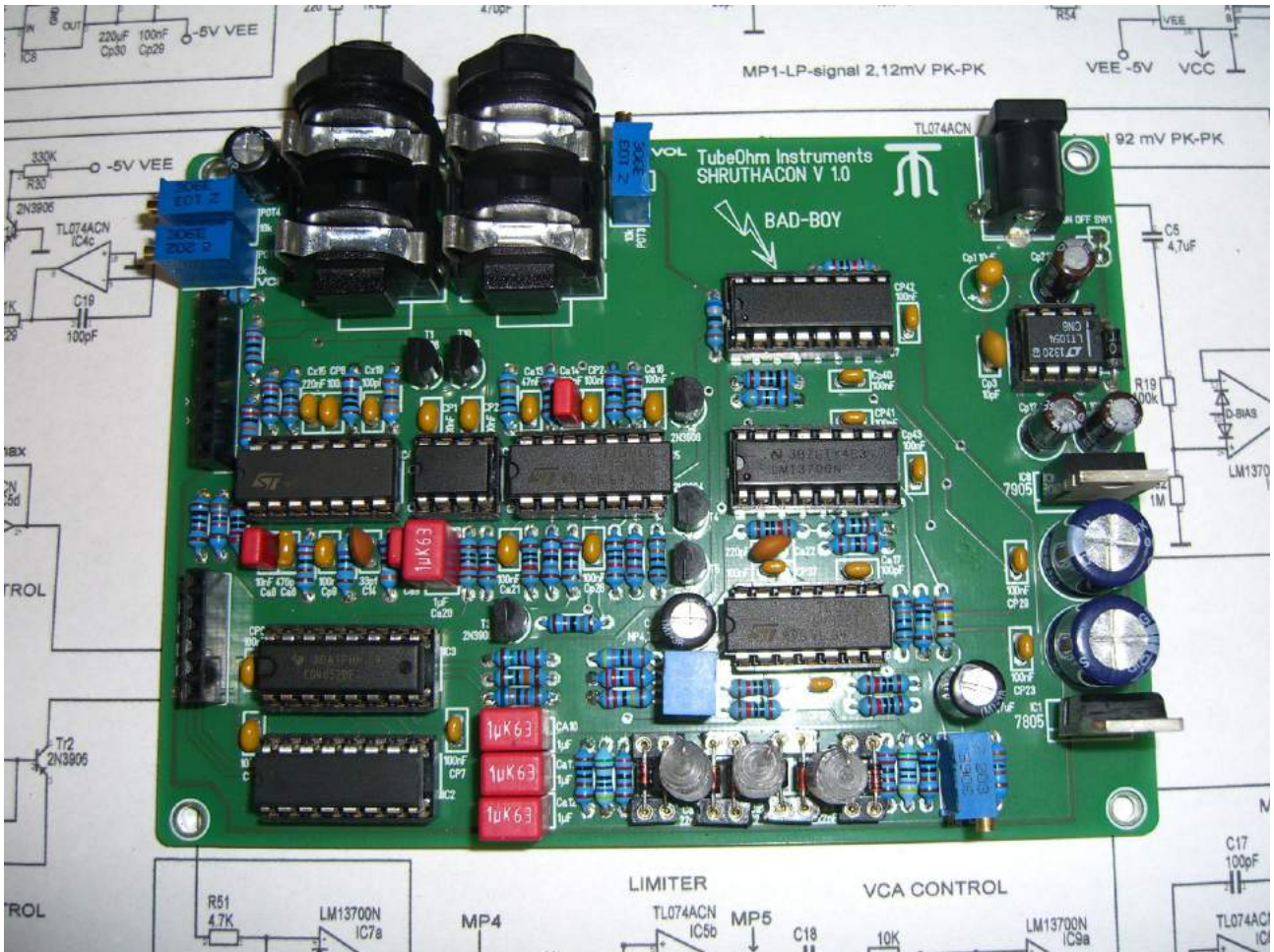


DIY MANUAL
TubeOhm SHRUTHACON-FILTER for SHRUTHI
from MUTABLE INSTRUMENTS
Version V 1.02 english



Preface:

Based on the function of the Steiner Parker filter, this filter has now been adapted and developed for the Shruthi from Mutable Instruments.

Despite the really simple circuit diagram what it really more difficult than expected to adapt/circuit parameters to the Shruthi.

But, now it's there. Have fun in the assembly and the sound.

Andre '
TubeOhm

The DIY kit and Shruthi Motherboard

The Shruthi MOBO **requires absolutely the last firmware 1.0x** which you can download from the Mutable Instruments page.

Kindly Olivier by Mutable Instruments has again extended the firmware to a Shruthacon <SP> setting.

If no ATMEL Programmer are available so you can refer the ATMEGA 644P-PU finished with the last firmware from Mutable Instruments or from TubeOhm.

the DIY

To build this filter together needs some experience in electronics, a (good) soldering iron, side cutter, a multi-meter should also be present and / or better an oscilloscope.

The assembly design is not difficult if basic knowledge of soldering and in recognizing the component values are available.

A word to the total NEWBIES. Good people, the component values should be MANDATORY observed. Just because you're just not have a 1 Kohm resistor , you can not solder 2 Kohm and think 'is already work'. This also applies to all other devices!

All values were calculated and already differences of a few 100 ohms may cause the circuit this not, or not as it should work. The circuit to build together is not difficult, but you must work precisely.

Before you are beginning to solder, you take an old board and practicing something.

As solder we use here FELDER solder S-Sn60Pb40 of Reichelt

No.: 32-.825 SOLDER

It is better also, prior to solder the individual values to check x 2 to make sure that also the right component is soldered! Resistors should be measured with an ohm meter principle before soldering. It takes one minute longer but saves sometimes for hours troubleshooting. I do it in any case like this.

Instrumental in assembling is the PCB. There are all values printed legibly.

Usually you can solder the components with the correct values blunt and the circuit will work. (But also depends on the soldering work)

So you also know how that works, I'm explain the individual function blocks of the filter by now. And then it starts.

The Shruthacon filter, how does it work?

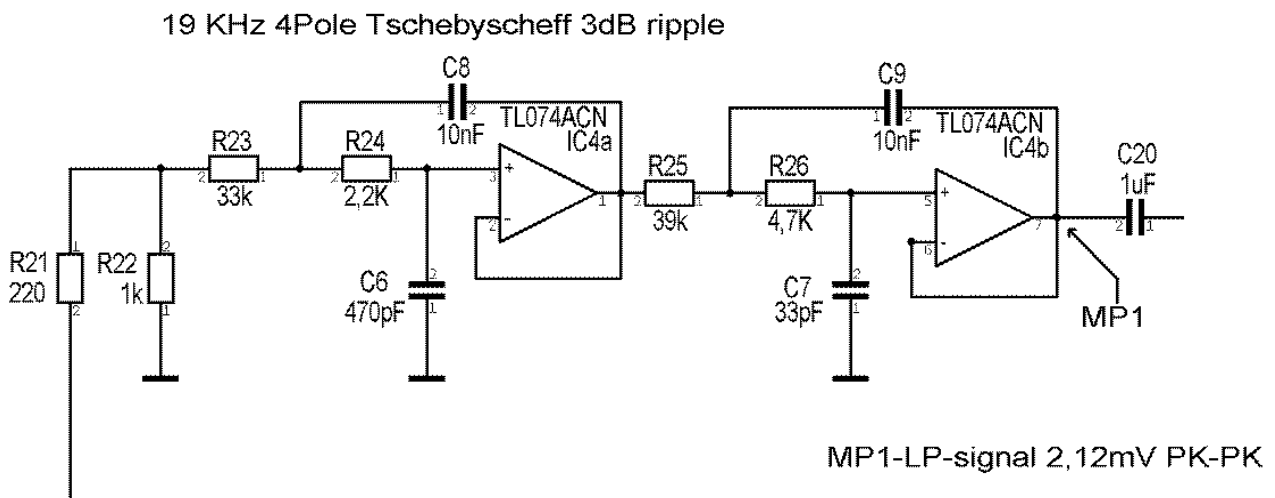
The audio information of Shruthis is included in the 39kHz PWM (Pulse-Width Modulation). The pure audio signal is generated from the PWM signal via a 24 dB Chebyshev filter.

PWM is fed via the voltage divider R 21 / R 22 in the filter.

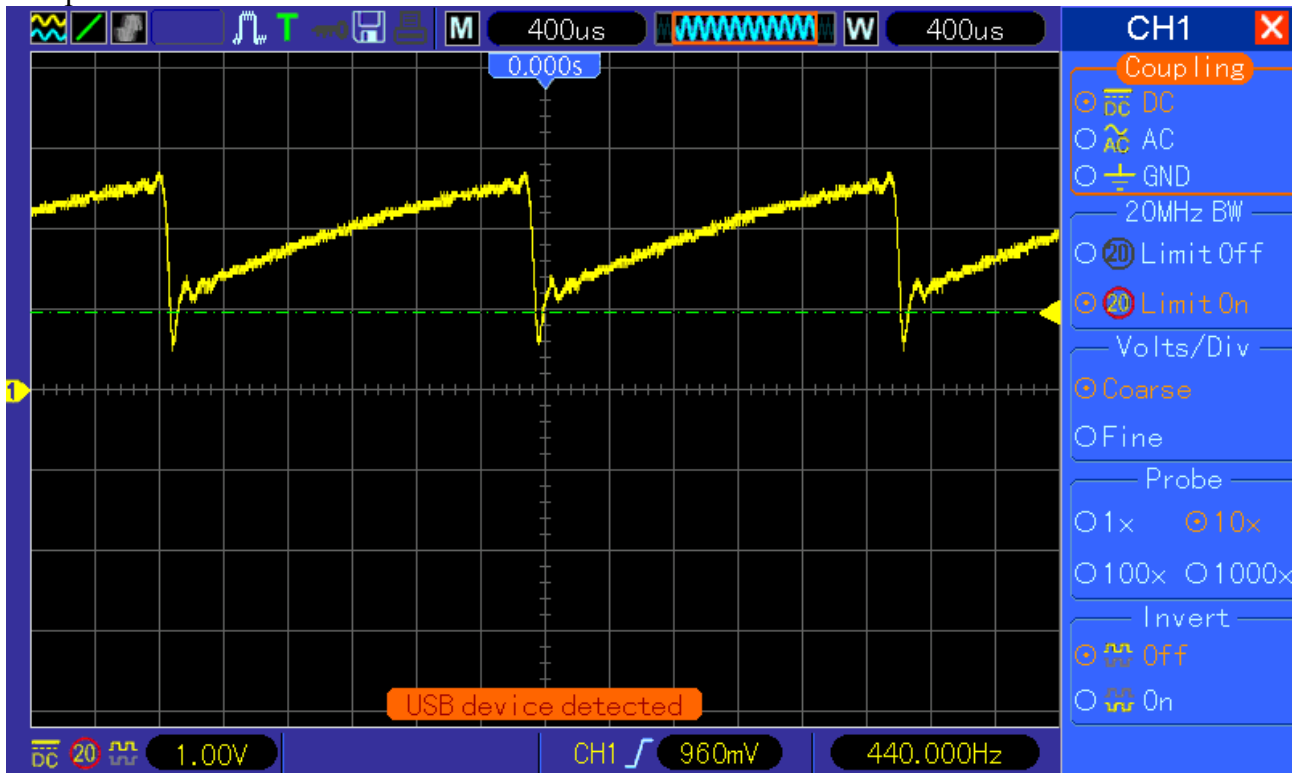
Since the operational amplifier is +/- 5 V only have a maximum voltage swing of 3,75Volt reduces the amplitude of the PWM via the voltage divider.

At measuring point 1, we now obtain an output signal of about 2.12 V peak to peak.

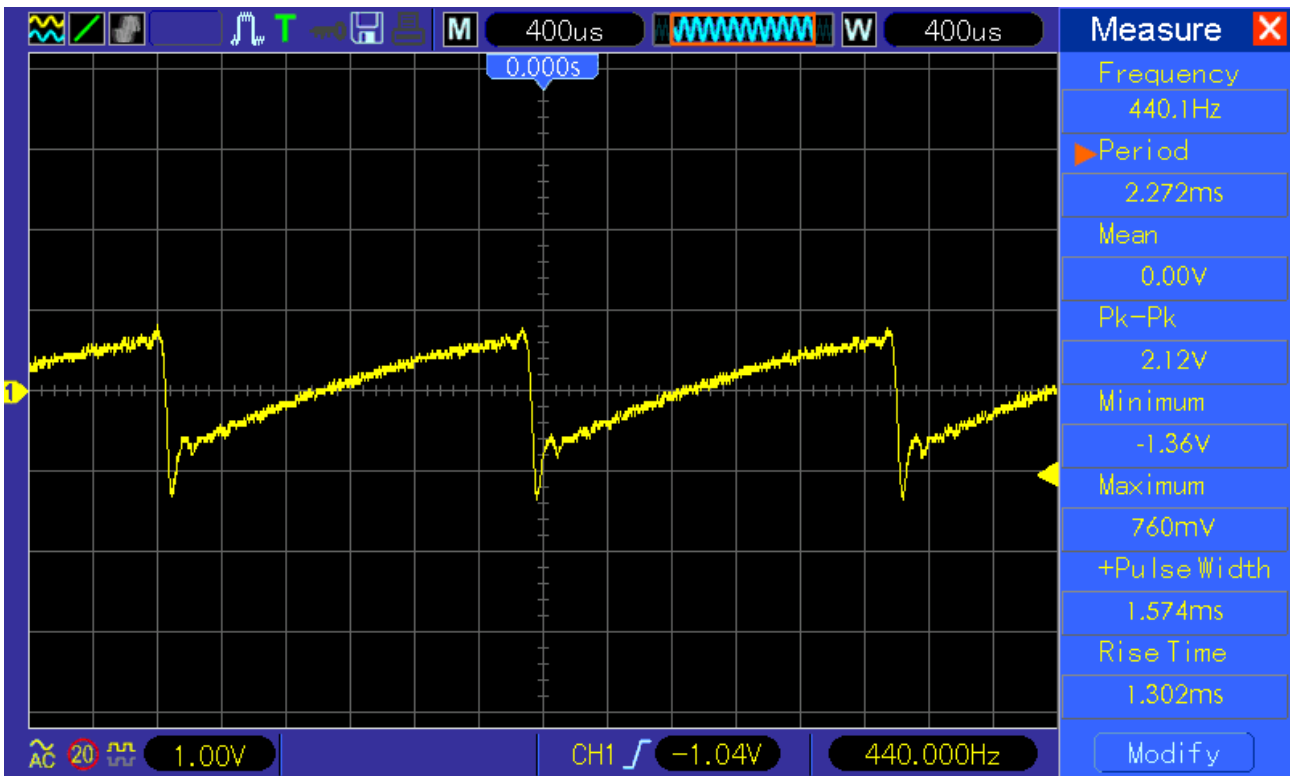
This output signal is virtually free of the 39 kHz carrier, but has a DC offset of approximately 1.5V. See measurement protocol MP1.



