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# Quad VCA

## Construction manual v1.0

This electronic project is rather easy to build, but there is a lot of wires to solder. The pcb is double side and it require solder joins on both sides, so it is very important to follow assembly steps. It should take the average builder around 5 or 6 hours to finish it with all part in hands. Please keep in mind the goal is to build a working module, not to solder/assemble it in a minimal time...

This construction manual contain, complete schematic of the board, part list and wiring diagrams.

First of all, please read entire instructions before starting. When done, use the bill of materials to collect/buy all parts. Other useful tools you may need to construct the Quad VCA are a soldering iron, good solder, some diagonal cutters, needle/chain nose pliers, screw drivers and a voltmeter to check the psu voltage.

An oscilloscope can be very useful for final test, as well as some synth's level signal sources.

### Module overview

The Quad VCA module is composed of a set of 4 identical VCAs provided by a couple of SSM2164 chips.

CV controls are independant and a LIN/EXP scale switch is present for each VCA. The method used to get a LIN VCA from the SSM2164 has been described originally by Mike Irwin in EDN issue. The tip is to use one VCA in the feedback loop of the CV control op amp to get the complementary LOG curve to cancel the EXP FX of the main VCA. If VCAs are correctly matched you get a rather good LIN response of the main VCA. This is the case for the SSM chip composed of 4 VCA. So two chip are necessary here. The CV control path is double and there is a path for LIN and another for EXP CV. Then a switch select the right curve for each VCA. This is not the most optimal design in terms of number of parts, but it simplify a lot all the switch path and by the way allow to keep a good quality design without to use relay or other electronic switches...

VCA1 and 3 have a "complete" set of control pots: Level (init CV) and CV (reversible attenuator) for modulation. VCA2 and 4 have only a Level pot but it can be also normalised to the input jack to be an attenuator if something is plugged into the CV in jack. You can also decide to use it as a level pot only and add ( or forget) the CV input attenuator. As a basic design i present here a 6 pot solution who fit in 2UX5Upanel, a good practical compromise. There is only one reference trimmer to setup all the module :the reference voltage.

As an extra feature, the signal outputs of each VCA can be summed together by a set of 3 ( or 4 ) switches.

So the Quad VCA become a CV-Mixer. Many combinations are possible between VCmix and independant VCAs.

It is possible to make a 4/1 CV-Mixer or 3/1+1VCA or 2/1+2VCA, or 2\*(2/1)...

Depending the way you will normalise I/Os jacks on front panel you can preset various set...

The Signal path is designed to be compatible with almost all kind of good dual inline op-amps. It is not DC coupled so the Quad VCA module can process CV as well as sounds ... Some optional capacitors footprints are provided on each feedback loop of the signal path to avoid self oscillations.

Power supply is +/-15V dc, classic...

### Parts Selection

I advise you to build the Quad VCA with matched resistors say at least at 1% or 2% ( but you can select by yourself from a 10% batch too) to get matching performances for each VCAs ... Unless you do not care to find some minor differences between them ... It is a choice...

For the audio path i suggest good op amps ( NE5532, op2604 or better ).

The CV op amps should be quad Fet like the TL074 or TL084...

For better perms ( and may be sound , who knows? ) you can also put some Styroflex/polystyrene instead of ceramic capacitors...

## Assembly of the Quad VCA pcb.

Note: the Quad VCA pcb is a double side pcb without metal holes. So you will have to solder parts on both sides of the pcb. Those points are marked with black dots on the implant schematic.

Some of them are on passive components, others on IC sockets and last ones are Vias ( simple links to join upper and lower sides of the pcb)

- 1) Solder resistors legs into "via" holes. If you don't know how to do , check this "how to" page at : <http://m.bareille.free.fr/techdoc/twosidesoldering.htm>
- 2) Solder sockets for all ICs . DO not forget to solder them on both sides for legs marked with black dots.
- 2) Solder all resistors ,selfs L1,L2 ( or 22 Ohms resistors instead ) . Solder resistors marked with a black dot on both sides of the pcb.
- 3) Same thing but for capacitors now. Chemical capacitors are polarised , take care with orientation
- 4) Solder the MTA156 (J1) connector and the trimmer RV2
- 6) If you do not use sockets for ICs, solder all op-amp first and then the two VCA chips.  
All ICs are oriented so check twice their position. Dont forget to solder on both sides ICs legs marked with black dots.
- 7) Deflux with alchohol or acetone
- 8) Assemble all pots
- 9) Verify again all solders and parts orientation. Check on both sides ... Modify if required.

