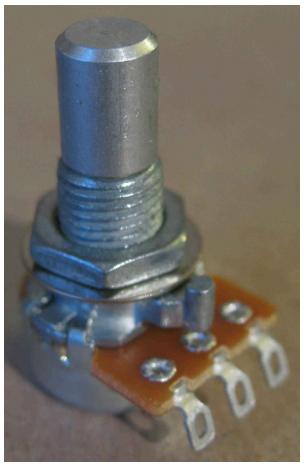
That's it for the little stuff – now on to the panel components.

Panel Part Preparations

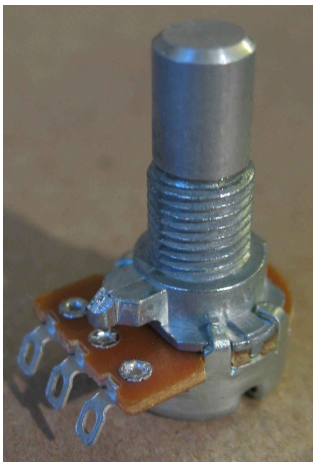
Some of the panel components need a little bit of beauty work before they're ready for the big time. Now's a good time to get them prepared for the show.

Switches:
Take one nut for each switch and screw it on. Keep screwing it in until the nut is seated snugly against the body of the switch, clear to the bottom of the thread. You can just tighten this by hand, no need to assert your dominance.

Pots:
The first step here is optional depending on your choice of knobs. ***If you are using the knobs featured in the build pictured on the manual cover (and the ones included in Synthcube's kits) then secure the nuts for the three B1M pots and one of the B100K pots clear down to the body of the pot, just like you did with the switches. You can tell which is which by the legending on the back of the pot. Do whatever you want with the thin metal washer, it's not necessary for the build.***



For any pots that you did **not** screw the nut down, take the nut entirely off. You'll need to cut the little round poles sticking out from the front. This is soft metal and can be cut with a standard wire/lead cutter and mildly bitter fury. Either tear the whole tab off or get it close to flush.

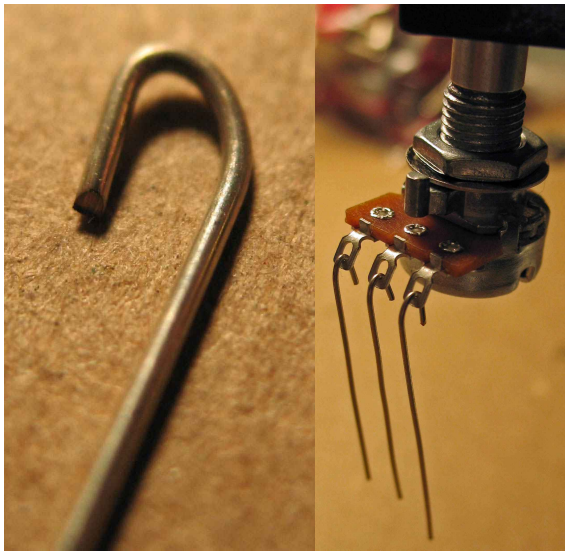


Now that your pots look pretty you'll need to mess them up with some soldering. Pull out the included purple length of wire – you're going to need 18 pieces of bare wire, each about an inch in length. Just eyeball it, no need for a ruler.

Straighten the wire, strip the insulation off a few inches at a time, make your cuts, then repeat. There are few things more emasculating than trying to pull too much insulation off a wire so save yourself the emotional scars and go bits at a time.

You're going to need to solder each of the leads you just cut to the lugs of the pots. This can be either an enormous pain or deceptively easy, so let's try the easy way:

- Make a tight "U" hook at the end of each lead with some needle nose pliers – clamp the wire in the tip and twirl.
- Lightly clamp the top of the pot shaft in a vice – you can just use whatever you were holding your PCBs with. If you can clamp a few at once more power to you, but don't feel ashamed if your vice can only reliably hold one pot at a time.



- With the pot lugs below the vice, hang your hooked wires off each lug like beautiful ornaments. Do it so the wires hang down naturally via "gravity" (if you believe in that crap).
- Solder the hooked end to the lug then back off so it hardens with the wire hanging naturally and without you getting all fresh with it.

Do this for all the pots, angle any stray leads so they are pointing downwards from the pot body, then set them aside for some seriously kinky through-hole action later.

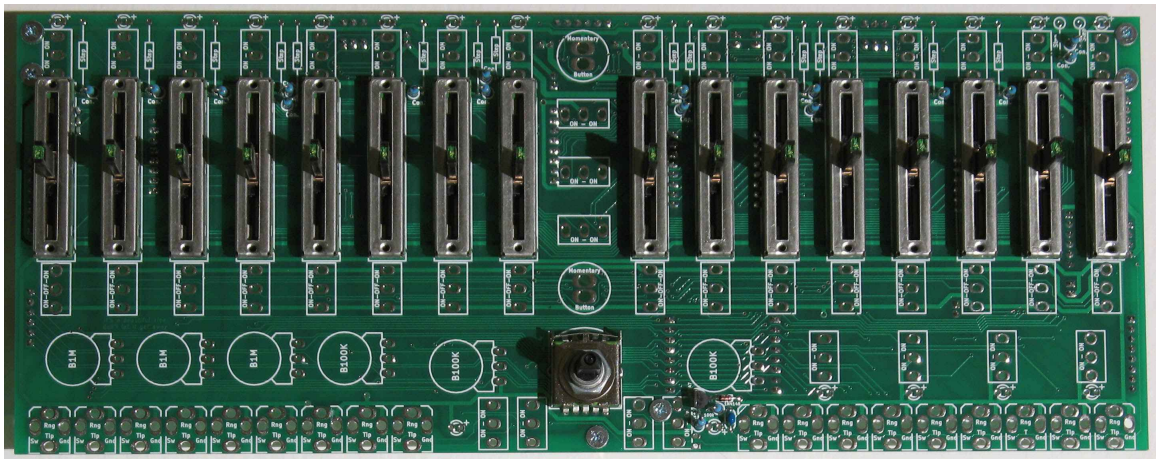
Now onto some board play.

