

ELECTRO-ACOUSTIC RESEARCH

MODEL 13 MINI: USER'S MANUAL/ASSEMBLY INSTRUCTIONS





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introduction

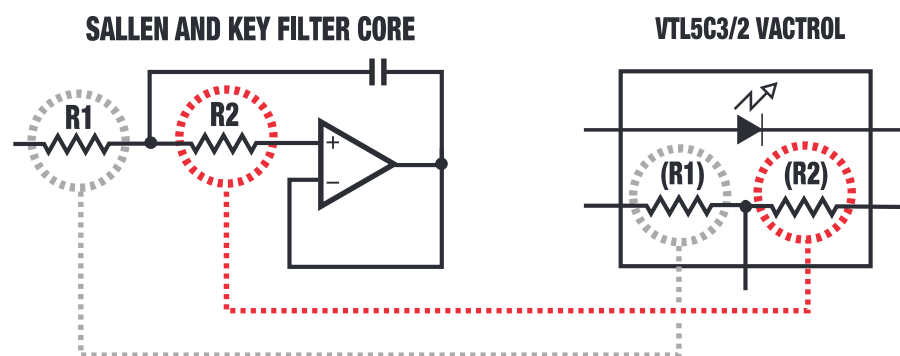
In 1971, Morton Subotnick played a pivotal role in defining the music composition department at the newly-formed California Institute of the Arts in Valencia, CA. Coming from New York, he assembled a group of colleagues to join him in that endeavor: composers Barry Schrader from the University of Pittsburgh; Ingram Marshall, Charlemagne Palestine and Serge Tcherepnin from NYU; and in an advisory role: Donald Buchla.

Through this affiliation with Don Buchla, CalArts took delivery of the very first Buchla 200 Electric Music Box. At the time the school's campus was still under construction, so initially the system was delivered to Mort Subotnick's home studio in Tarzana, CA where it would be utilized as the primary instrument for his seminal piece Sidewinder.

Benefiting from the expansive technology advancements of the late 60s, among the design innovations of Buchla's new music box was the inclusion of Integrated Circuits (ICs), and an opto-isolating device called a VACTROL. Of particular relevance here were the vactrols used at the core of the Model 292 Low Pass Gate - which acted as a VCA in the 200 - an eclectic choice that most engineers wouldn't have considered as vactrols are, by nature, slow reacting.

A vactrol-based Low Pass Gate utilizes fixed resonance unity gain Sallen and Key two pole filter typography, also known as a VCVS or Voltage Controlled Voltage Source. Variable center frequency is obtained by changing the value of two resistors simultaneously, which, as figure 1 indicates is ideally suited for a dual-element vactrol despite the speed penalty which would, over decades, serendipitously become its legacy: the Buchla 292's infamous 'ringing'.

FIGURE 1 • SALLEN AND KEY FILTER TYPOGRAPHY



In 2004, EAR (then 'Plan B') released the first LPG to the Eurorack market - the Model 13 Dual Timbral Gate. In 2020, while tasked to reconfigure the modular synthesizer EAR had designed a decade ago for the band Tool, a one-off 4HP wide single LPG was developed specifically for that system and is the basis of the M13 Mini. Like the original Timbral Gate, the Mini incorporates additional circuitry not found in other vactrol LPGs which significantly decreases the bleed associated with Don's original circuit when adapted for the higher amplitudes of Eurorack signals. As a bonus, this addition also enables the user to adjust the vactrol decay time.



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summary of controls

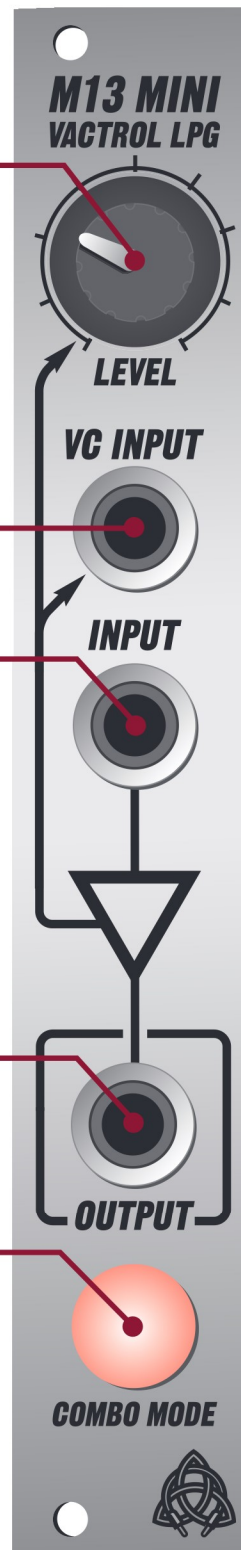
1 MANUAL OFFSET LEVEL

2 VC FREQ (LEVEL) INPUT

3 SIGNAL INPUT

4 SIGNAL OUTPUT

5 COMBO MODE SELECT





connecting and mounting your m13

Before installing your module, verify that your system's power supply (PSU) is capable of providing an additional 40 mA current required to operate the Model 13.

