DOUBLE PENETRATION (DP) FILTER

NONLINEARCIRCUITS

Build guide & BOM

Vers.1 18/1/2014

- **Large schematic is here** - http://www.sdiy.org/pinky/data/bipolar%20VCFs.pdf
- **Module description** - http://www.sdiy.org/pinky/data/bp.html
- **Muffs thread** - http://www.muffwiggler.com/forum/viewtopic.php?p=1377672

This PCB is very dense with a lot of 1206 SMD components. It is not suitable for beginners. If you are new to soldering SMD, have a look at some vids on You-tube to see how it is done. Once you learn the techniques you will find it quicker and easier than thru-hole……..except for the chip 👁

It was designed to work on +/-12V but has been tested and works okay on +/-15V. Most likely some resistor values will need to be changed to get optimum performance; these are noted in the BOM.

You can just build it with the values shown and it will work fine, but this *is* DIY and you *should* experiment!!!

BUILDING

Solder on all of the SMD components 1st

I usually solder on all of the SMD components on the top (component side) of the PCB first and then turn it over to solder on the ones on the solder side. Then solder on the TL074.

Once this is done just solder on the rest of the components in the usual order; resistors, caps, trannies, etc.

Unlike my other PCBs, this one is marked with component numbers rather than values (except for a few parts), this is because these filters can be built in different ways. There have been many ladder variations over the years. Also, some resistor values could possibly be tweaked to get better performance. These are noted in the BOM, if you think an alternative value is better, please share the info with others in the Muffs thread or let me know and I will update this guide.

I solder SMD with a pair of fine tweezers and a regular Hakko soldering iron.

1. solder one pad, just a little bit
2. push the component into position with the tweezers, or finger for the brave (Ken!)
3. reheat the solder and slide the component onto the pad
4. wait for it to cool
5. solder the other pad

6. wait for it to cool
7. add a bit of solder to the 1st pad to make it look nice
8. done

For the chip, it is similar;

1. solder a corner pad
2. put the chip in position
3. reheat the solder and slide the chip onto the pad
4. make sure all the pins are lined up on their respective pads
5. **do not try to twist the chip** once the 1st pin is soldered as you can easily lift the pad or bend the pin, reheat the solder a little if you need to adjust its position.
6. once the chip is nicely lined up, put a bit of solder on the diagonally opposite corner pin
7. wait for it to cool
8. solder up the other pins. There are a few techniques to do this, check it on You-tube, I just solder one pin at a time and wait for it to cool.
9. use solder-wick to remove any shorts between pins
10. done

B	A	M
2 decoupling caps	100n	marked 100n on PCB 1206
C1	100n	1206
C2	100n	(33n) **() = tb303 version**
C3	100n	(33n)
C4	100n	(33n)
C5	100n	(18n)
C6	10u	
C7	10u	
C8	10u	
C9	10u	

C10	10u	
C11	10u	
C12	100n	
C13	100n	
C14	100n	
C15	100n	
C16	10u	
C17	10u	
C18	10u	
C19	10u	
C20	10u	
C21	10u	
D1 – D4	signal diodes	1N4148 or 1N914, matched

		for V_{on}, if you like
opt 1-4	dual photo-coupler	TLP521-2 from Futurlec
Pots 1-6	100k	50k - 100k ok
Q1, Q2, Q3, Q5, Q6, Q7,	BC547	NPN
Q4, Q8	BC557	PNP
	RESISTORS:	
R1	100R	1206
R2	1K	1206
R3	1K	**vary to get Trans ladder CV range correct as no tune trimpot**
R4	150K	**adjust to centre CV for Trans ladder**
R5	100K	1206
R6	100K	1206
R7	1K	1206
R8	1K	1206
R9	6K2	MAYBE adjust (10k?) Trans ladder

