

Aaron Lanterman Buchla Timbre & Crossfader PCB Rev 1

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Errors

The schematic and PCBs linked above contain some significant errors, most of which must be corrected during construction.

- **Fixed in Rev 1:** The op amp inputs of IC1A (pins 2 and 3), IC7A (pins 2 and 3), IC7B (pins 5 and 6), and IC6B (pins 5 and 6) need to be SWAPPED to get proper negative feedback. Note IC1A is a spare op amp that is meant to be wired "off," so it's not necessary to fix it; if left unchanged, the output will swing to one of the rails, and it will draw a little extra current, but it probably won't hurt anything (I didn't bother doing the IC1A swap in my prototype). However, the other op amp inputs do need to be fixed if you want the waveshape crossfader to work. Note that if you don't care about the waveshape crossfader, and only want the main timbre circuit, you don't have to do the swaps, and can in fact omit all the parts you see in the lower right corner of the schematic.
- **Fixed in Rev 1:** There is a capacitor missing. If you look on the original schematic, you will see a 15 microfarad electrolytic capacitor (marked C2 on Buchla's schematic) between the non-grounded side of Q6 (equivalently R21) and the negative terminal of the op amp (marked IC1B on my schematic). You need to add this in somehow. The positive terminal of the electrolytic is connected to the negative terminal of the op amp IC1B. If you don't include this capacitor, the VCA won't have variable gain. (I used 10 microfarad instead of 15 microfarad in my prototype.)
- **Changed in Rev 1:** TRIM should be 100K, not 10K.
- **Changed in Rev 1:** R24 should be 130K, not 33K.
- **Changed in Rev 1 to 330K:** R21 is labeled as 6.7K; it should be 6.8K as marked on the schematic. I had to up this quite a lot in order to not get too much gain through the VCA with the offset knob at the lowest setting. I used 330K, and recommend that as a starting point if you're using a J201 or MPF102 for Q6 (I tried both and didn't notice any difference). Your mileage may vary. Different values of R21 may be appropriate for different choices of Q6.
- TOS and TCV should be 10K linear pots, not 50K.
- R100 and R101, and similarly R106 and R107, are intended to create +13.5 volt supplies. On the original Easel, this is created on another board with an op-amp and transistor buffer. Here it's just a couple of resistors, forming "soft" supply, so to counteract loading I found that lowering R100 and R106 from 10K to 1K is a good idea.
- **Fixed in Rev 1:** The silkscreen labels of R37 and R47 are swapped, as are R41 and R44. However, the part values listed inside the part outlines themselves are correct, so if you stuff these based on the ohm values you see on the PCB you will be fine.

Notes

- I am convinced that the 50K sliders marked on the original schematics (and this version of the board) should actually be 10K linear. The 120K input and shaping resistors (R102, R103, R104, R105, R108, R109, R110, and R110) are off-board in the original Easel, but included on-board in this adaptation.
- The original Easel has a 13.5 V supply, created using an op amp and a transistor. If you have such a supply, you may hook it to the two +13.5 pins and omit R100, R101, R106, and R107. Otherwise, leave the +13.5 pins unconnected and use R103 and R104, which create a "soft" +13.5 V supply. I found it important to lower R100 and R106 to something like 1K to counteract loading.
- The Q6 JFET is used as a variable resistor. It is specified as a 2N4341 in the original, but it appears to be out of production. I picked the J201 since it happened to come with the preinstalled Eagle libraries. I've tried a MPF102 here too, and didn't notice a difference. To get a decent control range at the lower end, I raised R21 to 330K. Different values of R21 may work better with different FETs.
- I specified Q5 as a 2N3906 since I happen to have of them and it also came preinstalled in the Eagle libraries. In the original Music Easel schematic, it is specified as a 2N4248, which seems to be out of production. You might want to try other transistors here.
- The circuit has been tested with RC4558s, which was deemed to be electrically similar to the original RC4136s used in the Easel. Other op amps will probably work (many will probably work better!), but they have not been tried.
- D3 is a 1N457. I suspect a 1N4148s or a 1N914 will work, but I have not tested them.
- D1 and D2 are not specified in the original schematic; I used 1N457s here, but my suspicions in the previous bullet point apply here too.
- Changed in Rev 1: I have a tradition of specifying 2.2 ohm resistors (should probably be 1/2 watt) at the power inputs to perform power supply filtering along with 10 microfarad electrolytics. I picked 2.2 ohms since this choice shows up on some Buchla schematics; I did not pick it through any particularly scientific means. Any low resistance should work here. I actually use "ferrite beads," as suggested by Ken Stone, and not resistors in these spots.