Placing the Components

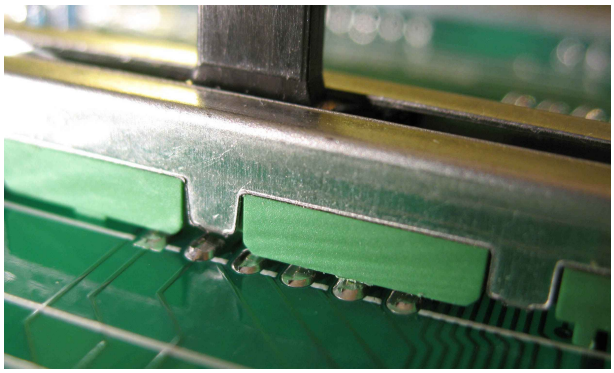
Rotary and Sliders

The first step is to place the LED sliders and center rotary into the panel. Place the rotary first - follow the silkscreen and make sure the bulging and horned side of the rotary matches the silkscreen. The rotary should snap into place.

After that, place the LED sliders. These do not conveniently snap into place like the rotary, so you'll need to bend a couple of their leads to keep them in place. A gentle bend is good enough, just to keep them from flying out when you flip the board.



Before finishing that, you'll need to do some more beauty work on one of the sliders – specifically the slider fitting into the 3rd position from the right (B6). This is the same position you spent so much time trimming earlier, and now you're going to have to trim some more. Fit the slider properly into the footprint – you'll notice that there is a small plastic "foot" on the slider that rests on the solder joints. This foot will prop your slider to the side so it must be destroyed. Take your flush cutters once again and shave it off. It's just plastic, so don't worry about damaging the slider. Once you've shaved the foot flush with the rest of the plastic, mount it and see if it sits nice and flat on the board now. If it doesn't, you either need to trim the solder down some more or the foot. You'll definitely want this sitting flat, so take a second to get it right.

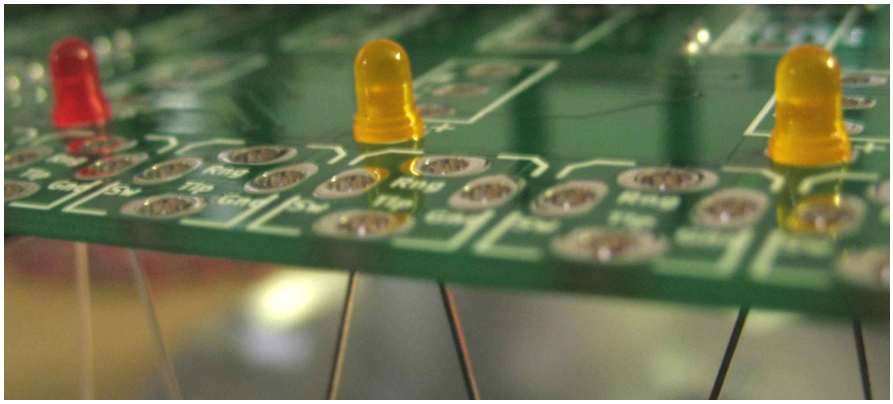


Once all the sliders have been mounted (don't forget to bend the leads on them), flip the assembly and solder everything in. When you solder each slider and the rotary, press on the part from below to make sure it's seated flat to the board. This may be a little tricky with the sliders as they have a little play in the mounting holes, so try your best to keep them straight and even in their silkscreen boxes and not pushed too far in one direction. It wouldn't hurt to solder in one of the leads first and then check to make sure the slider is sitting right before soldering the rest – better to desolder one pin than all six.

LEDs

Place the LEDs into the PCB but do not solder them in. You will be slipping them into their holes and pressing them down so the body rests against the board. Make sure you get the orientation right for each LED – the "+" on each LED silkscreen (also a square solder pad) illustrates the anode, which is usually the longer lead of the two. If you can't figure out which lead is the positive anode look up some info on the internet and become acquainted with LEDs before committing to a future problem. Also make sure you have your carefully chosen color arrangement in the proper places.

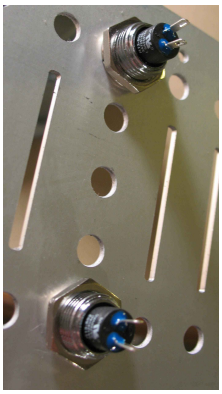
Gently bend the leads – just enough so they don't slip out of the holes without some pressure, but not so much where you won't be able to easily straighten them again in a few minutes.



Pushbuttons

You'll need your panel from here on out, so get it ready. Take the plastic covering off the front and marvel at how it isn't all messed up looking like you originally thought it was.

Take the nuts off your pushbuttons and place them into the panel from the front. Secure the lock washers and nuts onto the rear of each button and screw them in until they're just shy of a snug fit but able to rotate.