		Q1, 2 offset
R10	2K2	
R11	100K	1206
R12	10k	1206
R13	10k	1206
R14	10k	1206
R15	470k	
R16	470k	
R17	100k	1206 marked “c” on the PCB
R18	100k	1206 **adjust to change amplitude of sum out**
R19	1k	1206 (marked as 1k on pcb)
R20	100k	1206
R21	100k	1206 **adjust to change amplitude of diff output**
R22	100k	1206 **adjust to change amplitude of diff output**
R23	100k	1206 marked “c” on the PCB
R24	1k	1206 marked as 1k on pcb
R25	1k	1206 (marked as 1k on pcb)
R26	1k	1206

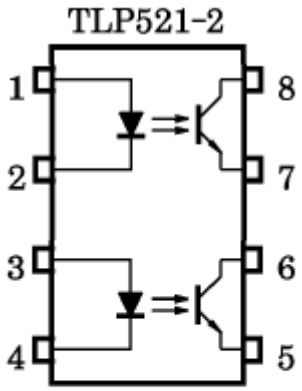
R27	1k	1206
R28	10k	1206
R29	2k2	1206
R30	47k	1206
R31	47k	1206
R32	1k	1206
R33	10k	1206
R34	1k	**vary to get CV range correct as no tune trimpot**
R35	100k	1206
R36	100k	1206
R37	150k	**adjust to centre CV for diode ladder**
R38	100k	1206

R39	10k	1206
R40	10k	1206
R41	10k	1206
R42	470k	
R43	470k	
R44	1k	1206
R45	100k	1206
R46	10K	1206
R47	100K	1206
	10R (2)	or link
switch	DPDT	on - on
U1234	TL074	SOIC

- 1206 indicates SMD, otherwise it is a thru-hole component.
- C2-C5, C12-C15 all 4.5mm pin spacing
- All electros are 2mm pin spacing
- Usually these filters have matched transistors or diodes in the ladders, not practical here, at least match Q1 with Q2 and Q5 with Q6, also match D1-D4 ……. or don't bother
- Pots should be 9mm upright, these ones from Tayda are fine - http://www.taydaelectronics.com/potentiometer-variable-resistors/rotary-potentiometer/linear/100k-ohm-linear-taper-potentiometer-round-shaft-pcb-9mm.html

or they have a cheaper plastic shaft version.

Dual photocoupler – there are many of these available. Maybe some work better than others; I only tried the TLP521-2 from Futurlec. The main point is the pinout matches the PCB:



1, 3 : ANODE
2, 4 : CATHODE
5, 7 : EMITTER
6, 8 : COLLECTOR

If you want to try other types, feel free to check the specs with me or on Muffs first. Some photocouplers have unusual parameters, though most are about the same.

