Samodular 296s Build Guide

Version 1.2 - May 2022

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Preparation & Expectations

The 296s is a complex build that takes upwards of 30 hours. For comparison, most of the cards have more components and take longer to build than some complete modules. With this in mind, it is important that you allocate enough time to build the module correctly and resist the temptation to rush through the build process. It's understandable that what you really want is a working module to play with, but a successful build requires careful attention to detail.

Paying careful attention to detail takes time, however paying careful attention to detail throughout the build process takes much less time overall than the hours/days it may take to find and correct a mistake that could have been avoided in the first place.

This guide provides a general build sequence and provides special notes and detailed information on areas that are non-obvious or require extra attention to detail, as such, this guide assumes that you have the necessary tools and general DIY skills to complete a build by following a bill of materials and referencing component maps.

Bug Fixes and Modifications

Samodular PCBs have been updated to include the fixes and modifications that were necessary with earlier DIY kits. No bug fixes or modifications are necessary to complete the 296 build. Additionally, the Samodular full kits are delivered with correctly selected critical components where necessary.

Build Overview

The build sequence is broken down into eight main steps with additional build breakdown under each step. Steps 2-6 can be performed in any order that works, though the sequence here is intended to have the panel and Main Board (MB) finished first so that when the cards are finished the last steps are final assembly and calibration.

1. **Verify Kit**
2. **Panel, Power, and Hookup Prep**
3. **MB Build**
4. **MB + Panel Assembly**
5. **Cards 1-5 Build**
6. **Cards 6-10 Build**
7. **Final Assembly**
8. **Calibration**

Step 1: Verify Kit Against BOM

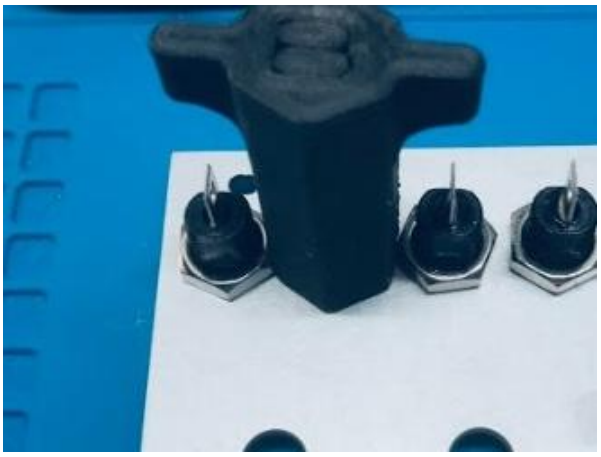
Samodular complete kits ship with all required components needed to complete a module. While great care is taken to ensure that kits ship with all the correct components, occasional component errors do happen. It's worth taking the time to verify components against the bill of materials to ensure that your kit is complete.

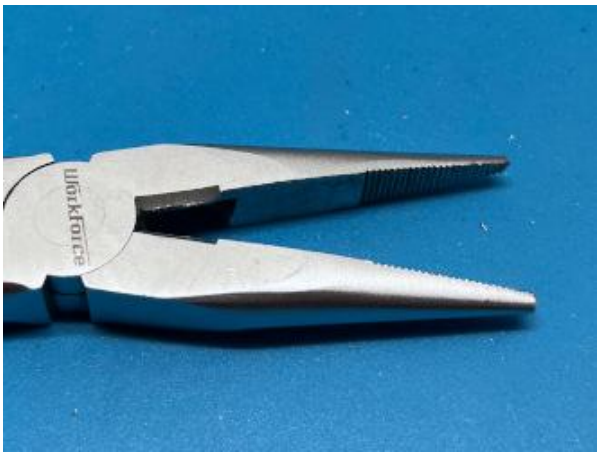
Step 2: Panel, Jacks, and Power Prep

1. **Mount Banana Jacks**: make sure to adequately tighten the banana jack nuts, but not so tightly that you strip the nylon threading on the jack. You don't want a jack coming loose after final assembly.

Black Banana Jacks	CV Inputs	Quantity 18
Blue Banana Jacks	Even Envelope Follower Outputs	Quantity 8
Purple Banana Jacks	Odd Envelope Follower Outputs	Quantity 8

NOTE: When tightening the nuts for the banana jacks, the spaces between the jacks are very close and prevent using regular tools to tighten the nuts. Having long nose pliers on hand helps here.





2. **Cut and Prep Hook Up Wire**: cutting, stripping, tinning (if you use stranded hook up wire), and crimping all of the necessary hookup wire takes a considerable amount of time. No-clean solder is used to tin the ends. Most builders use color coded hookup wire for banana jacks that follows the color scheme for voltage: black for CV input and blue for both blue and purple CV output. For Tinijax, white for signal, black for ground, and green (not pictured) for normal.

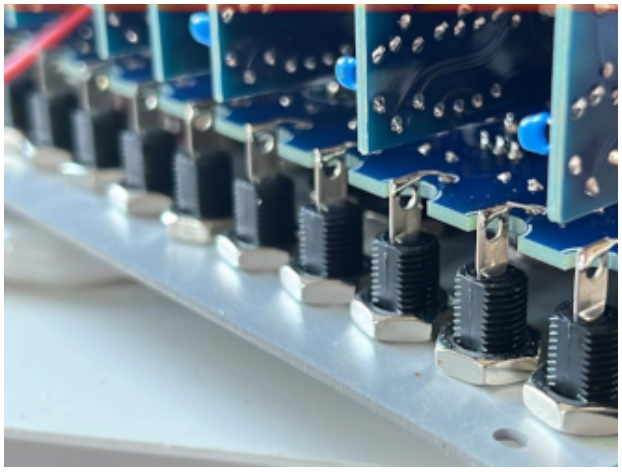
The following table provides the minimum list of necessary hookup wire and assumes ground bussing on all audio jacks.

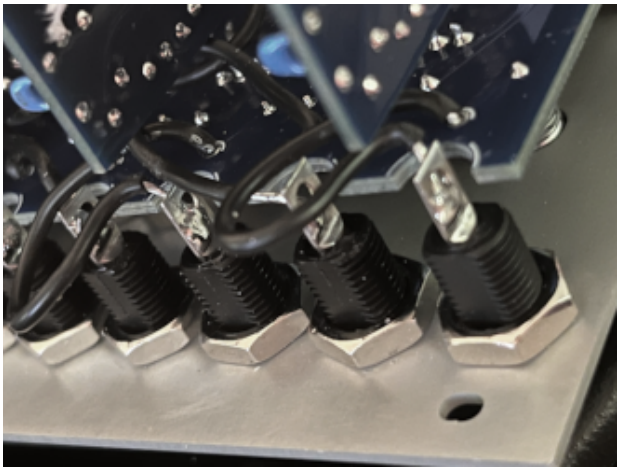
NOTE: 1” to 2” lengths are the maximum length for the 296s build to ensure space for the cards.

Black hook up wire	Black Banana Jacks - CV input	Quantity 18
Blue hookup wire	Blue & Purple Banana Jacks - CV output	Quantity 16
White hookup wire	Tinijax tip connection (S) - audio I/O	Quantity 27
Black hookup wire	Tinijax sleeve connection (G) - audio I/O	Quantity 6
Green hookup wire	Tinijax normal connection (N) - audio I/O	Quantity 2
24 awg solid	Tinijax ground bus - audio I/O	Quantity 6

PLANNING AHEAD TIP: there is more than one possible approach to connecting banana jacks and audio jack to the 296s MB. In either approach, it is advisable to use the shortest wire lengths possible because longer lengths can get in the way of the cards and final assembly.

For the 296s build in particular, another approach to banana jack hook up is using trimmed resistor legs instead of hookup wire to preserve space needed for final assembly. The images below show the tight card clearances and the advantages of using trimmed resistor legs for this build.





3. **Power Cable and EDAC Prep**: the 296s power cable requires three connections: +15v (red), -15v (white), and Quiet Ground (black). The colors listed are the standard colors for 4U power connections.

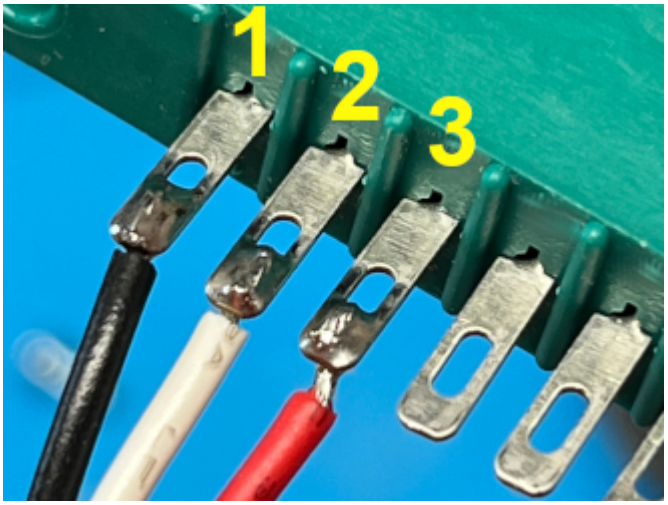
   Cut and Prep Power Hookup Wire: 18” is a good minimum length for the power cable.