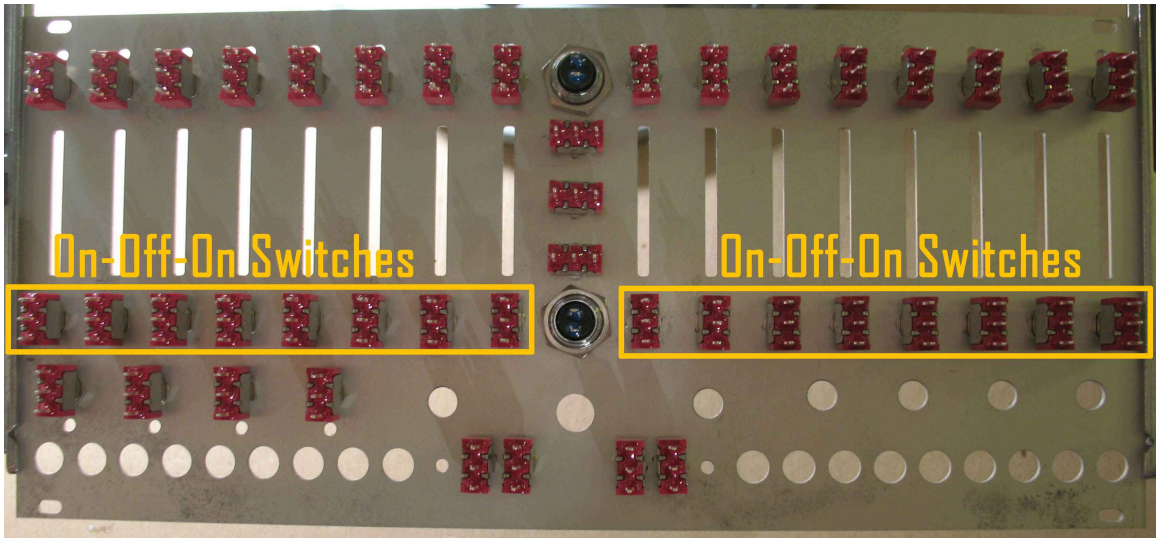
Flip the panel and view it from the back. You're going to want the two lugs of each switch to be perfectly vertical on the panel, one above the other. Once you've got the button situated as close to vertical as you can get it, screw it in nice and tight. Make sure it didn't rotate out of place while you were securing it. We won't be taking these out again, so get them situated properly. Hold it up to the PCB if you'd like to test the fit.

Switches

Next up are the switches, and once again we'll be messing with the panel for this. Place the panel face down into your vice (or between your books, whatever). Get it nice and flat so there isn't a slope that will pull everything around.

Note that you will not be securing any of the parts to the panel in these first few steps – just placing them. There is a specific point where we will secure the parts, and doing it early will promote one big headache.

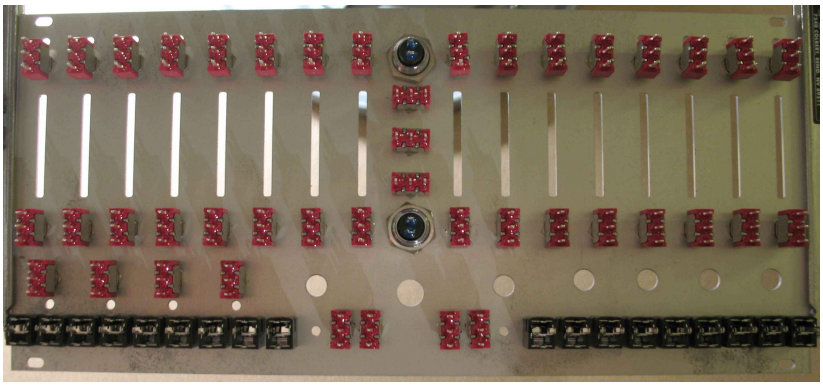
Slip all of the switches into the proper holes – note that the 3-position on-off-on switches will be placed into the 16 Gate Bus holes across the center length of the panel, with all the other switch placements for the 2-position on-on switches. Make sure you don't toss a switch into a pot or jack hole. Look up at the front of the panel from below if you're in doubt.



Once all the switches are in, try to line them up so they're all close to vertical. Don't worry about orientation, just get them vertical. If you want you can note the little notch in the threads of each switch and match those up (warning: only suitable for OCD level 10 or above).

Jacks

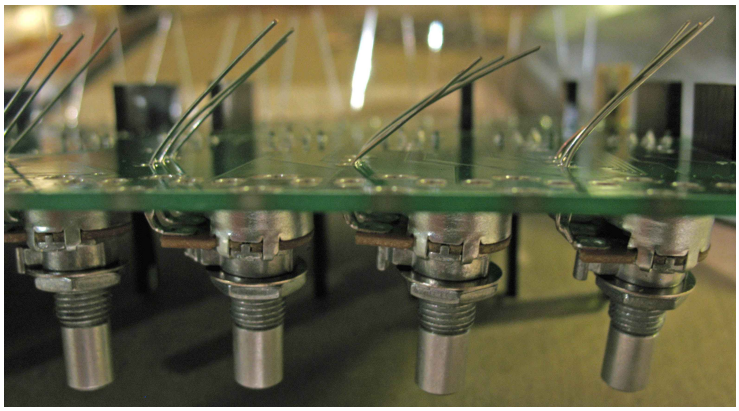
Place the jacks into the appropriate holes on the panel. Situate them so that the "rounded" side of each jack matches the silkscreen and is facing upwards towards the rest of the panel.



Pots

Place your soldered-n-ready pots into the appropriate spaces in the daughterboard PCB (not the panel). Make sure you get the pot values into the correct placements and that they are situated properly to match the PCB silkscreen, with the lugs pointing to the left. ***Also take careful note of which pots you screwed the nut down into the body in the earlier steps – those pots will need to be placed in the four left side positions (3x B1M and 1x B100K).***

As you lower the pots into the board, guide the wire legs through the holes below. Make sure you don't twist any around – they should go straight down from the lugs into the holes. Once they're sitting snug against the board, bend the wires on the other side of the PCB to keep the pots in place.



Placing the PCB

Go through all of the parts you placed and get them situated close to their ideal positions – you probably knocked a few out of place while moving things around, so fix it up nice and pretty.

Now that everything is lined up, lower the PCB onto the back of the panel. Make sure the LEDs or pots don't fly out as you do this – if so, place them back in the holes and bend the leads a bit more this time.

As you lower the PCB onto the components, you're going to have to fit the panel components and pins into the appropriate holes. This isn't as annoying as it sounds if you follow the proper procedure, and especially if you managed to get everything lined up nicely in the last few steps.

The sliders and rotary will get in the way first, so fit them through the slots and holes in the panel. It's easy for the top of a slider to catch the edge of the milling cutouts, so a pencil will once again do wonders in pressing the levers back into position.