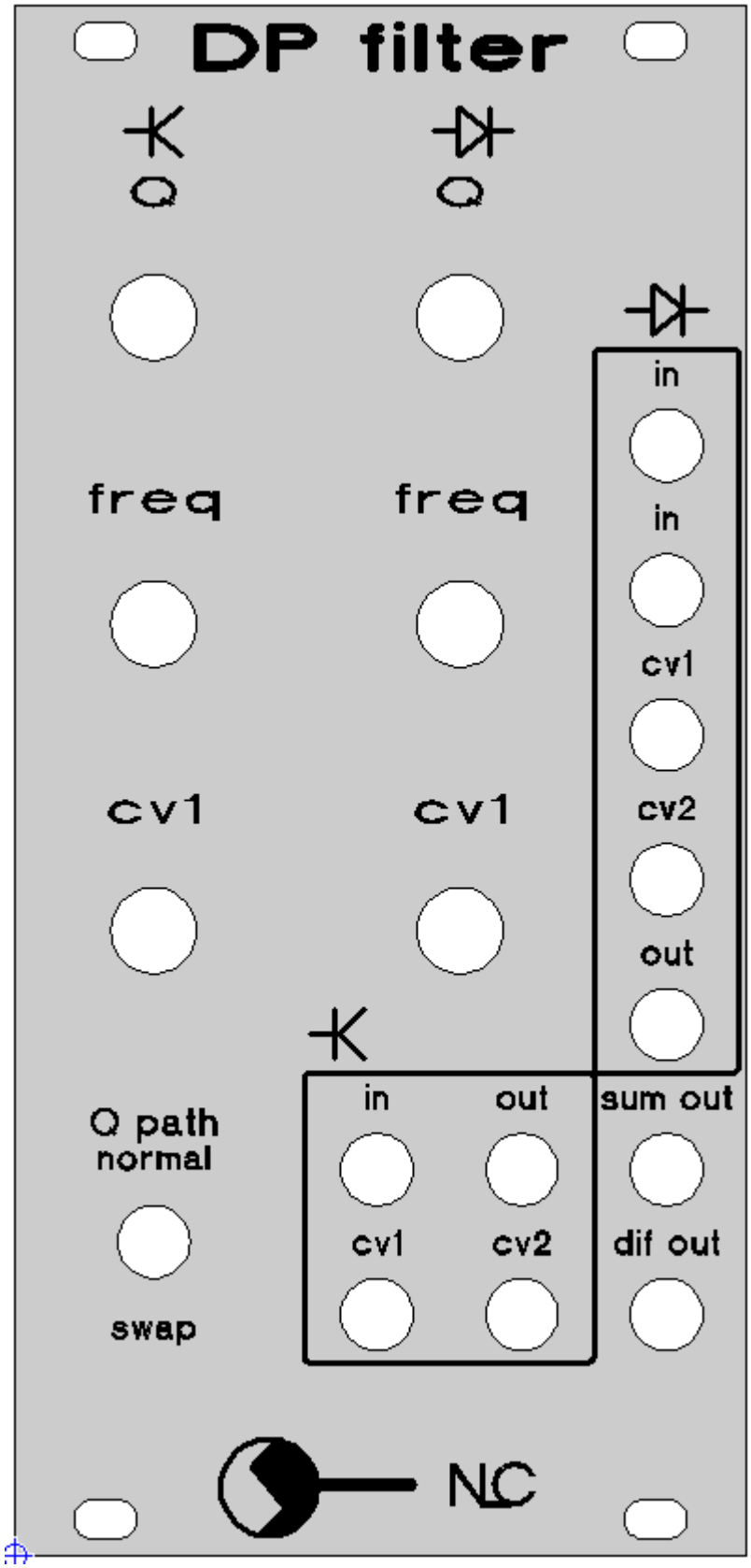
Here are some to try; the TLP series are near end of life, but still many around**. The BAD list will not work**, usually the pinout is different or it has an AC input (you want DC).

If you have the luxury of choice, look for ones with the lowest voltage drop on the LEDs.