Black Hookup Wire 18”	Quiet Ground, EDAC pin 1	Quantity 1
White Hookup Wire 18”	-15v, EDAC pin 2	Quantity 1
Red Hookup Wire 18”	+15v, EDAC pin 3	Quantity 1

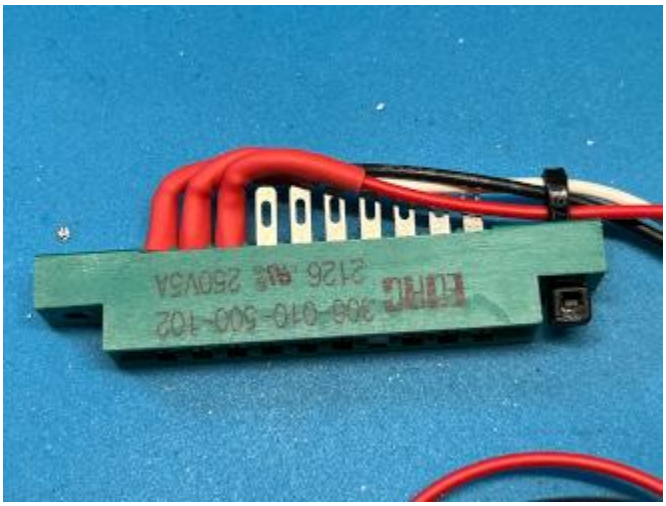
I use stranded wire so it can flex, as such I also strip and tin both ends. No-clean solder is used to tin the ends. I also prefer shrink tubing the cable with two sections of shrink tubing allowing each wire to follow its natural coil. Some builders like using zip ties to keep the power cable together. Either method is fine.

4. **EDAC Prep**: crimp the tinned wire ends before soldering to form a good physical connection to the EDAC eyelets. The pin numbers and colors adhere to the power connection standards for 4U. No-clean solder is used here.

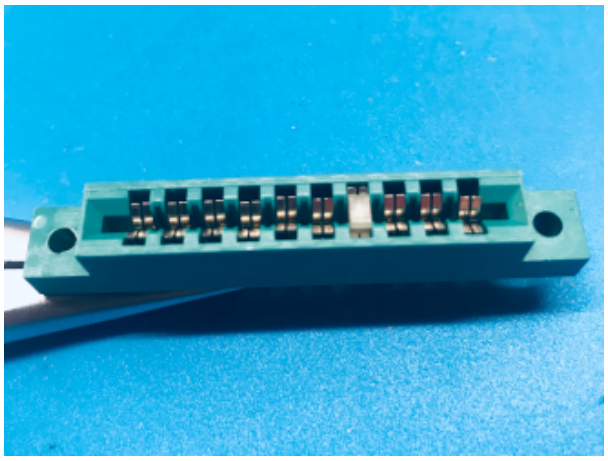
    - **Pin 1 Black**: Quiet Ground
    - **Pin 2 White**: -15v
    - **Pin 3 Red**: +15v



Adding shrink tubing to the eyelet connections and using a zip tie to secure the power cable to the EDAC is optional; though a good practice.



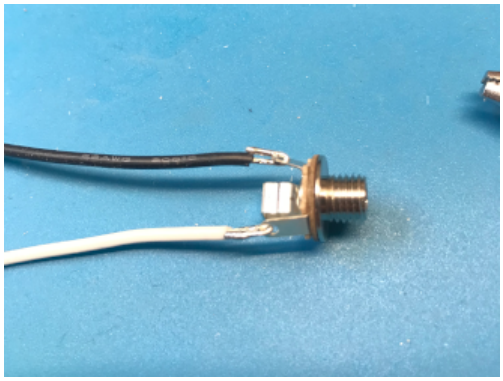
Preventing Reverse Power: if available, insert a polarizing key into EDAC pin 7. The polarizing key ensures that the power cannot be reverse connected. See Mouser part number 587-338-240-328. If you do not have a polarizing key, a solder bridge at pin 7 can also be used.



5. **Tinijax Prep**: two types of Tinijax used in the 296s build. Tinijax model 41 provides tip and sleeve. Tinijax model 42 provides tip, sleeve, and normal. The white, black, green, and solid hookup wire prepped above is used here. No-clean solder is preferred for preparing the Tinijax.

Tinijax 41 tip(S), sleeve(G)	Comb Filter Outputs	Quantity 2
Tinijax 41 tip(S), sleeve(G)	Attenuator Outputs	Quantity 3
Tinijax 41 tip(S), sleeve(G)	Programmed Outputs	Quantity 3
Tinijax 41 tip(S), sleeve(G)	Channel Outputs	Quantity 16
Tinijax 41 tip(S), sleeve(G)	Input All	Quantity 1
Tinijax 42 tip(S), sleeve(G), normal(N)	Input Even, Input Odd	Quantity 2

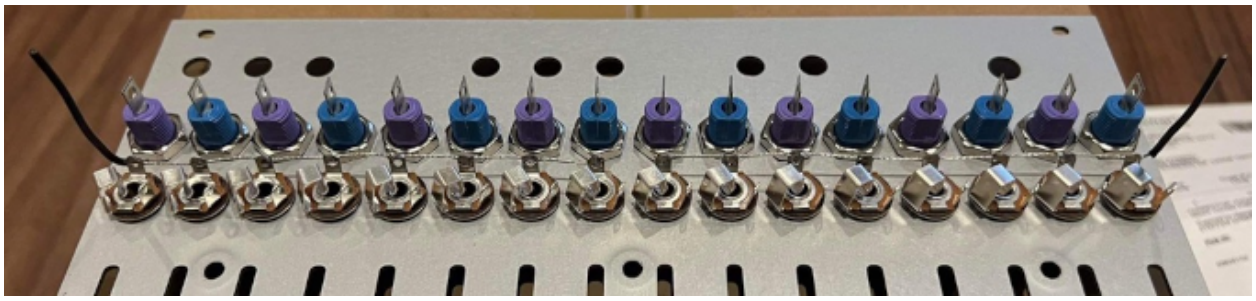
On Tinijax 41 the longer eyelet is tip (S) and the shorter eyelet is sleeve (G). Here, white is used for (S) and black is used for (G).



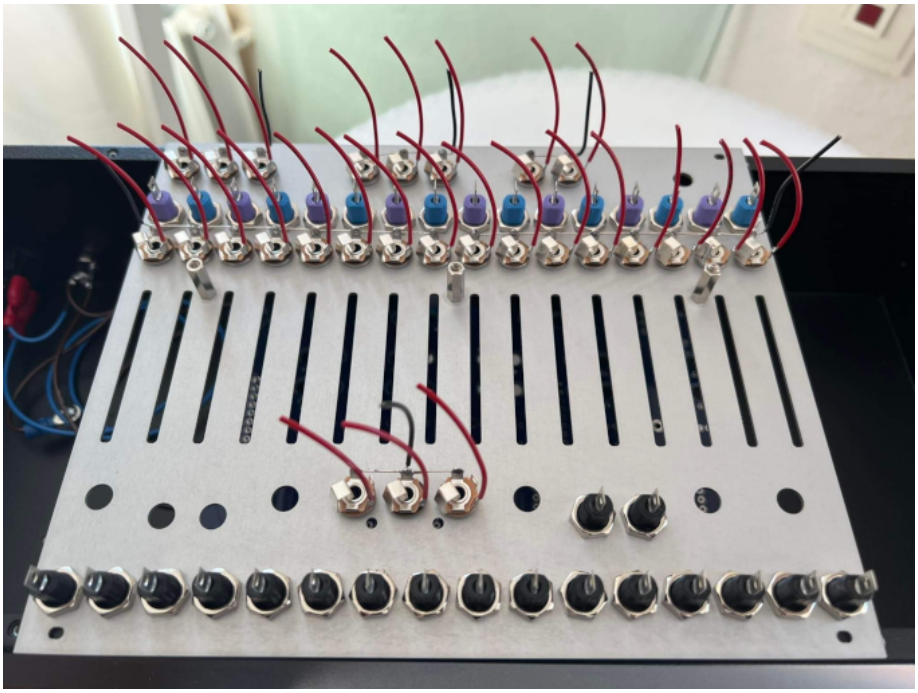
NOTE: you must install a ground bus across the Tinijax ground eyelets for the 16 channel outputs as there are only ground (G) pads on channels 1 and 16 for the channel outputs on the MB. Split the channel output Tinijax into 2 grounding groups: channels 1-8 grounded to channel 1 and channels 9-16 grounded to channel 16.

Example Ground Bus: for Channel Outputs 9-16, orient the Tinijax to ensure that the ground bus does not short on the tip (S) post. Ground connects to channel 16. Repeat in reverse for Channels Outputs 1-8 with ground connecting to channel 1.

The completed ground bus groups. Review the two sets of 8 Tinijax with ground bus. Note orientation of Tinijax and ground bus.