The pots will be the next hurdle. They'll likely be shifting around quite a bit since we didn't exactly stabilize them, but that's intentional – grab the wires we just bent a moment ago and use them to fish the pot shafts around and guide them into their respective holes. Once the pots are safely positioned, straighten the wires out – you'll need the pots to be able to slide up and down easily in a minute.

The switches should be next. Rest the PCB on top of all of the switch pins, then go through and lightly twist each switch from below the panel until the switch pins pop into the proper holes. Try starting on a far edge and working your way towards the opposite edge – that way you can slightly push the PCB down onto the switch pins bit by bit as you work your way across. The pushbuttons should slip right through during this step, since you spent so much time getting them straight earlier

Once all the switch pins have been fitted into their holes properly the jacks will be next. Follow the same procedure as with the switches – twist each jack until it slips through the holes. Chances are they'll all pop in without needing to adjust anything.

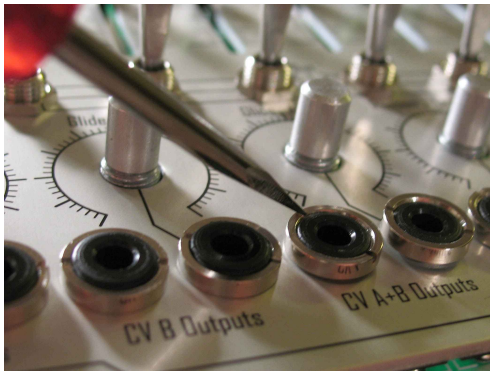
Double check everything and make sure there isn't a stray part that didn't make it through the holes – it should be fairly obvious if not, as the board won't be seated flat on all of the parts. Now would also be a good time to push each slider through its range to check that they won't rub against the edges of their slots during use. If any sliders are rubbing take a minute to reposition and re-solder them.

Securing the Panel

Once all the parts are fitting through their holes and the PCB is sitting nice and snug on everything, apply firm and distributed pressure to keep the panel and PCB together and then gently flip the assembly so you're looking at the panel with the PCB beneath. Keep the pressure on and secure the PCB with your vice (**not** the panel, unless you like ruining everything). Let the panel rest on top. Make sure the panel is seated firmly then start throwing the nuts onto each part - the small hex nuts on the switches, the larger hex nuts on the pots, and the round nuts on the jacks.

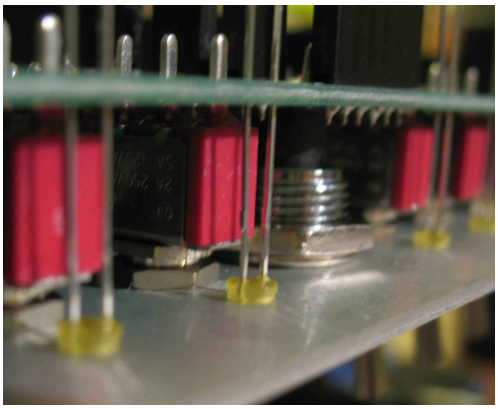
Start with the switches. Go through and tighten each nut with either a socket driver or your hands. If you're using pliers try not to gouge a scar in your satin fresh panel.

Now tighten the jacks. These use a circular nut with two notches in it. Unless you feel like fashioning a tool for this, your best bet is to hand tighten the nuts as far as you can get them then use the small flathead screwdriver to press the nuts a bit further for a secure fit. Keep your hand towards the tip of the screwdriver as you tighten and you shouldn't have any risk of flying off the cuff and dinging your panel.



Tighten the pot nuts last. You'll need to use your hands at first - slip the nut over the shaft, lift the pot up into the panel by the shaft, and keep it held securely with your hand as you tighten the nut with your other hand. Get it snug, then a socket driver is best to finish it up. Tighten the nut securely, but don't go crazy or you might rotate the pot.

Now everything should be secure. Hold the PCB to the panel as before and flip the assembly so you're staring at the PCB again. Secure the panel (**not** the PCB) into the vice or between your books or whatever you're doing. Now you'll place the LEDs into their holes.



Start at one corner and work your way down. Pick an LED and straighten the leads. Then while holding the leads guide the LED downward into the hole on the panel. The LED should slip in snugly and allow some room for you to push it all the way in until the little "lip" around the bottom of the LED catches the edge of the panel. Get each LED seated securely, make sure you're not twisting the leads around, and then get all fired up for some soldering.

Soldering the Daughterboard

This is fairly straight forward – start at one corner and work your way across. **Be careful while soldering that you don't rest the shaft of your iron against one of the sockets** – they're more than happy to melt if you do.

The jack and pushbutton solder pads have rather large holes – you don't need to entirely fill them with solder. Make a solid connection to at least half of the entire pad and that's good enough.

There are a handful of larger vias scattered around the board – there's no need to fill these with solder unless you're into that kind of thing. They'll carry the signal just fine without you getting all nasty.

Once you're done clip all of the LED, pot, and any other stray leads. Scan the board and make sure you didn't miss any joints – there are quite a few and it's not hard to miss one. Check the trickier joints to make sure you didn't create any solder bridges – the pads around P105 and between the pushbutton pads are good places to look.

Wrapping Up

Plug the electro-music boards back into the daughterboard sockets and secure them to the standoffs. If you happened to tighten that tricky corner standoff a bit too much you might notice that it is more recessed than some of the other standoffs. Don't bend the board trying to screw it down solid – these are just backup methods of securing the boards, so just get the screw snug against the PCB and call it good. Give the boards a scan underneath and make sure there isn't a stray set of pins that didn't slide into a socket.