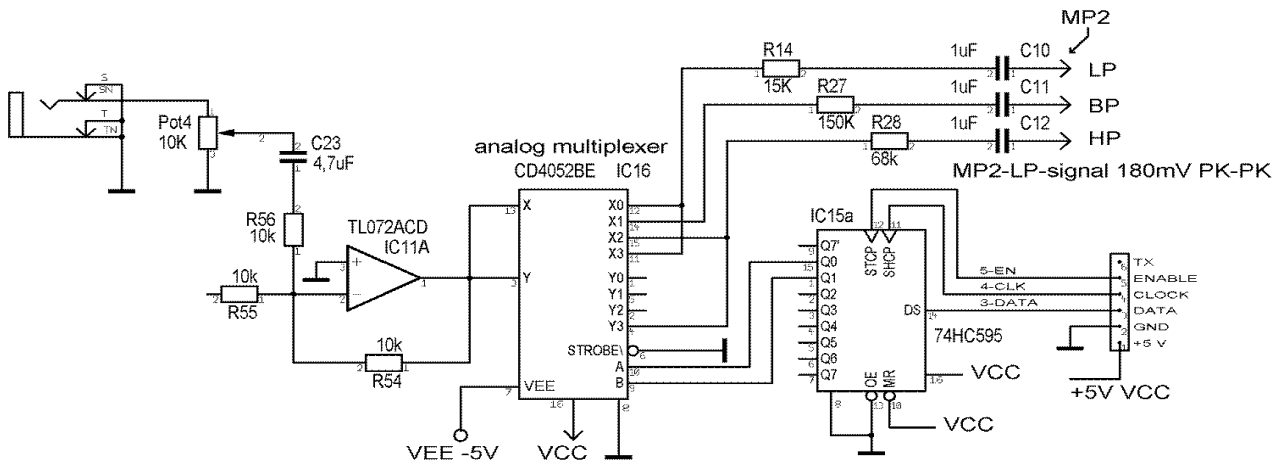
Meßprotokoll MP 1



C20 blocks the DC voltage, and now we get a AC signal.

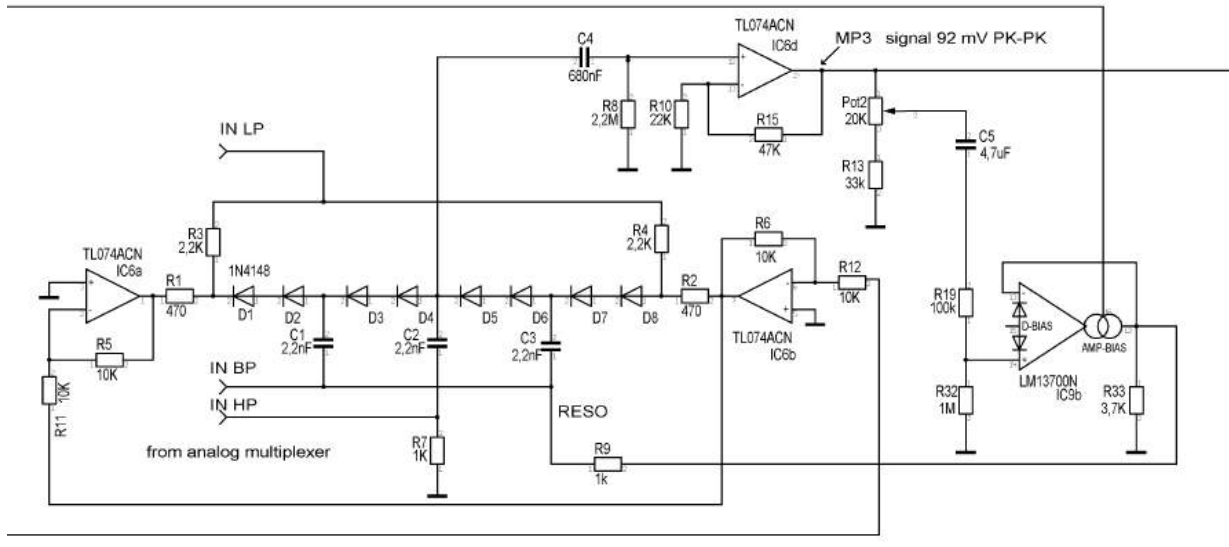


The analog multiplexer 4052 route the audio signal in the different filter inputs.



The control of the 4052 is performed by the 74HC595. This gets its data directly from the ATMEGA of the motherboard.

Now comes the actual filter circuit.



How it works? Well, let's see here ... diode1 to diode 8. These diodes are between the outputs of two operational amplifiers.

Flows through the diode current, then the differential resistance changes.

So we can speak of RC circuit, where R is controlled by a current. Now, an RC element is in this case a 6 dB low-pass with the cut-off frequency

$f = 1 / (2 * \pi * R * C)$. Now, if the resistance changes, so can control the cutoff frequency and thus the frequency of our filter.

As the current is controlled ??

The diodes are, as I said, between the outputs of two operational amplifiers.

These are connected, which is controlled by the op-amp 6b 0..ca 1.5Volt +. The OP-AMP 6a inverts the signal and controls accordingly from 0 ..- (minus) 1.5V

This works like a seesaw.

Has now OP-AMP 6a -1,5Volt and OPAMP 6b 1.5V, so we have between the diodes D1 / D8 a voltage difference of 3 volts. Thus, a current flows through the diodes.

We speak here of a stream of about a few nA to a maximum of 1.2 mA.

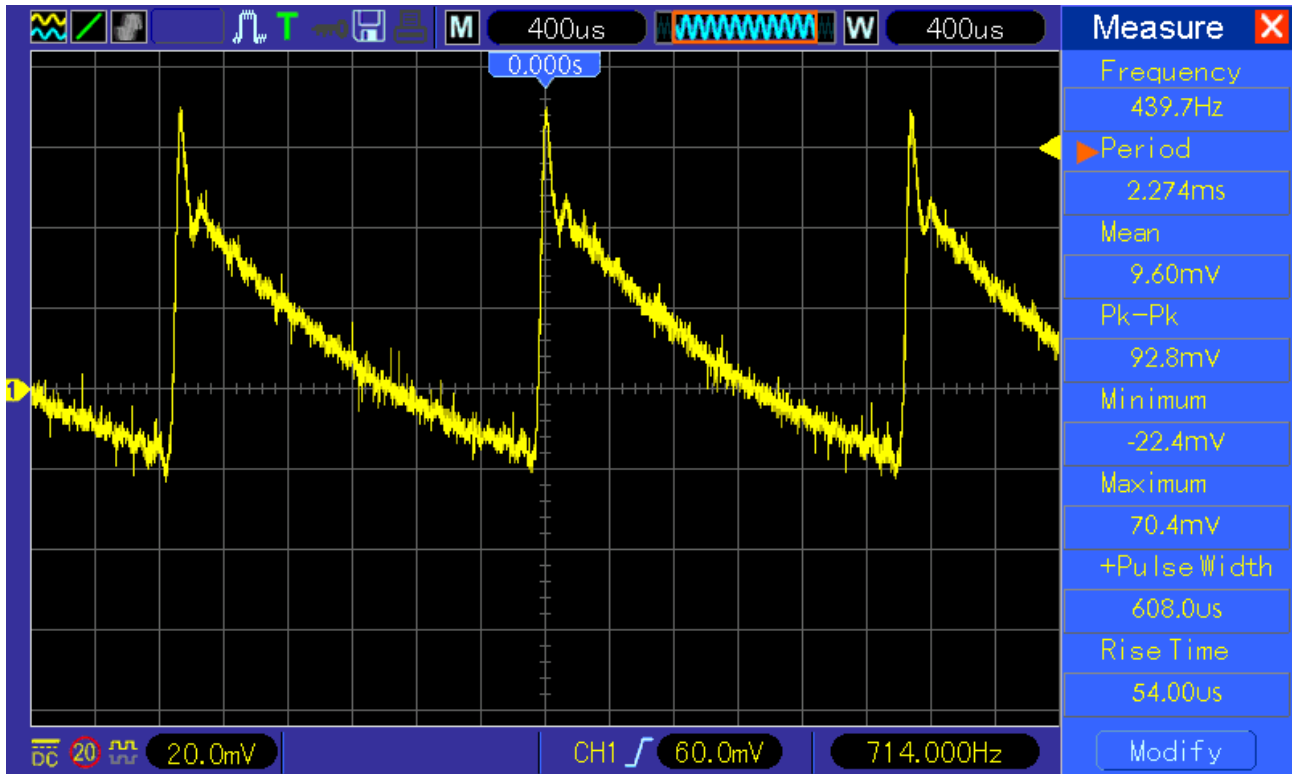
The diodes work before her break point 0.65V. Thus, it is understandable that only very small signals with up to about 60 ... 90 mV can be processed without cutting off the signal.

Usually, the diodes are current-controlled by a differential amplifier. But circuit principle, the linearity at an SP filter is not really accurate, we opted for a voltage control.

Of the tapping point between the diode D4 and D5, in this circuit is virtually connected to ground, which prevents a DC offset.

Through C 4, a 680nF capacitor, the filtered signal is then picked up and fed into a high impedance preamplifier IC 6D. The output voltage we get about 80..90 mV PP signal. See MP3.

MP 3

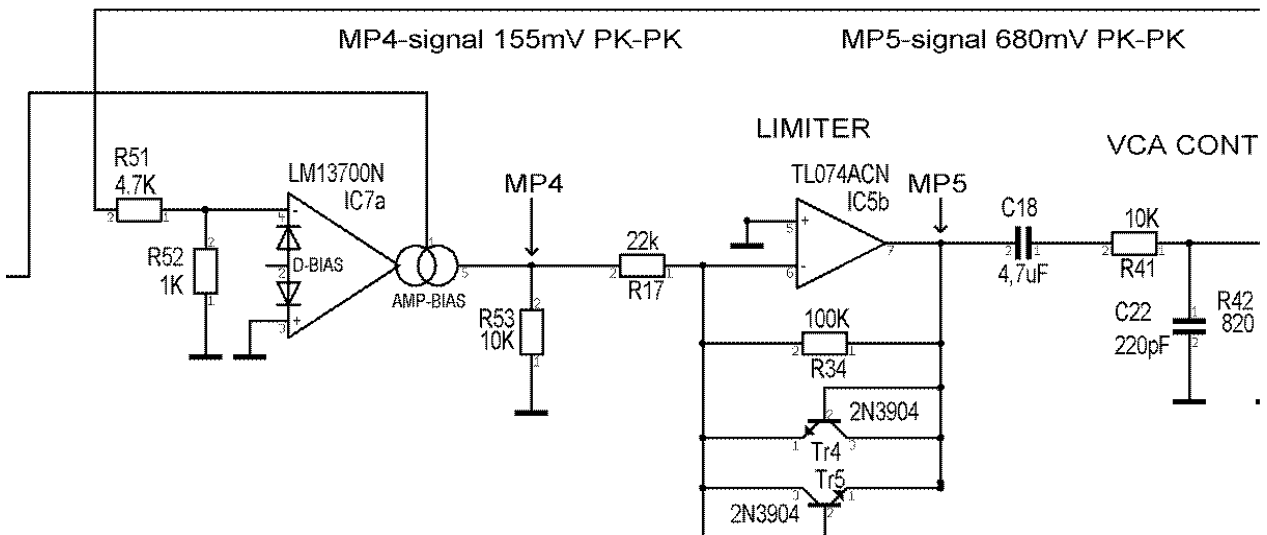


Well, and then we come to a thing which has made me real headache.

Now, when the resonance of the filter is set to a maximum, then the filter is oscillated at the maximum possible amplitude of +/-3.75 volts and cuts off the peaks of the signal. This is the special behavior of the SP filter. But just by the resonant peak, just before the self-oscillation certain frequencies are emphasized clearly, far more than one state variable or ladder filter. But in the case of full resonance, the resonance is now so high that the original signal is completely suppressed and the OP-AMPS go in the distortion.

Well, what do ??? Although I like distortion, but only if they can be controlled and therefore resulting in a special sound.