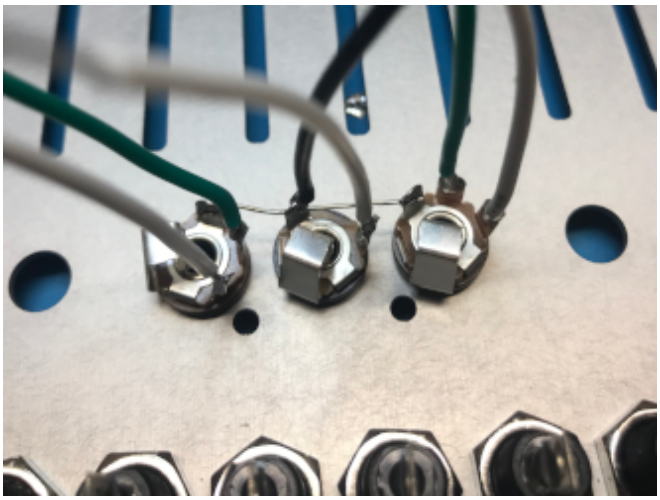


Ground busing the remaining Tinijax is optional, though advisable given the density of the build.



NOTE: Signal Input jacks are grounded to the Input All jack in the middle. Even Input and Odd Input use three-connecter Tinijax 42 and are only connected to the MB via (S) and (N). (S), (N), and (G) are labeled on the PCB silkscreen.

PLANNING AHEAD TIP: pay special attention to the orientation of the Signal Input Tinjiax and the proximity of the LED mounting holes. Once the final module is assembled, it is a very tight fit.



Step 3: Main Board (MB) Build

MB build is relatively quick and is divided into two separate phases: Wet Build and Dry Build. Wet Build uses solder with water soluble flux (Kester 331) and covers all of the components that can be washed in water. Dry Build uses no-clean solder (Kester 245) and covers all of the components that cannot get wet.

NOTE: the 296s PCB silkscreen denotes parts by their value rather than part number. It is highly recommended that builders make use of the component maps available here.

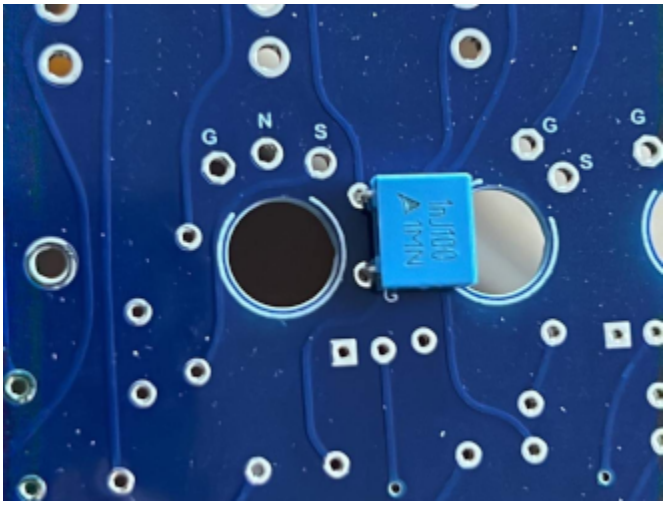
1. **Wet Build Resistors**: SMD resistors are pre-installed. Resistor installation on the MB is straightforward with no special considerations.

Resistors (component maps)		
SMD - Pre-installed	22K	Quantity 16
SMD - Pre-installed	33K	Quantity 16
Through Hole	1R 5% 1/2W	Quantity 2
Through Hole	680R 1% 1/4W	Quantity 1
Through hole	4.7K 1% 1/4W	Quantity 2
Through hole	22K 1% 1/4W	Quantity 7
Through hole	33K 1% 1/4W	Quantity 16
Through Hole	47K 1% 1/4W	Quantity 2
Through Hole	100K 1% 1/4W	Quantity 2
Through Hole	150K 1% 1/4W	Quantity 4

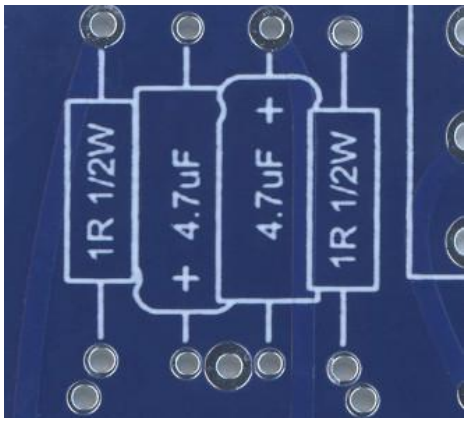
2. **Wet Build Capacitors**: there are only a few capacitors on the MB. Installation is straightforward with a few notes below.

Capacitors (component maps)		
Through Hole	1nF Film 5mm mount 1 on back of PCB	Quantity 2
Through Hole	15nF Film 5mm	Quantity 2
Through Hole - Axial Lead	4.7uF Electrolytic - NOTE Polarity	Quantity 2

NOTE: one of the 1nF caps should be mounted on the back of the MB otherwise it will interfere with one of the Input Tinijax. It should also be mounted at an angle so that it doesn't interfere with card 7. There is a silkscreen error on the back of MB. Ignore the (S) and (G) that are next to the pads for the capacitor (currently hidden by the capacitor in the photo).



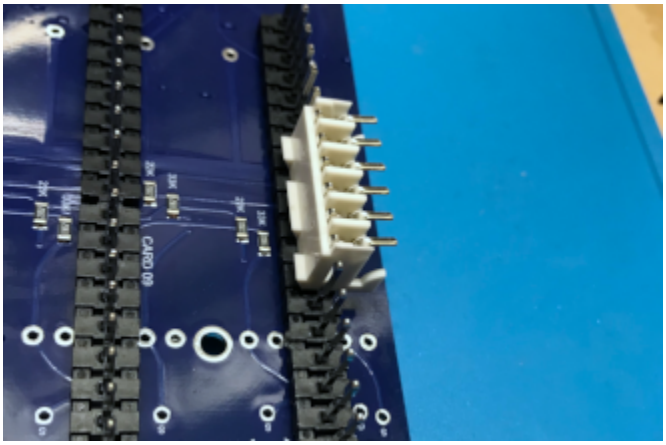
NOTE: 4.7uF Electrolytic capacitors are axial lead and polarized. The silkscreen denotes the correct orientation for polarity, but it is worth verifying.



3. **Wet Build Pin Headers:** pin headers mount on the rear of the MB PCB and are soldered into place on the front side. All card slots except card 4 are 20 pin connections and use 2x 10 pin headers. Card 4 is an 18 pin connection and uses 3x 6 pin headers.

Pin Header 6 pin Male	Card slot 4 - 18 pins	Quantity 3
Pin Header 10 pin Male	Card slots 1-3, 5-10 - 20 pins	Quantity 18

PLANNING AHEAD TIP: because of the depth of the completed 296s, it is important that the pin headers are mounted flush against the MB PCB. Also because of the proximity of neighboring cards, it is equally important that the pin headers are straight at a 90 degree angle perpendicular to the PCB. For best results, place a Molex connector across the joint between the pin headers to hold the group in place and while soldering.

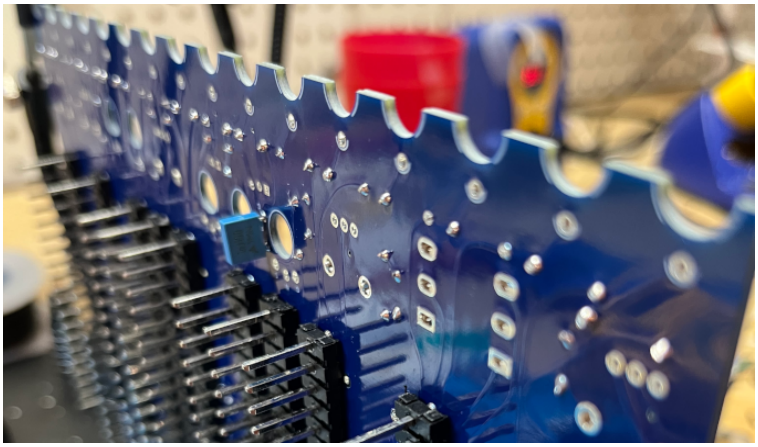


4. **Wet Build Banana Jack Hookup Wire**: installation of the banana jack hookup wire is optional at this point. Installing banana jack hook wire now allows using solder with water soluble flux for a cleaner final PCB.

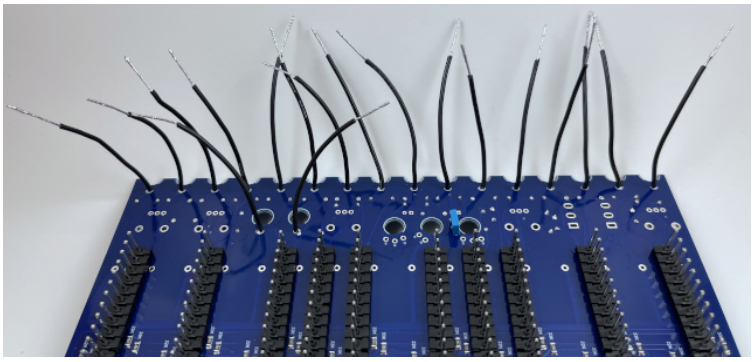
Black hook up wire	Black Banana Jacks - CV input	Quantity 18
Blue hookup wire	Blue & Purple Banana Jacks - CV output	Quantity 16

It is marginally easier to install the banana jack hookup wire to the PCB then solder to the banajack after MB assembly. Banana jack hookup wire is mounted on the rear of the PCB and soldered on the front. Standing the PCB allows for the quickest installation of the banana jack hookup wire.

