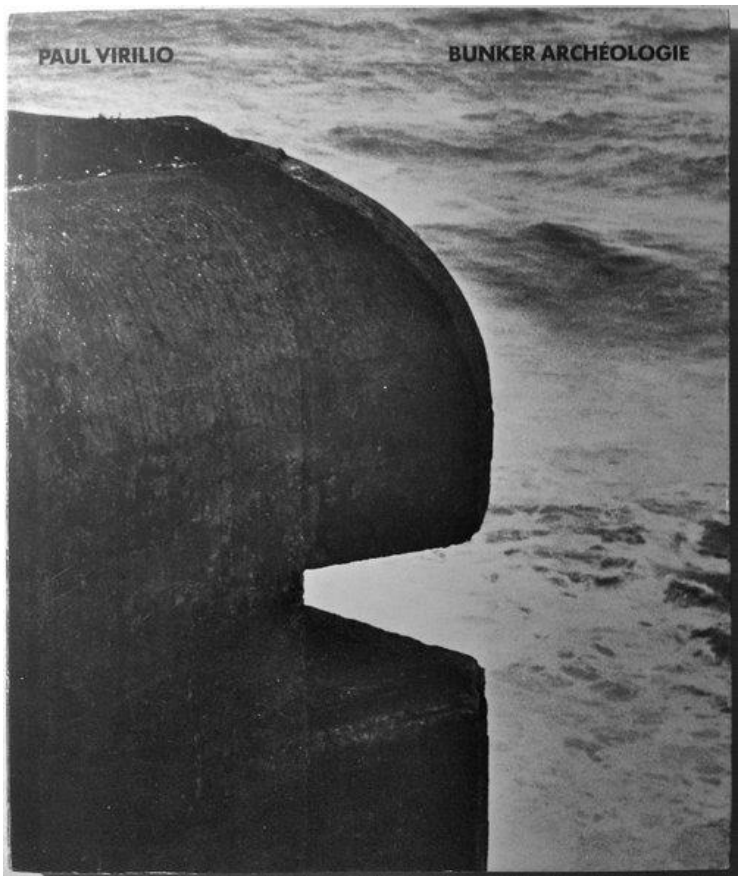
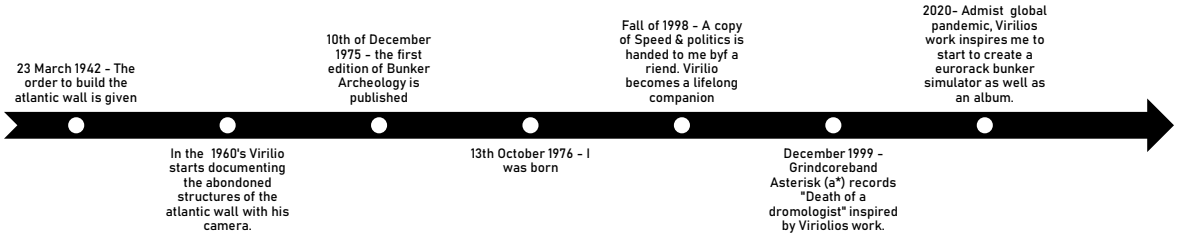
DE-3: BUNKER ARCHEOLOGY





1.1. Overall description

Bunker Archeology is the world's first "bunker simulator" composed by two different sections: an overdriven digital reverb "tank" as well as frequency driven tremolo/VCA[1]. The module is normalized so the incoming signal is first sent to the reverb tank and then to the static (tremolo) circuit. The latter could also be used as a crude (albeit backwards) VCA. However one can easily patch it the other way around by inserting an incoming signal to the "Static in" and patching "Output" to "Bunker In".

1.2 The Reverb

Using "Bunker Input" you can attenuate the incoming signal, this is helpful since the reverb tank is pushed to its very limits[2]. Depending on how you attenuate the incoming signal (also of course depending on how "hot" the incoming signal is, digital oscillators for instance tend to be a lot hotter) the module will behave differently, not just in regards of distortion[3]. You can regard the whole circuit as a bastardized envelope follower of sorts (that being said placing a VCA before the input is usually a fun idea, or any modulation of frequency really). When the modulation switch is switched on (ie. Downwards) it causes the reverb tank to gradually shut down (or attacking itself), shorting out the tank using a LDR and a LED. This creates interference and noise which is sent to the static circuit. It can be used for drones (shaped with the acoustics knob) or percussive sounds. The modulation knob lets you dial in the amount and character of that sound and how much of the tank that should be shorted. This knob also has CV control (expecting 0 to 5V and ignoring negative voltages). "Acoustics" knob lets you change the overall acoustics of the bunker which in turn effects how static behaves (since the static circuit is frequency driven, altering the frequency changes overall behavior of the static circuits speed and/or stuttering). Feedback is the amount of signal being fed back into the reverb tank[4]. "Reverb Out" is a dedicated output for the reverb section and can be used for mixing downstream in your rack for those times you don't want the static interference, just a grainy lo-fi reverb). You can also use an external mixer to combine the two outputs. Plugging in a cable into the "Reverb Out" will not stop sending the reverb signal to the static circuit.

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[1] A concept introduced to me by Wraalabs (now known as Glowfly): https://imgur.com/G7UXNUE and https://wraalabs.wixsite.com/pedals

[2] I have a small graveyard of BTDR's that didn't make it through the testing stages.

[3] Although of course you can pretty much distort the devil out of it.