## Wiring the Quad VCA

- 1) Power supply : you can use a 4 wire MTA156 connector ( MOTM format) or you can wire directly the filter pcb to a +\*/15V DC well regulated PSU. There is 2 pads for ground wires : solder 2 wire in parallel . This allow to have a better ground drain by dividing by two wire resistivity.
- 2) Wire Inputs and outputs as showned on the wiring schematic. The wires for "audio" inputs and outputs of VCAs should be shielded. You can solder the grounds of wires directly on the upper side of the pcb .  
It is not necessary to shield the CV inputs wires just keep them as short as possible. Same remark apply to the switches and pot wires excepted for the 3 "Link" switches that i advise you to shield anyway.
- 3) Check for no error on wiring ...

## First try of the Quad VCA

Procedure is described for one VCA channel only. Setting are identical for the other.

- If the VCA is not yet mounted in a box dispose all parts with care to avoid short cuts ...
- Connect power supply wires. Leave PSU off for the moment.
- Connect a sound source or a BF generator on audio input .
- Connect any CV modulation source ( LFO, adsr ...) to the CV input.
- Connect outputs to your audio system or scope , take care of the volume....
- Set all trimmer on pcb on their middle position .
- Set power supply ON ... Turn knobs , you may listen and see on scope the incoming audio signal modulated by the CV source.
- If nothing happens , check for the right voltages of PSU on op-amps and VCAs chips.If ok, adjust the RV2 reference voltage trimmer until you see soem signal at the VCA output.
- You can now calibrate with more accuracy the VCA CV input by injecting +5V dc on the CV inputand a 1 KHz waveform ( say a sine...) at the VCA input. Adjust Ref voltage until you get the signal at the output identical to the input signal ( gain =1) and for both modes LIN & EXP.
- Check on others channels , and try all combinations of linked VCA too. Doing this you may get some self oscilation on output summing stages . This depend a lot of op-amps you will use, if they are compensated or not etc... So if this happen, you can add some small capacitors ( value between 10p to 100pf). Generally a 22pF capacitor will fix the problem. Location is provided on the pcb for those caps.

## **BILL OF MATERIALS**

Design: **QUAD VCA MODULE**

Doc. no.: ssm2164A.IDS

Revision: 1.0

Author: Marc BAREILLE

Created: 05-May-04

Modified: 14-Oct-04

### **Resistors metal film 5% or 1%**

20	R1,R2,R3,R4,R12,R15,R16,R17,R19, R20,R27,R29,R30,R34,R35,R36,R37, R38,R41,R42	100k
8	R5,R9,R44,R47,R50,R54,R57,R60	33k
12	R6,R7,R11,R45,R49,R51,R52,R56,R58, R62,R63,R64	10k
4	R8,R46,R53,R59	1k
8	R10,R18,R28,R33,R43,R48,R55,R61	500
4	R13,R21,R31,R39	39k
4	R14,R22,R32,R40	1M
2	R23,R24	10k
2	R25,R26	20k
2	R100,R101	6k3