Connections

Front panel connections usually have a square and round pad together in a white box. The round pad is the signal, and the square pad provides a convenient ground.

- TAI - Timbre Audio Input
- TAO - Timbre Audio Output
- TCVI - Timbre CV input; amount of influence is controlled by setting of TCV pot

- WCVI - "Waveshape" crossfader CV input; amount of influence is controlled by setting of WCV pot
- A1I - Alternate input 1; buffered and appears at A1B
- A1B - Buffered version of A1I input; may be used connected to A2C, or not used at all, or connected to a switch
- A2C - This is misleadingly labeled; it would be better labeled as A1C. It corresponds to pin 10 of Board 8 of the original Easel schematics. It corresponds to what you get by turning the waveshape control counterclockwise. If you want to set this up like an original Easel, connect B9P4 or TOP directly A2C, so turning the waveshape control counterclockwise corresponds to the timbre circuit. If you want to always use the "waveshape" crossfader as a stand alone crossfader, you can directly hook A1B to A2C. If you'd like to switch between both options, hook A2C to the common terminal of an ON-NONE-ON SPDT switch, and hook TOP or B9P4 to one ON terminal and A1B to another ON terminal. (The issue of whether to use TOP or B9P4 is complex and depends on how you set the resistors OR119, OR120, OR1A, and OR47A; see below.)
- TOP - Timbre Output Pin - connected to A2C, or to a switch, or not used (see options listed under the A2C description above). This is the timbre output after the gain provided by IC5B (if gain is used).
- B9P4 - Corresponds to Pin 4 of Board 9 of the original Music Easel - connected to A2C, or to a switch, or not used (see options listed under the A2C description above). This is the timbre output before the gain provided by IC5B (assuming gain is used).
- A2I - "Alternate" input 2; buffered and appears at B8P; used if creating a stand-alone module. This corresponds to what you get when turning the waveshape control clockwise.
- B8P - Input to the Vactrol side of the "waveshape" crossfader. If you are using the A2I input, you won't need to use the B8P pad. If you are trying to build an complete Easel, B8P corresponds to pin 12 of IC 4 on the original Easel Board 8 schematic. This is the pulse, square, or triangle shape signal that you'd get by turning the waveshape control clockwise. If you hook a signal directly to B8P, you should omit IC7, R112, R113, R114, R115 (notice this also takes out the A1I, A1B functionality, but that's probably OK since you'll probably be directly hooked the timbre output to A2C anyway). Most users building stand-alone modules will probably not need to use B8P.
- MXO - Mixed Output of the "waveshape" crossfader
- CSW1, CSW2 - there's a capacitor that provides some filtering action on the timbre output. You can put a switch between CSW and CSW2 and experiment with switching this cap in and out. If you want it to act like an original Easel, just short CSW1 and CSW2.

Resistor options

- If you are using an op amp with some build in short-circuit protection, like the specified RC4558s, then you can use the 220R resistors OR121 and OR48A, and use wires instead of 1K resistors for OR115 and OR122. If, on the other hand, you are using a different op amp capable of creating much bigger currents, I recommend using wires instead of 220R resistors for OR121 and OR48A, and installing actual 1K protection resistors in the OR115 and OR122 spots.
- OK, here is where things get really complicated. OR1A and OR47A are specified as 15K and 75K; this is as things are in the original Easel. This gives the raw timbre signal at B8P4 and whatever it is mixed with at B8P a gain of 6. IC5B, OR119, OR120, OR121, and OR122 are not present in the original Easel; this is a copy of the circuitry around IC6B to give that gain of 6 at the TAO output. If you'd like your external signal input at A2I to be subject to the same gain, then you can use 15K and 75K in the OR1A and OR47A spots, respectively. However, you may prefer to take the timbre output to mixer from the TOP pin, so it already has the gain, in which case you can omit OR1A altogether, and use a wire for OR47A, which turns IC6B into a unity gain buffer; in this case, IC5B boosts the timbre output up to the level of typical signals, and will then be on an even footing with most external signals, and IC6B won't provide additional undesired gain. Think carefully about your particular desired gain structure.

Potentiometers

- WOS - "Waveshape" crossfader Offset (Easel schematics and this version of the PCB say 50K, but I recommend 10K linear)
- WCV - "Waveshape" crossfader CV; controls amount of influence of the WCVI input (Easel schematics and this version of the PCB say 50K, but I recommend 10K linear)
- TOS - Timbre Offset (Easel schematics and this version of the PCB say 50K, but I recommend 10K linear)
- TCV - Timbre CV; controls amount of influence of the TCVI input (Easel schematics and this version of the PCB say 50K, but I recommend 10K linear)