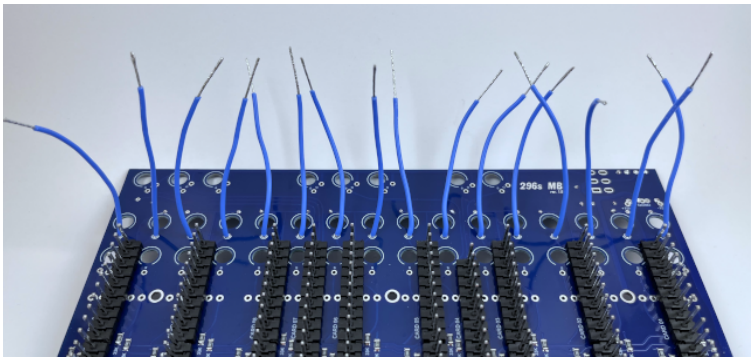
Here the mount points for the black banana jacks are easily accessible. The mount points for the blue and purple banana jacks are not as easily accessible.



Completed black banana jack hookup wire. This image is only illustrative. It is advisable to use much shorter wire length due to the proximity of the card slots and density of the build.

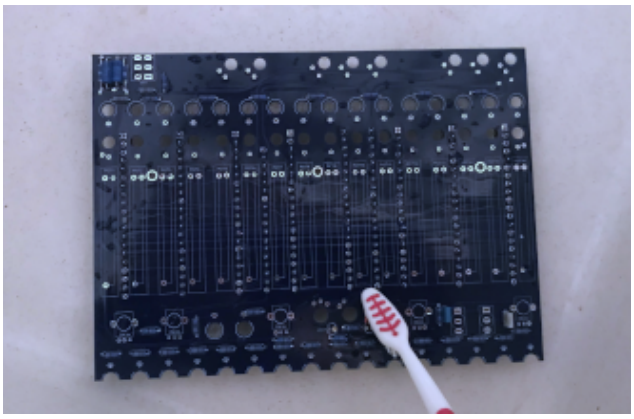


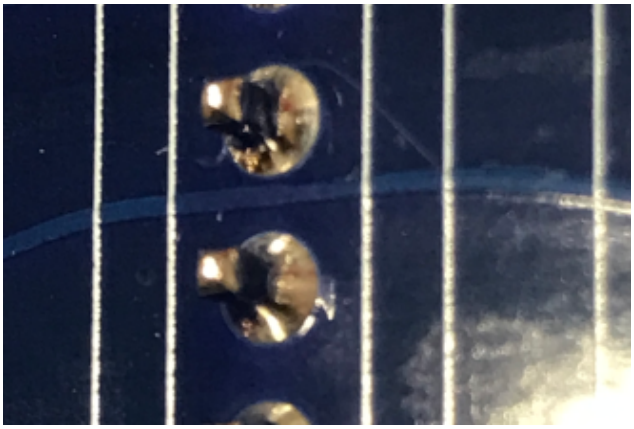
Completed blue banana jack hookup wire. This image is only illustrative. It is advisable to use much shorter wire length due to the proximity of the card slots and density of the build.



5. **Wash MB in Hot Water**: scrub lightly with a soft toothbrush under running hot water (120 to 140 degree F). Water soluble flux (Kester 331) will lather up and help clean the PCB leaving a nice, flux-free finish.

   NOTE: The Kester 331 Flux Cored Wire Technical Bulletin recommends cleaning within 48 hours. Most builders clean every hour or so. See kestor.com for details.



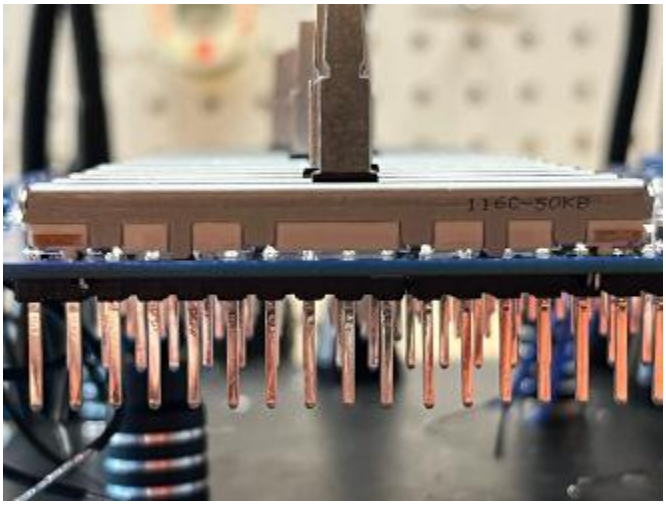


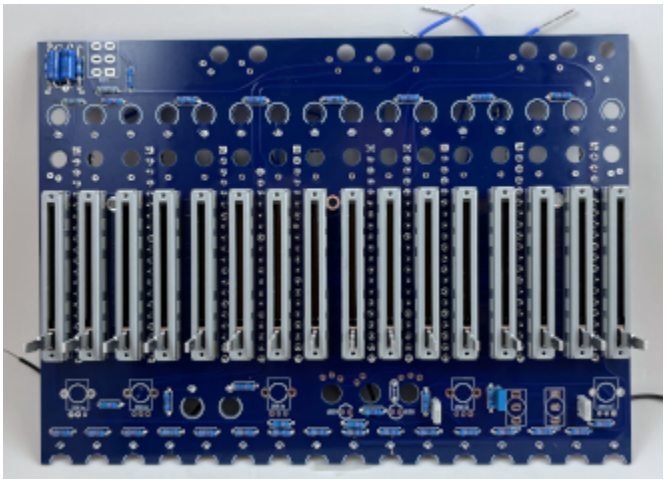
   NOTE: Dry PCBs thoroughly after washing before beginning the Dry Build. Let the PCB dry overnight if possible.

   After the PCB has dried completely, switch to no-clean solder for the remainder of the MB build.

6. **Dry Build Alps Slide Potentiometers**: the slide potentiometers are easy to install. There are only three pins to solder. Tack one pin into place then reflow that pin while pressing the slider against the PCB to ensure that it sits flush.

Slide Potentiometers	ALPS 50K Linear - Pots 1-16	Quantity 16





7. **Dry Build 9mm Potentiometers**: The 9mm potentiometers snap into place on the front side of the MB PCB. The 9mm potentiometers can be soldered now or after the panel is installed.

9mm Potentiometers	25K Linear	Quantity 16

NOTE: threads on the 9mm pot shafts will not extend above the panel so there is no need to fasten the nut on the panel. The nut can, however, be set at 15mm on the shaft to allow the potentiometer to also function as standoff.

8. **Dry Build Switches**: there are three switches in this build. Installation is straight forward. Because the switches are ON-ON-ON and ON-ON, orientation does not matter.

SW1	DPDT ON-ON-ON	Quantity 1
SW2, SW3	SPDT ON-ON	Quantity 2

NOTE: 15mm standoff provides a good reference for setting the switches under panel nuts to the correct height. For best results set the under panel nut height, install the panel, install the panel nut for the switch, then solder the switch to the MB.

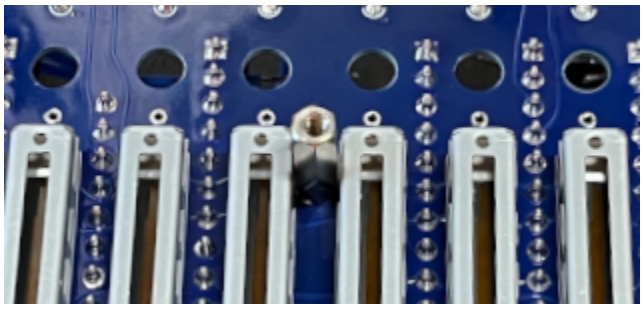
Step 4: MB & Panel Assembly

Finalizing the assembly of the MB to the Panel is best accomplished by mounting the stand offs to the MB, placing the MB on its back with the pots and switches facing upwards, then lowering the panel down onto the MB.