### **Capacitors**

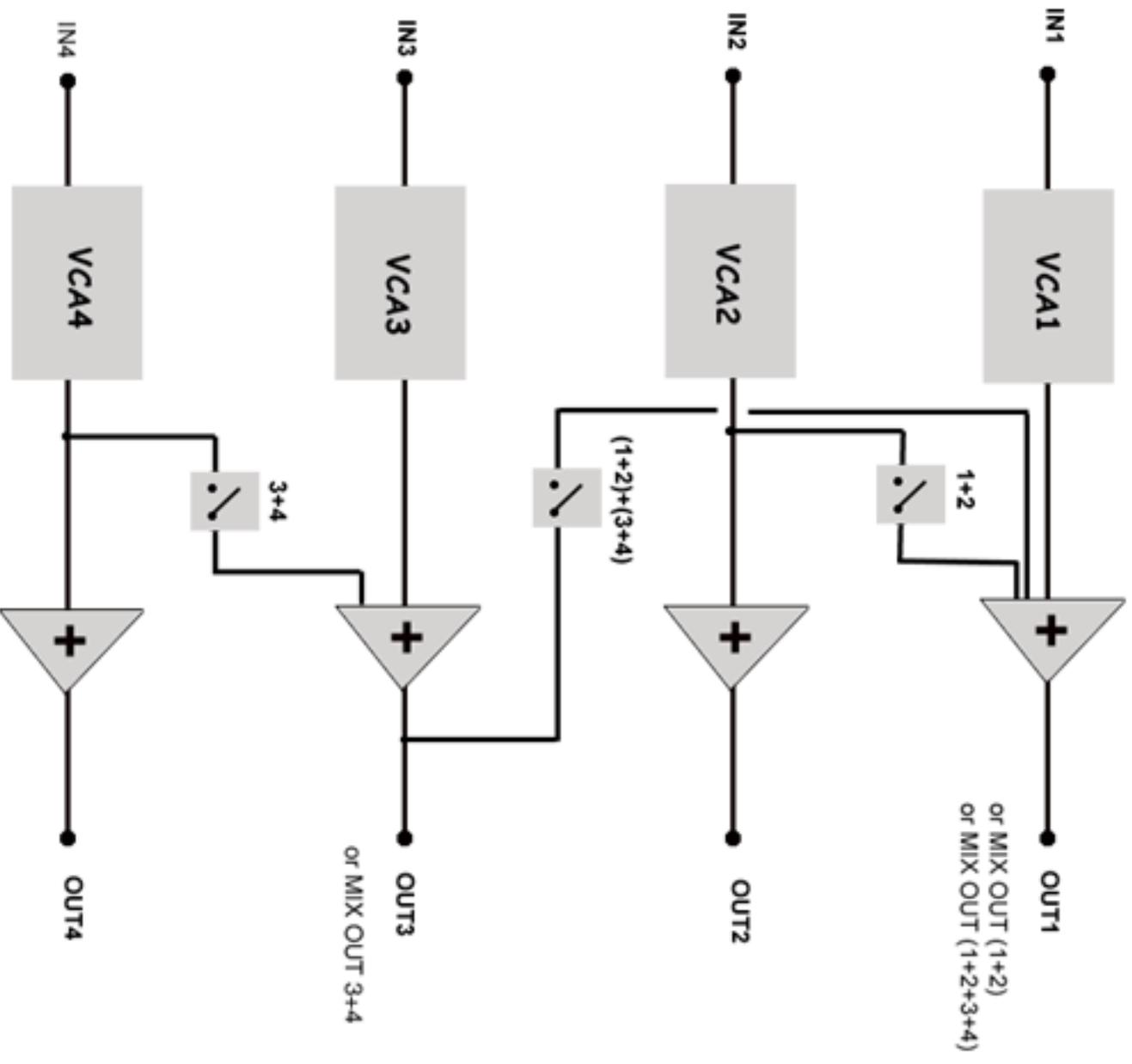
18	C1,C2,C3,C5,C6,C7,C8,C10,C11,C14, C15,C16,C18,C19,C21,C22,C24,C25	100p styro ou ceramic
8	C4,C9,C12,C13,C17,C20,C23,C26	560p styro ou ceramic
2	C27,C48	100uF /25V
16	C28,C29,C30,C31,C32,C33,C34,C35, C36,C37,C38,C39,C44,C45,C46,C47	100n
4	C40,C41,C42,C43	10uF/25V