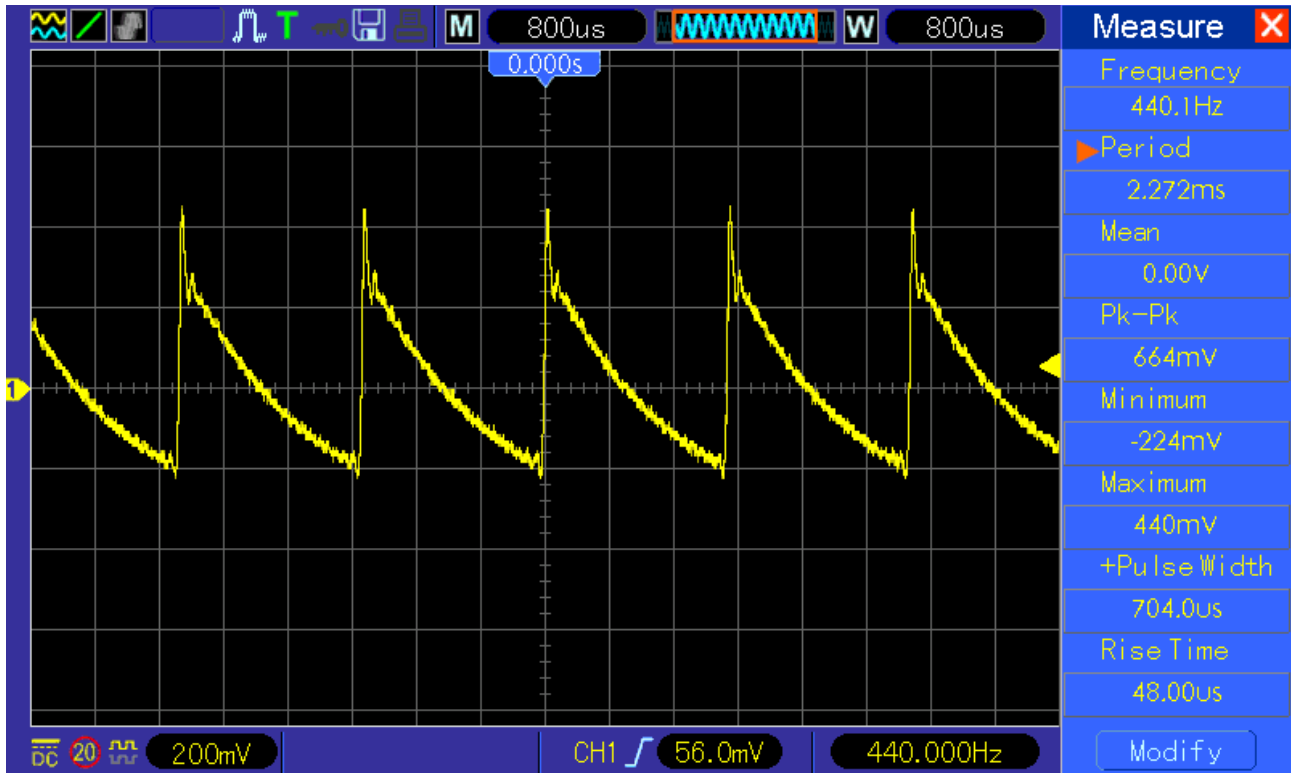
So the ratio has to be changed >> original signal / Reso-oscillation signal.



And as this circuit (above) comes into play.

The IC 7a amplifies the signal at idle to about 155m V PP.

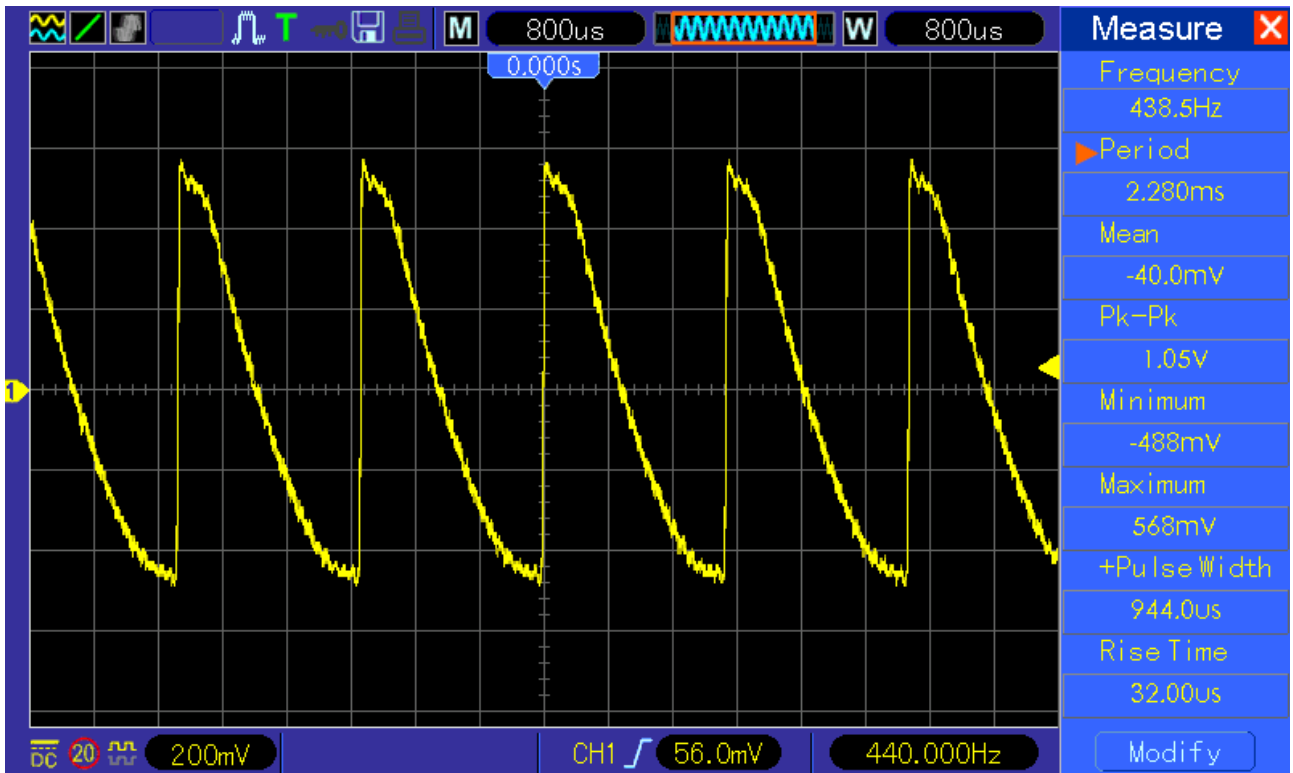
The Limiter IC 5b is designed so that it limit above 0.7V..1V by leaves unchanged the signal at 650 mV .



That's enough just to pass the filtered audio signal.

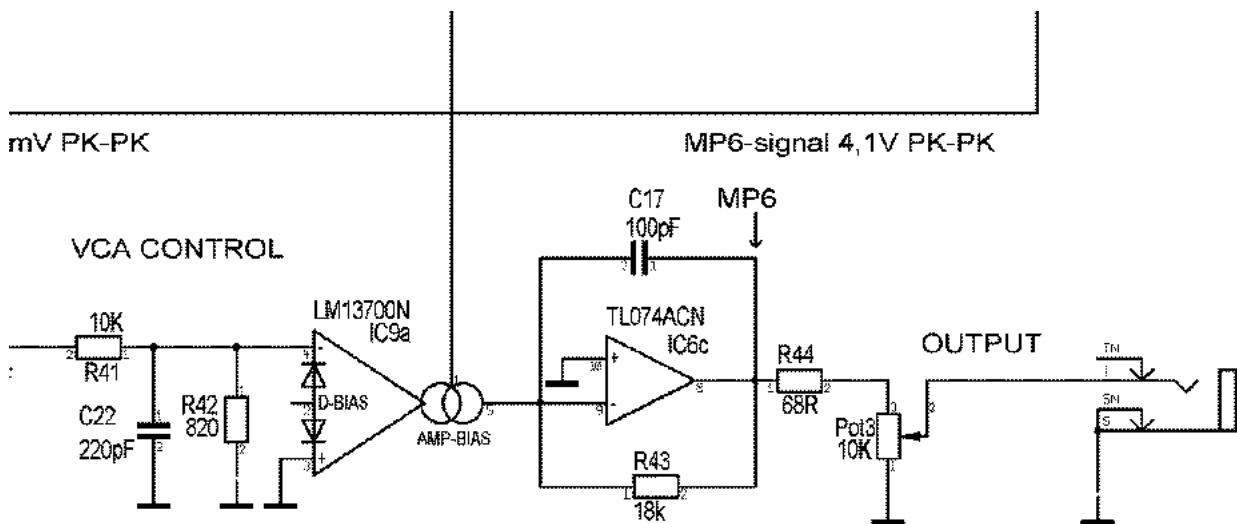
If the filter oscillates now itself, now the diodes limit the signal to about 1V.

Furthermore it can be amplified by the signal IC 7a nor by FEEDBACK in Shruthi, so the normal audio can still be distorted.

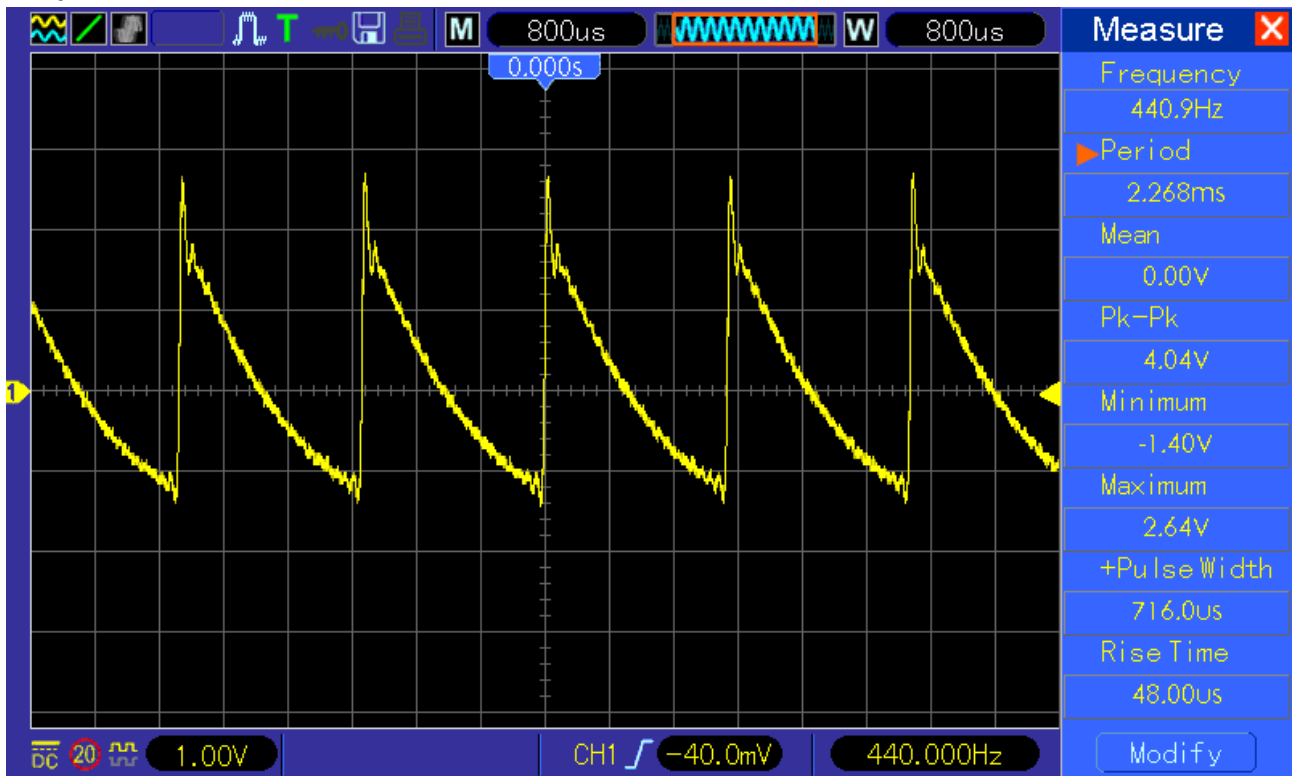


So the limiter serves a :) to distort the audio signal b :) to limit the resonance signal so the result does not override the following VCA.

We then get the output a signal (MP6) from about 4V PP or up to an oscillating signal of 6..7 V PP, and that's just barely in range of the operational amplifier which maximum signal to 7.5 V (3.75 +/- V) can output without distortion.