[4] duh

1.3 Static

"Static in" is a dedicated input for the static circuit. Plugging in a cable here will remove the reverb from the static circuit completely (but still present at the reverb out, as described above). "Divisions" switch determines the overall speed of the static circuit. There are three different options[5]. The CV input on the static side of the module lets you replace the frequency driven tremolo with a positive CV. Remember that this works as a backwards VCA, ie shutting the signal up when voltage goes high and makes it audible when voltage is low. It expects a 0-5V incoming signal and might not track your incoming envelope perfectly but it does its job[6][7]. The CV knob lets you either dial in the tremolo amount (when no cable is inserted into "CV") or attenuates the incoming CV signal. At about 11-12 a clock using the tremolo it should chop the sound up in and makes it grainy[8]. Feeding this CV input an audiorate signal creates bell like tones (similar to a ring modulator) or bitcrushing sounds depending on the division setting and the modulating waveform. This is made possible by using a lighting fast[9] transistor based optocoupler rather than the much more sluggish, standard LDR/LED or vactrol configuration. The "Output" is the end station of the module, when nothing is plugged into "Static In" it contains the reverb and the static circuit in series, when the input to the static circuit is used it just contains the static out. Which means you can use either half of this module if you want, or

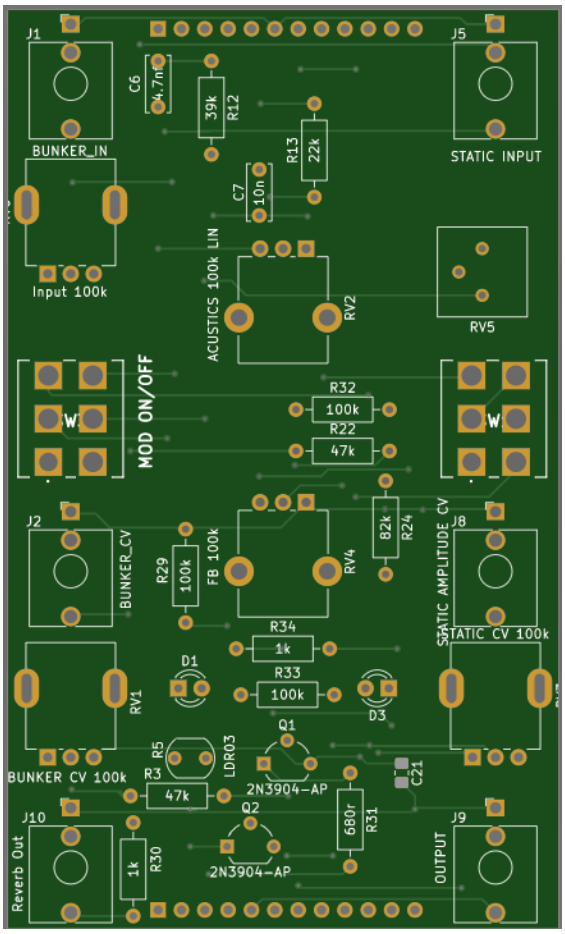
[5] A high pitched signal will always create a faster response though and a low note a slower response no matter what setting the switch is in.
[6] Its quite picky with incoming CV signals though, try different sources (YMMV)
[7] Since it works backwards to a normal VCA it might also be good for side-chaining?
[8] Similar to your run of the mill granular module in linear operation mode.
[9] Infrared even

both, or use the reverb to effect one sound and the static a different sound in patch. Also try it the other way around.