### **Integrated Circuits**

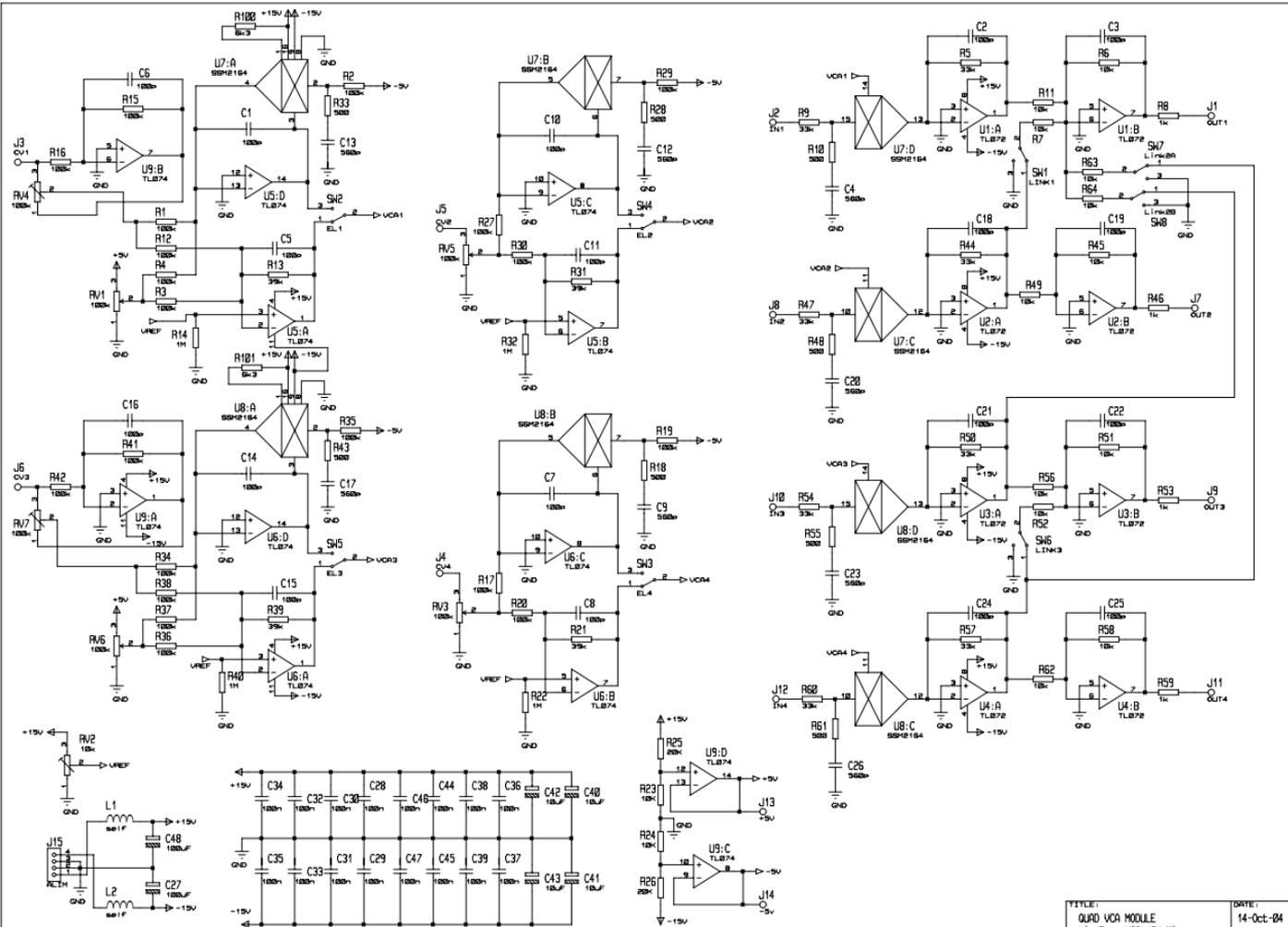
4	U1,U2,U3,U4	TL072,OP275,OPA2604
3	U5,U6,U9	TL074
2	U7,U8	SSM2164