Once everything is solid it's time to install the MTA cables. Lay the cables out so you can see their lengths – reference the chart and instructions below to avoid placing a cable in the wrong space:

Digital J6 -> Analogue J2
(8-pins ~185mm)

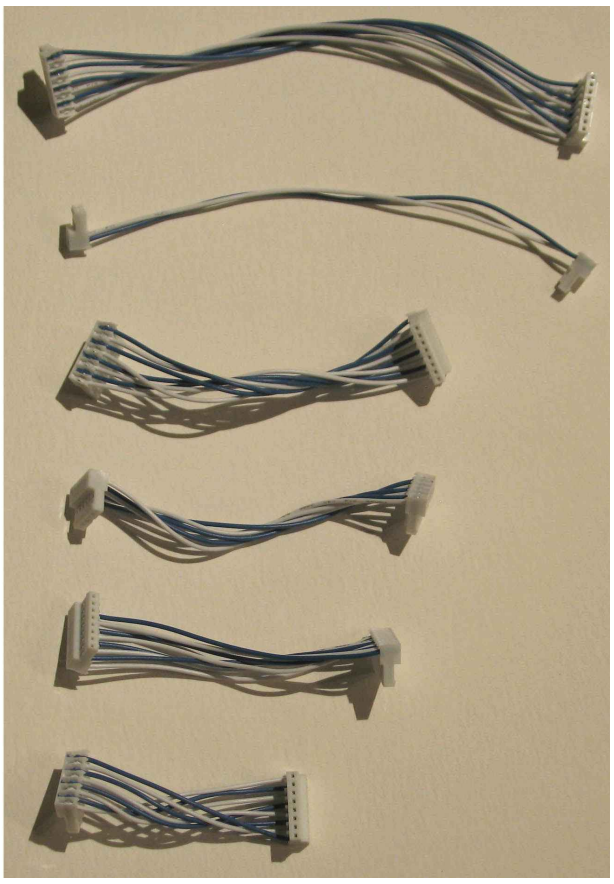
Digital J1 -> Analogue J11
(2-pins ~170mm)

Digital J7 -> Analogue J4
(8-pins ~120mm)

Digital J10 -> Sideboard D-J10
(6-pins ~115mm)

Analogue J9 -> Sideboard A-J9
(8-pins ~100mm)

Digital J3 -> Sideboard D-J3
(8-pins ~85mm)



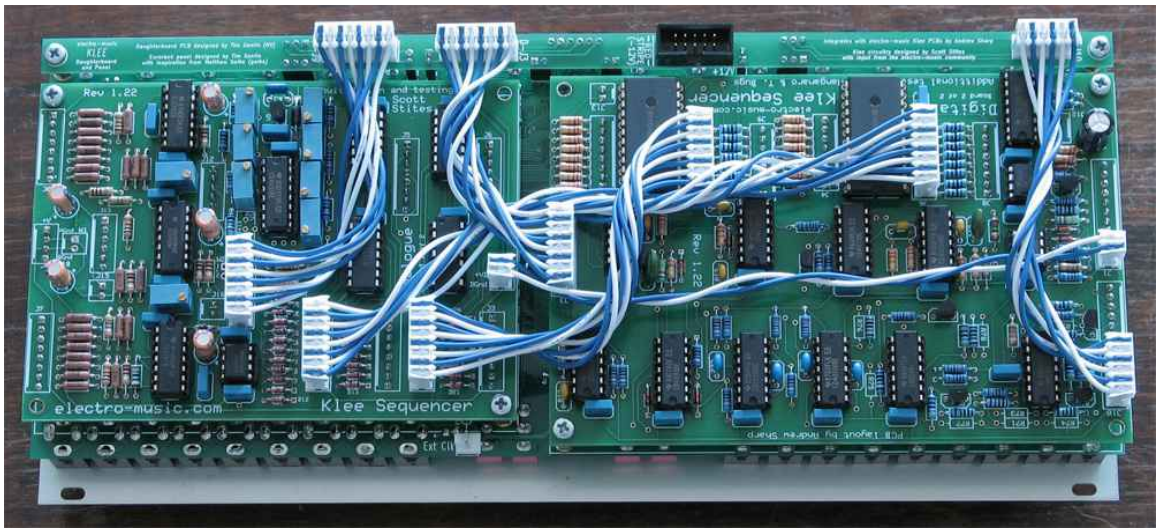
Note that some of the cables are wired straight across and others have crossed wires. It is important to note which is which and place them properly, otherwise you'll be running signals to the wrong places. All of the cables that go to the sideboard are straight and all of the cables between the analogue/digital boards have crossed wires.

You may want to give each cable a twist before placing them to tidy it up. Don't go crazy with the twisting, otherwise you may run the risk of pulling one of the crimped connections.

The connections you will be making with the cables are as follows and in the order I recommend placing them:

> ***Analogue J11 > Digital J1 (2-pin)***
> ***Analogue J2 > Digital J6 (8-pin)***
> ***Analogue J4 > Digital J7 (8-pin)***
> ***Analogue J9 > Sideboard A-J9 (8-pin)***
> ***Digital J3 > Sideboard D-J3 (8-pin)***
> ***Digital J10 > Sideboard D-J10 (6-pin)***