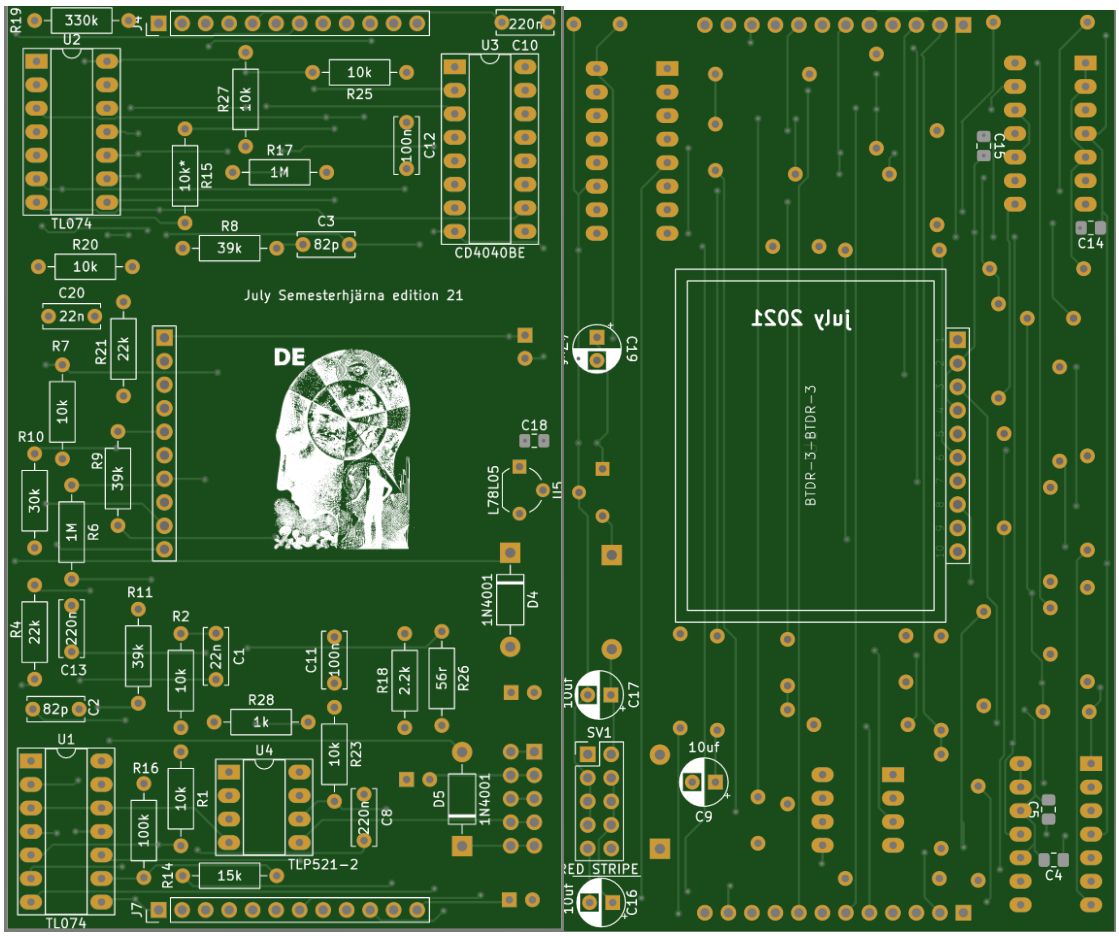
1.4 Conclusion

The input attenuator, the acoustic knob, feedback, modulation and static CV amount are all meant to play around with, there are usually several sweet spots here, but remember it is also affected by your incoming signal. Try different incoming signals, and see what you like (VCA's and filters are usually a good idea too to alter the signal before it hits the bunker). It is also encouraged to use this module without any incoming signal, just turn the modulation switch and introduce noise/drones to the static circuit. Use acoustics and feedback to shape it. Use a 0-5v incoming CV signal to effect the LED/LDR and making different sounds and volume (usually a lower setting on the CV pot here causes bigger changes when using incoming CV). Plug in a steady, or polyrhythmic clock into the static CV in. What do you hear?

