

Mal-2 assembly guide v1.0

SONIC POTIONS

Schematic and BOM

The BOM can be found on [Google Docs](#)

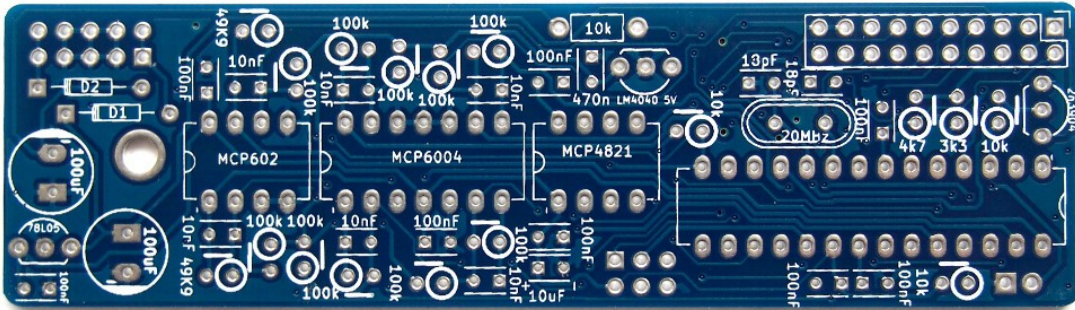
Prepare the PCB

Separate the PCBs using some pliers.



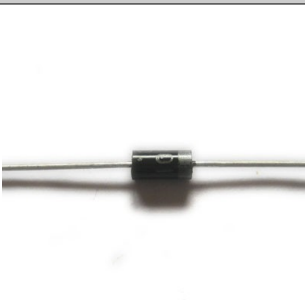
PCB 1

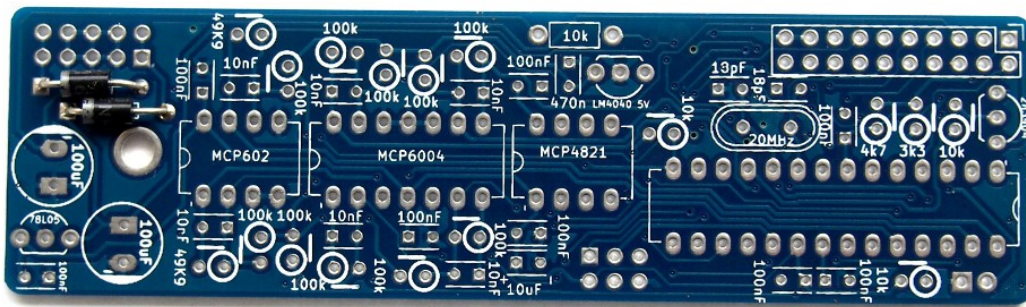
We start with the lower PCB and assemble it beginning with the flat and working our way to the high components.



Diodes

Diodes are polarized parts, so the orientation is important. You have to align the silver ring on the diode to the line on the silkscreen as seen on the picture.

Image	Description	Quantity	Part No.	Notes
	1N5819 diode	2	D1 D2	Polarized part. Orientation is important. Look at the silver line on the diode and silkscreen.



Ceramic capacitors

!!!ATTENTION!!!

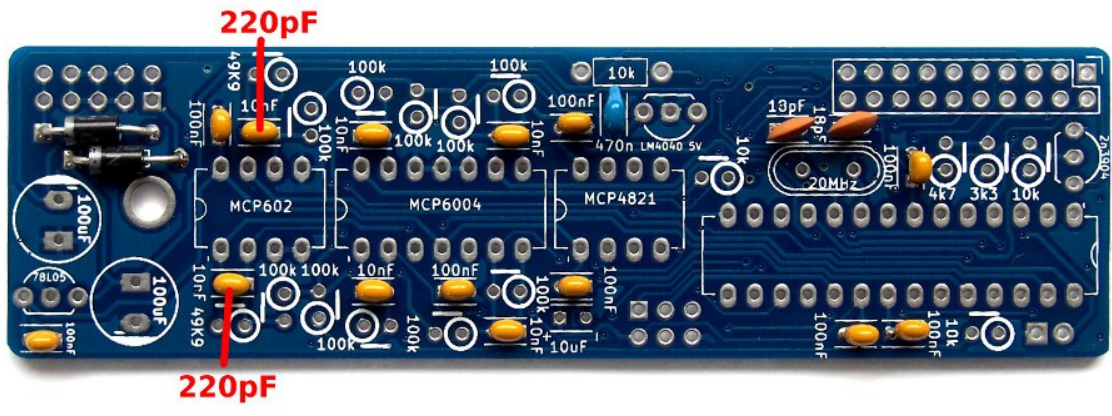
There is an error on the silkscreen. C1 and C16 are 220pF capacitors, NOT 10nF as indicated on the PCB.

The ceramic capacitors are non polarized parts. So the orientation does not matter.


Image	Description	Quantity	Notes
	100nF	8	Has "104" written on it
	10nF	4	Has "103" written on it
 or 	470nF	1	Has "474" written on it

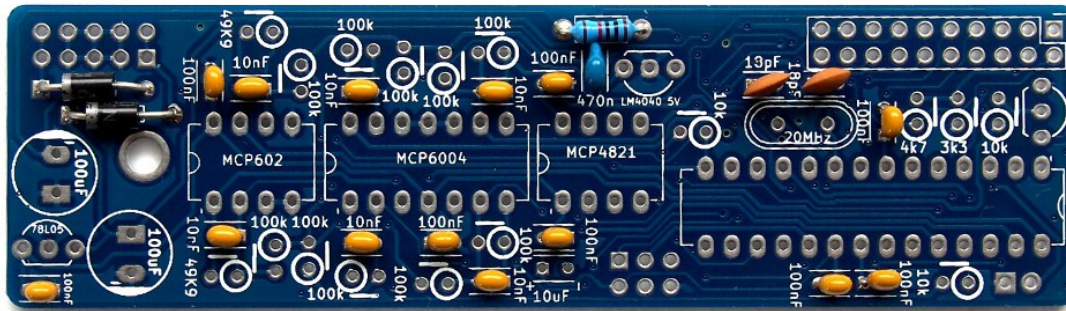


	18pF	2	Has "180" written on it
	220pf	2	Has "221" written on it




Flat resistors

Image	Description	Quantity	Notes
	10k	1	brown, black, black, red, brown



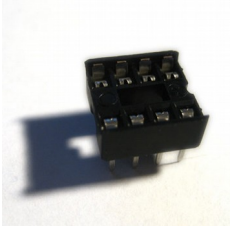


Quartz

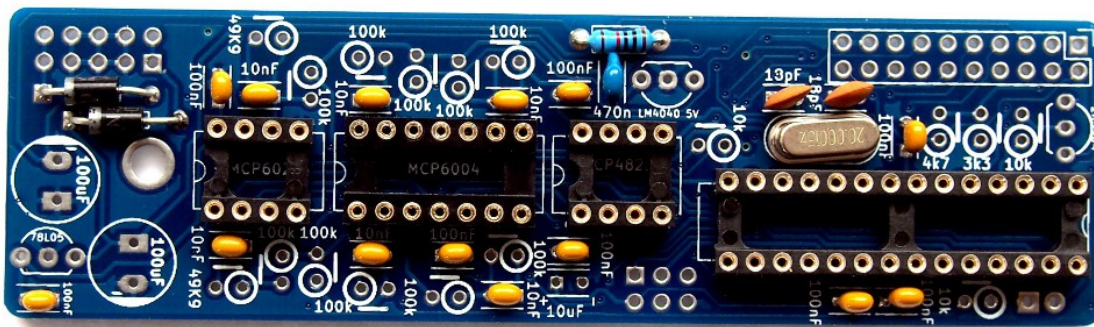
Image	Description	Quantity	Notes
	20 MHz quartz	1	Generates the clock for the microcontroller



IC sockets

Align the notch of the IC sockets with the notch on the silkscreen. The notch indicates the IC orientation.