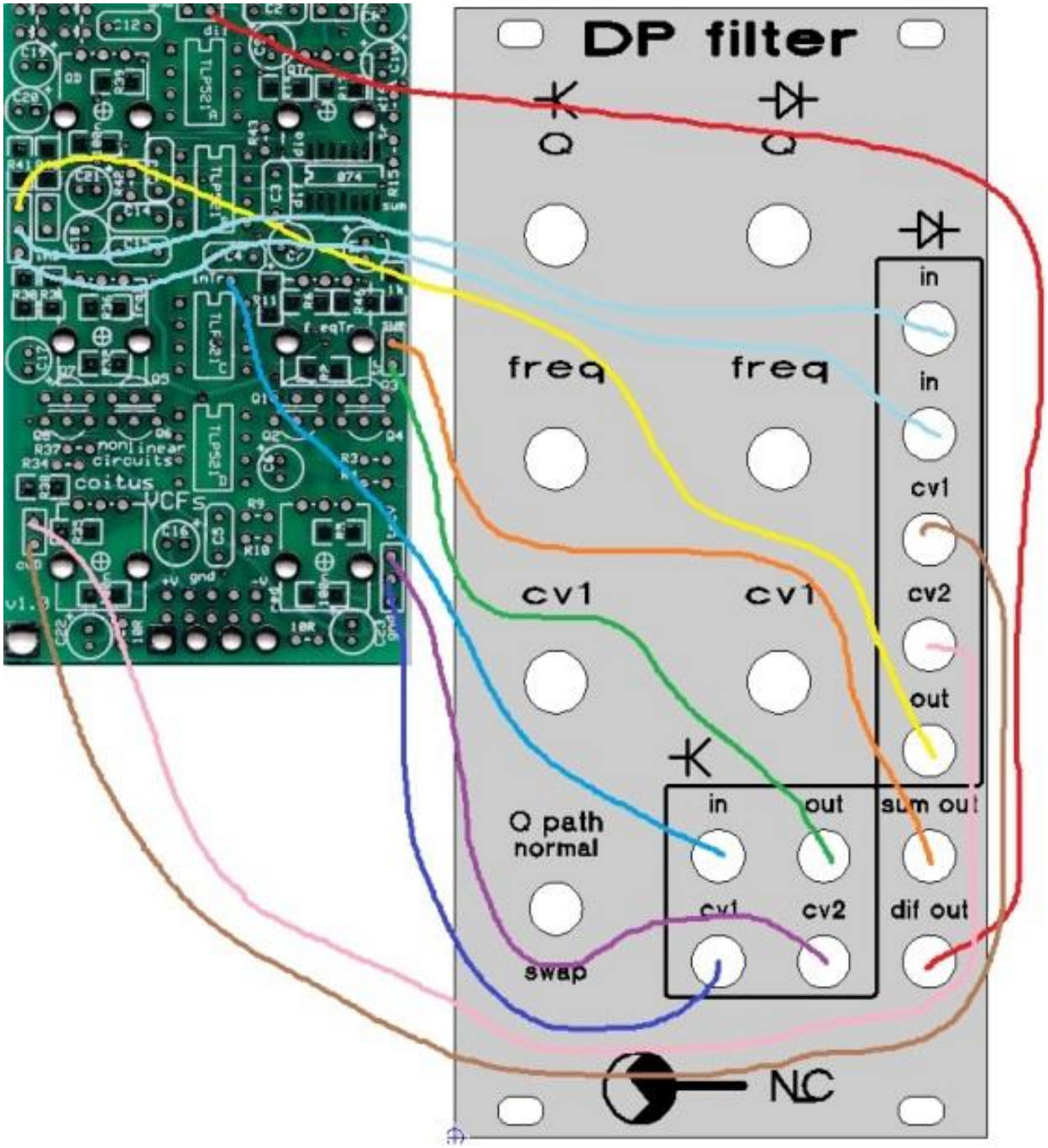
The list below is not exhaustive, just ones I found on RS Components, manufacturer websites and the google machine. At this stage I have only tried the TLP521-2.

GOOD	***BAD***
ILD615	~~TLP620~~
ACPL-827	~~HCPL-0530 0531 0534~~
TLP521-2	~~TLP504A~~
KB827	~~ILD74~~
K827PH	~~ISD1, ISD5, ISD74~~
LTV827	~~CNY74-2H~~
LTV826	~~MCT6~~
ISP827	~~KB824~~