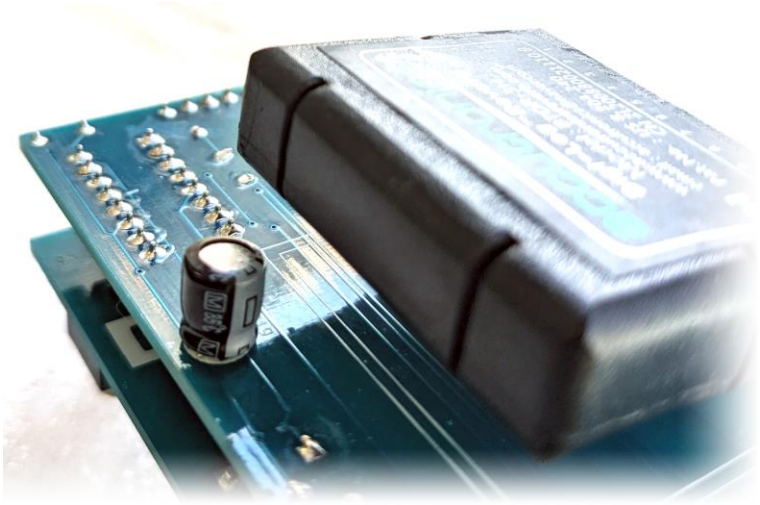
2.1 Building the module

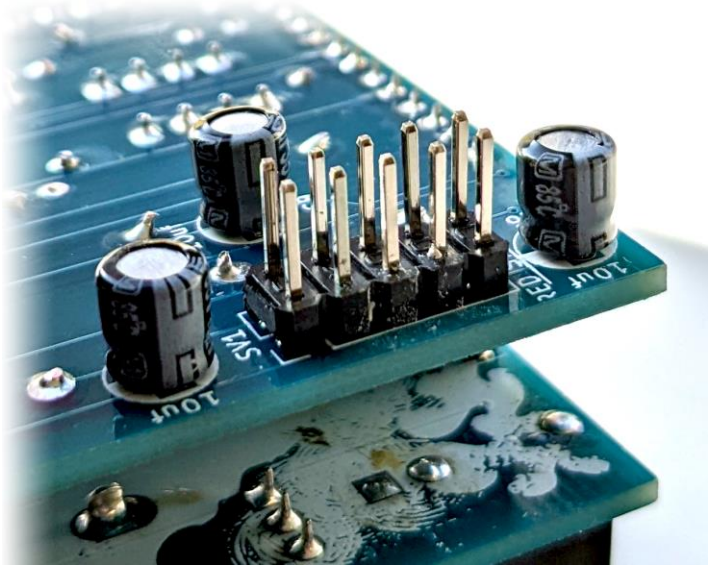


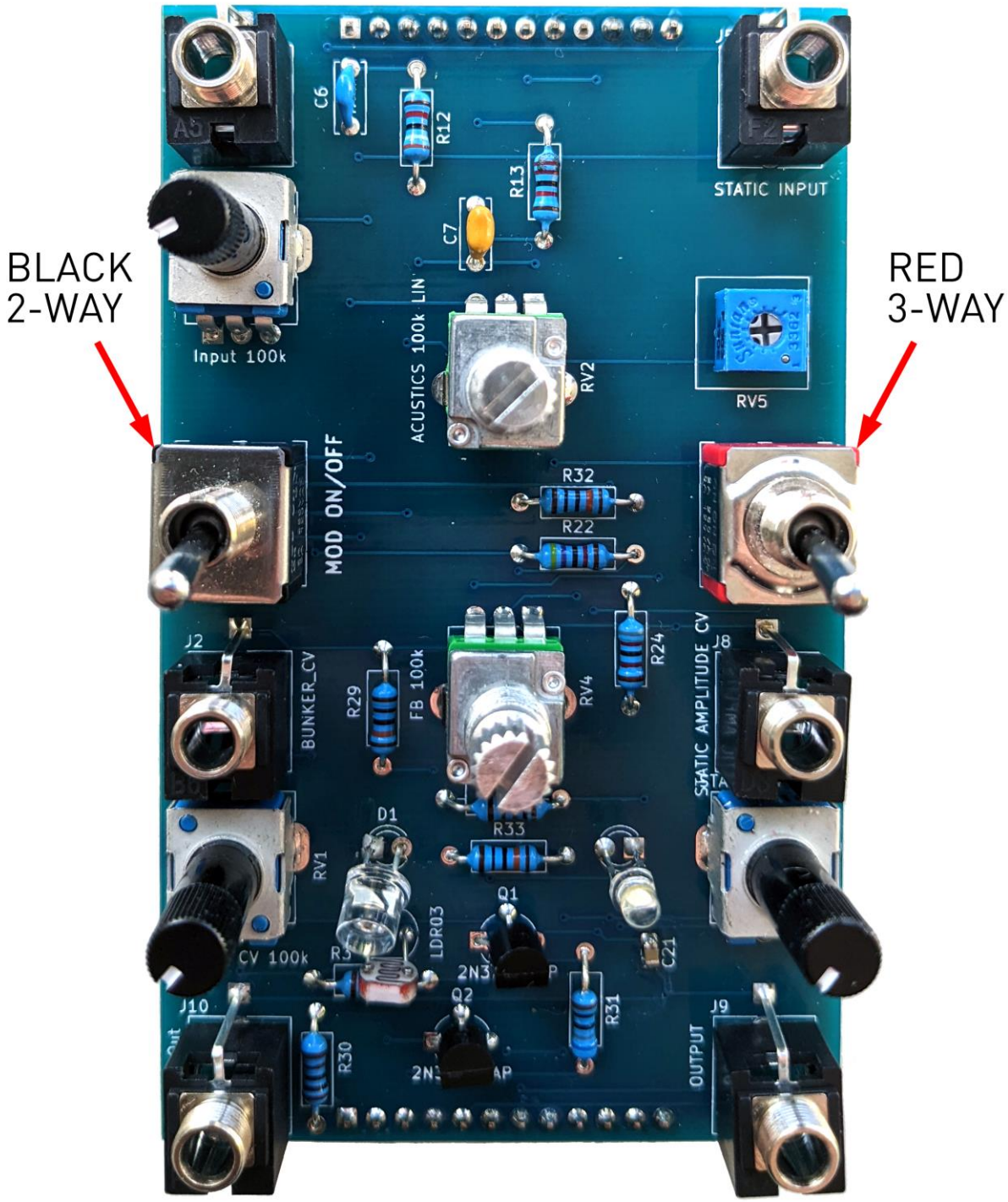
Jack Board

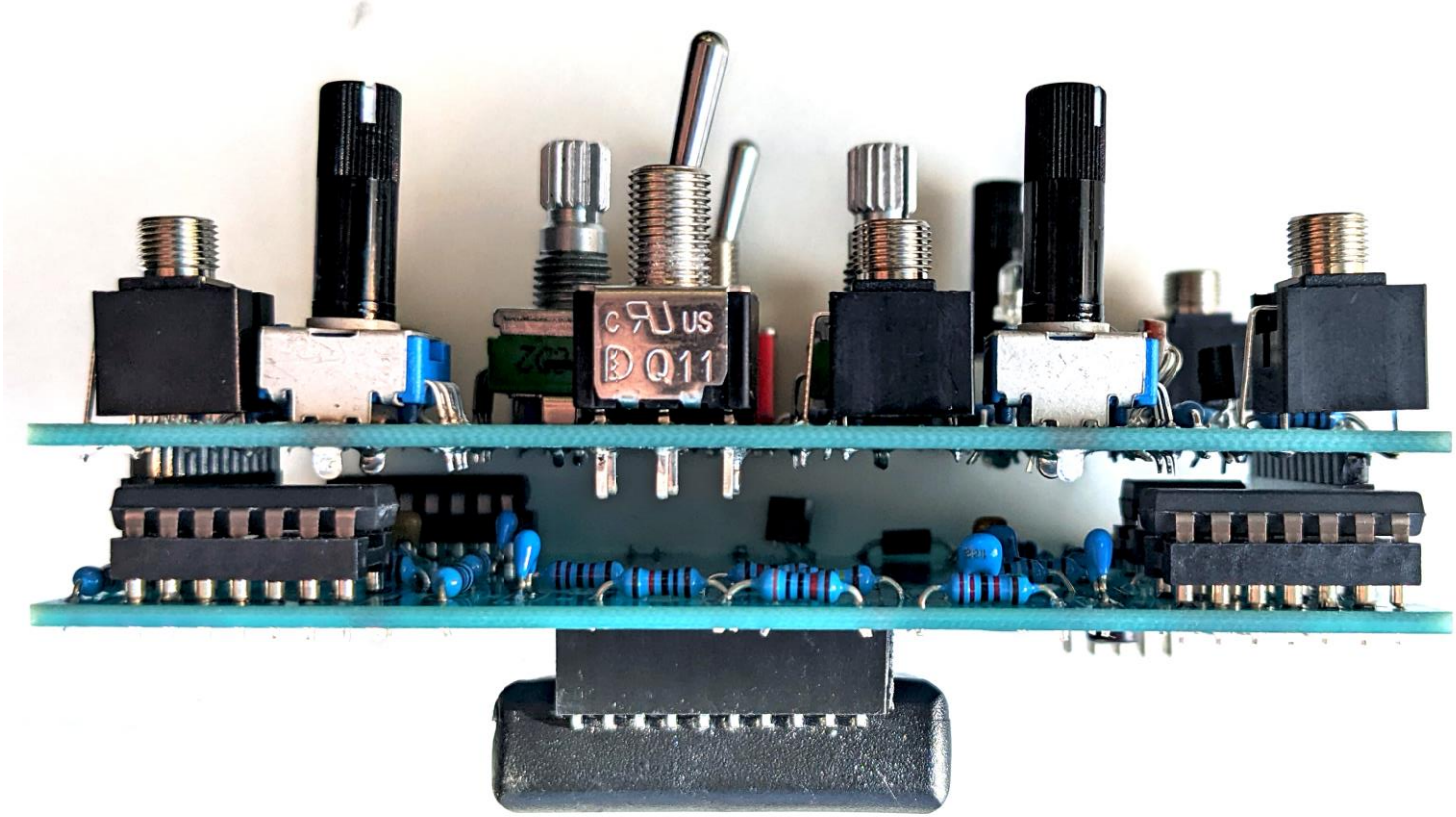


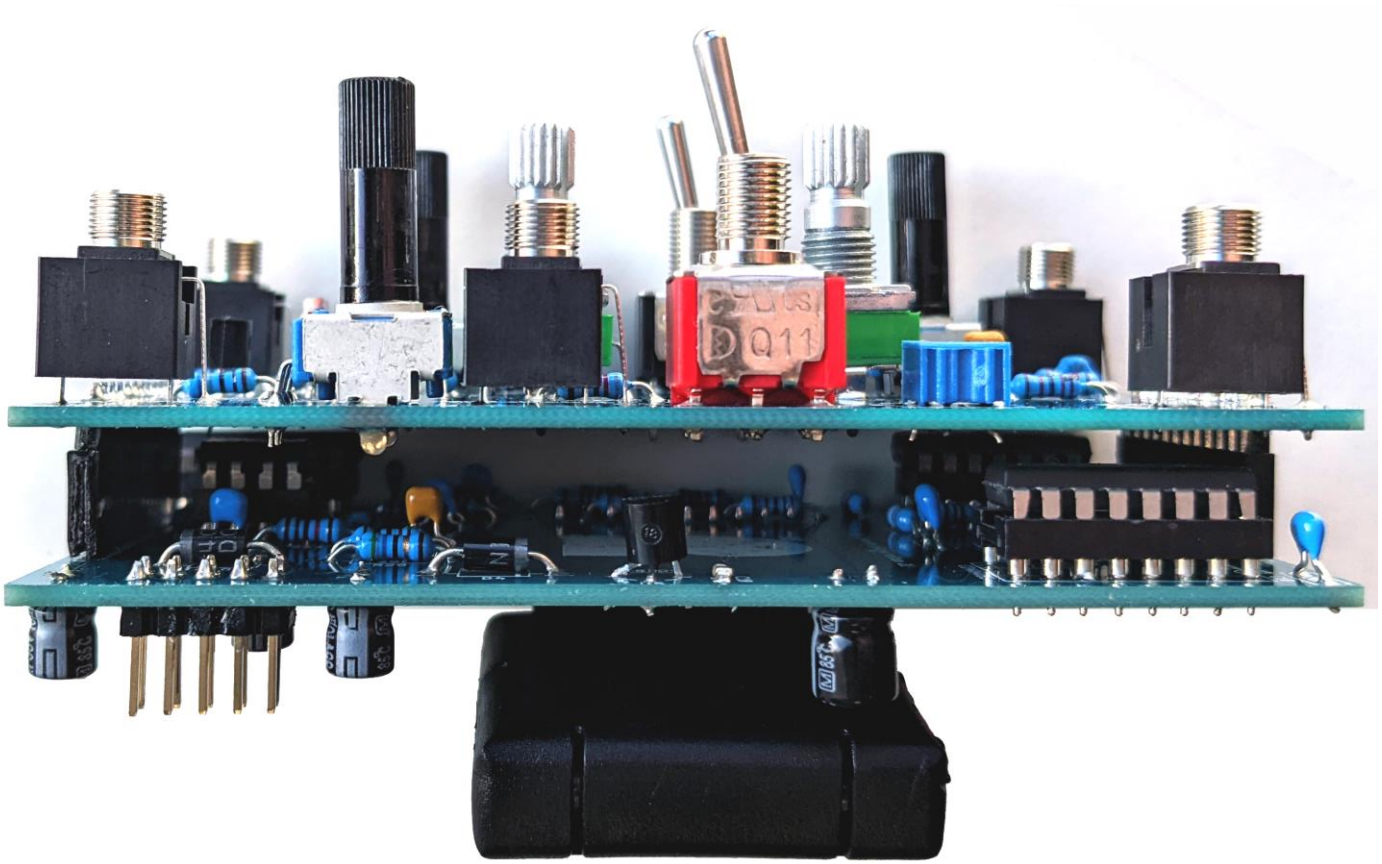
Component board front and backside

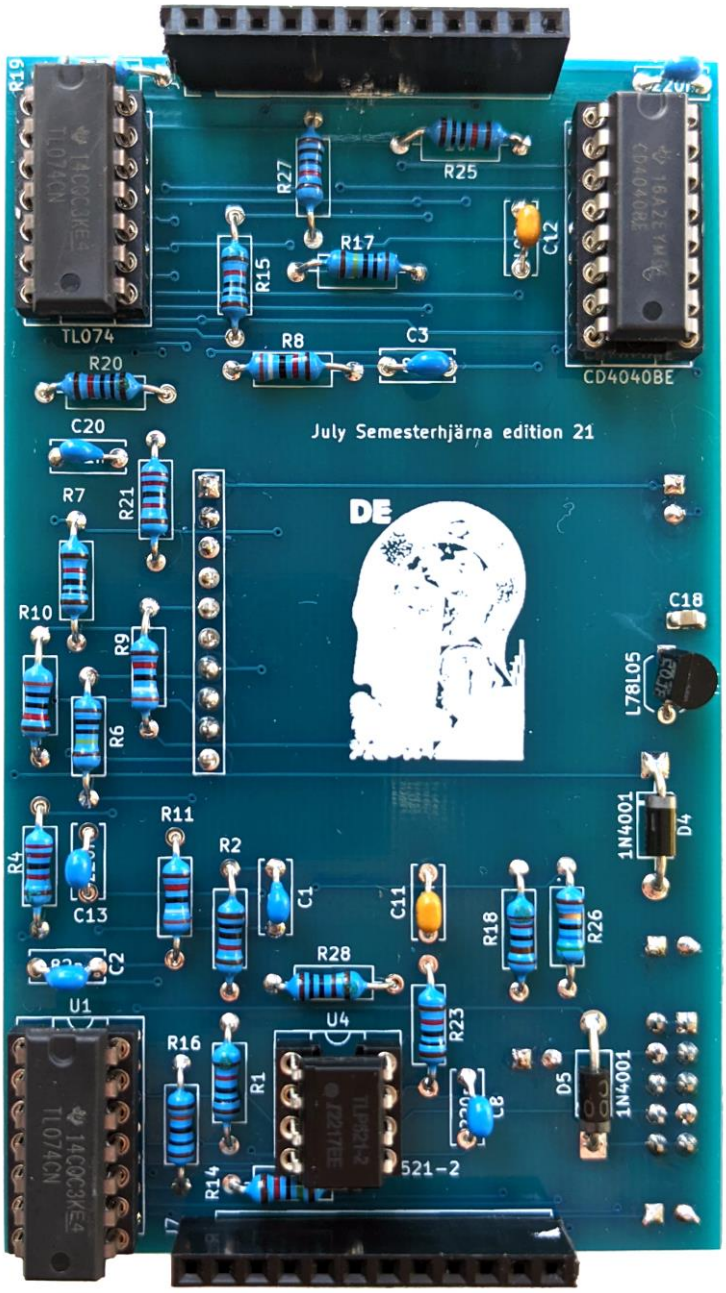


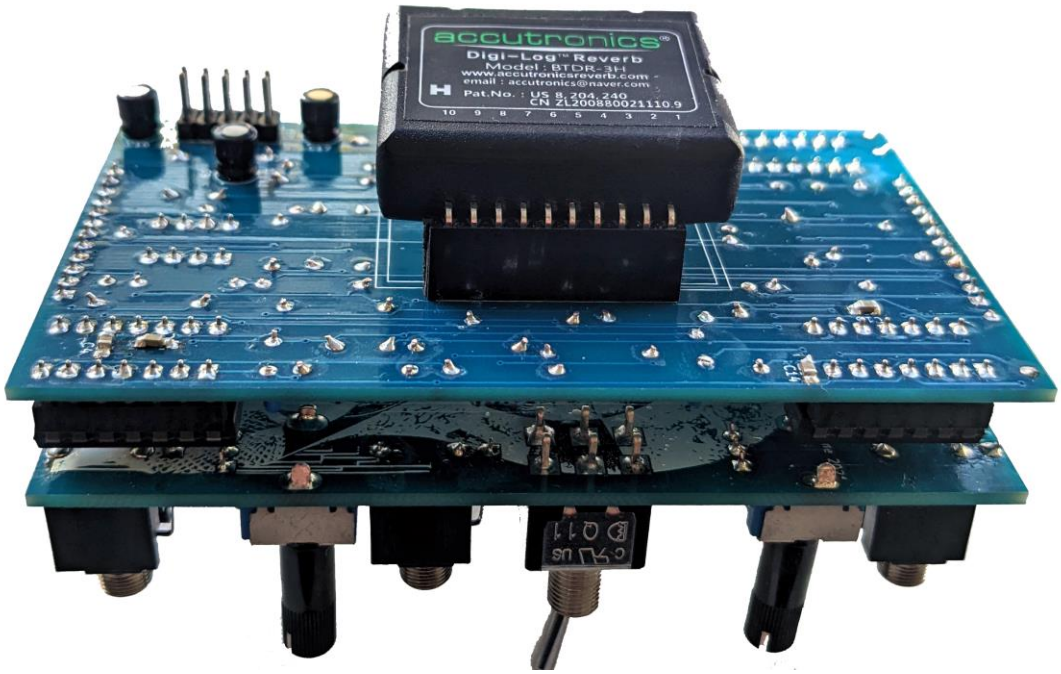

10uf
SW1


BLACK
2-WAY
RED
3-WAY
STATIC INPUT
Input 100k