### **Miscellaneous**

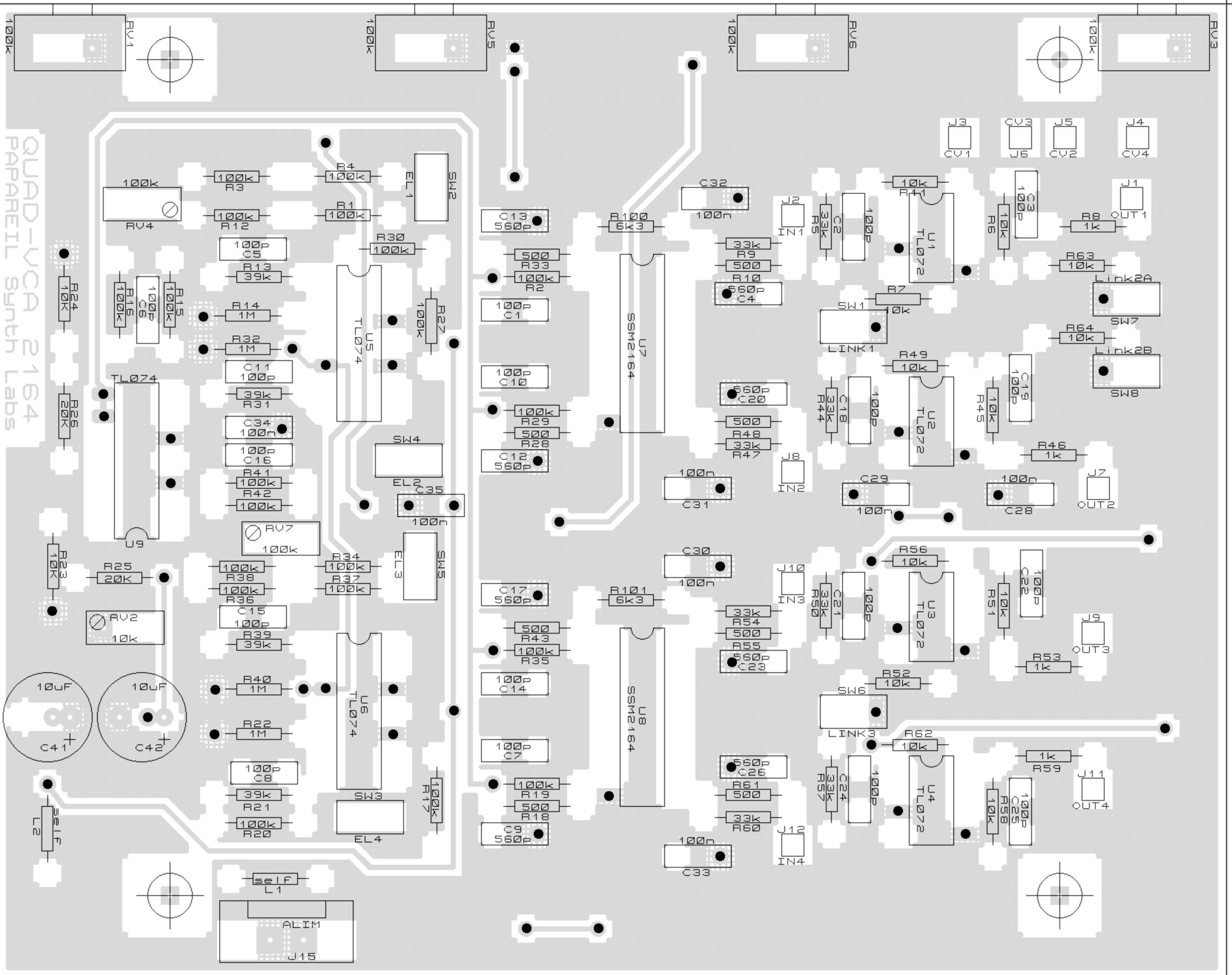
1	J15	conn MTA156
2	L1,L2	self ou 22 Ohms
6	RV1,RV3,RV4,RV5,RV6,RV7	100k Spectrol S149
1	RV2 10k trimmer	10turns vertical
6	SWx	switches 2 DPDT, 4 SPDT