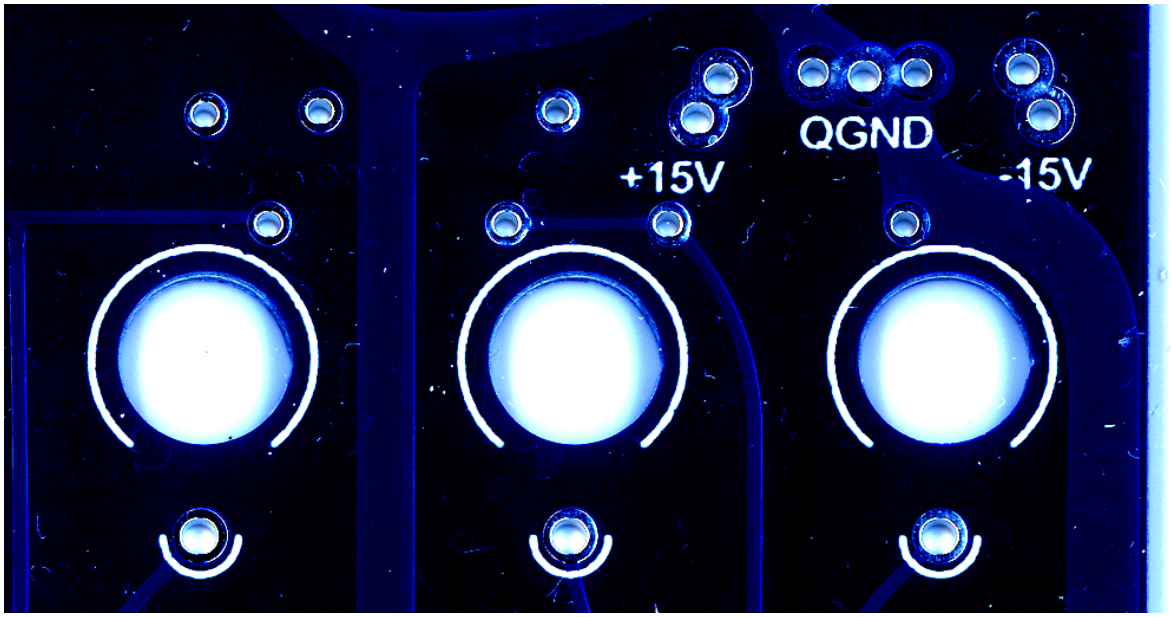
1. **15mm Standoffs**: there are three 15mm standoffs that attach to the front of the MB. Because of the tight fit between the sliders, attach the standoff to the MB.

Standoff	15mm	Quantity 3

NOTE: pay special attention to the orientation of the standoffs so that they fit cleanly between the sliders.



9. **Power Cable Installation:** the power cable pads for +15v (red), -15v (white), and quiet ground (black) are clearly labeled on the silk screen.



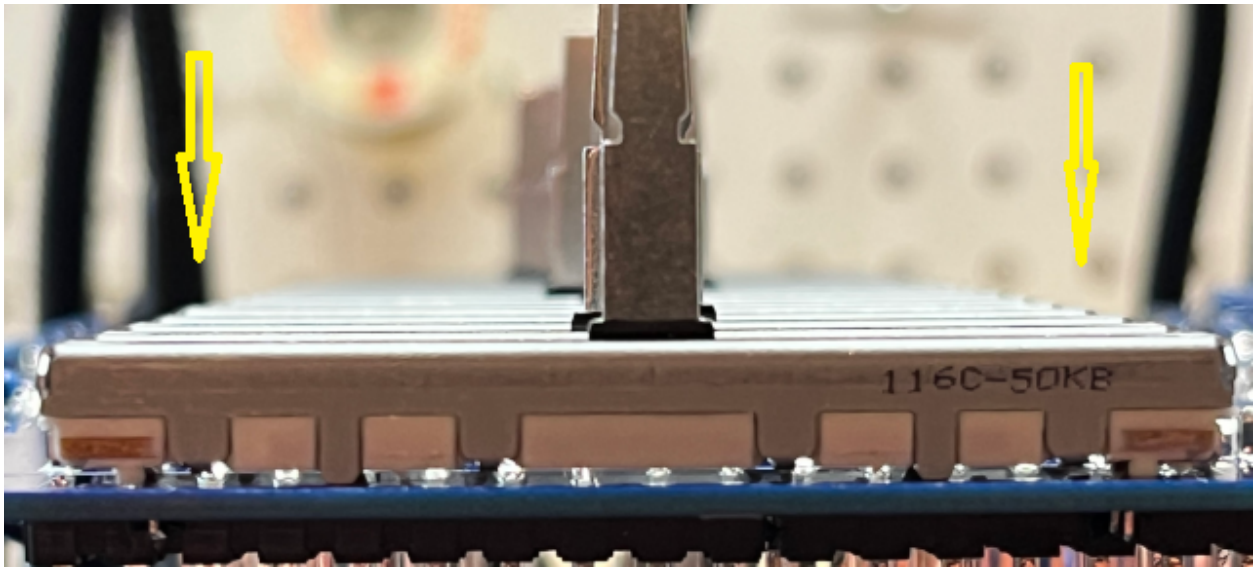
POWER CABLE TIP: there are no zip tie mount points for securing the power cable to the MB. The channel 0 (<100) banana jack socket can be used to secure the power cable to the MB using a zip tie.

10. **LEDs**: LEDs are the last item added to the MB before installing the panel. LEDs install on the front and are soldered on the back of the MB. The LED cathode is the shorter leg and is inserted into the square pad.

LED 3mm Red	LED1, LED1	Quantity 2

LED INSTALLATION TIP: cover the LED holes on the panel with cellophane tape until you are ready to solder the LEDs into place. Depending on your preference, leave the tape in place so that the LEDs are mounted flush with the panel. Remove the tape and adjust the LED protrusion should you prefer more LED above the panel surface.

11. **Panel Installation**: with the MB front facing upwards, lower the panel onto the MB. The slider and potentiometer shafts should line up perfectly. It may take a little adjusting to get the switches through.



Once the panel is seated correctly, install the flat head screws into the countersunk holes for securing the panel to the standoffs.

Install the switch nuts onto the panel to hold the switches in place.

12. **Dry Build MB Final Soldering**: complete the MB & Panel by soldering the remaining components using no-clean solder:

    a. 9mm potentiometers
    b. Switches
    c. LEDs
    d. Tinijax hookup wire
    e. Banana jack hook up wire

13. **Install switch caps, slider caps, and knobs**: the MB & Panel assembly is complete.

Step 5: Cards 1-5

Building the cards 1-5 is generally straightforward with a few details that require special attention. The card build process is split into two phases: Wet Build using solder with water soluble flux, and Dry Build using no-clean solder. Only the Trimmers are installed using no-clean solder, all other components can be washed in water.

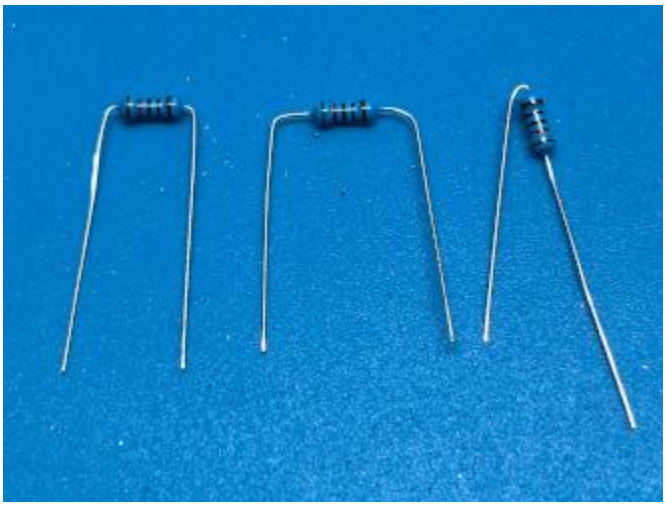
NOTE: the silkscreen on cards 1-5 shows parts values not parts numbers.

1. **Wet Build Cards 1-5**: diodes, resistors, capacitors, transistors, IC sockets, and Molex connectors are all installed in this step. There are too many components to list individually. It is highly recommended that you follow the component maps here for cards 1-5.

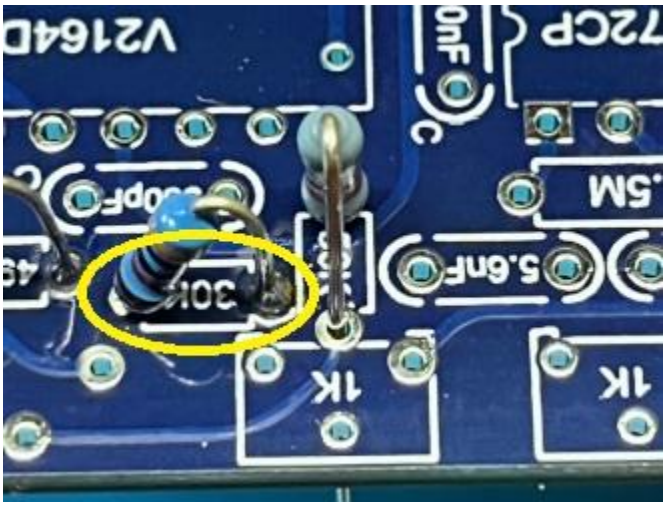
Cards 1-5 Wet Build (component maps)

2. **Wet Build Diodes**: no special notes. Only 1N457 diodes on card 1-5. Orientation is marked on silkscreen. Refer to the (component maps) for diode locations.