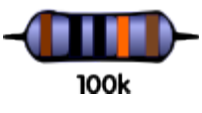
Image	Description	Quantity	Notes
	DIP 8	2	Notch left
	DIP 14	1	Notch left
	DIP 28	1	Notch right

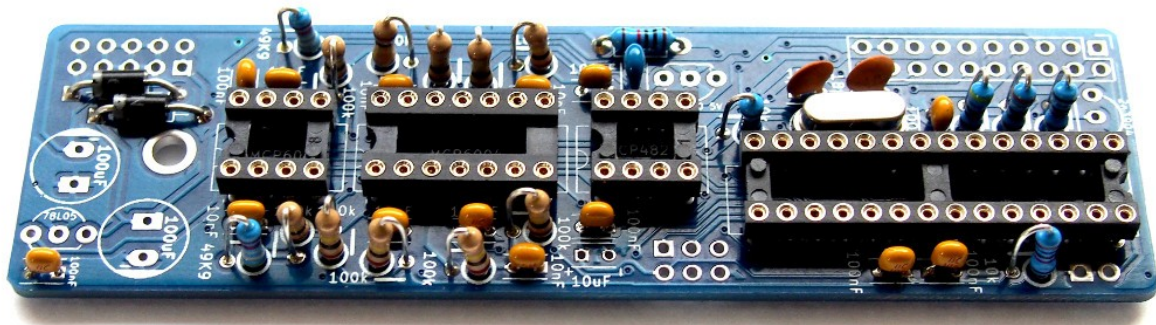


Standing resistors


Next are the upright resistors. Just bend one leg over so it is parallel to the other.





Image	Description	Quantity	Notes
	10k	3	brown, black, black, red, brown
	100k	10	if 1% metal film (blue body): brown, black, black, orange, brown if 5% carbon (brown body): brown, black yellow gold
	3k3	1	The 3k3 resistor must not be populated, otherwise the gate out will only be 2V
	4k7	1	yellow, violet, black, brown, brown
	49k9	2	yellow, white, white, red, brown



Transistor and Voltage Regulator

Image	Description	Quantity	Notes
	78L05 voltage regulator	1	5V voltage regulator.



	LM404-5.0	1	Reference voltage source. Generates -5V that is used for the pots and CVs
	2N3904 transistor	1	Gate out buffer

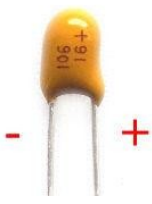



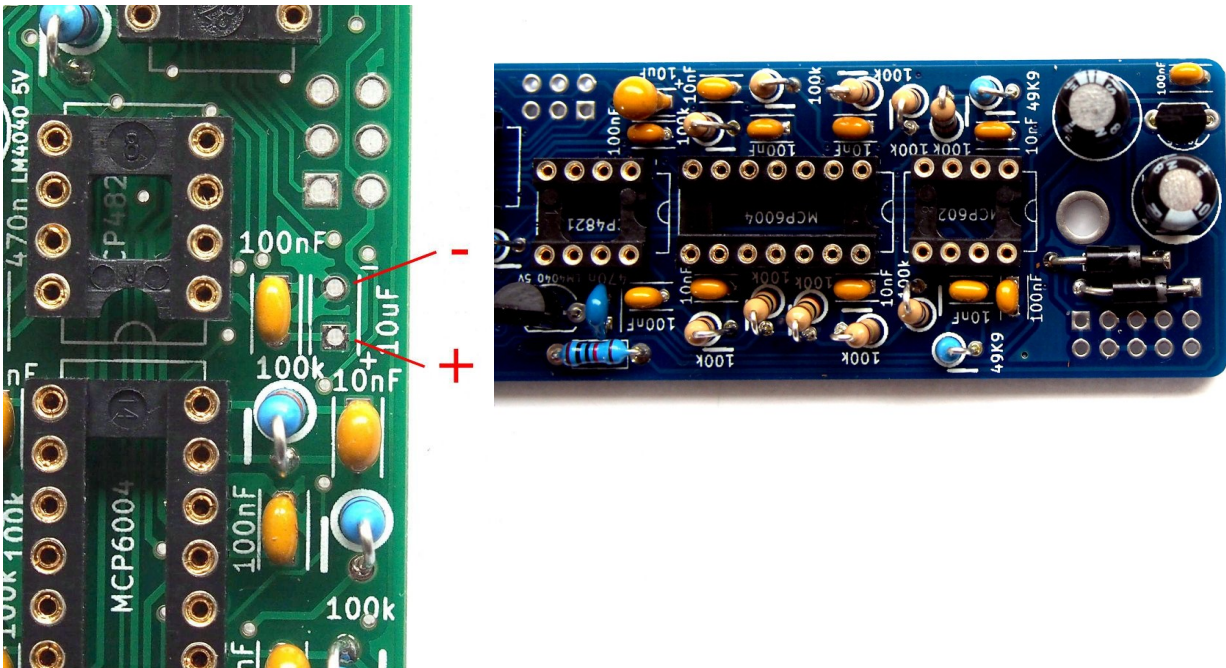
Big capacitors

For these capacitors the orientation is important! On both cap types the long leg is positive (+) and the short leg is negative (-). On the electrolytic capacitors the negative side is also marked with a big white stripe. The footprints on the silkscreen have a '+' sign on the side where the long leg has to be inserted.

Some tantalum capacitor legs have equal length. In that case you will find a small '+' sign printed on the cap that indicates the positive side of the part.



Image	Description	Quantity	Notes
	10uF tantalum capacitor	1	Polarized part! Long leg is + Short leg is - Has "106" written on it
	100uF electrolytic capacitor	2	Polarized part!