ACUSTICS 100k LIN
RV2
RV5
MOD ON/OFF
R32
R22
J2
BUNKER_CV
R29
FB 100k
RV4
R24
J8
STATIC AMPLITUDE CV
D1
R33
RV1
Q1
LDR03
CV 100k
C21
J10
R30
Q2
R31
J9
OUTPUT


c US
Q11


Q11


TL074
CD4040BE
July Semesterhjärna edition 21
DE
L78L05
1N4001
1N4001
521-2
R19
R27
R25
R17
R15
C12
R8
C3
R20
C20
R7
R21
R10
R9
R6
C18
R4
R11
R2
C1
C11
R18
R26
C13
C2
R28
U1
U4
R16
R1
R23
D5
D4
R14
C8



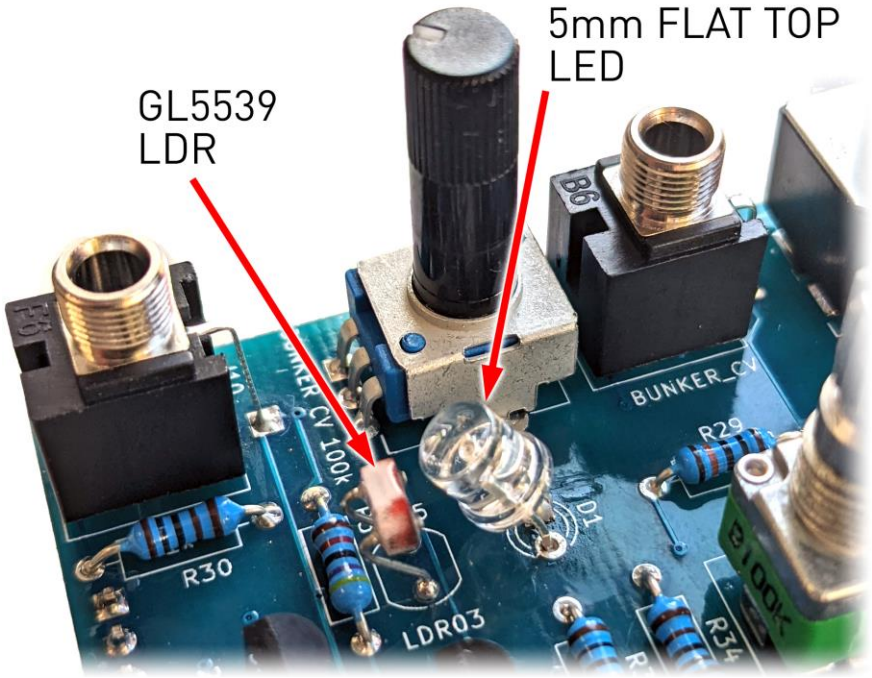
Building is rather straight forward. I start with the components PCB and do the pcb with all the jacks and switches last. I use pin headers for holding the btdr-3 tank just in case one needs to swap it. The module contains a few 0805 smd components, they are all decoupling capacitors and depend on what school of thought you belong to[10] you can leave them out (I leave them in). If you decide you want them I would start to solder them first[11].