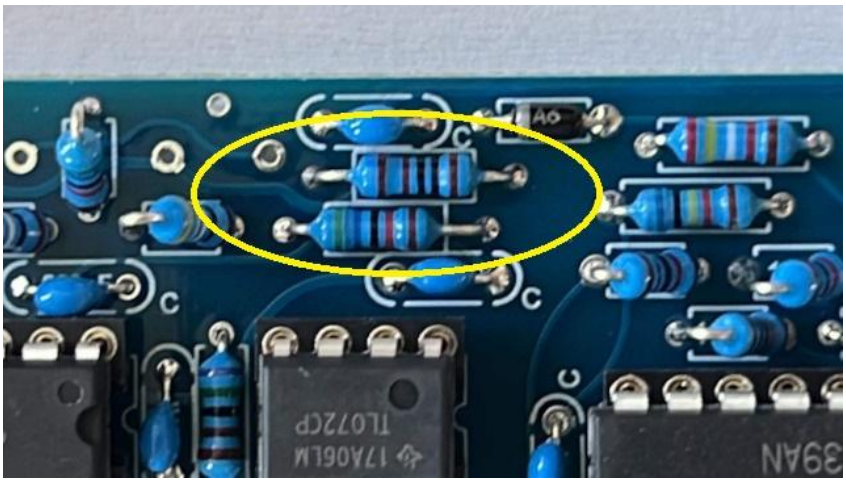
3. **Wet Build Resistors**: There are three different resistor footprints on the card 1-5. Standard, wide, and standing. Inspect the resistor footprints ahead of time. Refer to the (component maps) for resistor locations. Standard footprint resistors have no special instructions.

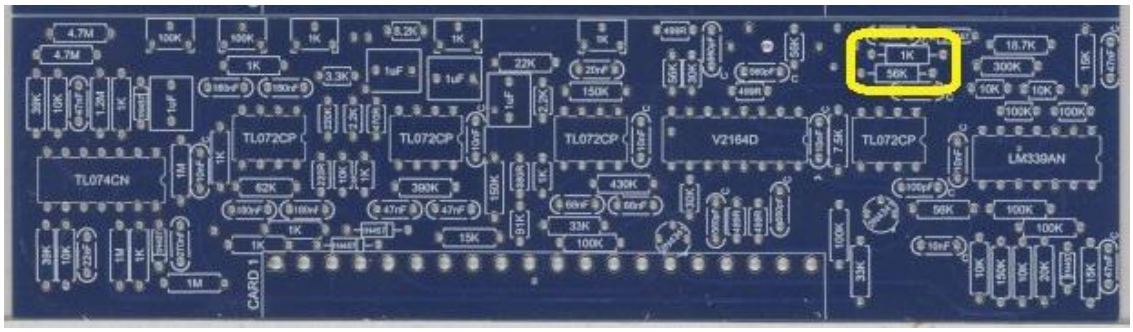


Standing Resistors: due to the density of the build, about half of the resistors need to be mounted standing. The angle of the resistor is not important as long as the resistor fits into the footprint as shown below. Inspect the resistor footprints ahead of time. Refer to the (component maps) for resistor locations.



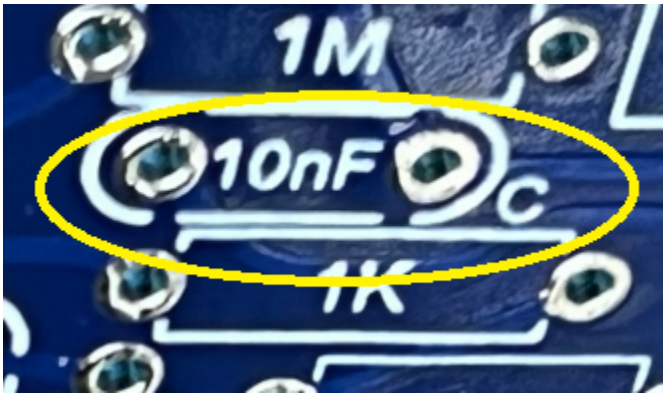
Wide Footprint Resistors: Cards 1, 2, 3, and 5 have two wide footprint resistors which are in the same location on all cards. Card 4 does not have any wide footprint resistors.



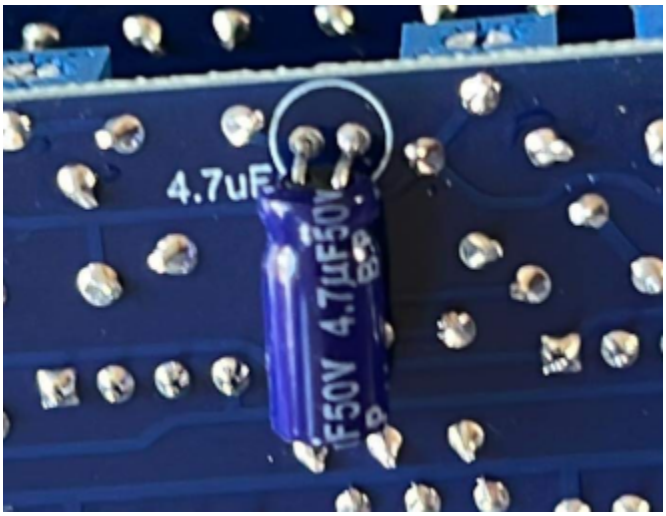


4. **Wet Build Capacitors**: ceramic, electrolytic, and film capacitors are used on cards 1-5. Special attention is required for the ceramic and electrolytic capacitors. Refer to the (component maps) for capacitor locations.

   Ceramic Capacitors: on all cards except 4 & 7, the silkscreen denotes ceramic capacitor with a small “c” next to the footprint. Cards 4 & 7 have no small “c” next to the foot print. Card 4 only has ceramic caps, Card 7 has 2x 220nF film caps in addition to ceramic caps.

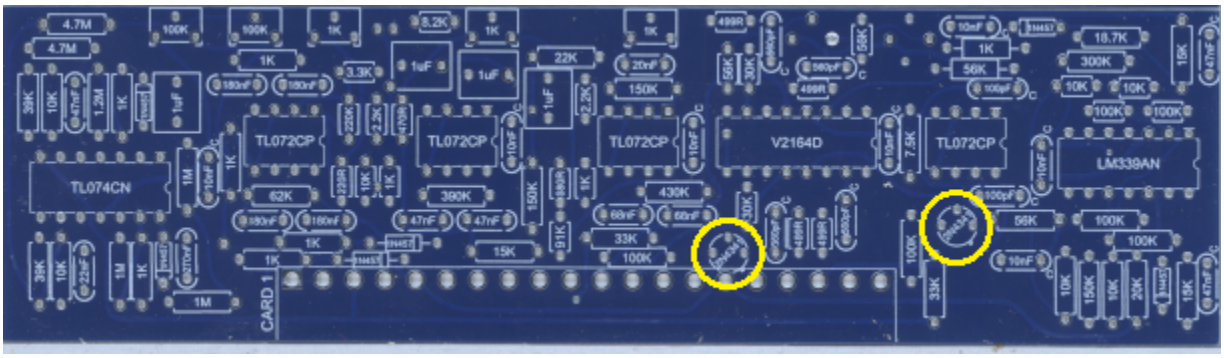


   Bipolar Electrolytic Capacitor: there is a single 4.7uF bipolar electrolytic capacitor that mounts on the back of card 1. Its leads should be bent at a 90 degree angle so that it can lie flat against the card. **NOTE**: this capacitor is bipolar so there is no polarity.



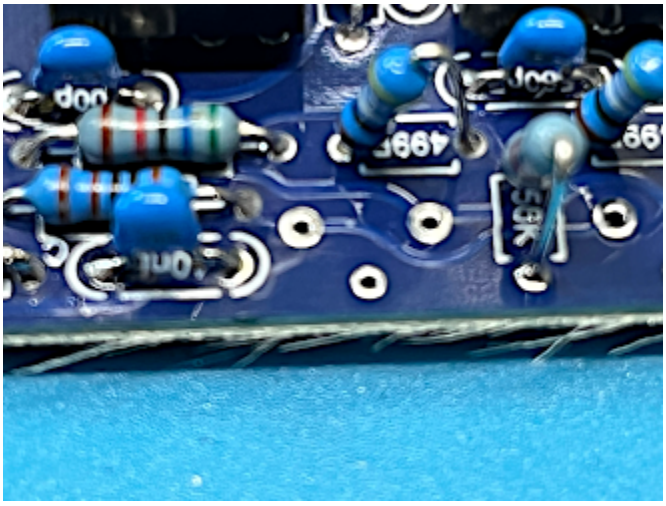
5. **Wet Build Transistors**: J203's are included with the kit and are used in place of metal can 2N4341's. The J203's are mounted as shown. The component maps do not currently cover 2N4341/J203 placement.

Transistors are installed on cards 1, 2, 3, and 5. Card 4 has no transistors. The transistor footprints for the 2N4341's are easy to find as they are all in the same location and same orientation on all cards.