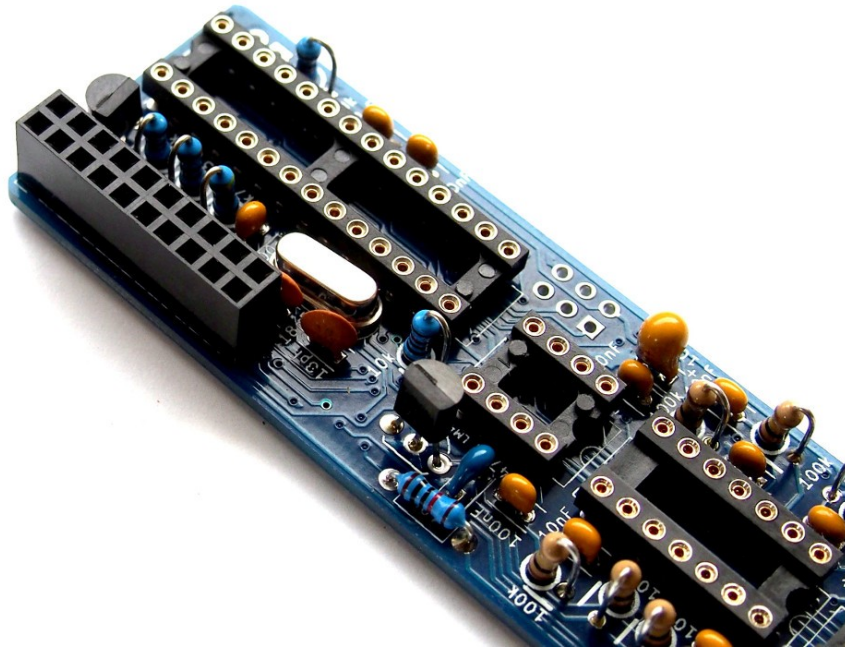
Board and power connectors

Now it's time for the board and power connectors. You have to break apart the long 2x8 pin header into 2x5 and 2x3 pieces. Be careful not to break away single pins. A side cutter may help here. Also pay attention to which side of the PCB the parts have to be soldered.

The female socket goes on top of the PCB, the other connectors to the bottom.

Image	Description	Quantity	Notes
	2x10 female	1	Board connector top
	2x5 male	1	Power connector bottom
	2x3 male	1	AVR ISP connector bottom
	1x2 male	1	Speed range select
	jumper	1	Speed range select



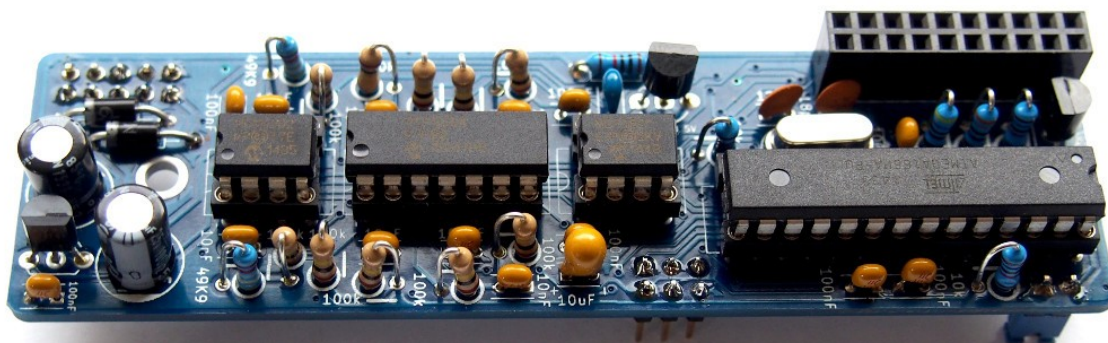


The blue jumper selects the speed range of the module. With the jumper in place the module runs slow, barely touching audio range, but with modulation cycles down to 10-15 minutes. With the jumper removed it runs up to audio range, but the low end is reduced.



Insert ICs

Image	Description	Quantity	Notes
	Programmed Atmega 168	1	Microcontroller
	MCP6002	1	Dual OpAmp
	MCP6004	1	Quad OpAmp
	MCP4821	1	DAC



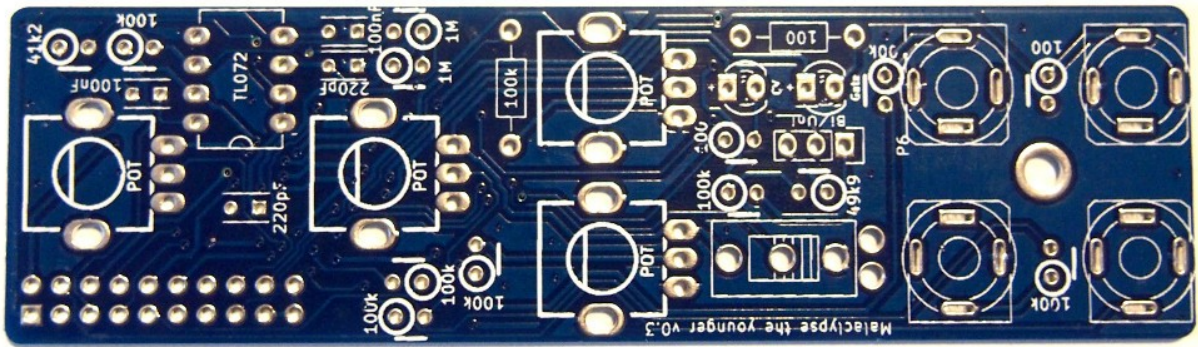
Interlude

Congratulations on finishing the first PCB! Now is a good time to drink a nice cup of tea or coffee, take a step back for a few minutes and get a clear head. Trust me it's worth it!



PCB 2

Wasn't that refreshing? Then back to work with the 2nd PCB.

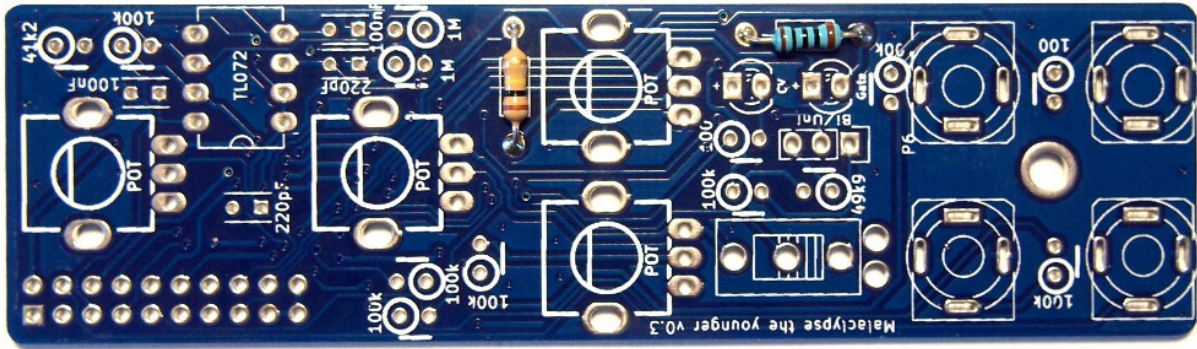
As before we start with the flat parts and work our way up higher and higher.