I suggest to start with the power of the module. Which is the power eurorack header, 1N4001 the Electrolyte caps and the L78L05. When soldered in nicely take your multimeter out and measure leg 1 on the BDTR (square pad) as well as leg 16 on the CD4040. Both should have +5v volt present. If not, troubleshooting the power sections should be real easy since there are just a few components present at the board. Check that you have -12v and +12v present at the header then measure the legs at the L78L05 for starters.

Then start with the smallest components: resistors followed by the caps. I usually do the IC holders after the resistors but before the caps but some people like to start with them even before resistors. Then insert IC's into the holders. Put the headers into their holes (female ones on the component board) but only solder one pad (in the middle somewhere). Then move on to the jack board. Don't forget the components on the backside of this board (electrolyte caps 10uf and one 47uf).

[10] Aristoteles for instance hated them while Karl Marx loved them, Prague school were indecisive.
[11] First time with SMD? It's easy, but prepare by watching some instructional videos like this one: https://www.youtube.com/watch?v=f9fbqks3BS8&ab_channel=LeoMakes

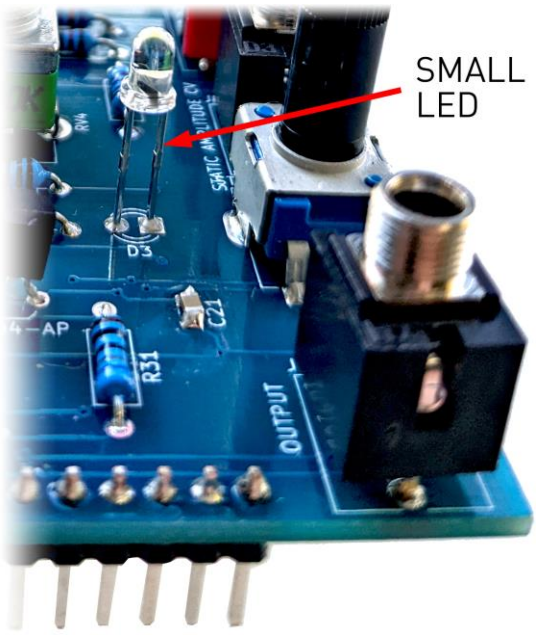
The jack board contains just few resistors, some caps and a transistor to start with. Repeat the procedure form above, start with resistors, then caps and lastly the 2N3904 transistor. Then some more tricky stuff. Put in the 5mm Led (D1) with flat head and the LDR. Short leg goes through the square pad. Bend the LDR so the pad is facing the led but not touching (there should be a 3-4mm gap between them[12]). The LDR should have a "swan neck" and make sure that the leads are not toughing something and that both are as close to the pcb as possible (they need to fit underneath the panel eventually).



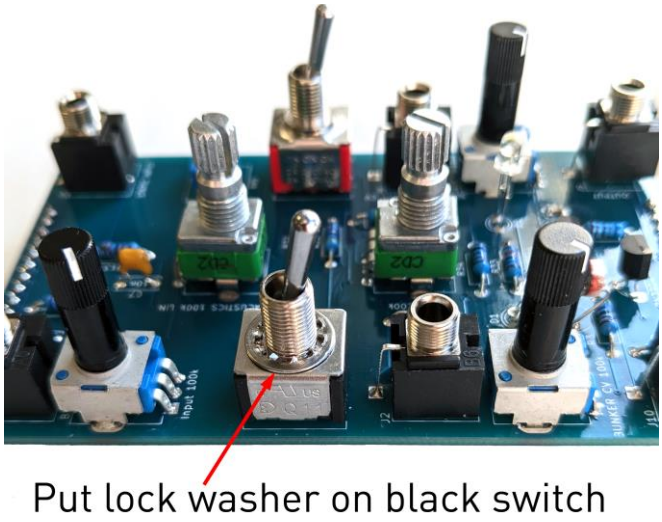
Now solder in the trimmer (RV5)

Then the switches, pads are made to fit both pcb ones (which are quite rare in this config) and the ones usually made for panel mount (which has little soldering terminals). You might need to use a tad bit of force to push the switches through the pads, but once in there they should be pretty solid (not moving around). Then fit all the pots and jacks but don't solder anything. Insert the 3mm led into its pads (short leg goes into square pad).

[12] You can experiment what works best before attaching the panel.



Before placing the panel add a single lock washer on to the black switch as in the photo below. Then place the panel and screw a nut onto all jacks, switches and both alpha pots before soldering anything. The jacks should be hanging very slightly off the PCB due to the size of the switches (like they are someway floating: See picture below). Don't screw the jack nuts on too far. Check everything is aligned and the 3mm LED is peeping out from beneath the panel.



If it looks ok you should start soldering them in one by one.

Remove the panel and put the male headers into the holes of the jack board, solder one pad in the middle. Merge the two boards together using the male and female headers, if it's hard to make them fit just re-heat the one pad on the header to move it. When fitted nicely like a

sandwich solder all pads on both sides. Header pads are usually pretty close to each other so make sure there are not any solder joints touching each other creating a short[13]. Solder the header for the BTDR-3 and insert it.

Inspect your pads before turning the pcb's on for the first time. Look for solder bridges etc. Turn it on: no magic smoke? Good. We can move on.

Before putting the panel back on you need to set your personal setting on the feedback circuit using the trimmer on the jack board (RV5). I usually set it so it is "glowing" hard but doesn't get too crazy[14], I encourage you to find your own best setting though. To set this up, turn feedback pot on the jack board fully clock wise. I usually use a gated signal (and oscillator though a vca regulated by a medium fast envelope) so you can hear the reverbs behavior clearly. With Feedback full CW on the panel adjust the trimmer until you have a behavior that you like. Listen to the reverb output when you do this. Remember this is when the feedback pot on the panel is set to full, you can always tame it on the panel using that pot (RV4), this just sets its most extreme behavior when set to maximum.

Then attach the panel and you are done.