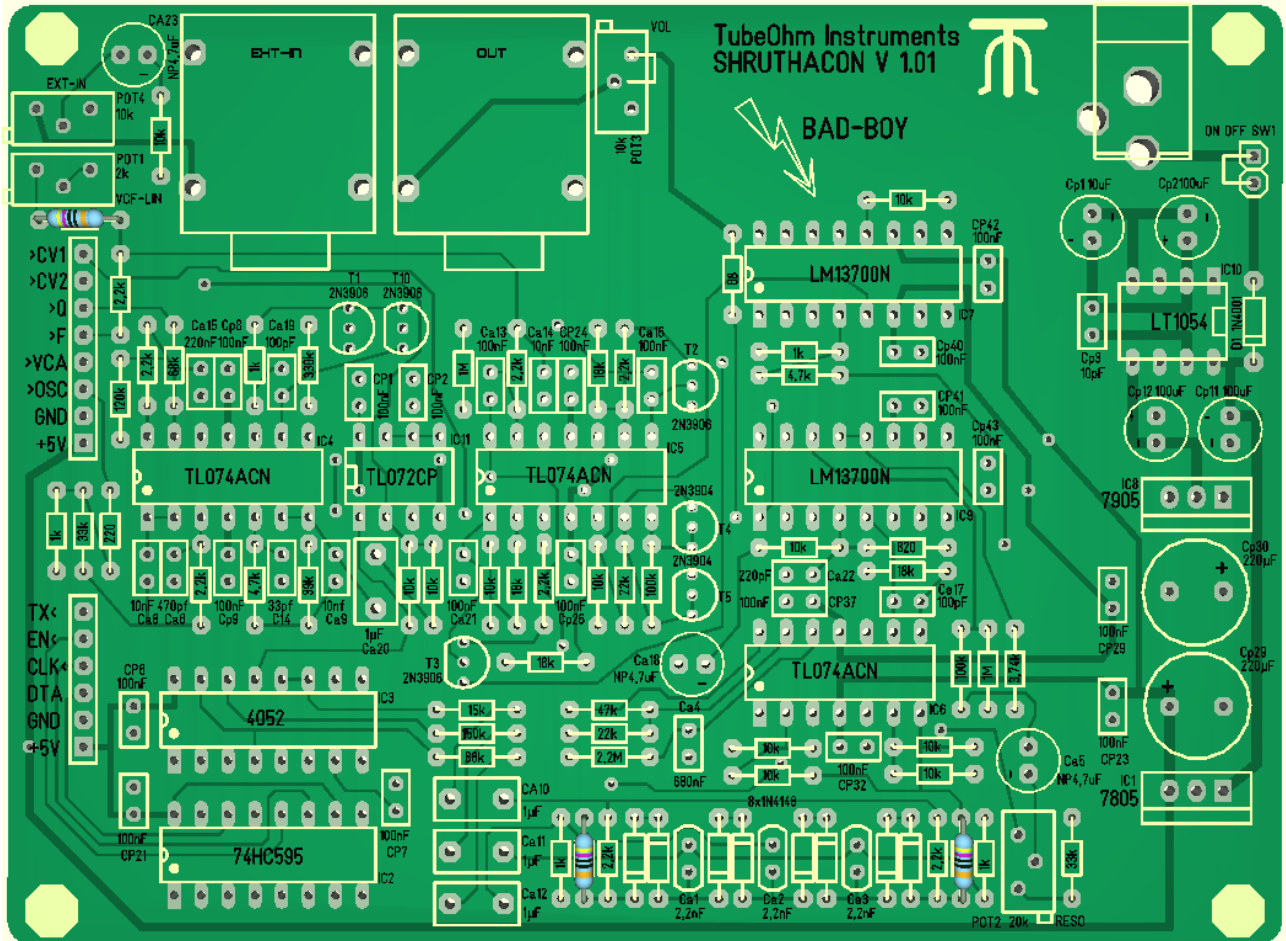


MP6

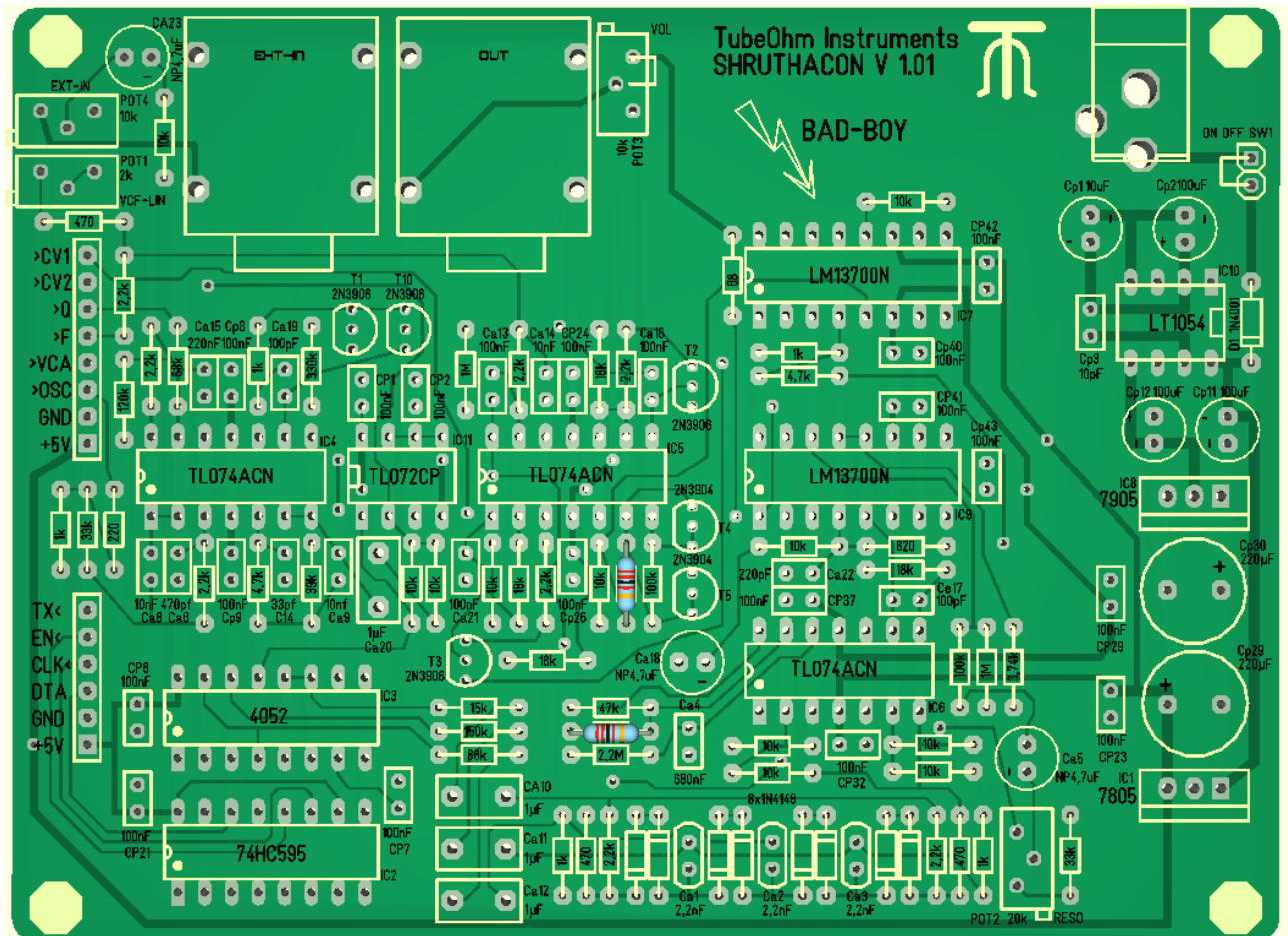


That is the theory, ha, and now to practice.

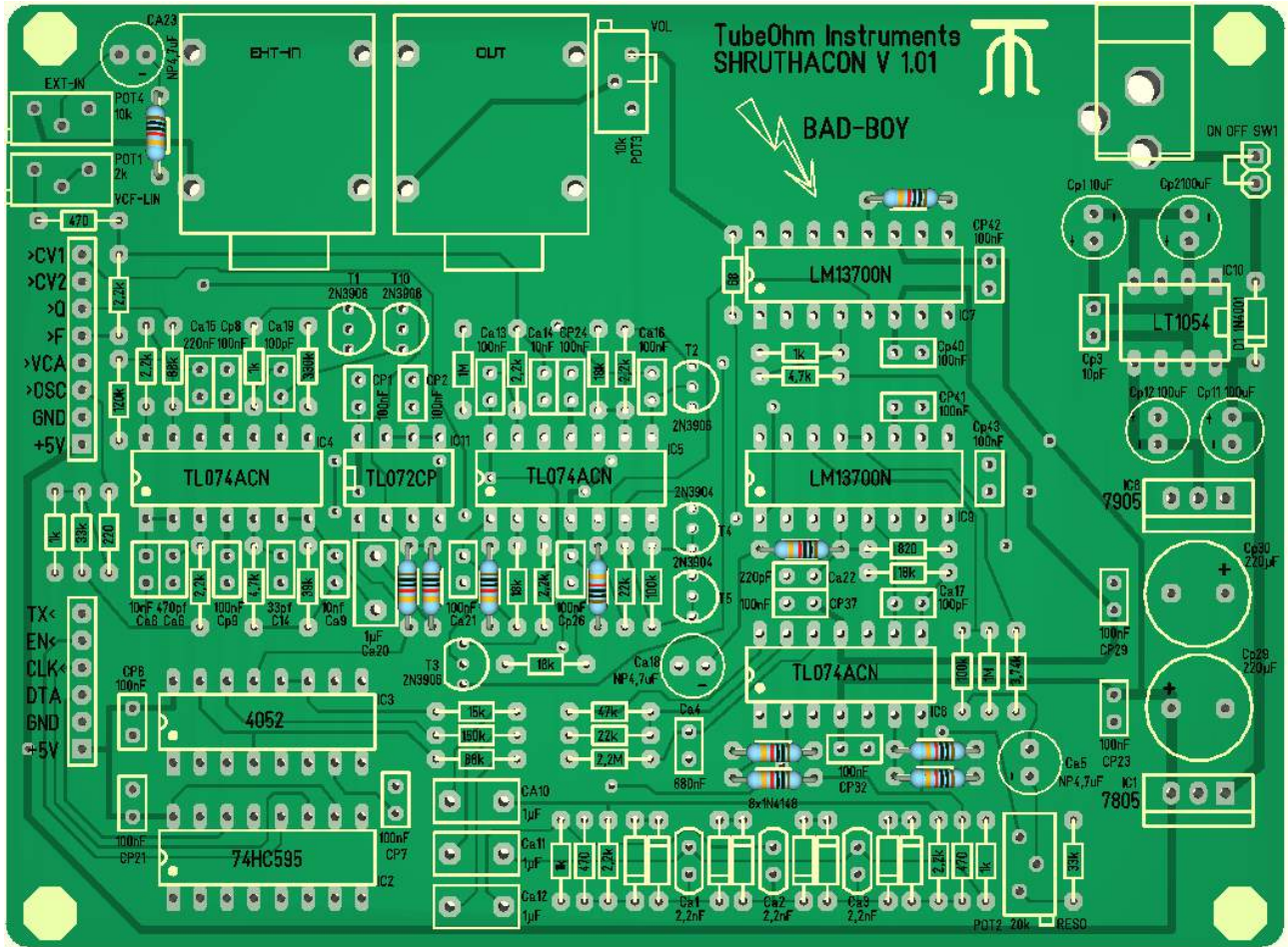
3 x 470 Ohm color code: yellow, purple, black, black, brown



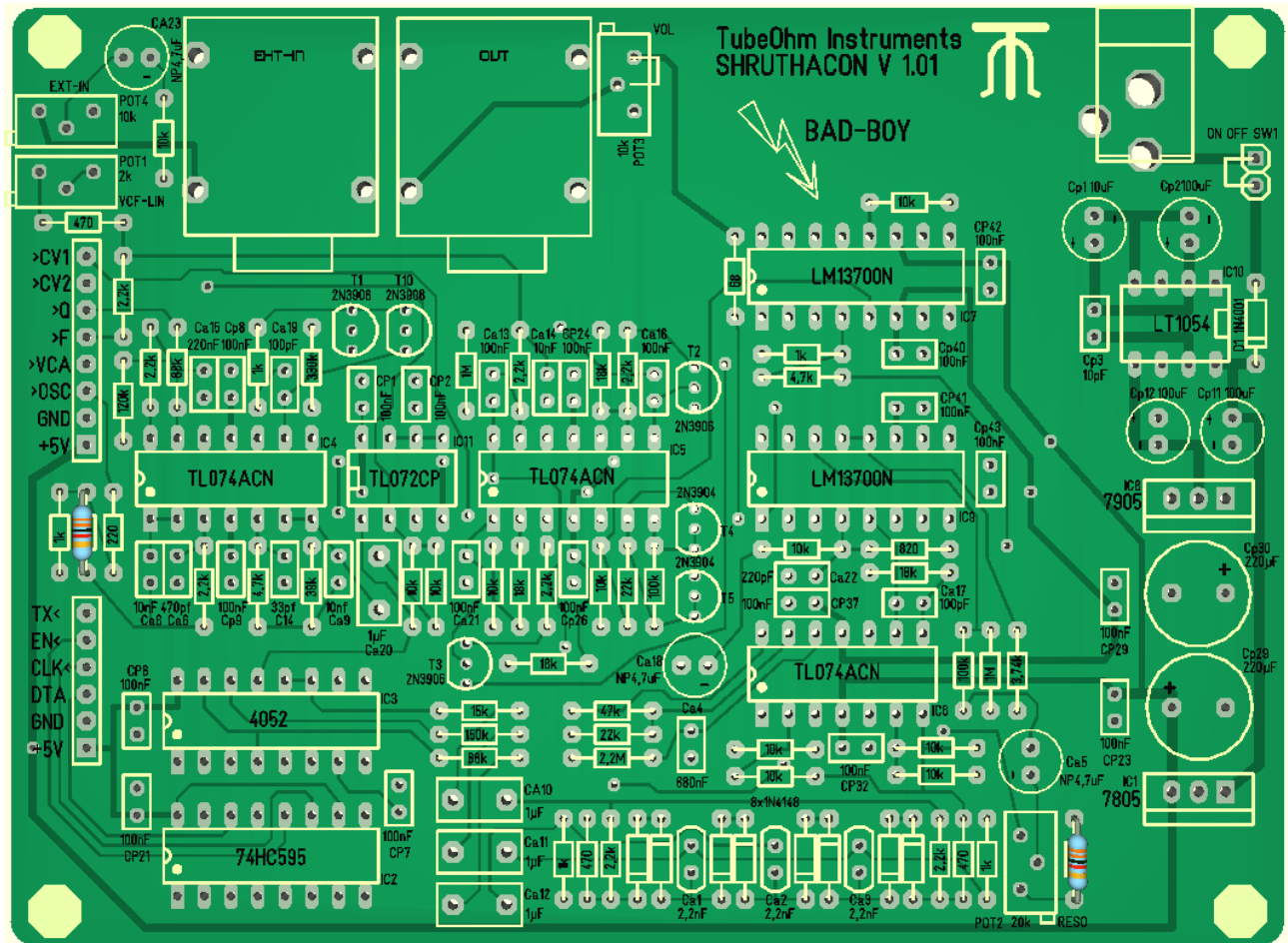
2x 22kohm, color code: red, red, black, red, brown