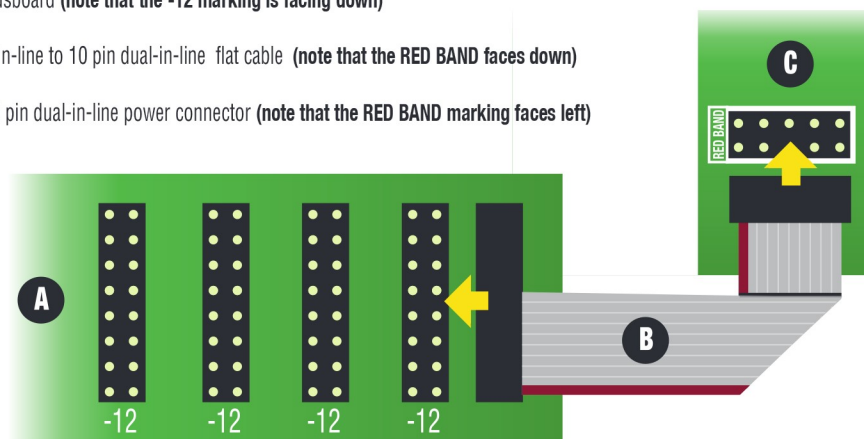
As with all Plan B/EAR modular products, the Model 13 Mini adheres to the mechanical and electronic conventions of Doepfer MusikElektronok as outlined on their website at www.doepfer.de/a100_man/a100m_e.htm. Power is connected via the 16-to-10 pin flat cable included with your module. While all EAR products are diode-protected to safeguard against power connection errors, EAR cannot be responsible for damage to other modules which may occur as a result. As the module will withstand reversed power applied to it, a keyed connector is not required.

You will notice that one end of the cable terminates to a 10 pin dual row header connector, while the other end is 16. The 10 pin end is intended for module termination and the 16 pin end to your power busboard.

With the system power turned off, first connect the flat cable to the module. Notice that down the length of the cable one side is colored red. That red stripe should face the **RED BAND** marking on the module's 10 pin power connector.

FIGURE 2 • POWER CONNECTION VIA FLAT CABLE

- (A) Eurorack Busboard (note that the -12 marking is facing down)
- (B) 16 pin dual-in-line to 10 pin dual-in-line flat cable (note that the RED BAND faces down)
- (C) Model 13 10 pin dual-in-line power connector (note that the RED BAND marking faces left)



Now connect the other end of the flat cable to one of the 16 pin power connectors on your busboard, making sure that the cable's **RED BAND is FACING DOWN** towards the **-12 VOLT MARKING** on the bus connector. Your last step before powering up is securing the module in place by installing the two mounting screws. Please note that in some cases your faceplate may become marred by the head of the screw. Plastic washers (not included) will stop this from happening.

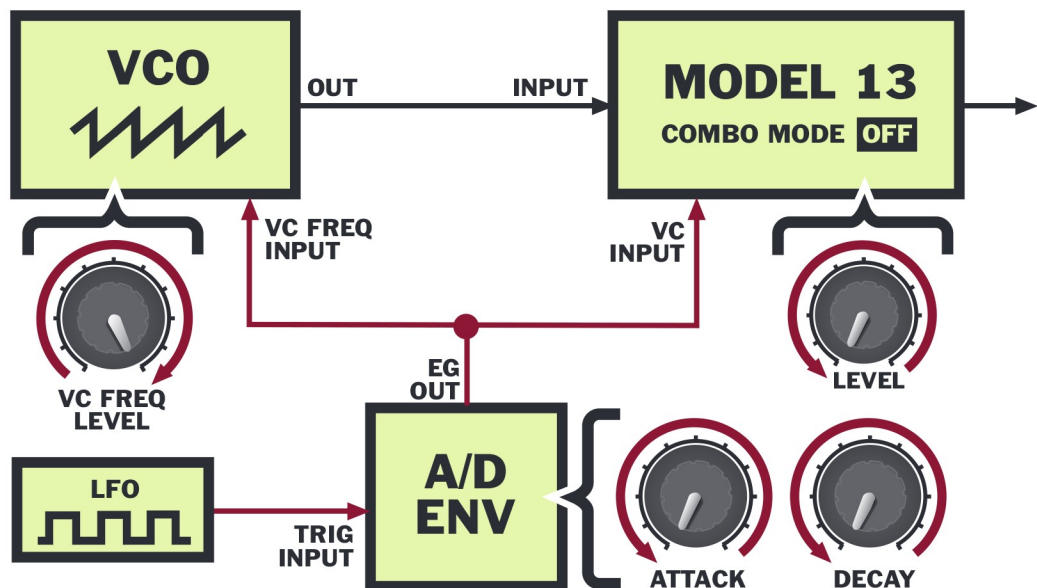


basic operation

The primary function of a Voltage Controlled Amplifier (VCA) in synthesizers is shaping sound. An external voltage can be applied as automation to raise or lower the amplitude of the signal being gated. LPGs serve this same function utilizing an AC coupled fixed resonance 12dB/oct lowpass filter.