TLP321-2	~~ISD20x~~
TLP621-2	~~LTV-824~~
TLP624-2	~~ISP824~~
TLP628-2	
TLP629-2	
MCT9001	
LDA203	
SDT800	
TIL918	



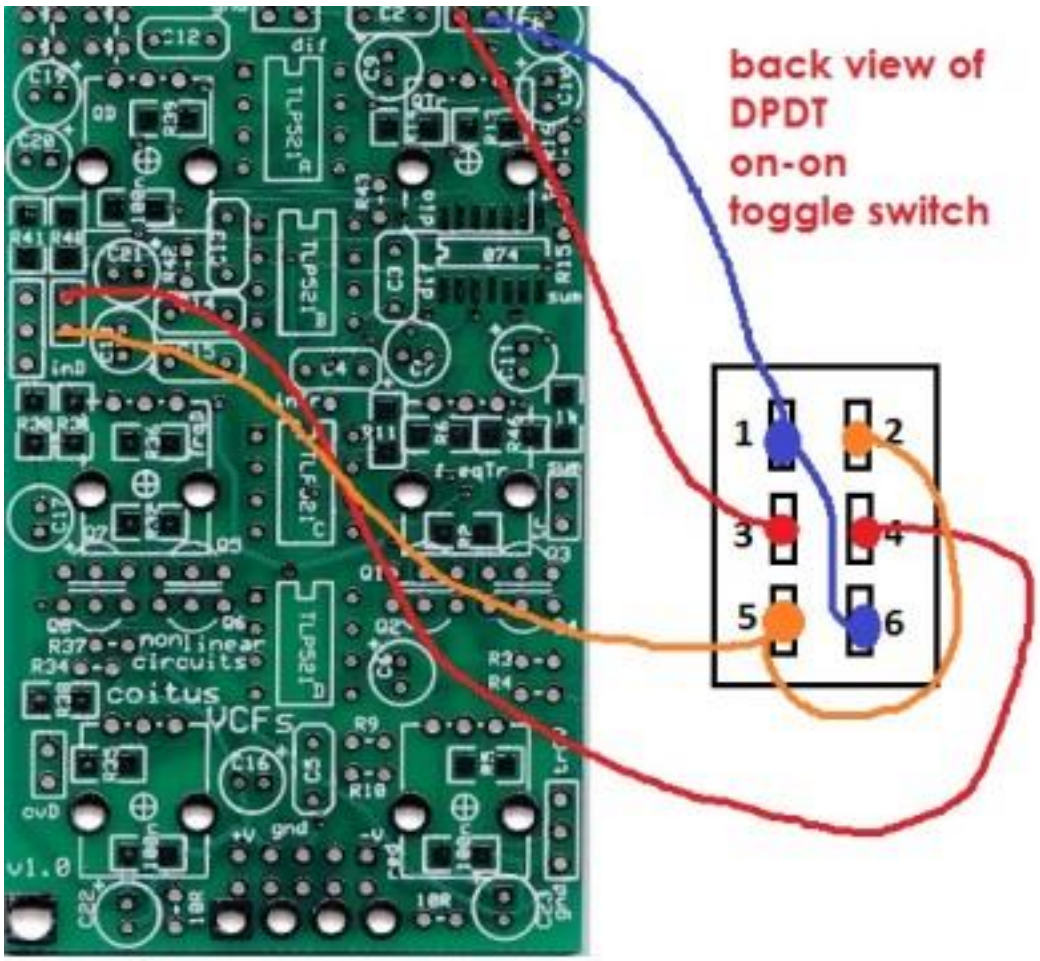
Panel is 12HP



red	Difference out
orange	Sum out
yellow	diode ladder out
light blue (2)	Diode ladder inputs
blue	Transistor ladder input
dark blue	Transistor ladder CV1
purple	Transistor ladder CV2
brown	Diode ladder CV1
pink	Diode ladder CV2
green	transistor ladder out