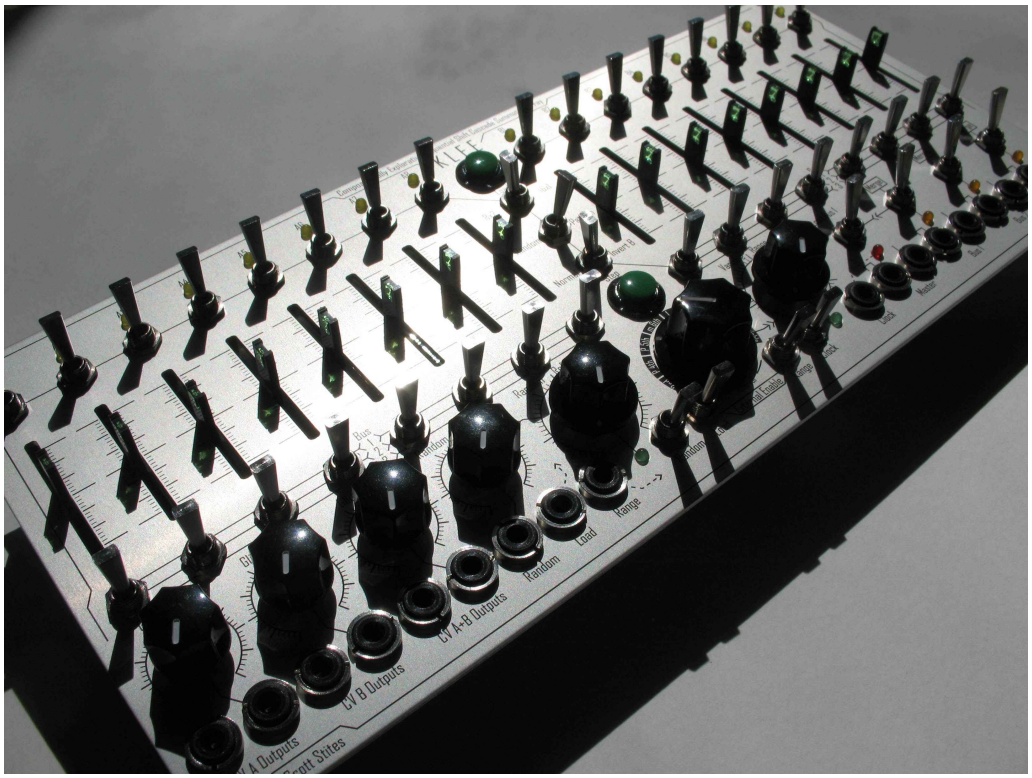
Move the wires around as you plug and tuck them in nicely to minimize the depth of the module. Here's my recommended approach:



Make sure you have the proper cables in the proper headers – remember which ones are straight and which are crossed.

Now plug the Euro power ribbon into the shrouded header. **The red stripe should line up with the "RED STRIPE (-12V)" marking on the silkscreen.** If it doesn't make sure you oriented your header correctly and that the locking cable connector is properly oriented as well.

Flip the assembly and check to make sure there aren't any loose nuts spinning around. Screw your knobs onto your pots, aligning them with the dials. The rotary has a D-shaft but a set-screw knob will fit just fine. Set the rotary to the first position, line the knob up, and screw it in. Magic.



That's it! Now time to test the thing.

Testing

Plug your new Klee into your rack, make sure the busboard end is oriented correctly (-12V to -12V), and fire it up. If you went with the "constantly on" resistor option for the slider LEDs you should see all of them light up. If you went with the "step" option then probably not, unless some of the bit LEDs light upon powering up (which happens with some CD4013 chips). The Range and Random LEDs may or may not light up but don't panic if nothing else does - you'll need some external input before the fireworks start.

The official electro-music Klee build manual contains a detailed bring-up procedure that will walk you through your initial tests of the Klee. Don't worry about whether or not the rotary settings sound right during this procedure or if one bank of sliders seems to be pitched differently than the other – you'll adjust them to be exact later.

Testing the Random function will be a bit different due to the inclusion of a modification in the daughterboard. To follow the manual's testing procedure make sure the External Enable Random switch is **up** and that the Random Level pot is set to about noon. More details on the Random modification are provided towards the end of this manual.

When you reach the variable range testing, you'll be testing both the internal and external variable range options – internal will be with the External Enable Range switch **down**, external will be with the Range switch **up**. Details on the LED behavior will be provided towards the end of this manual.

If anything isn't working during your bring up procedure, your first step will be to make sure everything is correct with your daughterboard construction – check for missed or cold solder joints, make sure the headers and sockets are seated right, ***and check the continuity of each of your cables to make sure a crimp wasn't knocked loose or a wire crossed during construction. The square solder pad of each header should match to the square pad of the other header it is wired to, with the wires continuing to match progressing down from there.*** If all of that checks out, check the continuity of the traces leading to whichever part doesn't seem to be working. These boards were electrically tested during manufacture so a broken trace should not be present, but it's something to test for. If everything checks out here, make sure the individual components are working as they should – check the resistance on the pot solder joints as you turn them, check the continuity on the switches as you flip them, and make sure signals are getting through the jacks to the board. If everything still checks out then chances are it's a problem on the main analogue/digital Klee boards. Head to the Muff Wiggler order thread (http://www.muffwiggler.com/forum/viewtopic.php?t=79912) for help with your build. **Also be sure to check the troubleshooting appendix at the end of this manual for more ideas** – many of the most common problems are explained there, and by that I mean probably 90% of the problems I've seen.

If the bring-up procedure works as planned then you've built yourself a working Klee! The next step will be to go through the calibration procedure to get the pots and ranges working as they should – this is detailed in the electro-music Klee build manual immediately following the bring-up procedure. You'll need a good ground point to clip to for calibration – I recommend the two middle pins of J10 on the far mid-left of the electro-music analogue board.

Now for some detail on the additional modifications featured in the daughterboard.

Included Modifications

The daughterboard features several functional modifications that are not included in the official Klee build manual. If you built the module by this build manual then there's nothing more you need to do – they're part of the circuit. The extra features are primarily contained in the "External Enable" switch matrix along the bottom/center of the module. They are as follows:

Range:

The LED underneath the "Variable Range" knob indicates the voltage currently heading into the Variable Range control. The Variable Range knob serves as an attenuator for this voltage. If the External Enable Range switch is flipped **down** this LED will light fully, meaning the full 8V is heading into the Variable Range pot for you to attenuate via the knob. If this switch is flipped **up** and nothing is plugged into the Range jack, the LED will go dark indicating that no voltage is heading into the Variable Range pot. However, with an input into the Range jack and the Range switch flipped **up**, the LED will indicate the positive voltage of whatever signal is heading into the range jack. This LED operates independently of the attenuator – it shows the maximum voltage going *into* the pot, not the voltage coming out.