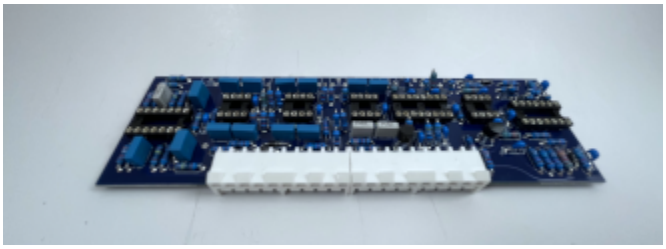


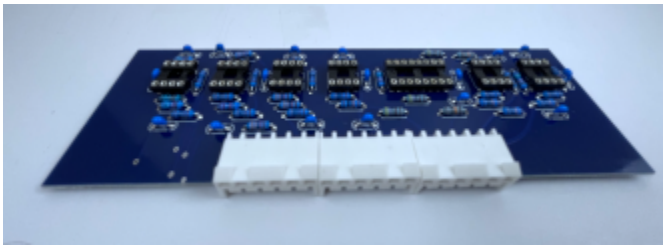
6. **Wet Build IC Sockets**: cards 1-5 use 8 pin, 14 pin, and 16 pin IC sockets. Installation is straightforward as the IC sockets are all oriented in the same direction and location is obvious.

7. **Wet Build Molex Card Connectors**: installing the Molex connectors is the last step before washing the PCB. You must break apart the cards at this point. Lightly file or sand the edges to remove excess fibers.



Molex Connectors: cards 1, 2, 3, and 5 require 2x 10 pin Molex connectors. Card 4 requires 3x 6 pin Molex connectors. Ensure that the Molex connectors are flat against the PCB and evenly aligned. This is important for installation onto the pin headers in each card slot on the MB.





8. **Wash Cards 1-5 in Warm Water**:scrub lightly with a soft toothbrush under running hot water (120 to 140 degree F). Water soluble flux (Kester 331) will lather up and help clean the PCB leaving a nice, flux-free finish.

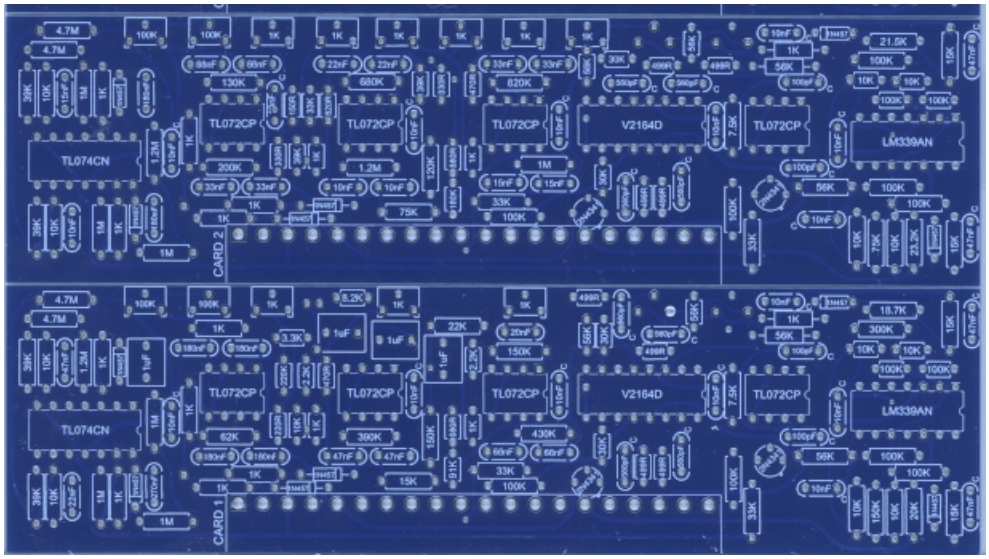
   NOTE: The Kester 331 Flux Cored Wire Technical Bulletin recommends cleaning within 48 hours. Most builders clean every hour or so. See kestor.com for details.

   NOTE: dry cards 1-5 thoroughly after washing before beginning the Dry Build. Let the cards dry overnight if possible. After cards 1-5 have dried completely, switch to no-clean solder for the remainder of the MB build.

9. **Cards 1-5 Dry Build Trimmers**: cards 1, 2, 3, and 5 require both 100K and 1K trimmers. Location is clearly marked on each card. Cards 1, 2, 3, and 5 each have 2x 100K trimmers. Card 1 only has 3x 1K trimmers. Cards 2, 3, and 5 have 6x 1K trimmers. Use no-clean solder to install the trimmers.

100K Trimmers Cards 1, 2, 3, and 5	Envelope follower output calibration	Quantity 8
1K trimmers Cards 1, 2, 3, and 5	Filter band calibration	Quantity 21

   Trimmer Locations: Trimmers are located along the top edge of each card. Card 1 has 2x 100k and 3x 1K trimmers. Card 2 has 2x 100k and 6x 1K trimmer. Cards 3 and 5 are the same as card 2. Card 4 has no trimmers. 100K are the two leftmost trimmers on every card. The rest are 1K.



10. **Install IC's**: IC installation is the final step in the card 1-5 build. The silkscreen denotes the correct IC for each location. Pin 1 is on the right side of each IC mount point. There are no special directions for installing the IC's.

Step 6: Cards 6-10

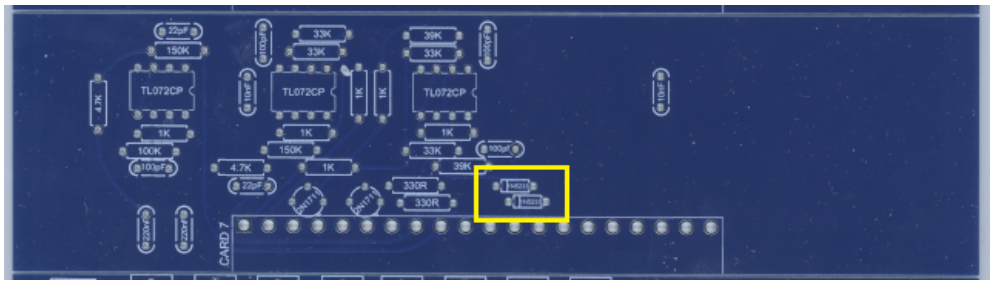
Building cards 6-10 is generally straightforward and follows the same guidance as cards 1-5 with a few details that require special attention. The card build process is split into two phases: Wet Build using solder with water soluble flux, and Dry Build using no-clean solder. Only the Trimmers are installed using no-clean solder, all other components are washed in water.

NOTE: the silkscreen on cards 6-10 shows parts values not parts numbers.

1. **Wet Build Cards 6-10**: diodes, resistors, capacitors, transistors, IC sockets, and Molex connectors are all installed in this step. There are too many components to list individually. It is highly recommended that you follow the component maps here for cards 6-10.

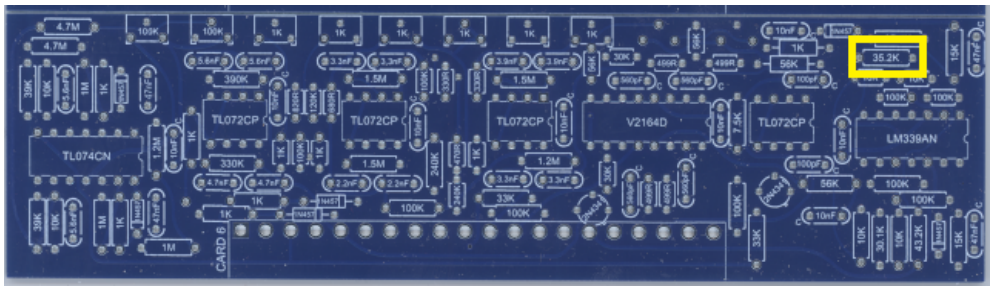
Cards 6-10 Wet Build (component maps)

2. **Wet Build Diodes**: cards 6, 8, 9, and 10 have 1N457 diodes similar to cards 1-5. Additionally, Card 7 has two 1N5223 Zener Diodes. Refer to the (component maps) for diode locations.

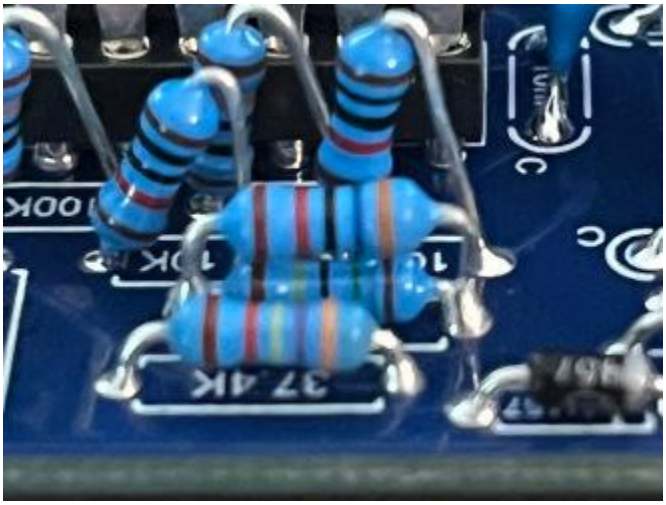


3. **Wet Build Resistors**: Cards 6-10 have three resistors footprints?: standard, wide, and standing. Follow the same guidance as was provided for cards 1-5. Additionally, there is a 35.2K resistor which is two resistors in parallel. Refer to the (component maps) for resistor locations.

   NOTE: card 6 has a 35.2K resistor that is made from 36K and 1.5M resistors in parallel.



The 35.2K resistor is accomplished by stacking the 1.5M and the 36K resistor as shown in the photos. Another approach is mounting the 1.5M resistor on the back of the card.