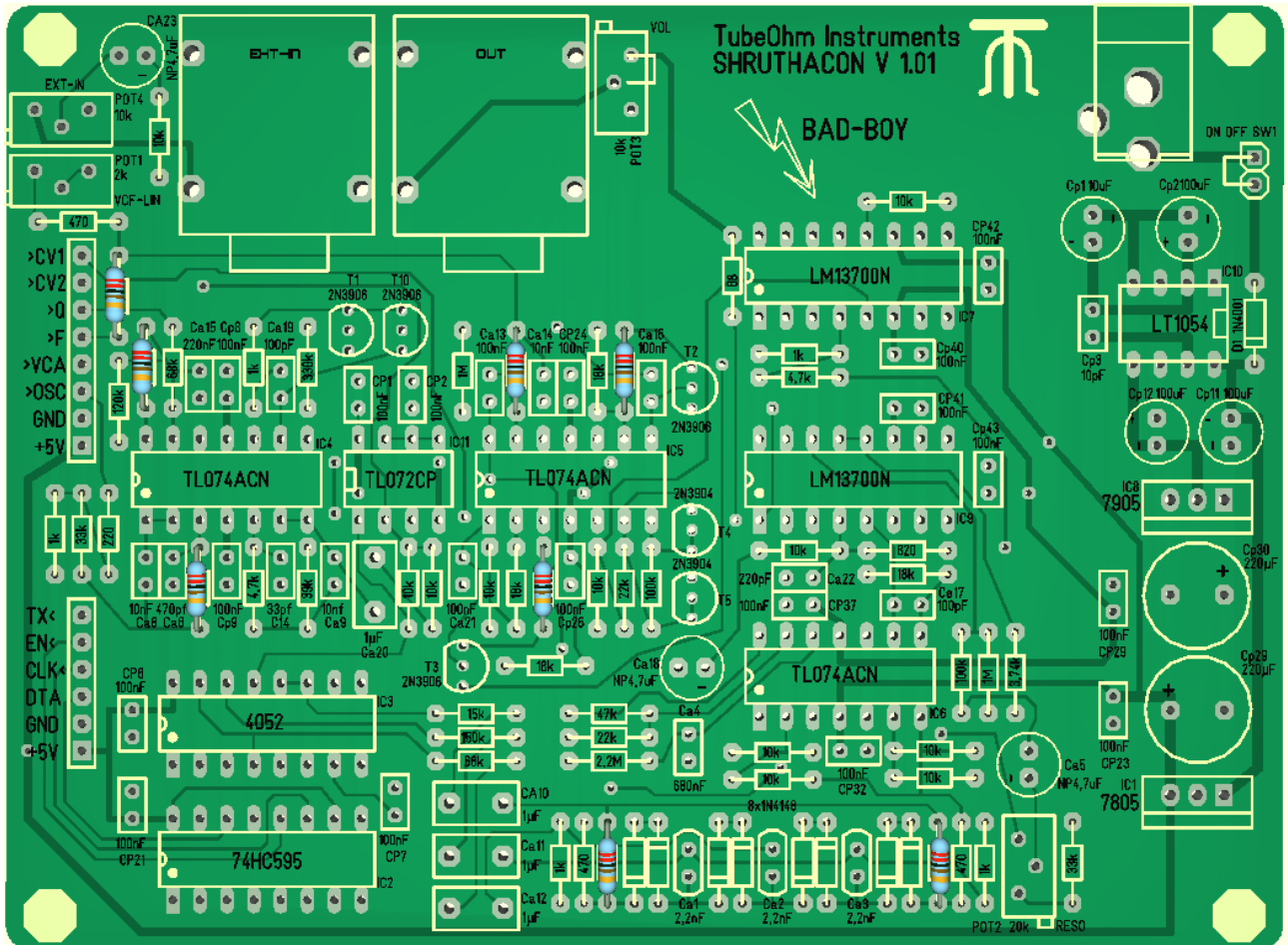
11 x 10Kohm, color code: brown, black, black, red, brown



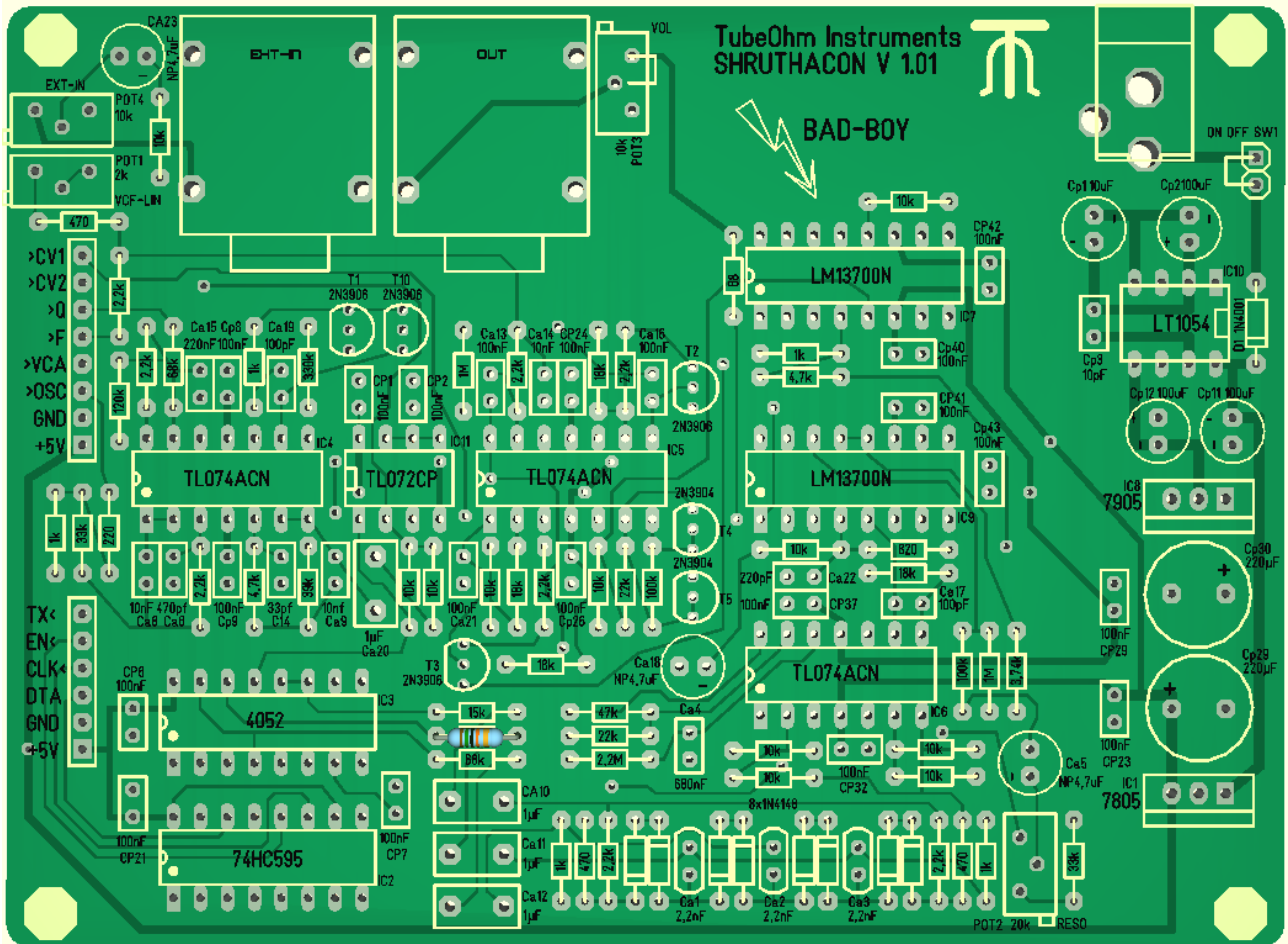
2x 33kOhm, color code: orange, orange, black, red, brown



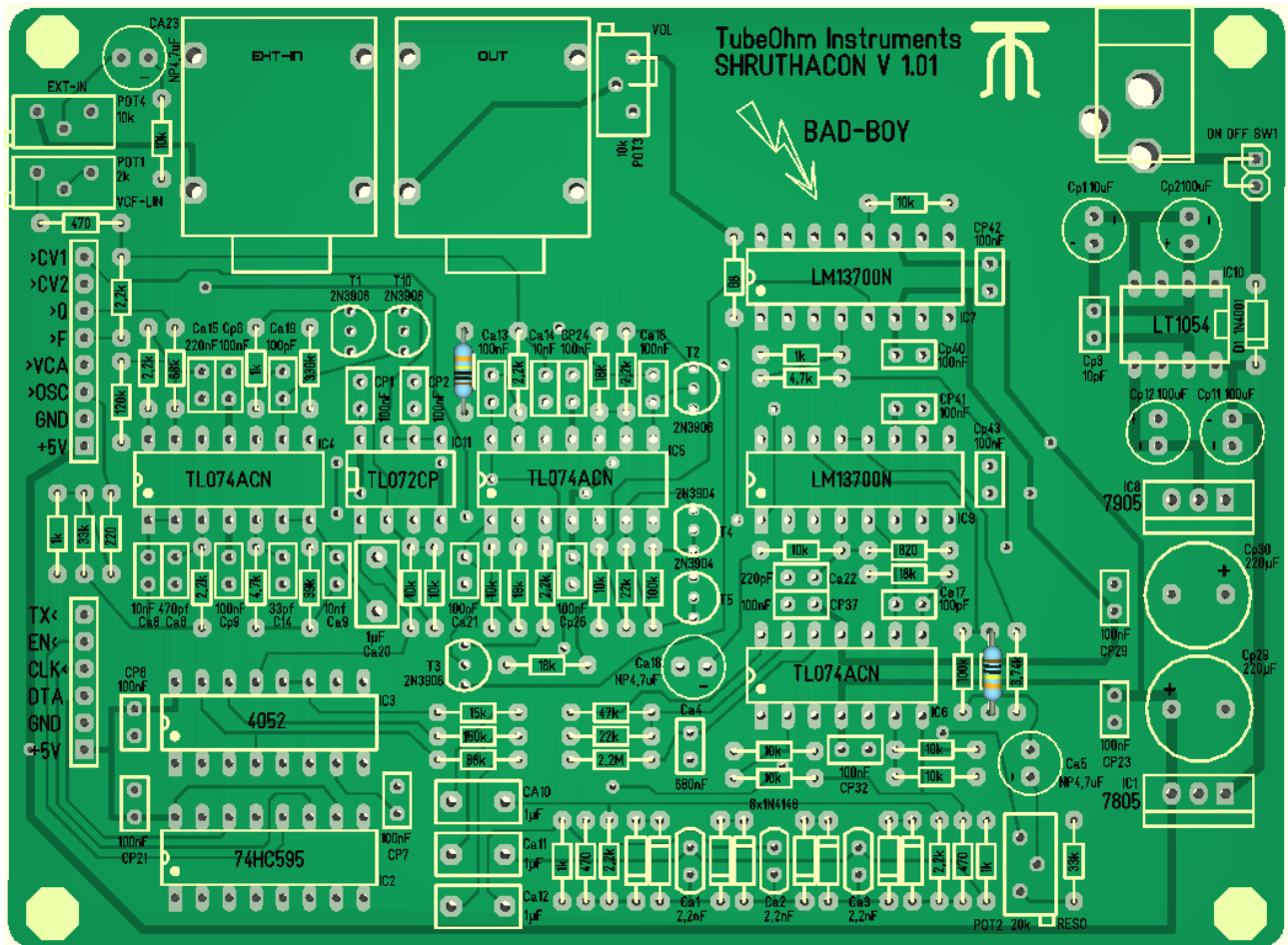
8x 2.2kOhm, color code: red, red, black, brown, brown



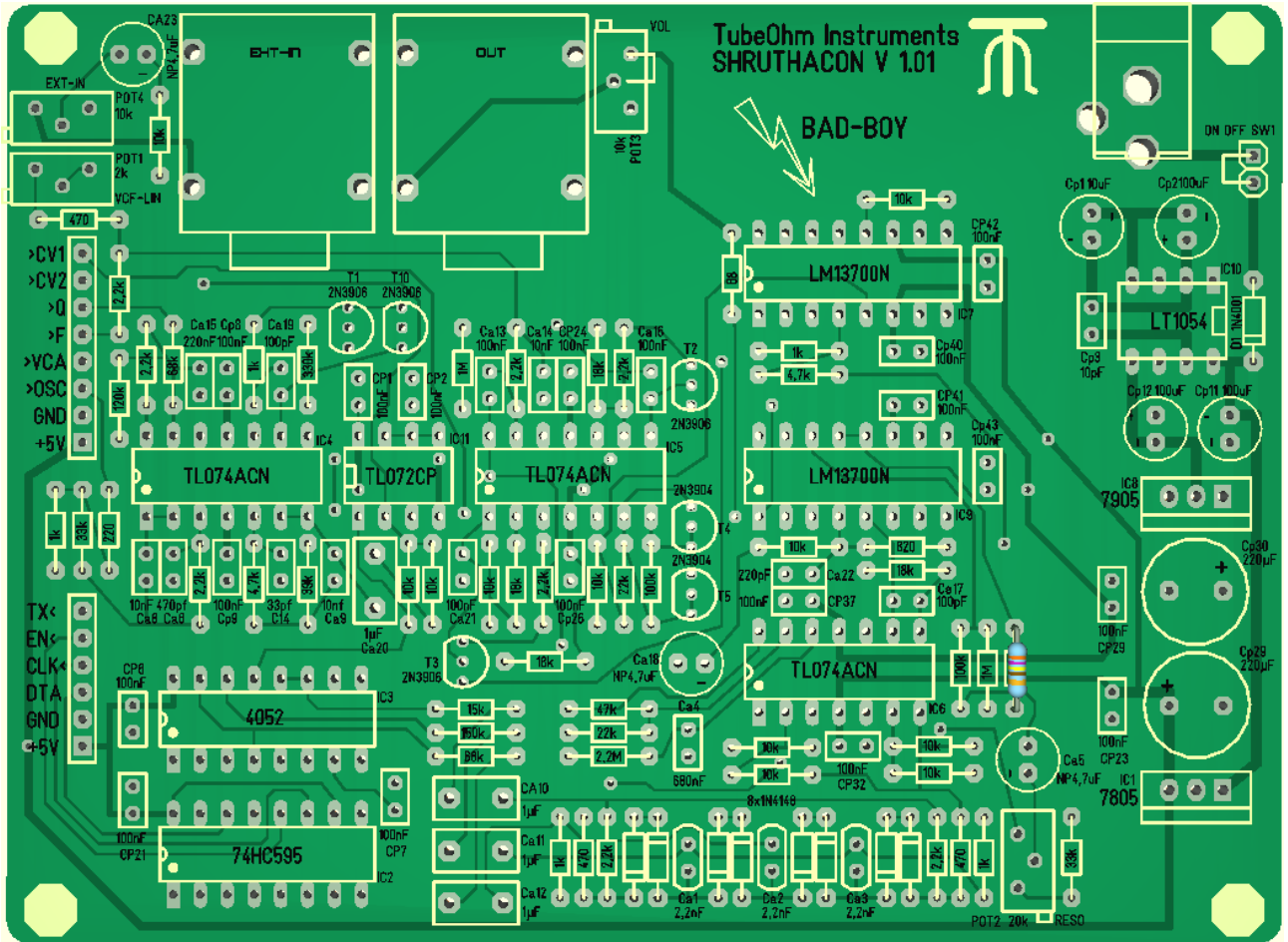
1x 150kOhm, color code: brown, green, black, orange, brown