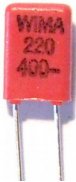
Flat resistors

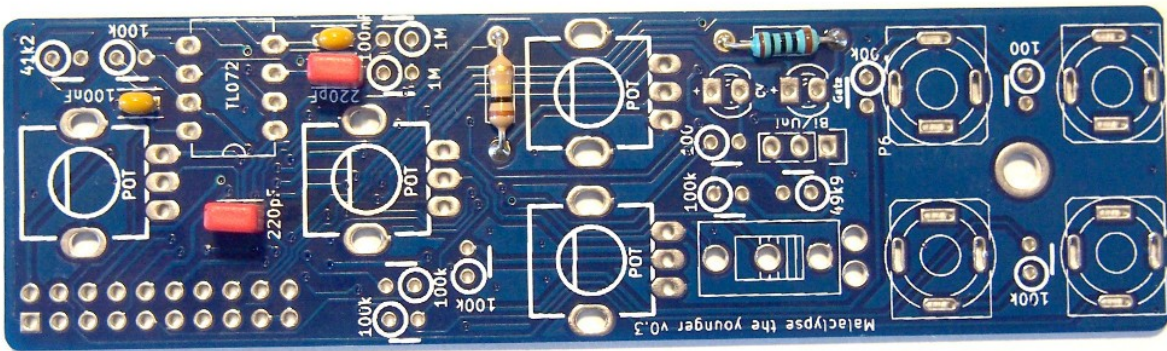
Image	Description	Quantity	Notes
	100 ohm	1	brown, black, black, black, brown
	100k	1	If 1% metal film (blue body): brown, black, black, orange, brown If 5% carbon (brown body): brown, black yellow gold





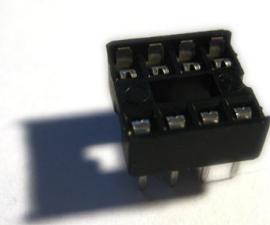
Capacitors

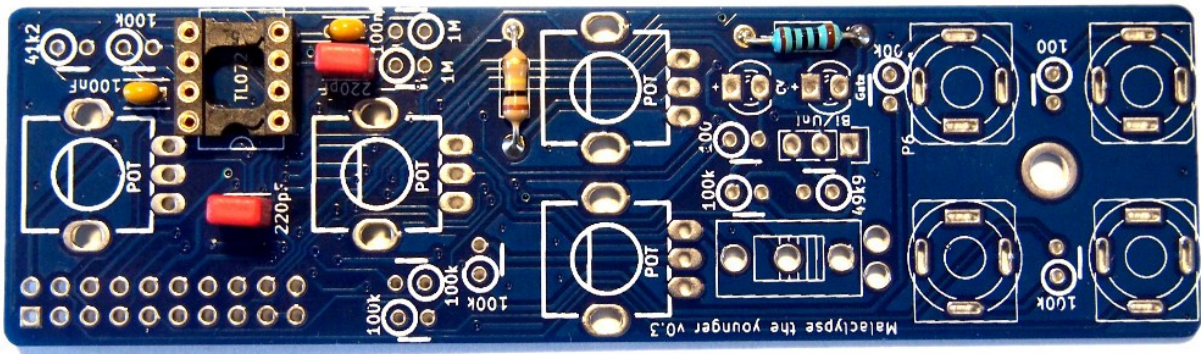
Image	Description	Quantity	Notes
	100nF	2	Has "104" written on it
	220pF film capacitor	2	Has "220" written on it




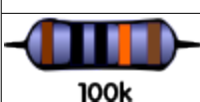

IC socket

Align the notch of the IC sockets with the notch on the silkscreen. The notch indicates the IC orientation.

Image	Description	Quantity	Notes
	DIP 8	1	Align notch with silkscreen

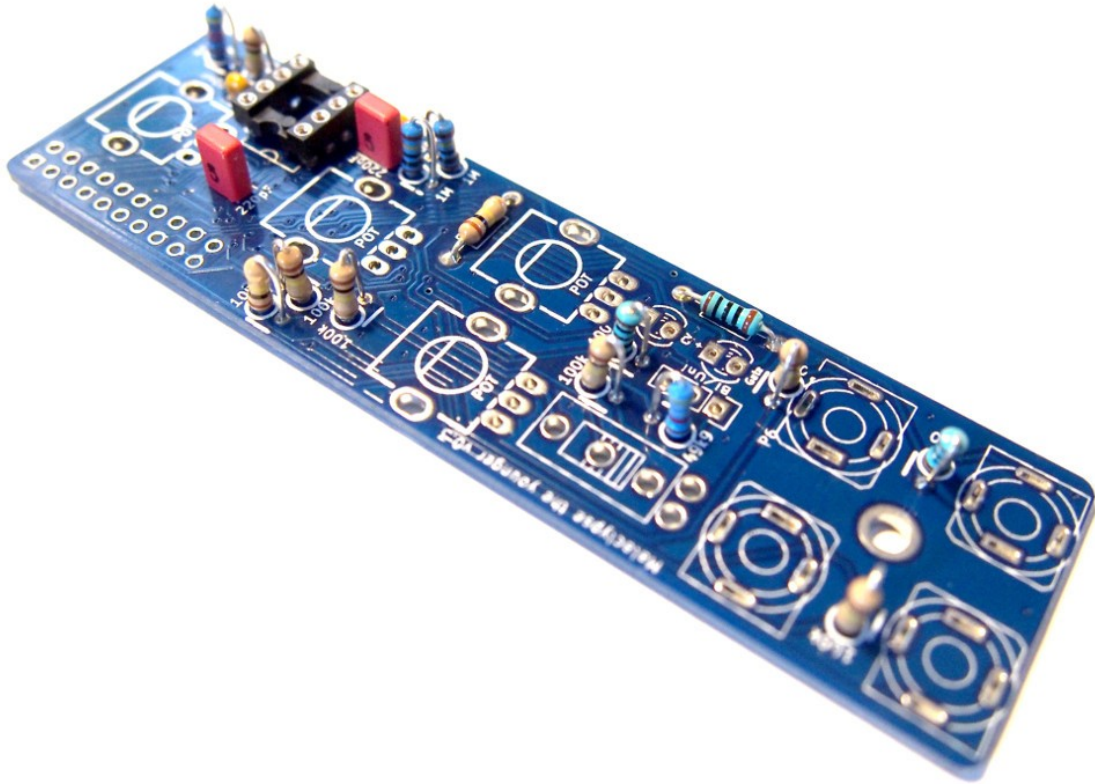


Standing resistors

Image	Description	Quantity	Notes
	100 ohm	2	brown, black, black, black, brown
	100k	7	brown, black, black, orange, brown
	4k2	1	yellow, brown, red, red, brown