Unlike the original M13 and the Buchla 292, the Model 13 Mini only has two operating modes: **LOW PASS** (filter only) and **COMBO** (low pass and VCA modes combined). Each mode has very distinct attributes which will be demonstrated in the test patch in figure 3 below:

FIGURE 3 • MODEL 13 MINI TEST PATCH



The signal path (black lines) is quite simple: A ramp wave output of a VCO routed to the **INPUT** of the Model 13 with its **OUTPUT** connected directly to speakers without additional processing. The **COMBO MODE** should not be engaged - (the LED should be off).

The control architecture (red lines) is also straightforward: an A/D or A/R Envelope Generator* which responds to rising-edge triggers configured as a 1-2 millisecond transient by setting the **ATTACK** and **DECAY** pots fully counterclockwise. The **ENVELOPE OUTPUT** of the EG should be routed to both the Model 13 **VC INPUT** and into a **VC FREQUENCY INPUT** of the VCO with its Level Attenuator fully clockwise (set to max).

*An ADSR may also be used by setting the **ATTACK**, **DECAY**, **SUSTAIN** and **RELEASE** pots fully counterclockwise.



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FIRST PATCH VARIATION • SAWTOOTH WAVE IN LOW PASS MODE

Once the patch in figure 3 is loaded on your modular, first verify that the M13's **MANUAL OFFSET POT** is fully counterclockwise and the **COMBO MODE** pushbutton is **DISENGAGED** (LED is off). Connect a square wave LFO into the Envelope Generator's **GATE** or **TRIGGER INPUT**. Once the EG begins firing it will produce a string of relatively short, slightly muted filtered beats with a distinctly percussive attack due to the frequency transient applied to the oscillator. Regardless of the short envelope you have loaded (1-2 milliseconds) the LPG's output decay will be significantly longer - approx. 300 milliseconds. Welcome to vactrol's slow reaction time!

SECOND PATCH VARIATION • SAWTOOTH WAVE IN COMBO MODE

Depress the **COMBO MODE** button so that the **LED IS ON** to engage the LPGs characteristic 'ringing' effect. You will notice the decay has increased even further, lasting anywhere from .5 from to 1 second depending on the setting of the trim pot on the back side of the module (reference the last page of this manual for the trim adjustment procedure). Along with the extended duration, **COMBO MODE** increases the high frequency transient response of the filter which adds a natural sounding ambience to short percussive events.

THIRD PATCH VARIATION • SINE ON SINE IN COMBO MODE

As a third variation, change the input waveshape from a Sawtooth to a Sine wave, then introduce a second Sine VCO to frequency modulate the first oscillator. Adjust the amount of FM to taste and experiment with the frequency of the modulating VCO. Lower frequencies produce deep wood tones while higher frequencies sound metallic

FORTH PATCH VARIATION • REPLACE MODEL 13 MINI LPG WITH A STANDARD VCA

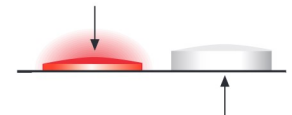
To fully appreciate the Low Pass Gate, replace the Model 13 Mini with a standard VCA. Due to the short envelope required for the initial test patch, the VCA output will consist of short unpitched clicks, dramatically different to the result when the same envelope is applied to the Model 13. Again, welcome to vactrols and why you will learn to love them!

While Low Pass Gates have a magical effect on audio signals, unlike standard VCAs they cannot gate control voltages efficiently. The ringing that gives vactrol-based LPGs their unique personality translates to portamento when gating DC or sub-audio AC signals. For that reason, the inputs have been AC decoupled to block signals of 12 hertz less.

Apart from the trim pot adjustment procedure on page 13, this concludes the user section of this manual. The remaining pages are instructions for those who have purchased the Model 13 Mini as a kit. Thank you for purchasing EAR products....enjoy your Low Pass Gate and tell your vactrols you love them!

FIGURE 4 • MODES

.....
BUTTON DEPRESSED (LED ON):
COMBO MODE



.....
BUTTON RELEASED (LED OFF):
LOWPASS MODE



model 13 mini kit: inventory

Congratulations on your purchase of an EAR Model 13 Mini Vactrol LPG Kit. You will find the following:

1. Qty 1 Main Board - gloss black soldermask
2. Qty 1 Pot Board - gloss black soldermask
3. Qty 1 FR4 Faceplate in flat black with gold flash graphics
4. Qty 1 100K Linear Potentiometer with associated mounting hardware (nut/washers)
5. Qty 1 Red Illuminated Latching Pushbutton
6. Qty 1 Davies type 1900H Splined Control Knob
7. Qty 3 3.5MM Jacks with associated mounting hardware (round nuts)
8. Qty 3 Jack Washers
- 9 Qty 1 10 Pin to 16 Pin dual-in-line Eurorack format power cable

general assembly instructions

The EAR Model 13 kit does not include all the components needed to build this module. A Bill of Materials is included on page 9 listing all the additional parts, with Mouser part number provided where applicable. Building this kit involves soldering 0805, SOIC and SOT23 format SMT components. Prior SMT soldering experience is required. Page 9 maps all component locations, as well as which side of the board thru hole parts are installed.

If hand soldering the SMT components it is suggested that you begin with **IC 1 (TL074)**, as it is the most challenging and will be easier to rework without the clutter of other parts crowding around it.