Load:

With an input into the Load jack, flipping the switch **up** will pass the signal to the load circuit. Flip the switch **down** and the external load will be disabled.

Clock:

With an input into the Clock jack, flipping the switch **up** will pass the clock signal and progress the sequence. Flip the switch **down** and the clock will be disabled.

Random:

A steady positive voltage has been normaled to the random circuit. This allows for two modes of Random operation:

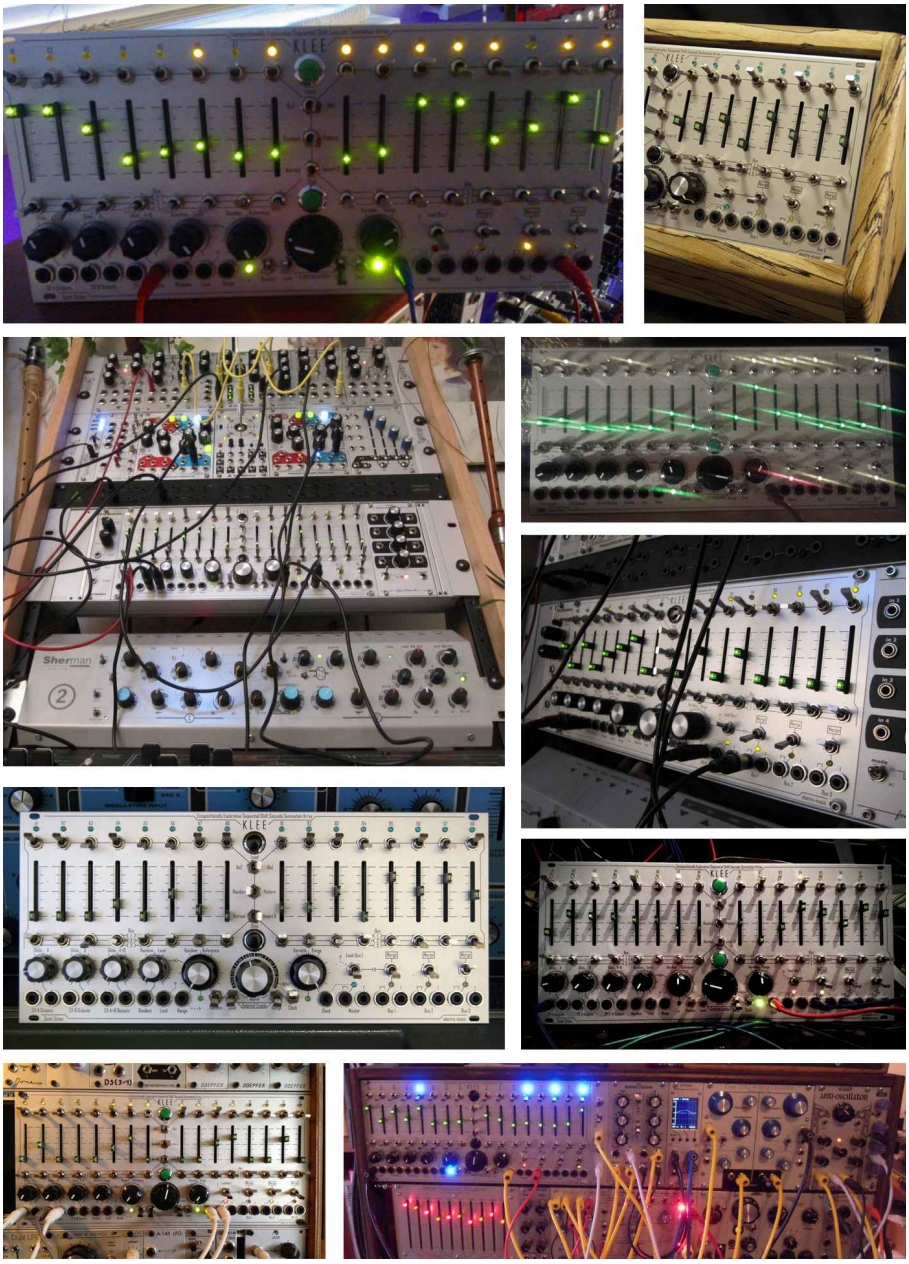
No input to the Random jack:
With the switch **down**, the Random LED will not light unless you turn the Random Reference all the way down (to 0V). With the switch **up**, a voltage is normaled to the Random Level pot which then passes into the Random Reference. Set the Random Reference knob below the Random Level knob and the Random LED will light, passing the Random signal to the sequencer. This allows the Random switch to function as an on/off window switch when in Random mode.

Signal input to the Random jack:
With the switch **up** this functions just as normally described in the Klee manual. Flip the switch **down** and the Random signal will not pass.

Operating the Klee

If you haven't already read the "Know the Klee" documentation from the collection of manuals (http://electro-music.com/forum/viewtopic.php?t=24821) now would be the time to do so - it will tell you everything you need to know about the inner workings of the Klee. The Klee is a bit more complex than your standard step sequencer, so if ever there were a module manual worth reading this would be it. Once you've scoured the "Know the Klee" manual, the "Klee Operating Tips" document is a great way to help you get in sync with your Klee.

Congrats! All done! Go forth and Klee hard.