	1M	2	brown, black, black, yellow, brown
	49k9	1	yellow, white, white, red, brown



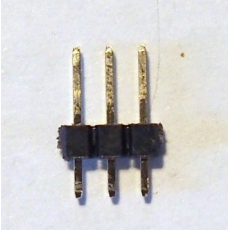
Uni/Bipolar jumper

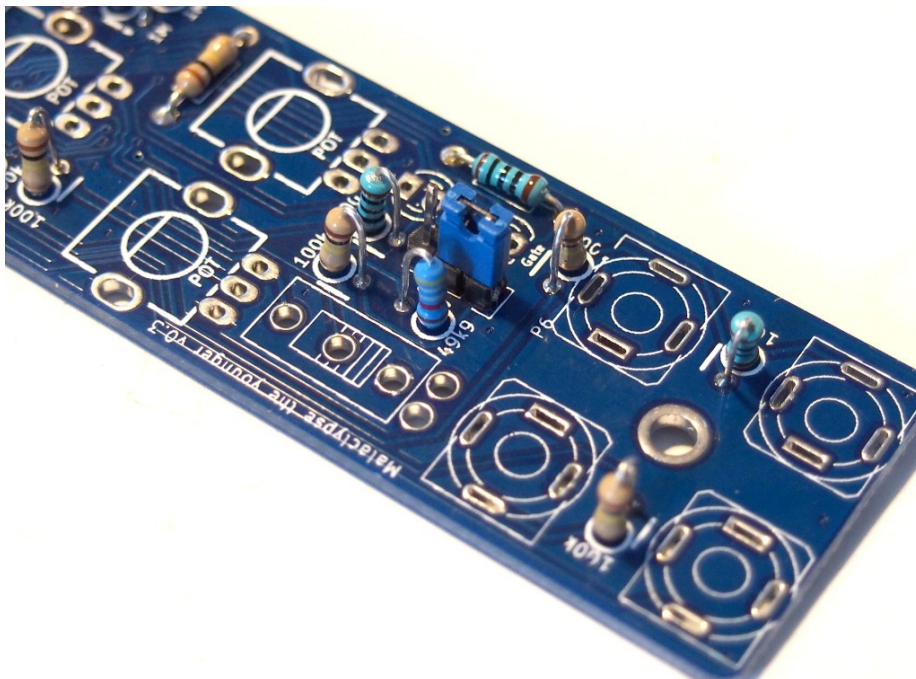
This jumper sets the CV output range. 'Uni' equals 0V-10V and 'Bi' equals -5V to 5V.

You have to decide where you want it now! If unsure set it to bipolar. This jumper is not accessible after the panel is mounted. I'm sorry for that, but there was just no other place to put this on the PCB.

If you think you will change this setting very often, consider attaching some wires and a switch instead.

If the jumper is set to 'Uni', the Voltage range is 0-10V, on the 'Bi' setting it is -5V to 5V.

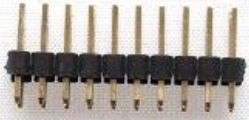
Image	Description	Quantity	Notes
	1x3 pin header male	1	

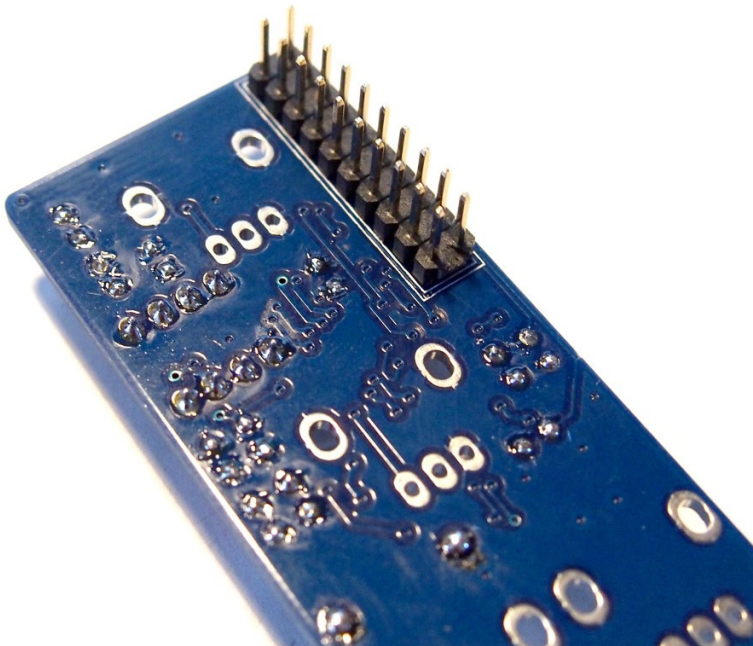




Pin array bottom

Solder the pin header to the bottom of the PCB.


Image	Description	Quantity	Notes
	2x10 pin header male	1	

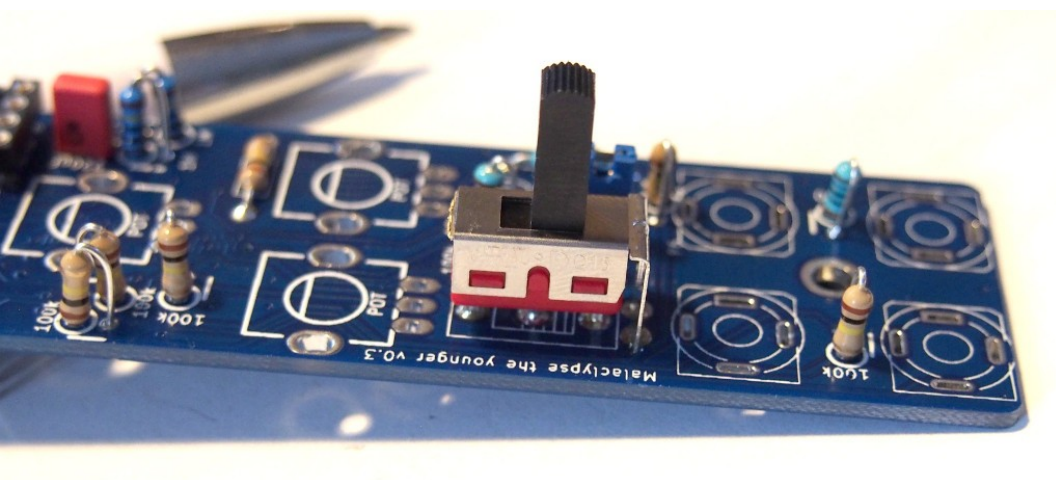
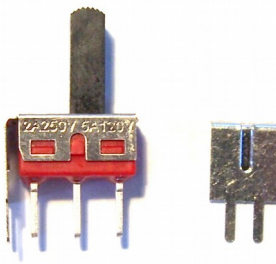
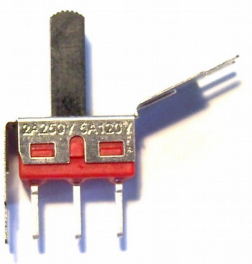


Switch

You have to remove the metal part on one side of the switch to fit the PCB.
The side does not matter. Just bend it up and down a few times until it comes off.


Make sure to solder the switch completely straight. Solder a single leg first, adjust position, then solder the rest of the pins.