Assembly should be completed in the following order:

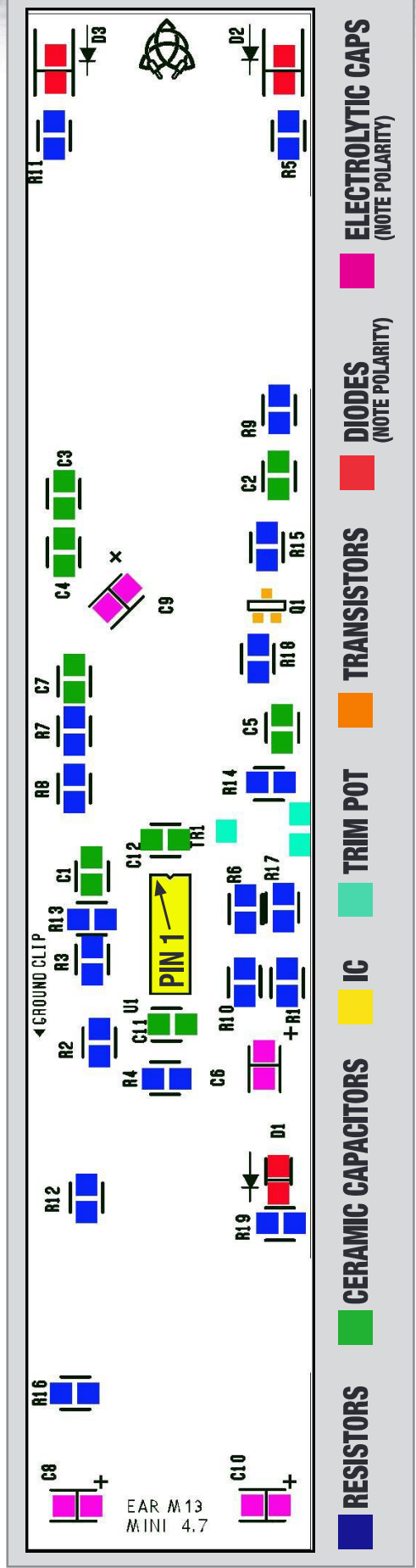
- A. Placement and soldering of all SMT components.
- B. Installation and soldering of jacks.
- C. Installation of the 10-pin header power connector.
- D. Pot Board assembly, then mounting to the Main Board.
- E. Installation and soldering of the pushbutton
- F. Installation and soldering of vactrols.
- G. Installation of faceplate and associated hardware / faceplate alignment.
- H. Placing Davies 1900H knob
- I. Making endless bleeps and bleeps geared to drive your cats cray.



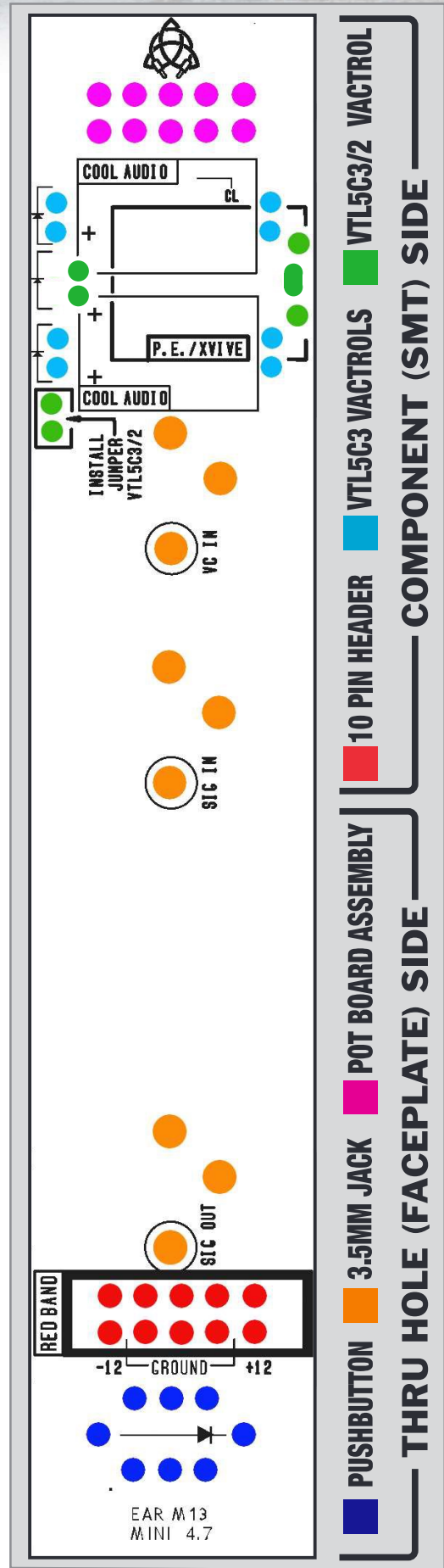
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NOVA