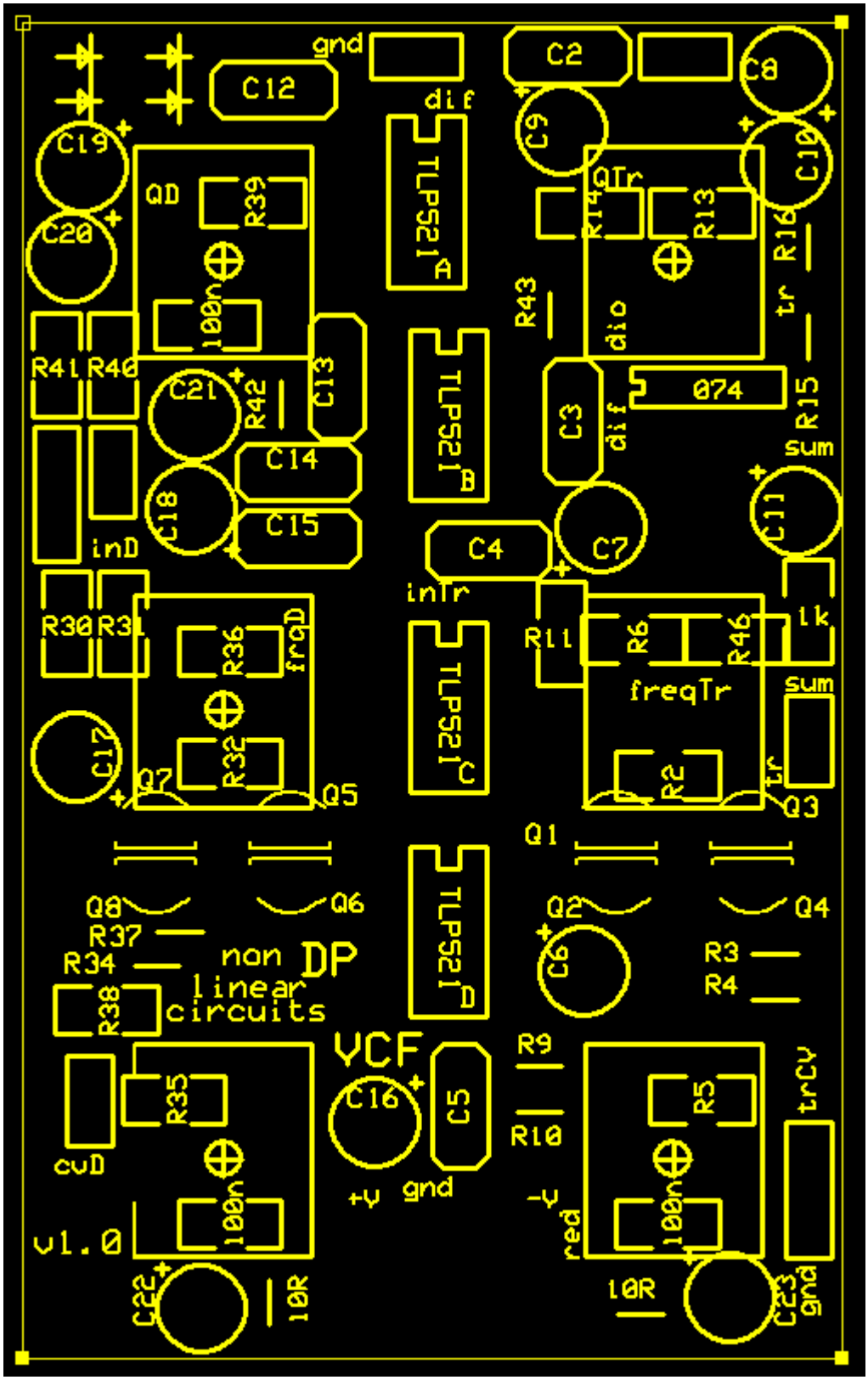
There are two ground pins marked “gnd”, one is next to the difference out and the other is next to the Transistor ladder CV inputs

The Transistor ladder input is sitting alone in the middle of the PCB. If using IDC connectors for the wiring it would be easiest to solder this one in before installing C4, otherwise it is a pretty tight fit…. it really depends on the size of your C4.