The 78L05 does get hot because it is dropping the voltage down from 12V to 5V, so the excess is washed off as heat. I have had these running for several hours/days with no shutdown (78L05 will turn off if too hot). So don't worry about it.

Modwiggler build thread will be available here:

https://modwiggler.com/forum/viewtopic.php?t=251984

[13] This is one of the first things I check when a module is malfunctioning

[14] Massonna style

3.1 Acknowledgments

Thank you:

Wraalabs for getting the ball rolling.

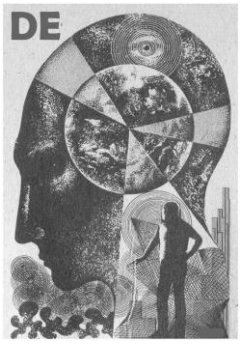
Jon Nensén: For answering literary hundreds of questions on circuit design etc.

Ezhi & Aka: for introducing this style of Lo-Fi reverbs to me also helping me push the BTDR to its very limits.

Tom Withwell: For early in my career introducing the Music Thing Modular reverb which was my first reverb diy build. Unbeknownst to him it became my "Integral Accident"[15] which made my Bunker module possible to begin with.

Zeon Light: For releasing the album "Bunker Archeology"[16]. Available at bandcamp for you to listen to while you are soldering or going through life.

Steven and Thonk.



[15] http://www.artandpopularculture.com/Integral_accident
[16] Senza Testa 2022

BOM

Ref	Qnty	Value	Source
C1, C20	2	22n	Mouser: 810-FG28X7R1H223KNT0
C2, C3	2	82p	Mouser: 810-FG28C0G1H820JNT0
C4, C5, C14, C15, C18	5	100n 0805 SMD (optional)	Mouser: 187-CL21B104KBFNNNE
C6	1	4.7nf	Mouser: 810-FG18X7R1H472KNT6
C7	1	10n	Mouser: 810-FG18X7R1H103KNT6
C8, C10, C13	3	220n	Mouser: 810-FG18X7R1H224KRT0
C11, C12	2	100n	Mouser: 810-FG28X7R1H104KNT6
C21	1	100n 0805 SMD (mandatory)	Mouser: 187-CL21B104KBFNNNE
C9, C16, C17	3	10uf 25v	Mouser: 667-ECE-A1EKA100B
C19	1	47uf 25v	Mouser: 667-ECA-1EM470B
D1	1	5mm Orange or Red Led (flat top)	ebay: https://www.ebay.com/itm/265129617063?hash=item3dbaf4e6a7:g:1JUAAOSwLQ5gfYA2

D3	1	3mm clear LED (cold white)	ebay: https://www.ebay.com/itm/264956805333?hash=item3db0a800d5:g:MfUAAOSwurBgdHVQ
D4, D5	2	1N4001	Mouser: 750-1N4001T-G
IU1	1	BTDR-3H	Banzai: https://www.banzaimusic.com/Accutronics-Digi-Log-BTDR-3H.html
J1, J2, J5, J8, J9, J10	6	Thonkiconn jacks	Thonk!
J3, J6	2	Conn_01x12_Male	Tayda: https://www.taydaelectronics.com/12-pin-2-54-mm-single-row-pin-header-strip.html
J4, J7	2	Conn_01x12_Female	Tayda: https://www.taydaelectronics.com/15-pin-2-54-mm-single-row-female-pin-header.html (cut it to fit 12 pin)
Q1, Q2	2	2N3904	Mouser: 833-2N3904-AP
R1, R2, R7, R15, R20, R23, R25 R27	8	10k	
R3, R22	2	47k	
R4	1	22k	

R5	1	GL5539 - LDR	Ebay: https://www.ebay.com/sch/i.html?_from=R40&_trksid=p2380057.m570.l1313&_nkw=GL5539&_sacat=0
R6, R17	2	1M	
R8, R9, R11. R12	4	39k	
R10	1	30k	
R13, R21	2	22k	
R14	1	15k	
R16, R29, R32, R33	4	100k	
R18	1	2.2k	
R19	1	330k	
R24	1	82k	
R26	1	56r	
R28, R30, R34	3	1k	
R31	1	680r	
RV 2, RV 4	2	BUNKER CV 100k Potentiometer 9mm alpha t18	Thonk: https://www.thonk.co.uk/shop/alpha-9mm-pots/
RV3,RV4, RV6,	3	Song Huei 9mm trimmer tall 100k lin	Thonk: https://www.thonk.co.uk/shop/ttpots/

RV5	1	POT_TRIM 50k 3386p vertical	https://www.mouser.se/ProductDetail/Bourns/3386P-1-503LF?qs=0VqvB9JLnlvJpCTIF%252BL7%2FA%3D%3D
SV1	1	10_PIN_HEADER	unshrouded power pins: https://www.thonk.co.uk/shop/eurorack-diy-essentials/
SW1	1	TYPE A, DPDT ON-ON-ON Switch	Ebay: https://www.ebay.com/itm/111415248385
SW3	1	DPDT ON/OFF Switch	Ebay: https://www.ebay.com/itm/233571280537
U1, U2	2	TL074	Mouser: 595-TL074ACN
U3	1	CD4040	Mouser: 595-CD4040BEE4
U4	1	TLP521-2	Ebay: https://www.ebay.com/itm/191674539879?hash=item2ca0b15f67:g:RBAAAOxy~dNTIpgD
U5	1	L78L05	Mouser: 511-L78L05ACZ-TR
Knobs 1	3	Dark grey trimmer toppers	Thonk: https://www.thonk.co.uk/shop/tall-trimmer-toppers/
Knobs 2	2	Synth pointer knobs dark gray small t18 shaft.	Thonk https://www.thonk.co.uk/shop/synth-pointer-knobs/
IC sockets 1	2	14 pin	https://www.thonk.co.uk/shop/eurorack-diy-essentials/
IC sockets 2	1	16 pin	https://www.thonk.co.uk/shop/eurorack-diy-essentials/
IC sockets 3	1	8 pin	https://www.thonk.co.uk/shop/eurorack-diy-essentials/