smt component placement reference



thru hole component placement reference





ELECTRO-ACOUSTIC RESEARCH

model 13 mini kit: BOM

ELECTRO-ACOUSTIC RESEARCH MODEL 13 MINI LOW PASS GATE BOM REV. 4.7.3													
ITEM	DETAILS/ VALUE	PACKAGE TYPE	SMT INSERT	SUB OK?	QTY	DESIGNATOR NUMBER	MANU	MANUFACTURER PART NUMBER	MOUSER PART NUMBER	PIECE PRICE	EXT. PRICE		
Resistor	100K 1/8w	SMT-0805	YES	YES	3	R7, R8, R17	YAGEO	RC0805FR07100KL	603-RC0805FR07100KL	0.14	0.42		
	68K 1/8w	SMT-0805	YES	YES	1	R1	YAGEO	RE0805FRE1068KL	603-RE0805FRE1068KL	0.17	0.17		
	15K 1/8w	SMT-0805	YES	YES	2	R2, R4	YAGEO	RC0805FR0715KL	603-RC0805FR0715KL	0.1	0.2		
	4.7K 1/8w	SMT-0805	YES	YES	2	R3, R19	YAGEO	RC0805FR074K7L	603-RC0805FR074K7L	0.1	0.2		
	47K 1/8w	SMT-0805	YES	YES	2	R5, R6	YAGEO	RC0805FR0747KL	603-RC0805FR0747KL	0.1	0.2		
	33K 1/8w	SMT-0805	YES	YES	4	R9, R10, R14, R18	YAGEO	RC0805FR1333KL	603-RC0805FR1333KL	0.1	0.4		
	1K 1/8w	SMT-0805	YES	YES	1	R12	BOURNS	CRT0805FZ1001ELF	652-CRT0805FZ1001ELF	0.092	0.092		
	470 ohm 1/8w	SMT-0805	YES	YES	2	R16, R11	YAGEO	RC0805FR-0747ORL	603-RC0805FR-0747ORL	0.1	0.2		
	10K 1/8w	SMT-0805	YES	YES	1	R13	YAGEO	RC0805FR0710KL	603-RC0805FR0710KL	0.1	0.1		
	2.2M 1/8w	SMT-0805	YES	YES	1	R15	BOURNS	CR0805JW225ELF	652-CR0805JW-225ELF	0.1	0.1		
Capacitor, ceramic	.001 uF	SMT-0805	YES	YES	4	C1, C2, C11, C12	YAGEO	CC0805FRNPO9BN102	603-CC805FRNPO9BN102	0.26	1.04		
	.47 uF	SMT-0805	YES	YES	2	C5, C7	YAGEO	CC0805KKX7R7BB474	603-CC805KKX7R7BB474	0.21	0.42		
	4700 pF	SMT-0805	YES	YES	1	C4	YAGEO	AC0805KRX7R9BB472	603-AC805KRX7R9BB472	0.2	0.2		
	220 pF	SMT-0805	YES	YES	1	C3	YAGEO	CC0805KRX7R9BB221	603-CC805KRX7R9BB221	0.11	0.11		
Capacitor, electrolytic	10 uF	TEH-Y	YES	YES	3	C9, C10, C6	WURTH	86-5230542002	710-865230542002	0.21	0.63		
	1 uF	TEH-Y	YES	YES	1	C8	WURTH	86-5230640005	710-865230640005	0.2	0.2		
Diodes	3.9 V Zener	SOD123	YES	YES	1	D1	ON SEMI	MMSZ5228BT1G	863-MMSZ5228BT1G	0.27	0.27		
	1N4002	SMA	YES	YES	2	D2, D3	RECTRON	FM4002W	583-FM4002	0.28	0.56		
Transistor	4393 FET	SOT23	YES	YES	1	Q1	CENTRAL	CMPP4393 TR	610-CMPF4393TRTIN	0.54	0.54		
	TL074	SOIC-14	YES	YES	1	U1	Ti Precision	TL074CDR	595-TL074CDR	0.54	0.54		
Trim Pot	1M Single turn	CVR42A	YES	NO	1	TP1	BOURNS	3314G-2-105E	652-3314G-2-105E	1.83	1.83		
	10 PIN	PCB Mount	NO	NO	2		ALL ELECT	DHS-40	DHS-40	1.5	3		
										\$7.25	\$11.42		

For SUPERCHARGED operation change the value of R3 from 4.7K to 15K

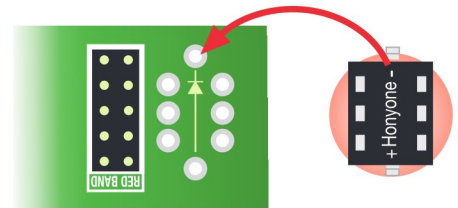


assembly/modification/calibration guidelines

COMBO MODE PUSHBUTTON INSTALLATION

The Combo Mode pushbutton is illuminated with an LED and is polarized with a Cathode (-) and an Anode (+) lead. On the base of the switch you will see an embossed + and - marking indicating the direction of polarity. Install the pushbutton facing the thru hole (faceplate) side of the Main Board (opposite side as the silkscreen marking) so that the LED's CATHODE (-) is inserted into the designated PCB hole as shown (fig 5).