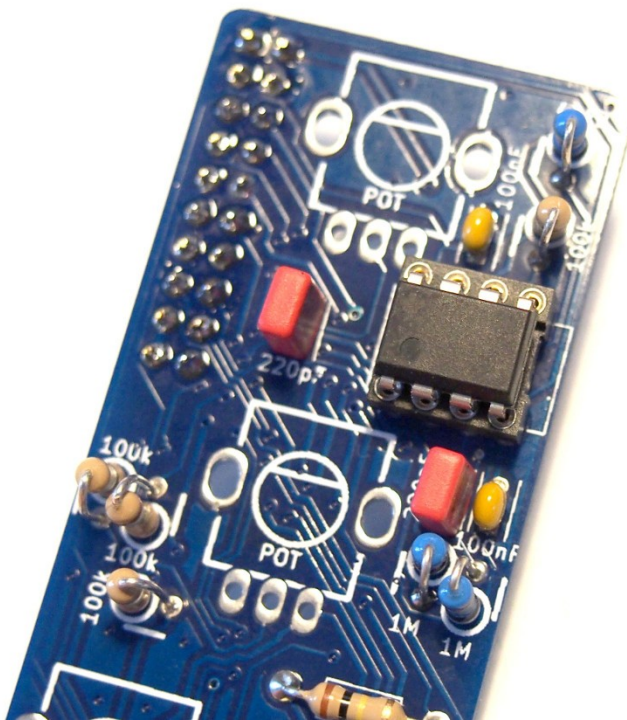
Image	Description	Quantity	Notes
	SPST switch	1	Selects the operation mode



Insert IC



Insert the TL072 IC into the socket. The small round dot on the IC marks pin 1 and goes to the side of the socket with the notch (left).

Image	Description	Quantity	Notes
	TL072	1	dual OpAmp



Bolt and Screw

Put an M3 screw in the hole of the PCB from the top and screw the 11mm bolt to the bottom. The bolt will secure the other PCB later on.

Image	Description	Quantity	Notes
	M3 screw	1	
	11mm bolt	1	




Attention!

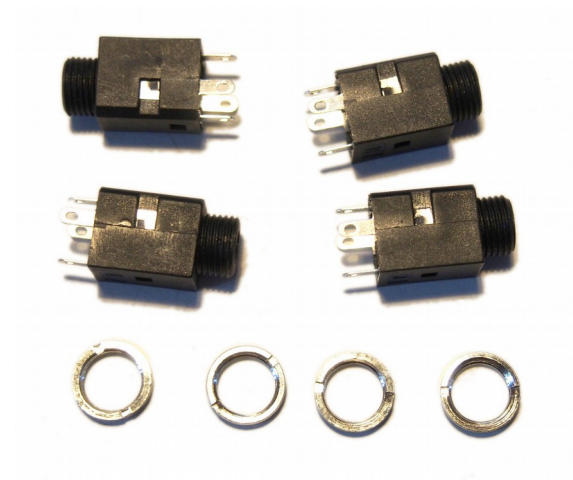
For the following steps parts have to be placed on the PCB but **not soldered** before the frontpanel is attached. This is to make sure all components are properly aligned with the panel and fit through the holes.



Jacks

Remove the nuts and put the 4 audio jacks on the PCB. **Do not solder yet!**

Image	Description	Quantity	Notes
	3.5mm Jacks	4	

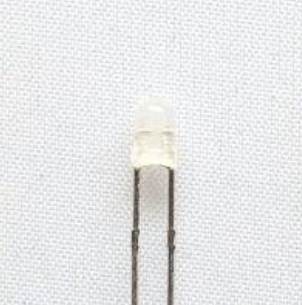


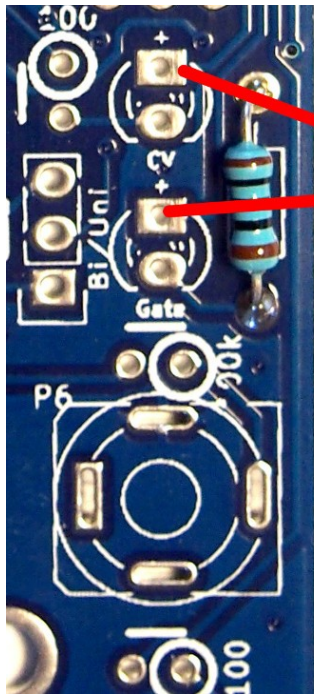
LED

The LED is a polarized part. The long leg has to be put in the upper pad marked with a '+' sign. **Do not solder yet!**

Image	Description	Quantity	Notes
	3mm LED green	1	



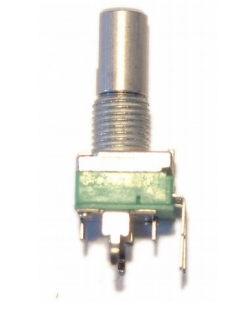
	3mm LED bi-color	1	
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Long Leg

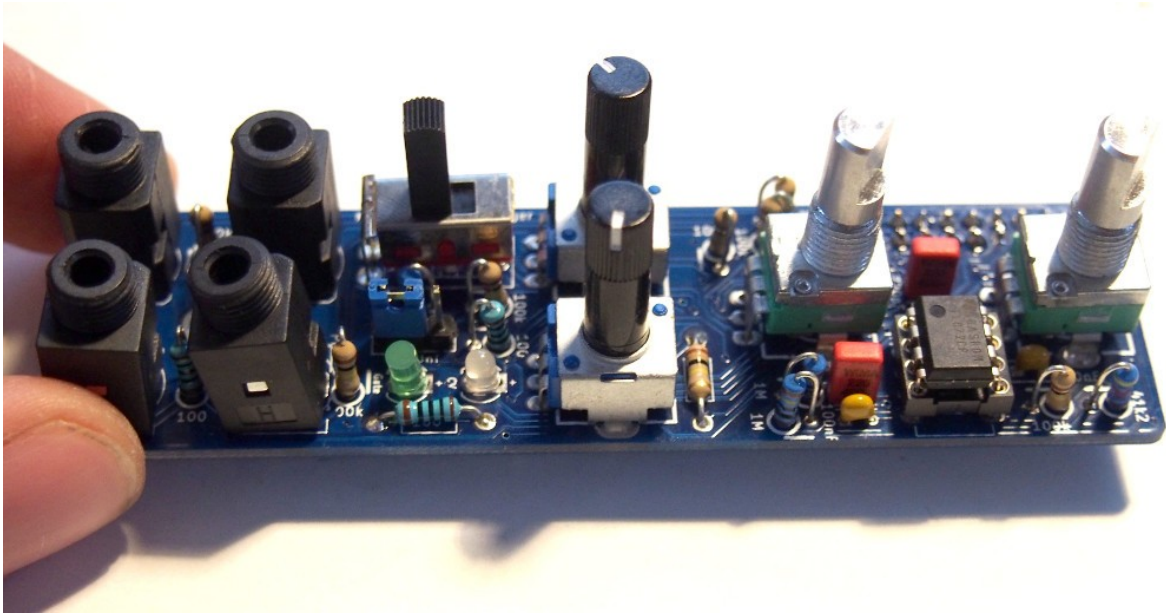
Potentiometer

Same for the pots. Put them in place but do not solder yet.