4. **Wet Build Capacitors**: ceramic and film capacitors are used on cards 6-10. Special attention is required for the ceramic capacitors. Refer to the (component maps) for capacitor locations.

   Ceramic Capacitors: on all cards except 4 & 7, the silkscreen denotes ceramic capacitor with a small “c” next to the footprint. Card 4 only has ceramic capacitors. Card 7 has no small “c” designation, though it has 2x 220nF film caps.

5. **Wet Build Transistors**: cards 6-10 use J203 and 2N3904 transistors. The J203’s are used in place of 2N4341’s on cards 6, 8, 9, and 10 and follow the same guidance as cards 1-5. 2N3904’s are used in place of metal can 2N1711 transistors on card 7 only. 2N3904’s are mounted belly down as shown here on card 7.

6. **Wet Build IC Sockets**: IC socket installation follows the same guidance as cards 1-5

7. **Wet Build Molex Connectors**: Molex connector installation follows the same guidance as cards 1-5. Break apart the cards and sand or file the edges. Each card requires 2x 10 pin connectors. Ensure they are even and flat against the PCB.

8. **Wash Cards 6-10 in Warm Water**: scrub lightly with a soft toothbrush under running hot water (120 to 140 degree F). Water soluble flux (Kester 331) will lather up and help clean the PCB leaving a nice, flux-free finish.

   NOTE: The Kester 331 Flux Cored Wire Technical Bulletin recommends cleaning within 48 hours. Most builders clean every hour or so. See kestor.com for details.

   NOTE: dry cards 6-10 thoroughly after washing before beginning the Dry Build. Let the cards dry overnight if possible. After cards 6-10 have dried completely, switch to no-clean solder for the remainder of the MB build.

9. **Cards 6-10 Dry Build Trimmers**: cards 6, 8, 9, and 10 require both 100K and 1K trimmers. Location is clearly marked on each card. Card 7 requires no trimmers Cards 6, 8, 9, and 10 all have 2x 100K trimmers and 6x 1K trimmers. Use no-clean solder to install the trimmers.

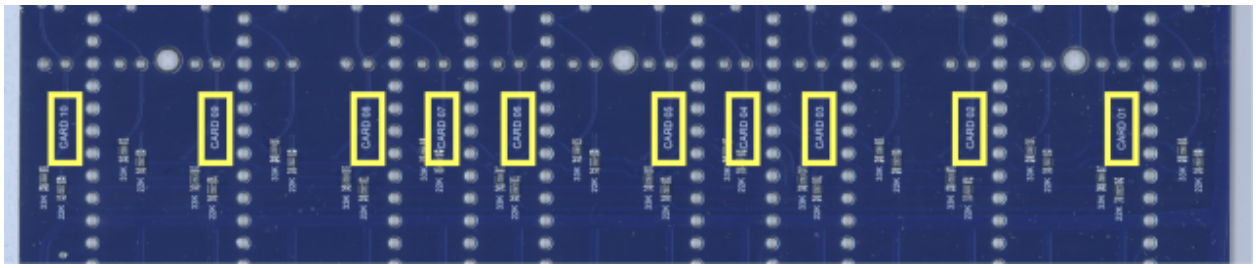
100K Trimmers Cards 6, 8, 9, and 10	Envelope follower output calibration	Quantity 8
1K trimmers Cards 6, 8, 9, and 10	Filter band calibration	Quantity 24

   Trimmer Locations: trimmers are located along the top edge of each card and follow the same pattern as shown for card 2 above.

10. **Install IC's**: IC installation is the final step in the card 6-10 build. The silkscreen denotes the correct IC for each location. Pin 1 is on the right side of each IC mount point. There are no special directions for installing the IC's.

Step 7: Final Assembly

Final assembly is quick and simple. Insert cards 1-10 into their slots on the MB. When viewing the rear of the MB the card slots are arranged from left to right: card 10, 9, 8, 7, 6, 5, 4, 3, 2, 1. Each card slot is labeled to the left of its pin header.



All cards are installed with the Molex connector and components facing left towards the channel label. Here you can see the Molex connector on card 10 is facing the label for card 10 on the MB.

With all cards installed facing left the build is complete.

Step 8: Calibration

Updated calibration instructions (text and images) are borrowed with permission from Dave Brown's excellent DIY website modularsynthesis.com. Dave Brown generously updated the calibration instructions for this build guide.

Calibration
Calibration is straightforward. Use a DMM on the individual channel output and adjust each to <2mV with no signal inputs. If you can't get them to this level then sometimes excess flux on the PCB can be the cause. Do all 16 channels first.

***Samodular NOTE**: Samodular 296s EF outputs should adjust to <2mV with no issues.*

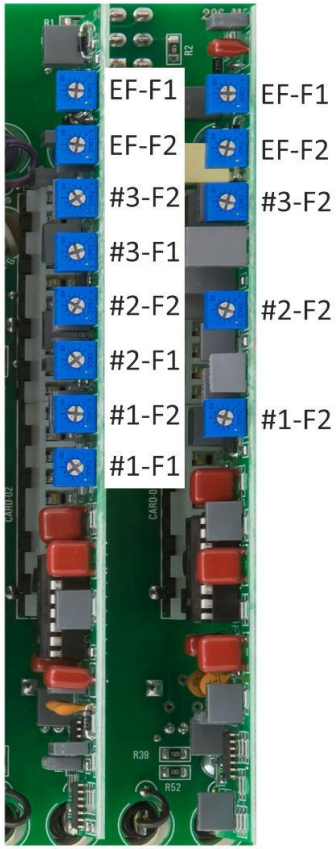
The filter topology is designed around three cascaded single op-amp multiple feedback bandpass filters in a stagger tuned configuration. Each of the filters is a small frequency offset from the next to get a wide and flat passband with steep slopes. You adjust each of the three filters for maximum output at their specific frequency.

There are three trimmers per channel except for the <100 Hz channel. To adjust the frequency trimmers, monitor the individual filter output with an oscilloscope and apply the correct frequency input. Keep the pre-emphasis knobs at minimum (full CCW). Adjust the trimmer for maximum amplitude. The amplitudes will be different since the other trimmers for that channel may not yet be set. Also, there is some variation in overall amplitude between channels. (Note – if you have a two channel oscilloscope then monitor the output of your signal generator and trigger on channel 1 and monitor the individual filter output on channel 2. This will make the display a bit more stable).

There is a regular pattern to follow for calibration. Set the input frequency to what is shown for Trim #1 and adjust, then set the frequency for Trim #2 and adjust, and then set the frequency for Trim #3 and adjust. Then repeat for the second channel on that card. You soon learn the pattern of adjusting the lowest trimmer, then moving up two, then moving up two, then going to the next to the lowest trimmer, then moving up two, then moving up two. I kept a marker on the card I was adjusting so I didn't venture to either side which is easy to do. Calibration is pretty quick.

***Samodular NOTE:** for calibration, high resolution audio files at each of the target frequencies are available on samodular.com. The audio files are available for builders who do not have a function generator or reliable frequency source for calibrating the 296s.*

SEE NEXT PAGE FOR CALIBRATION CHART



	Card 1		Card 2		Card 3		Card 5	
	F1	F2	F1	F2	F1	F2	F1	F2
Channel	0	1	2	3	4	5	6	7
Frequency	<100 Hz	150 Hz	250 Hz	350 Hz	500 Hz	630 Hz	800 Hz	1000 Hz
EF Trim	TR5	TR4	TR13	TR12	TR21	TR20	TR29	TR28
Freq Trim #1	na	105 Hz TR3	210 Hz TR11	310 Hz TR10	450 Hz TR19	580 Hz TR18	730 Hz TR27	920 Hz TR26
Freq Trim #2	na	185 Hz TR1	285 Hz TR7	415 Hz TR6	545 Hz TR15	690 Hz TR14	870 Hz TR23	1080 Hz TR22
Freq Trim #3	na	138 Hz TR2	245 Hz TR9	355 Hz TR8	490 Hz TR17	630 Hz TR16	790 Hz TR25	1000 Hz TR24

	Card 6		Card 8		Card 9		Card 10	
	F1	F2	F1	F2	F1	F2	F1	F2
Channel	8	9	A	B	C	D	E	F
Frequency	1300 Hz	1600 Hz	2000 Hz	2600 Hz	3500 Hz	5000 Hz	8000 Hz	>10 KHz
EF Trim	TR37	TR36	TR45	TR44	TR53	TR52	TR61	TR60
Freq Trim #1	1160 Hz TR35	1460 Hz TR34	1850 Hz TR43	2360 Hz	3100 Hz TR51	4500 Hz TR50	6700 Hz TR59	10.6 KHz TR58
Freq Trim #2	1360 Hz TR31	1730 Hz TR30	2200 Hz TR39	2880 Hz TR38	4100 Hz TR47	6100 Hz TR46	9700 Hz TR55	17 KHz TR54
Freq Trim #3	1250 Hz TR33	1600 Hz TR32	2000 Hz TR41	2600 Hz TR40	3550 Hz TR49	5200 Hz TR48	8000 Hz TR57	13.2 KHz TR56