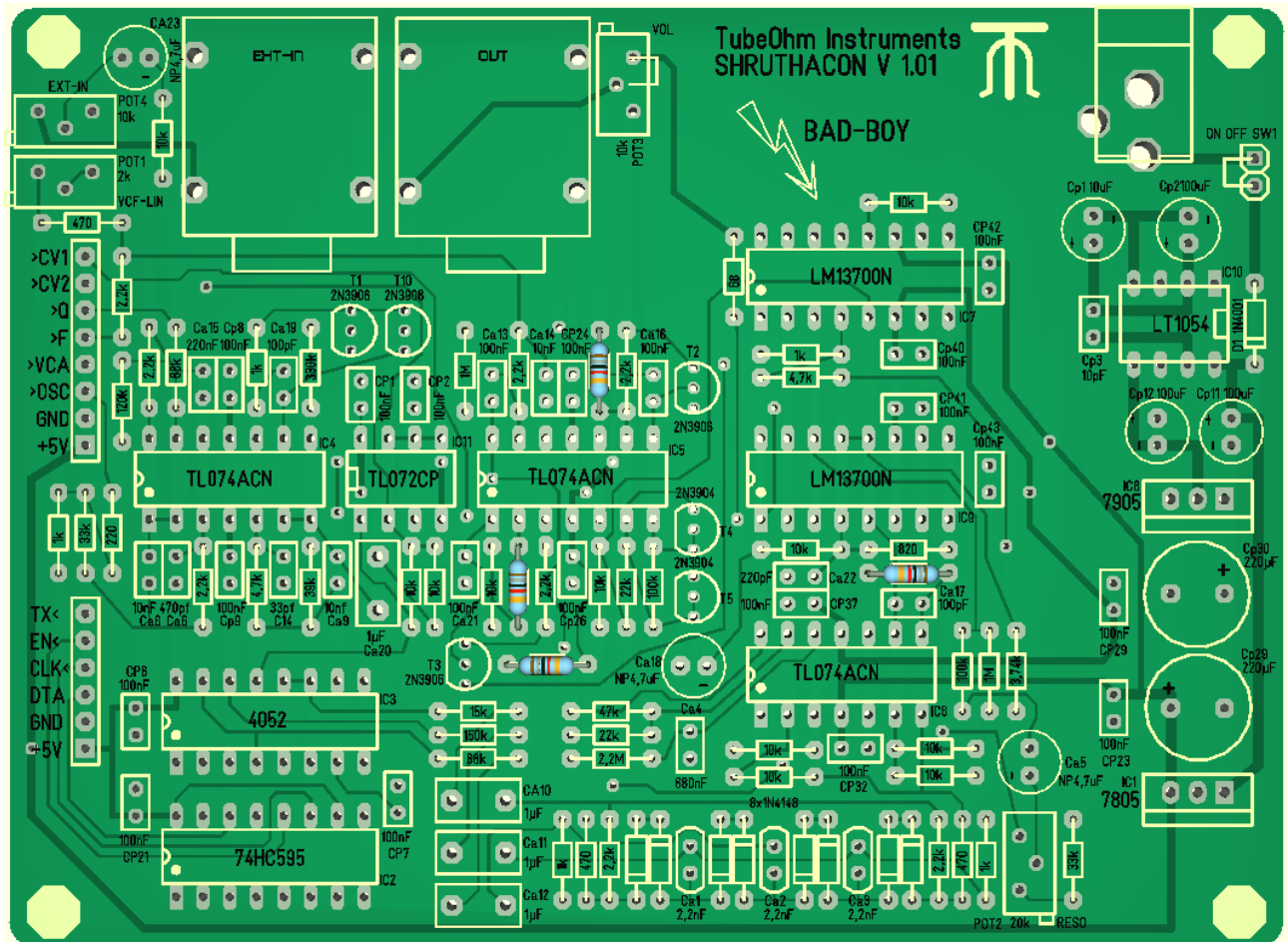
2 x 1 Mohm, color code: brown, black, black, yellow, brown



1 x 3,74Kohm, color code: orange, purple, yellow, brown, brown



4 x 18 Kohm, color code: brown, gray, black, red, brown



1x 120Kohm, color code: brown, red, black, orange, brown



1 x 220 Ohm color code: red, red, black, black, brown



1x 330Kohm, color code: orange, orange, black, orange, brown



1x 820 Ohm color code: gray, red, black, black, brown



1x 15 kohm, color code: brown, green, black, red, brown



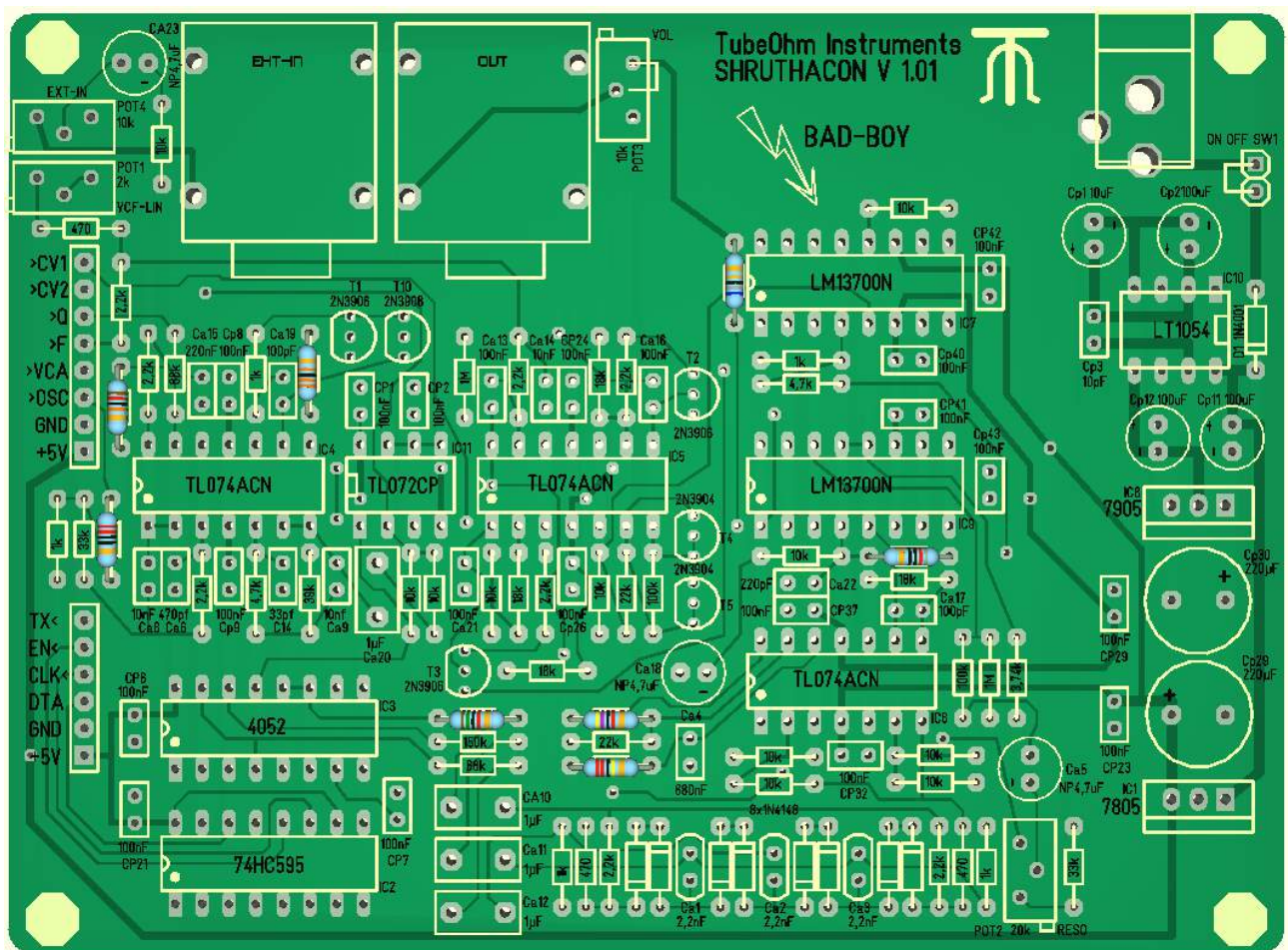
1x 47KOhm, color code: yellow, purple, black, red, brown



1x 2,2Mohm, color code: red, red, black, yellow, brown

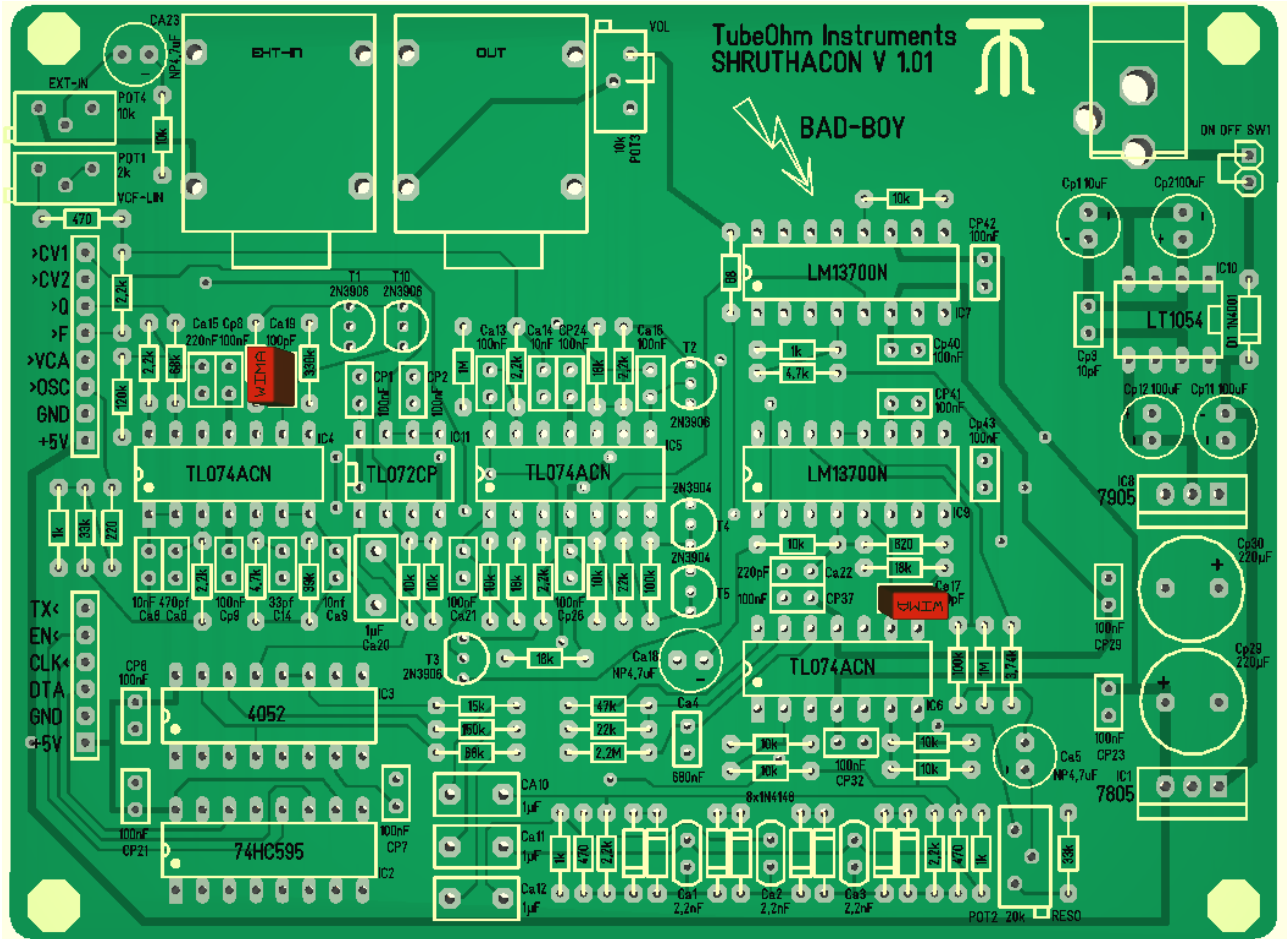
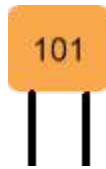