FIGURE 5 • LED POLARITY



SINGLE / DUAL VACTROL INSTALLATION

The Model 13 main board is equipped to accept either a dual VTL5C3/2 vactrol or two VTL5C3 vactrols (the brands of which can be mixed). Their location, and the thru holes they are inserted into vary for these two configurations. Figure 6 shows the different silkscreen and thru locations for installing either A) two VTL5C3 vactrols, or B) a single VTL5C3/2. If you're using a /2 dual a jumper will need to be installed into the thru holes marked **INSTALL JUMPER VTL5C3/2**.

FIGURE 6 • VACTROL INSTALLATION (VTL5C3 OR (VTL5C3/2)

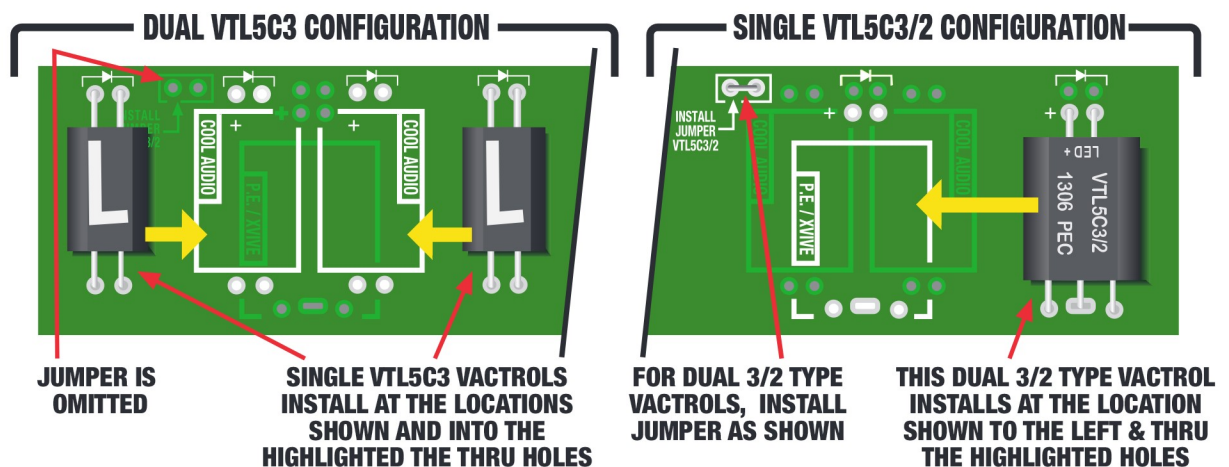


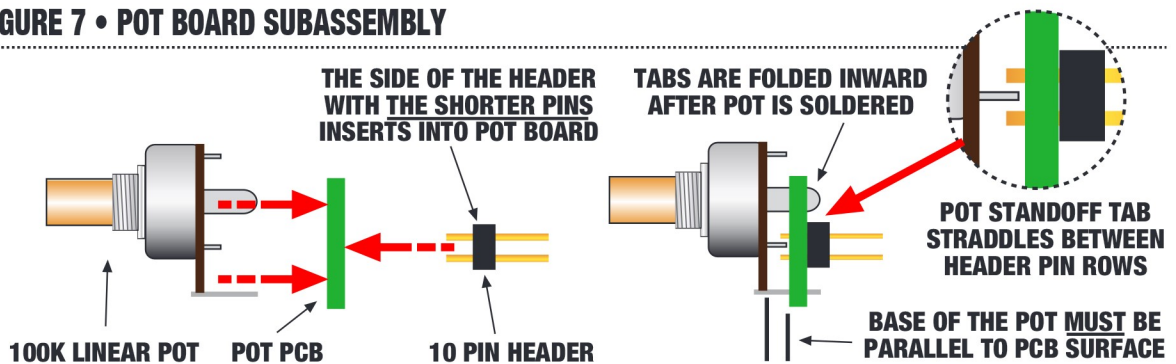
Figure 6 above shows the same area of the board, highlighting which markings and which thru holes to focus on depending on the vactrol configuration being installed. Diode symbols are provided on the PCB indicating polarity. Vactrols made by Perkin Elmer, Vactec, Excelitas Technologies and Xvive are clearly marked indicating which leads are the LED end, as well as the polarity. In all cases, the + LED lead is inserted into the lefthand thru hole, also marked with a +. Cool Audio vactrols are unmarked, and orientation is determined by the diode end (it has one long and one short lead), with the long lead corresponding to the LED ANODE which should be inserted into the upper left thru hole. Cool Audio parts purchased with a M13 kit have been **hand-marked with a L** which should be oriented as shown.



POT BOARD SUBASSEMBLY

The M13 kit includes a small 14 x 16mm printed circuit board - the POT BOARD which adapts the 100K Level pot to the stack height of the 3.5mm jacks. Its artwork is symmetrical - you can solder the pot and header connector to either side, as long as the two are on opposite sides of the board from one another. The header connector must be installed first. You'll notice that the pins on either side of the connector are different lengths. As figure 5 shows, solder the SHORTER PIN end into this PCB.