Some additional tips to remember going forward…

- In order for your Klee to do anything once it's started, you'll first need to load it. Classic builder's panic right there.
- Gate Bus 2 functions as NOR logic of Gate Bus 1 and Gate Bus 3. It will take a little getting used to before you stop panicking when Gate Bus 2 seems like it isn't working.
- The Klee can easily function as a standard 16x1 or 8x2 sequencer. Flip on bit A1 in 16x1 mode or A1 and B1 in 8x2 and think of "Load" as "Reset."
- Don't underestimate the interplay between the Random on/off mod and the Random/Pattern switch. You can immediately throw some extra bits into a pattern without changing the bit switches by quickly flipping the two.
- The External Load feature is a great way to implement some structure into your Klee madness. Run your clock into a divider and send a divided trigger to the load input every 4^{th}/8^{th}/whatever bar. You can then focus on programming your Klee knowing that things will re-load in time with the structure you're working in. Flip the External Enable Load switch off whenever you want to break the structure and flip it back whenever you want some order again.
- When using the External Range function the Klee is essentially a sequenced attenuator/amplifier. Run an audio signal into the Range input and one of the CV outputs into the FM of an oscillator and you can create a Klee-style FM sequence.
- The Klee can function as a graphic oscillator up to about 620Hz, depending on your part tolerances.
- The Klee can function as a "one-shot" event generator by setting the Klee into Random mode and flipping the Random External Enable switch off. Run a clock into the Klee and a pulse into the Load input – the Klee will load the programmed bits on each pulse and the clock will cycle them off the grid. You can also manipulate the Random External Enable switch to "strum" the Klee bits this way.
- If you happen to have more than one Klee you can chain them together to form a 32-step, 48-step, or whatever-step Klee. Set one of the Klee's Gate Bus Merge switches on and connect that gate bus' Gate output to the Random Input of the next Klee. Follow the same procedure with the same Gate Bus outputs from the second Klee running into the Random Input of the next and continue the process until eventually a full circle is made, with the last Klee connecting to the first. Set all of the Klees to Random and 16x1 modes. Set the bit switches, load it, and off you go - the gates out of one Klee will trigger bits into the other creating a massive cycling bit pattern. Switch up the selected gate bus between Klees or try other approaches for further madness.
- Scott says delay and reverb are the Klee's best friends, and he's right. But don't forget that a quantizer is its pet.

Troubleshooting Appendix

Here you'll find the most common issues experienced by builders and how to go about fixing them. The most important element of troubleshooting is patience, which unfortunately is also the last thing you have at your disposal after a long build. Thus far every kit builder who has approached the forum with an issue has been able to resolve it, so rest assured that with some of that patience stuff you'll be able to get things working.

Schematics are your best friend as troubleshooting graduates from the "check joints/connections/orientation" stage into the "what the hell" phases. Scott has included the Klee schematics in his "Klee Documentation" electro-music thread linked at the beginning of this manual. Don't be intimidated by them – find the element of your build that is not working and trace the schematics back, checking each part in the line until you find the problem. If you have more than one element that is not working, find what parts those elements all seem to share and start digging around there. Print them out and go at them with some old fashioned ink and paper – it will make it much easier to keep things straight in your head and keep track of your progress.

Once again, don't be shy about asking for help. If you've come this far then you deserve to have a Klee inspiring your aleatoric atari bongo bug music needs, so get vocal. Ask me, Scott, and the electro-music and Muff Wiggler communities for help. Soon things will be humming away and you can focus on figuring out how the hell it all works.

Loose MTA Cable Assemblies:

By far the most common problem experienced by builders of this kit is a loose wire in one of the MTA cables. I did my best to build these cables to exacting standards but the process of packing, shipping, and plugging/pulling them can work a wire loose here and there. Fortunately this issue is easy to figure out and even easier to fix.

The cables all exist to connect a particular panel function to the Klee boards. If you have a particular jack, pot, or LED that seems to be flat out not working, chances are there's a loose wire in one of the cables. On pages 46-52 of Scott's Klee Build Documentation are lists of the various headers and what components they run to. Find the part that isn't working, get the associated cable number, and find the MTA cable with that same number on the main Klee boards - read the bottom of page 45 in the manual for information on how to decode the cable numbers. To streamline things even further here are the MTA cables used in the daughterboard and the manual page you'll find them on:

P103 (Digital board J3 to sideboard D-J3), p.46
P110 (Digital board J10 to sideboard D-J10), p.49
P209 (Analogue board J9 to sideboard A-J9), p.48
P106 → P202 (Digital board J6 to Analogue board J2), p.51
P107 → P204 (Digital board J7 to Analogue board J4), p.52
P101 → P211 (Digital board J1 to Analogue board J11), p.52

If you find that your problem seems to correlate with one of the cables, check each of the wires in the cable for continuity with your multimeter. Do this while the cable is plugged in if possible rather than pulled from the header. If one of the wires doesn't show continuity then you've found your problem.

Usually all it takes to fix this is pressing the wire deeper into the crimp. You can do this with a typical flathead screwdriver and something to keep things steady so you don't stab yourself – a vice is a good plan. If the wire is damaged you'll need to pull the wire from the cable and cram a new one in there. Just yank the wire out like a savage beast and cut a new piece to the same length. Use stranded core 22awg wire and press the wire into place on the header with a screw driver or an MTA hand tool if you happen to have one. Check the continuity of all the wires in the cable again (to make sure you didn't pull any others loose in your rage), plug it in, and see if everything works. Voilà.

The Mysterious Via Resistor:

The Analogue/Digital electro-music boards utilize vias which look very similar to the through-holes intended for components. As a result there are several vias on the boards which have a history of confusing builders due to their placement directly onto the silkscreening for various resistors. These resistors are listed below:

Digital board:
- ***R1-R8***
- ***R9-R16***
- ***R20***

Analogue board:
- ***R22***

The most common via resistor placement is in R20 of the Digital board. The symptoms associated with this are issues with loading, most noticeably a non-functioning Manual Load button.

R22 on the Analogue board is associated with the CV B Outputs. If you're having problems there be sure to check R22 for possible via placement.

R1-R8 and R9-R16 on the Digital board are associated with the Pattern (Bit) switches, so any issues with a particular Pattern switch may be the result of a resistor into a via.

Negative Voltage Scaling:

During the Klee calibration procedure the voltages you read on the trimpots (Analogue board R34-R41) should be a negative value rather than the positive value stated in the Klee build manual. This is a minor error in the manual – the values for the trimpots are intended to be negative, so no need to molest those trimpots to try and coax a positive value from them.