1x68Ohm, color code: blue, gray, black, gold, brown

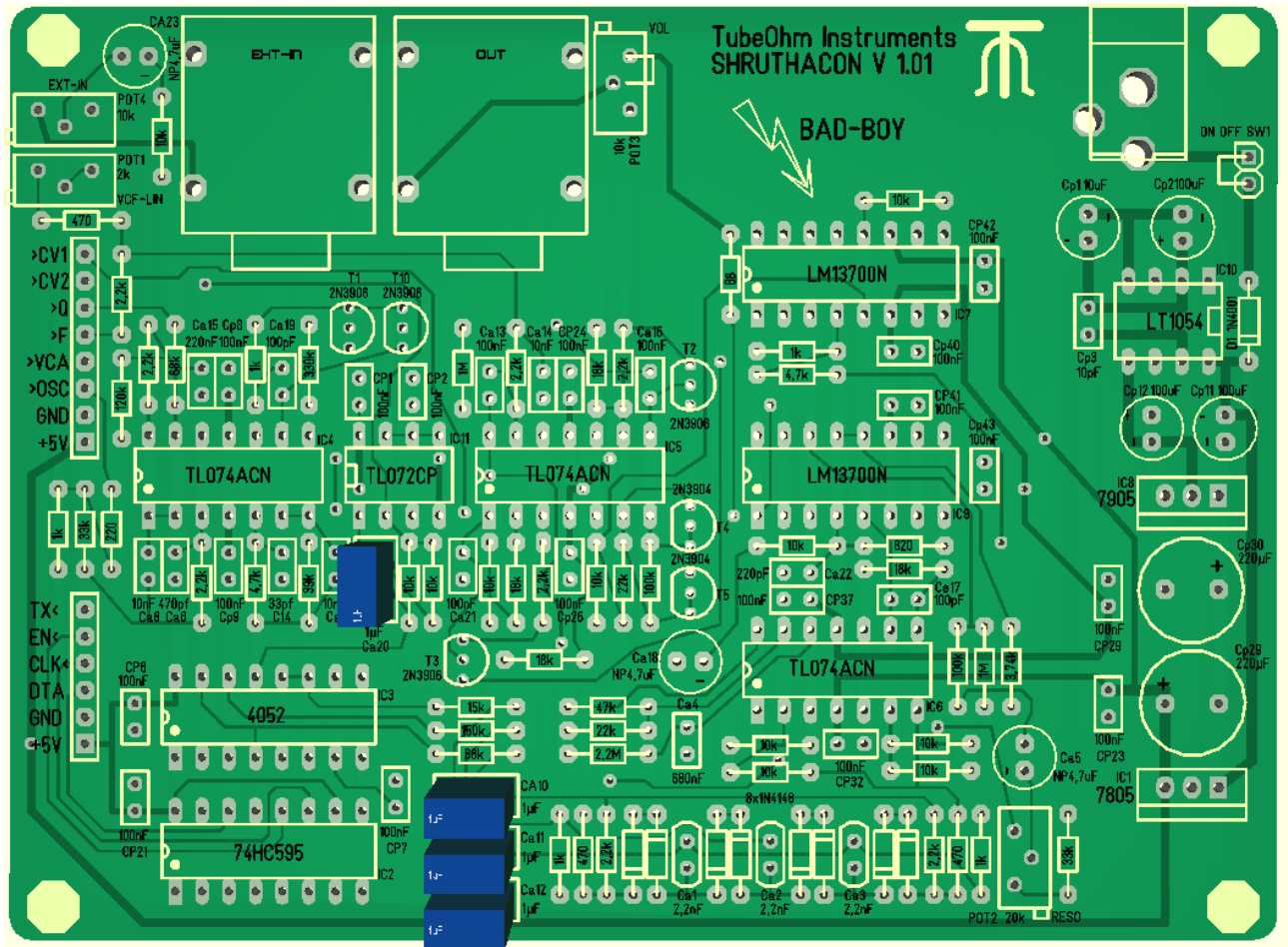


End of the resistors.

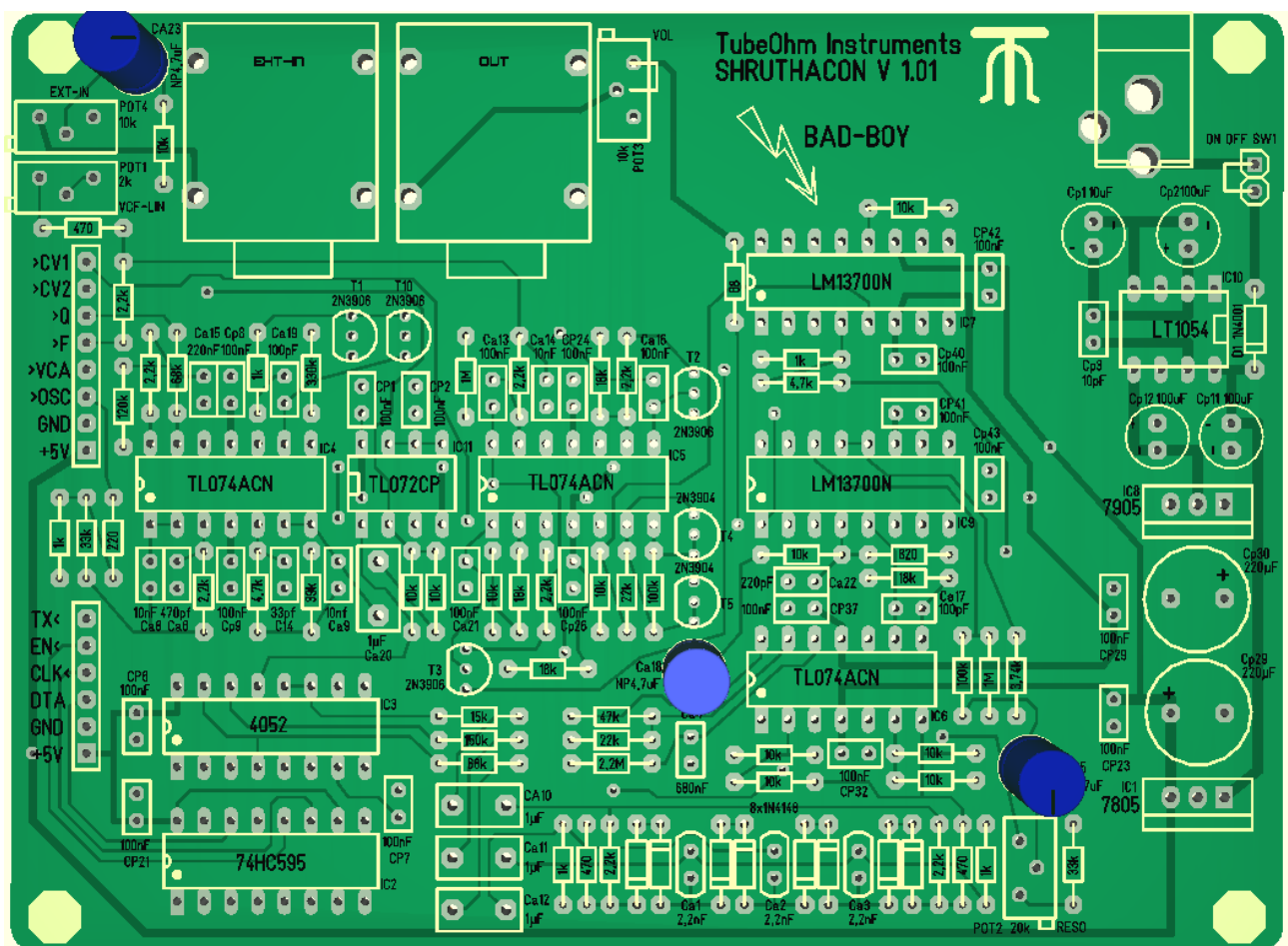
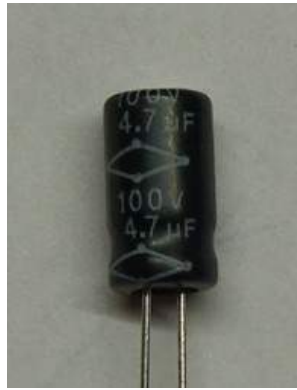
2x 100 pF code 101



4 x 1 uF code WIMA 1uK63



Not polarized 3 x 4.7uF



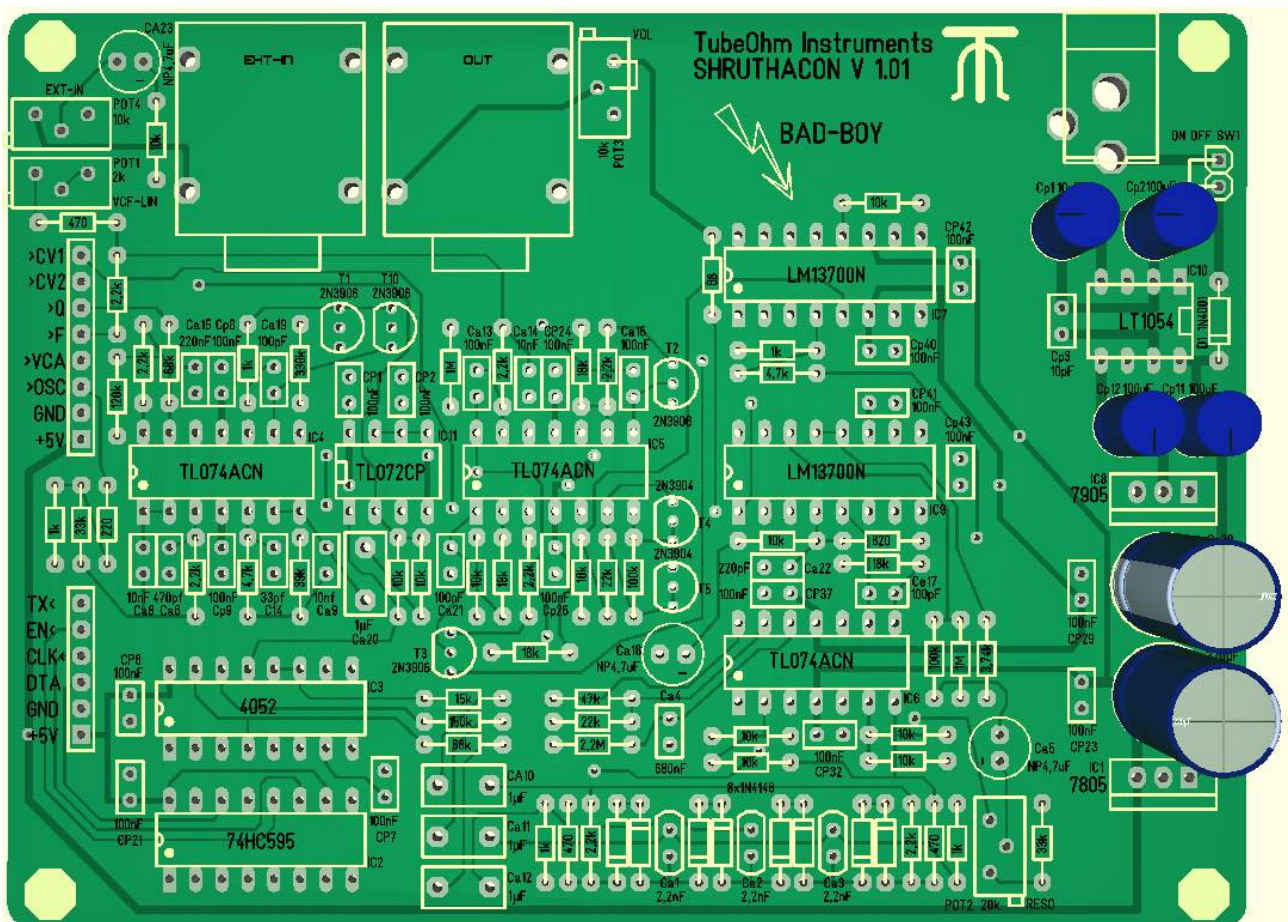
1x 10 uF polarized tantalum, pay respect to the polarity



3x 100uF electrolytic capacitor polarized, pay respect to the polarity



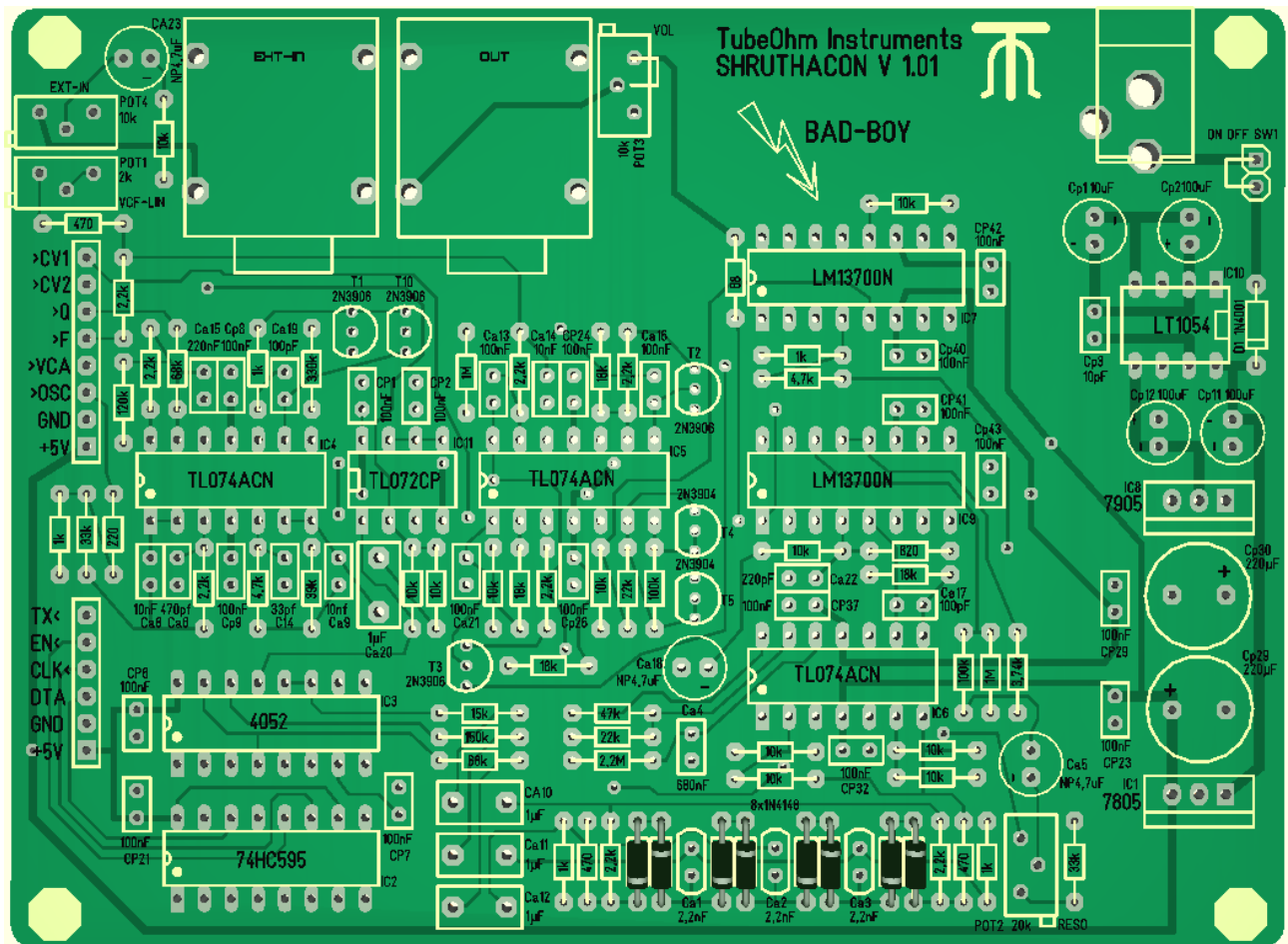
2x 220 uF electrolytic capacitor polarized, pay respect to the polarity



Up to 2.2 nF capacitors Styroflex® all C's are now equipped.