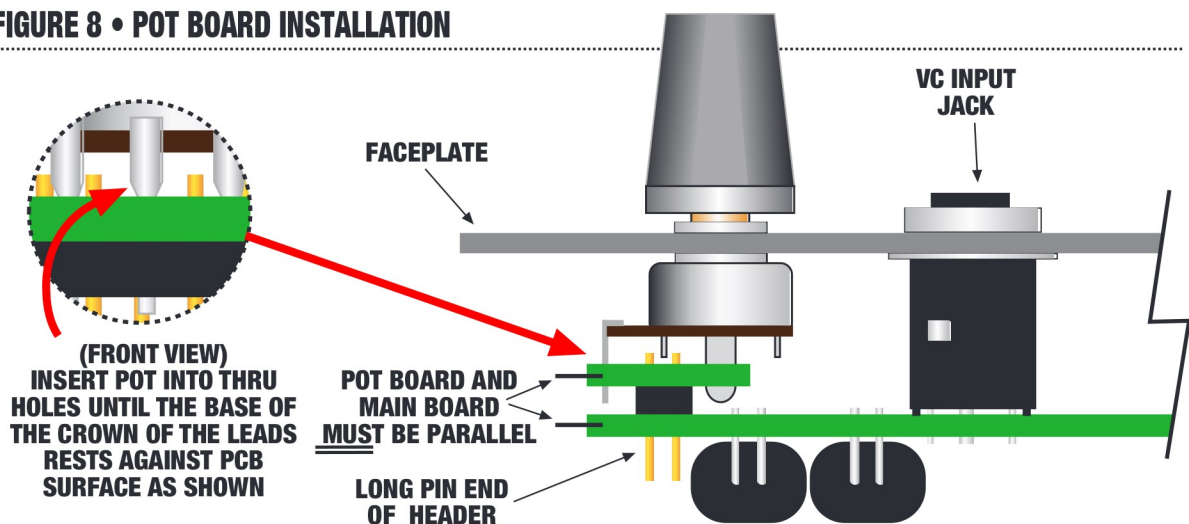
FIGURE 7 • POT BOARD SUBASSEMBLY



Next install the 100k pot to the opposite side of the assembly. There are two unplated slots on the pot board. Insert the longer flat tabs at the base of the pot into these slots **A)** making sure the shorter standoff pins on the base of the pot straddle between the rows of header pins (ref: fig. 7) and **B)** that the PCB and the base of the pot are parallel to one another. Once soldered, fold the two flat tabs inward on the opposite side of the PCB.

Now install the pot board subassembly onto the thru hole (faceplate) side of the main PCB, making sure that the two board surface are parallel to one another. This is required to maintain alignment between the board components and their faceplate clearance holes.

FIGURE 8 • POT BOARD INSTALLATION





FACEPLATE ALIGNMENT

Z Axis alignment: Three round spacers have been included in your kit. They must be placed on the jacks like standard hardware washers, but underneath the faceplate. They are required to maintain proper height in relation to the Offset Level pot so that the faceplate and PCB are parallel to assure the Combo Mode pushbutton travels freely.

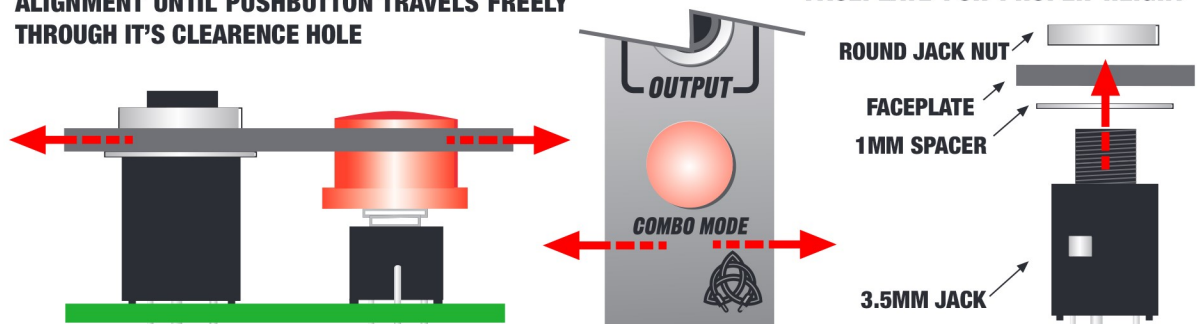
X and Y Axis alignment: Position the faceplate & install the round jack nuts. Before they are fully tightened, jog the faceplate's horizontal & vertical position to align the Combo Mode pushbutton through its clearance hole.

Once you are satisfied with the alignment, you can apply final tightening to the jack nuts and install and secure the pot hardware and the Davies 1900H knob. Resist the temptation to over-tighten the jack nuts. The jack body and threads are made of a relatively soft material, which will hold tension without the need for a washer or excessive tightening.