Image	Description	Quantity	Notes
	9mm potentiometer 10k linear	2	



	<p>9mm tall trimmer 10k linear</p>	<p>2</p>	
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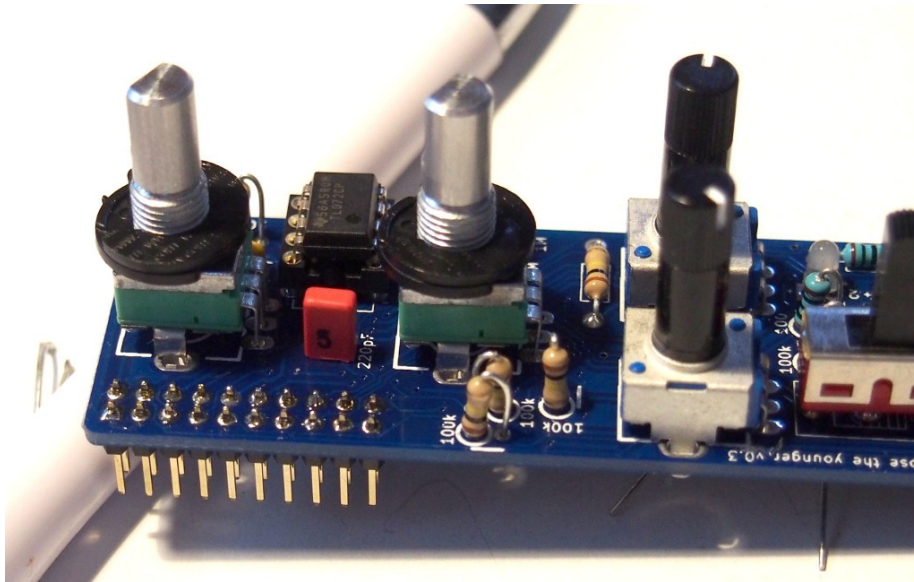
Panel

Image	Description	Quantity	Notes
	Aluminum Panel	1	
	washer	2	
	nuts	2	
	plastic spacers	4	

First, put the plastic spacers on the threading of the pots. 2 spacers each.

Since the jacks are a bit higher than the body of the potentiometers, these spacers assure that you can screw the nuts from the pots tight to the frontpanel.





Then attach the panel and secure the 2 metal pots with a washer and a nut each.

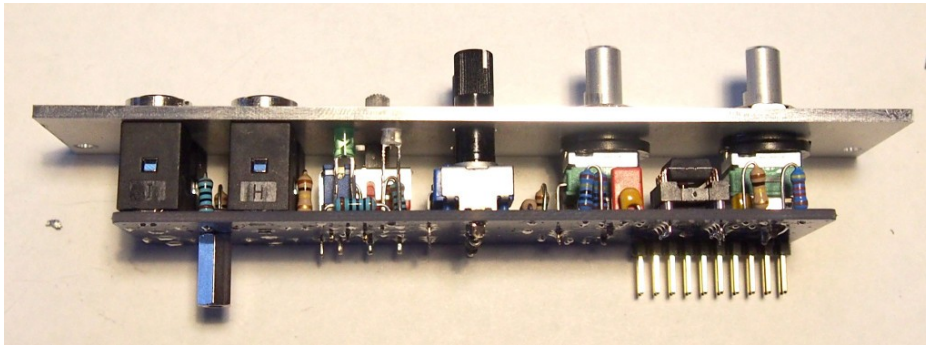


The jacks should be attached with their nuts, too. Push up the LEDs so they are flat with the front panel. Make sure everything is properly aligned and straight.

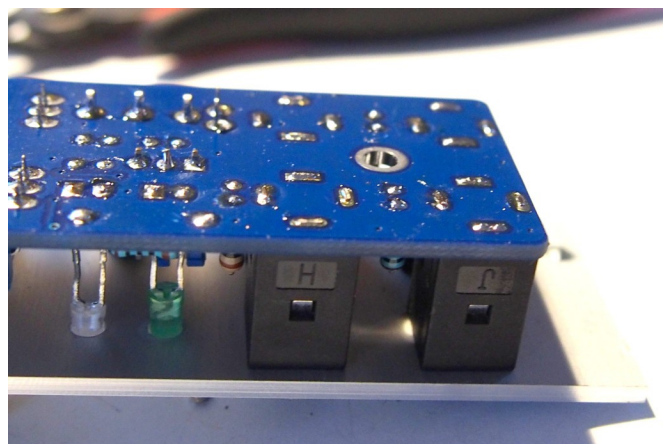
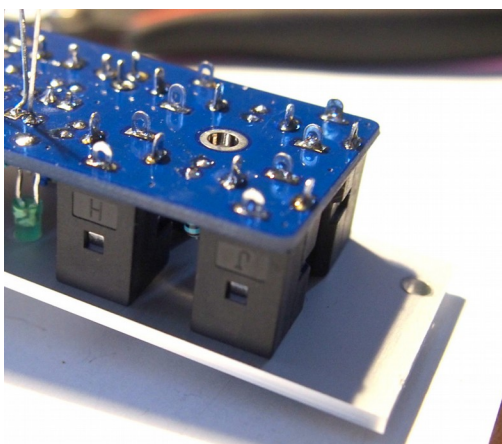


Solder the components

Now solder 1 pin on each component. Before soldering the other pins, make sure that all components are straight. Then solder the rest of the pins. This method assures that everything fits into the panel later on.



Cut off the pins of the jacks as flat as possible, otherwise they may touch the caps on the lower PCB later on. Be careful, the legs of the jacks are like small powered high energy projectiles when cut off with wire cutters! (You'll shoot your eye out!) Ignore the missing bolt on the following pictures.



Knobs

Image	Description	Quantity	Notes
	Big knob	1	
	Big cap	1	
	Small knob	1	
	Small cap	1	

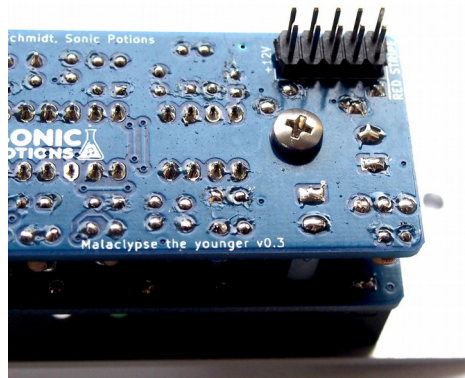
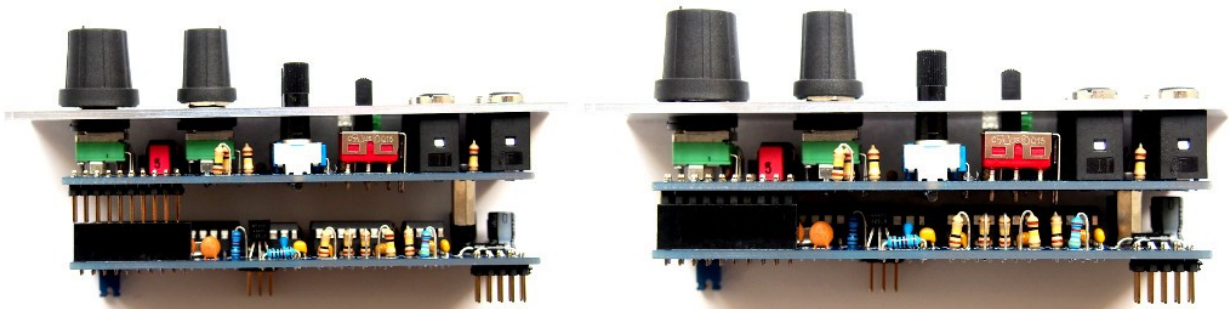