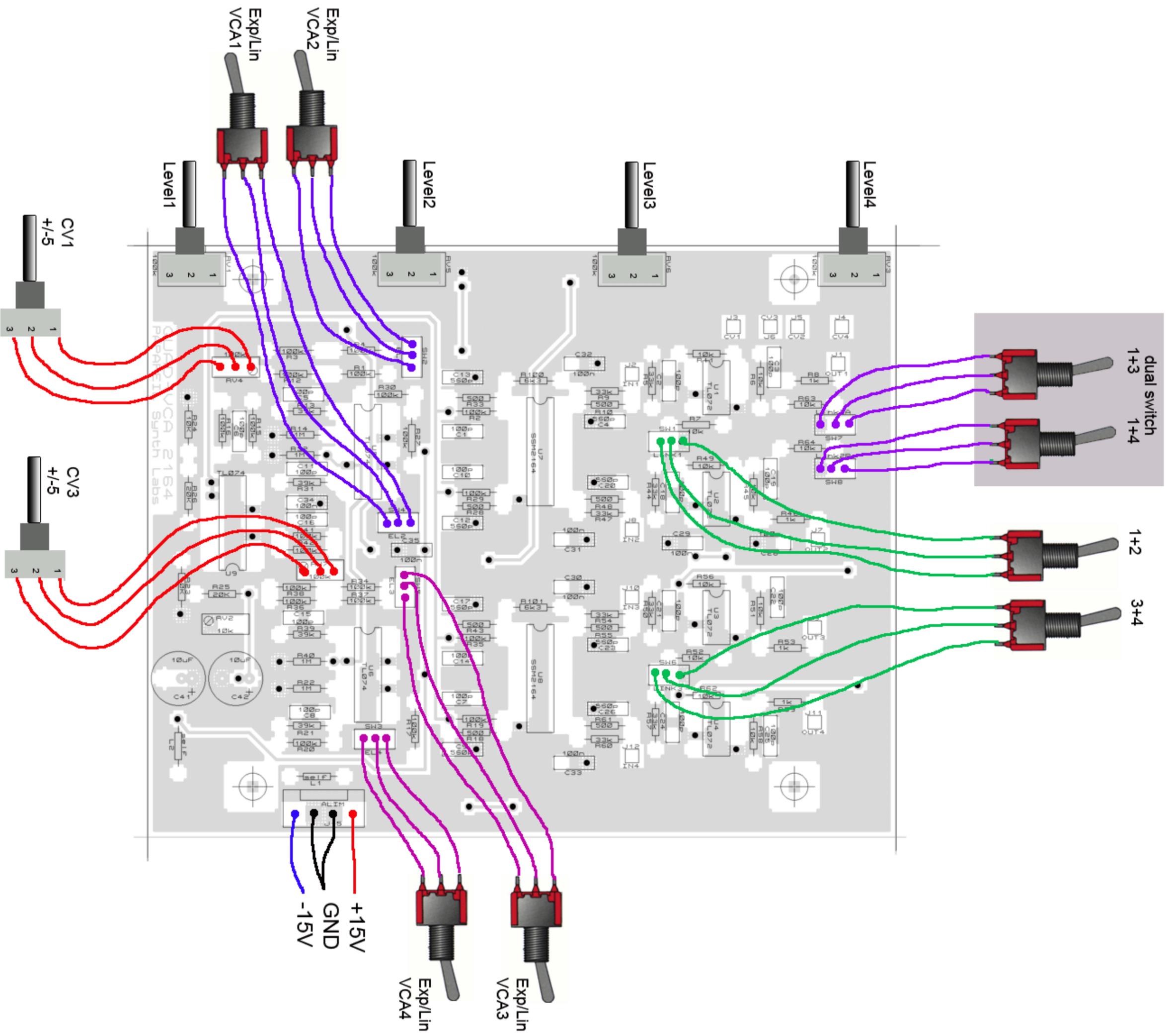
**Audio Path of the QUAD VCA module**  
 PAPAREIL SYNTHS LABS (c)2005



QUAD-VCA 2164  
PAPAREIL Synth Labs







PAPAREIL SYNTH LABS  
 Quad VCA /CV Mixer  
 Wiring Schematic part 2 = Switches & pots  
 (c) Marc Bareille 2004-2005