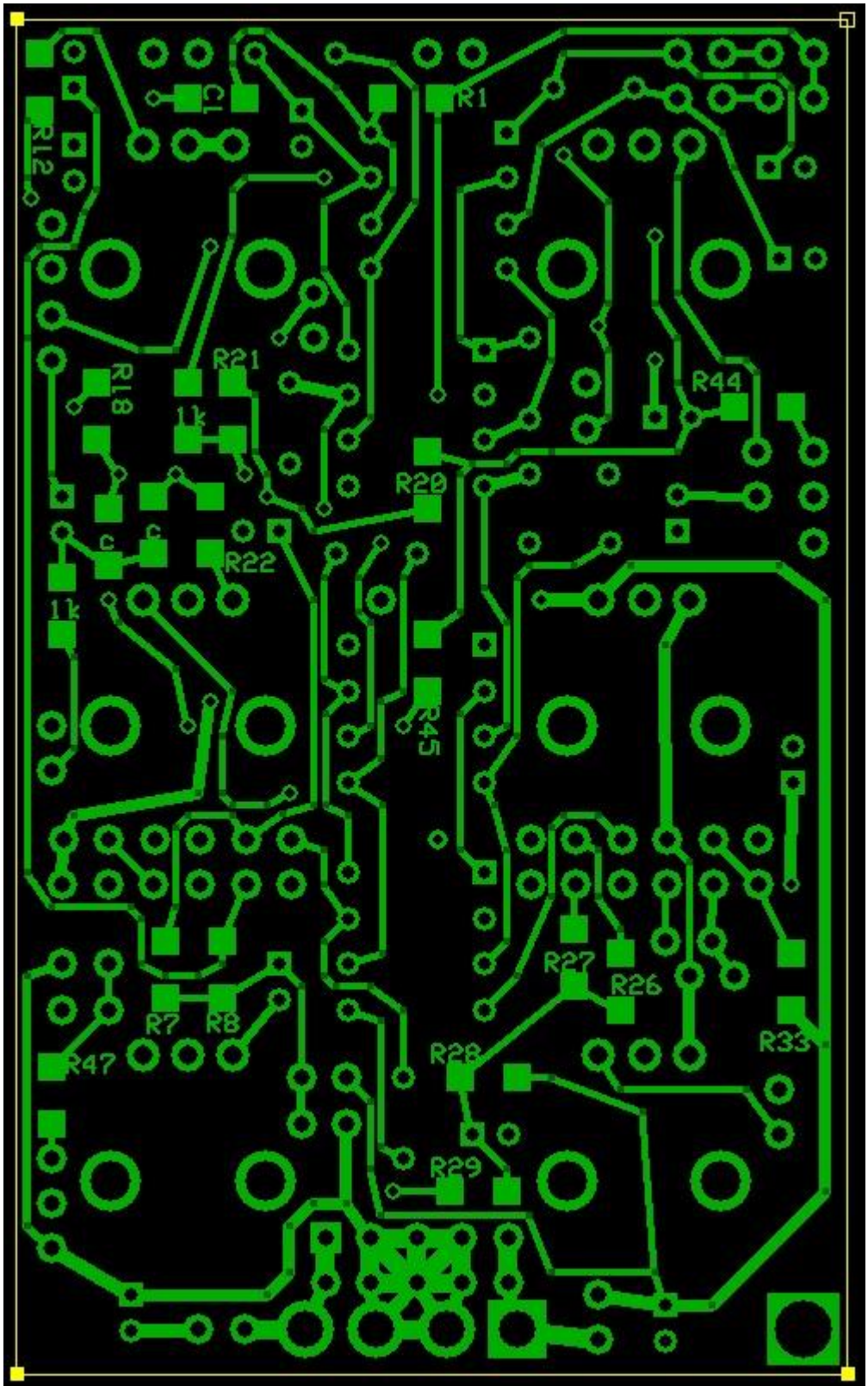


Wiring for the Q swap switch.

Make sure the red wires are connected to the holes as shown.



PCB silkscreen


C1
R1
R12
R21
R18
1k
R44
R20
C
C
R22
1k
R45
R27
R26
R7
R8
R47
R28
R33
R29

Back of PCB

USING THIS MODULE

Firstly, the transistor ladder will not work by itself. The diode ladder can be used as a stand-alone filter if desired.

The audio signal to the diode ladder is fed to the transistor ladder as infra-red light by the photo-couplers.

So in general use, just use the diode ladder inputs, for most pot settings you will be able to get filtered signals from all four outputs. The freq cut-off and Q of each filter can be modulated independently.

So why have an input for the transistor ladder? If you insert an audio signal here it will have an FM effect on the audio signal coming in from the diode ladder, so consider it another modulation input. If the signal on the transistor input is of a similar frequency to the one on the diode filter input, you can get some pretty good filtered harmonics happening.

The Q swap switch swaps the Q feedback paths of the 2 filters. The effect is quite brutal though can be tamed with careful tweaking of the Q pots. At some settings you will get chaos (unverified, the maths is beyond me) but the module will take on a life of it's on. Sometimes you will hear the original audio signal, other times it will glitch away or no sound at all can be heard. This behaviour can of course be semi-controlled by CV.