FIGURE 9 • FACEPLATE ALIGNMENT AND HEIGHT ADJUSTMENT

BEFORE THE JACK NUTS ARE FULLY TIGHTENED, JOG THE FACEPLATE INTO HORIZONTAL & VERTICAL ALIGNMENT UNTIL PUSHBUTTON TRAVELS FREELY THROUGH IT'S CLEARANCE HOLE

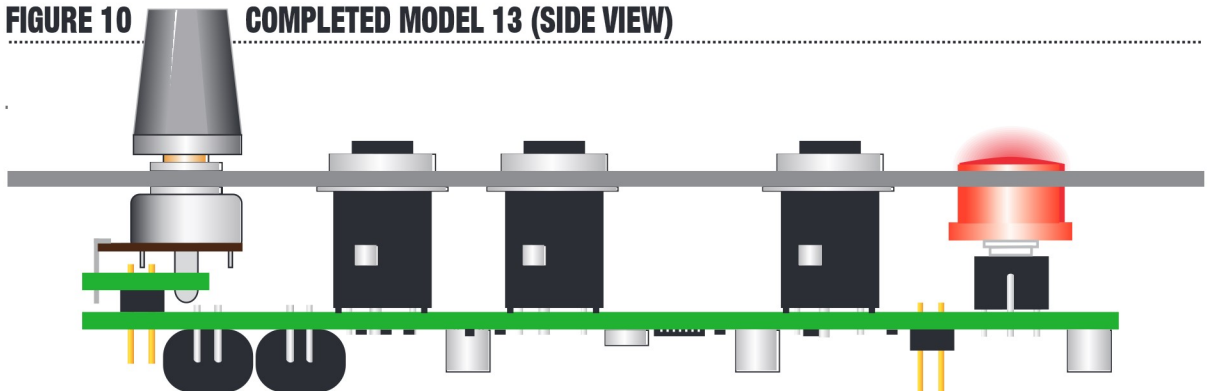
HARDWARE STACK: PLACE 1MM ROUND SPACERS ON JACKS UNDER FACEPLATE FOR PROPER HEIGHT



FINAL ASSEMBLY STACK

Fig 10 gives a side view of a completed Model 13 kit. Note which components are on which side of the PCB. This shows a VTL5C3 configuration. If using a single VTL5C3/2, there would be only one vactrol. On the back of the PCBA, 1/2 inch up from the power connector on the left side is a thin 1/2" exposed trace labelled "Ground Clip" for a scope probe ground.

FIGURE 10 COMPLETED MODEL 13 (SIDE VIEW)





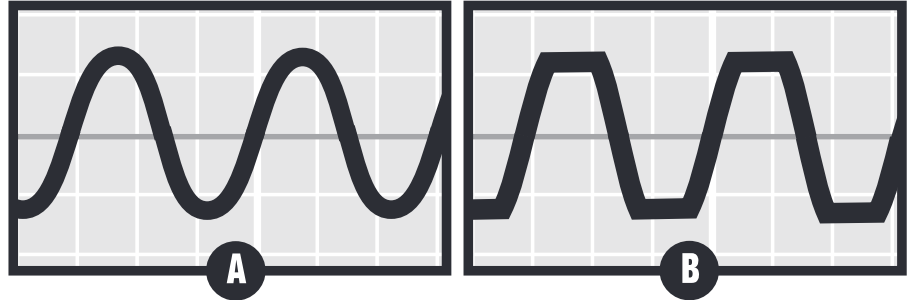
THE SUPERCHARGE OPTION

The Model 13 has been optimized for clean, noise free operation. However, a simple modification - the substitution of a single resistor (R3) from 4.7K to 15K - will introduce a blush of distortion. Great for harmonically rich signals. With purer tones where you don't want clipping the input must be attenuated 2 volts Vpp (approx 3 dB) prior to gating.

FIGURE 11 • SUPERCHARGED MODE

The graphic indicates the resultant output waveform at 10 Vpp when:

- A** R3 = 4.7K
- B** R3 = 15K



calibration

A unique feature exclusive to Plan B/EAR vactrol-based Low Pass Gates is the addition of compensation circuitry designed to improve the bleed associated with VTL5C3 LPGs in the amplified Eurorack signal environment (20v Vpp vs. Buchla's 3v Vpp line level standard). Another benefit of this modification however it allows the user to adjust vactrol decay time - the ringing- while in COMBO MODE operation

Preassembled M13s have been factory calibrated to an approx half second decay. The user is encouraged to experiment with longer or shorter decays or periodically return the module to its factory settings. On the back side of the module a single trim pot TR1 located to the right of the TL074 Op Amp. To make this adjustment, run a harmonically robust signal such as a Square or Sawtooth wave through the M13 with a very short envelope. Depress the COMBO MODE button so that the LED lights and using a pot tweaker tool, adjust the pot setting while the sound is active to increase or decrease the decay time to your liking. You cannot damage the circuit making this adjustment.

playlist/suggested listening

Given you've purchased an EAR Model 13 Mini LPG, it would be fair to assume Buchla synthesizers and the esoteric music they make resonates with you. While you're building may we suggest the following playlist of albums utilizing that very first Buchla 200 mentioned in the introduction which Donald Buchla hand delivered to CalArts in 1971.

WHO

BARRY SCHRADER
BARRY SCHRADER
MORTON SUBOTNICK
MORTON SUBOTNICK

WHAT

LOST ATLANTIS
LOST ANALOG
VOL 1: ELECTRONIC WORKS
VOL 2: ELECTRONIC WORKS 2

WHERE

APPLE MUSIC, BANDCAMP
APPLE MUSIC, BANDCAMP
APPLE MUSIC, BANDCAMP
APPLE MUSIC, BANDCAMP