Attach the knobs and turn the pots to their minimum position. Then put the caps onto the knobs with their marker pointing to 7 o'clock

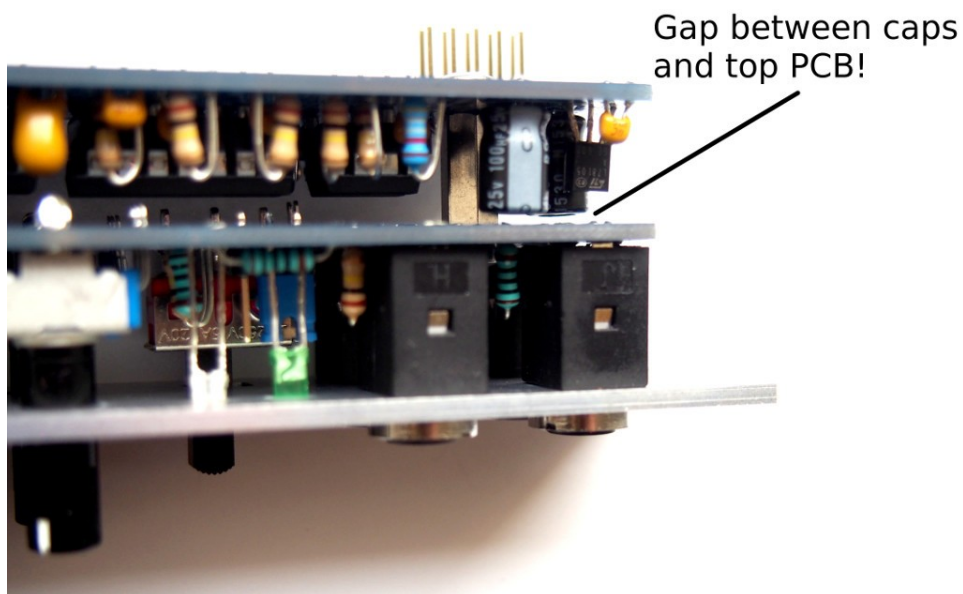


Final assembly

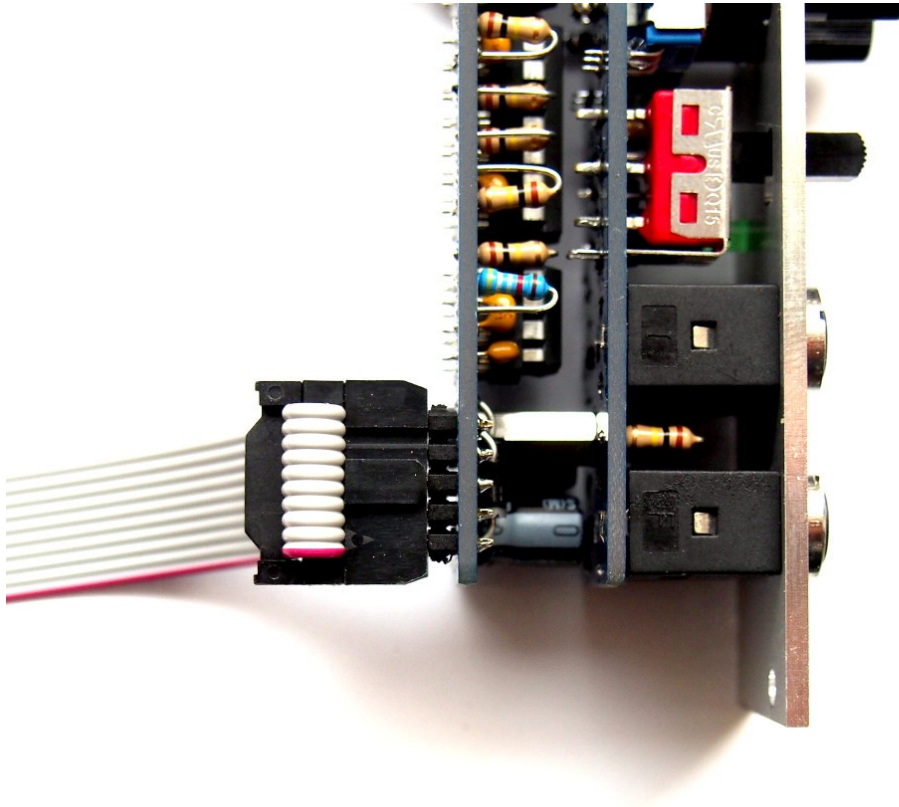
Attach the lower to the upper PCB and attach it with the M3 screw to the bolt.



Make sure the electrolytic capacitors do not touch the upper PCB!!!



Attach the power cable with regard to the proper orientation (**red stripe to the bottom of the PCB**)



Test the module

Congratulations! You should now have a working Mal-2 module in front of you.

Turn both knobs to the maximum position and attach it to a power source. The upper LED should flash green for a moment and then start to wildly alternate between red and green. The lower LED should start to flash as well.

If that is not the case, turn off the power and re-check your work!

Now turn the upper knob to the left. The blinking of the LEDs should get slower, and turn into a fading from red to green and back again.

If that works chances are good that you did a great job and the module is working.

Proceed with the normal user manual and have fun with your new module!



Firmware Updates

The firmware can be updated with an audio file. This procedure is not necessary with a newly bought module, as the latest firmware is flashed by us when the AVR leaves our workshop.

Update procedure

When the module is powered up, the CV LED flashes very fast in green.

If the switch on the module is moved during this time, the flashing LED color changes to red.

This indicates that the module is waiting for an audio firmware update on the change CV input (right jack).

A mobile phone output has not enough voltage to properly drive the CV input (normally 1.2V peak to peak) so you might need to use a mixer between the phone and the module. You can also use another module that is able to amplify the signal (I used the Intellijel VCA for this purpose) or a louder audio source like your computer soundcard.

Play back the audio file.

The LED should start flashing green in a slower speed, indicating successfully received packages.

If the LEDs stays off or turns a solid red your volume is probably too low. When it is red you can just start over by moving the switch again and turn the volume up a bit.

After an successful update the module will automatically reboot and run the new firmware.