The 2.2 nF capacitors Styroflex® are very temperature-sensitive and are completely soldered at last to the circuit. Quick solder because the capacitors only 3 s to withstand 70 degrees. Otherwise they are zer-shruthi't.

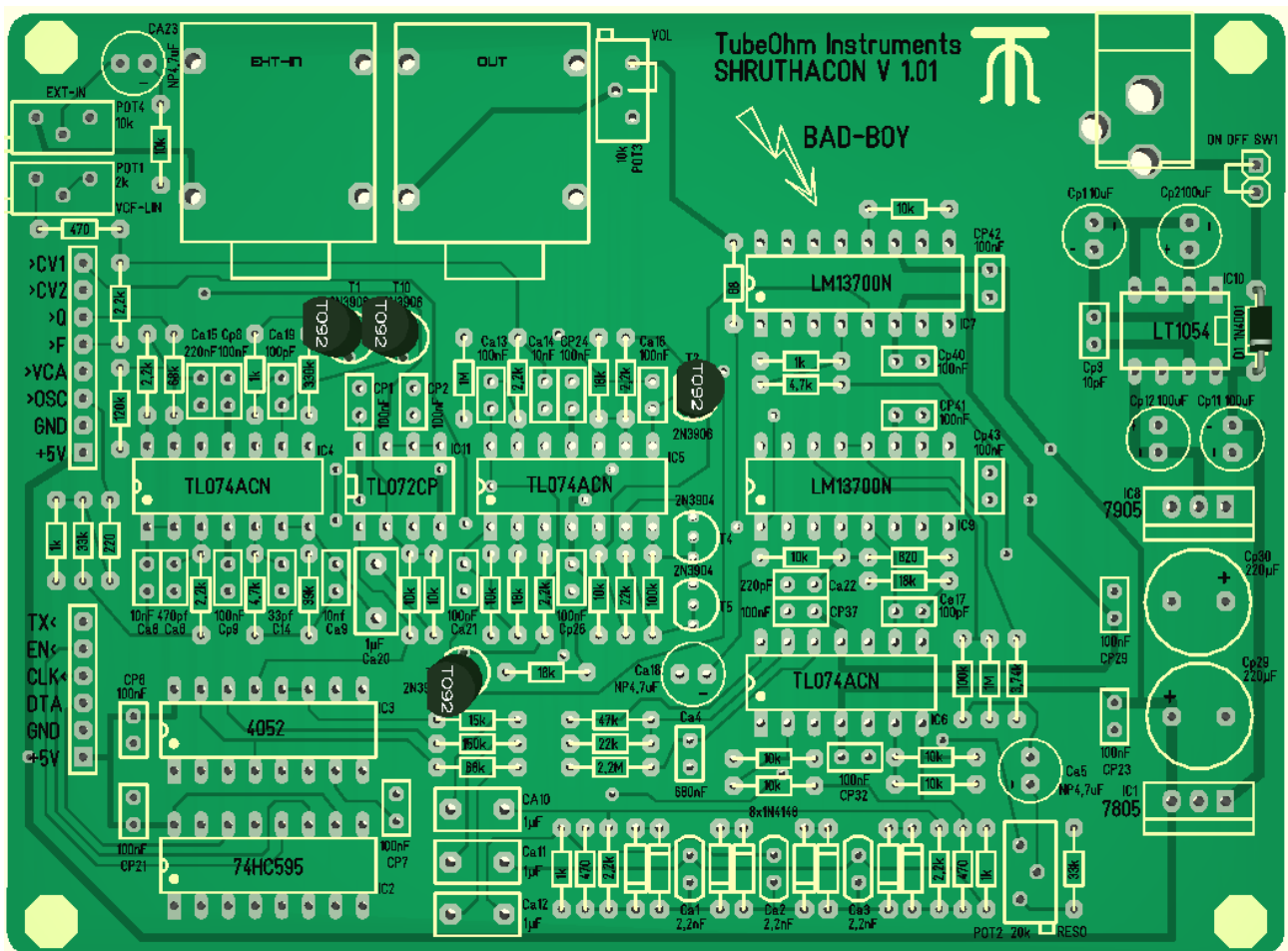
8x 1N4184 diode polarized, Attention pay attention to the polarity



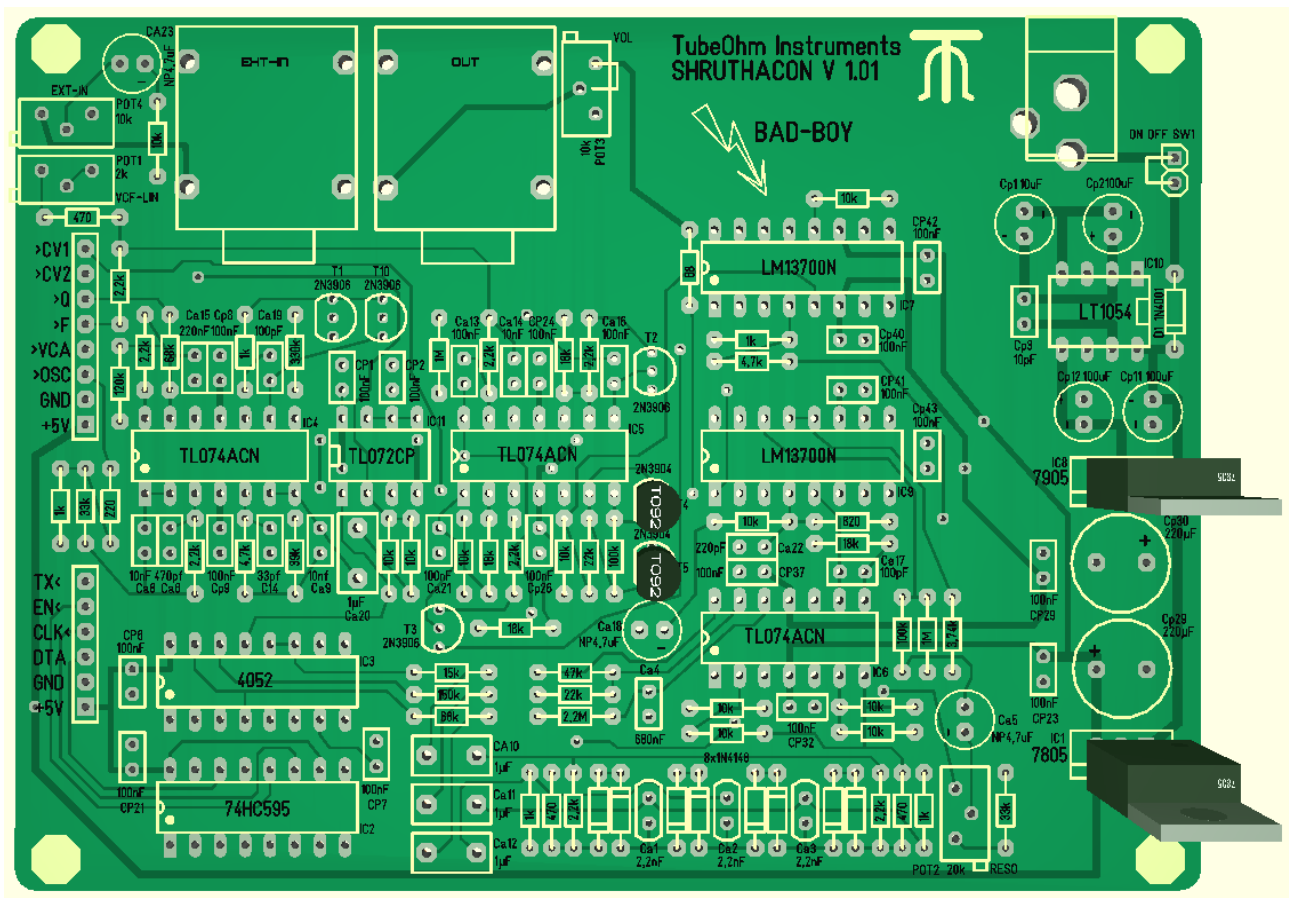
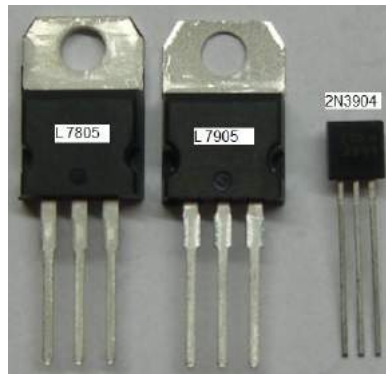
1x polarized diode 1N4001



4x Transistor 2N3906



- 1x 7805 Voltage regulator positiv
- 1x 7905 Voltage regulator negativ
- 2 x 2N 3904 Transistoren

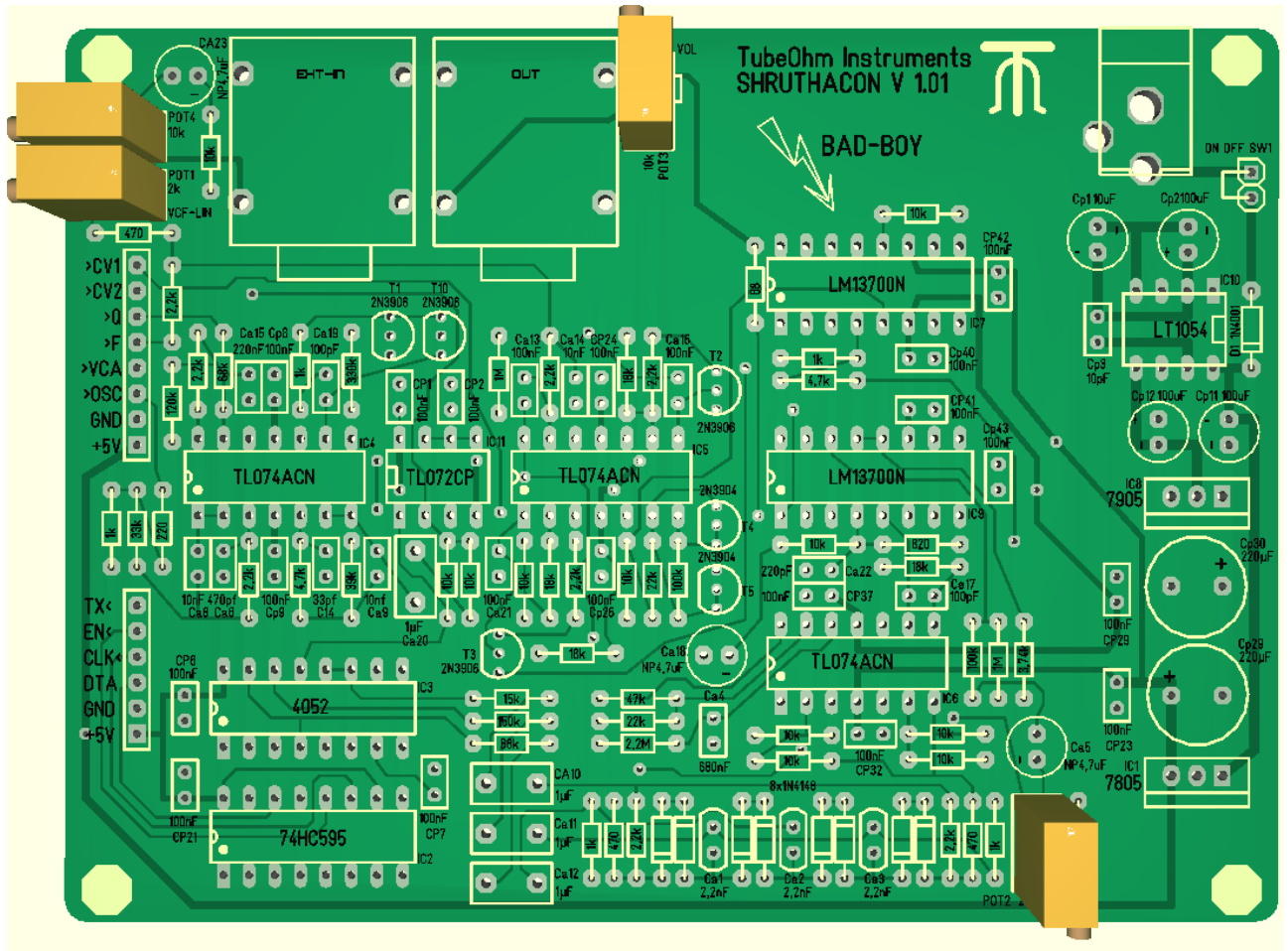


Trimpot

1x 2kOhm code 202

2x 10kOhm code 103

1x 20kOhm code 203



Please contact your IC's to IC socket !!!!!Solder the sockets first !!

1x LT 1054 pay attention to the label. Mark right !!!

3x TL 073 Mark left

2x LM 13700 Mark left

1x TL 072 Mark left

1x CD 4052 Mark left

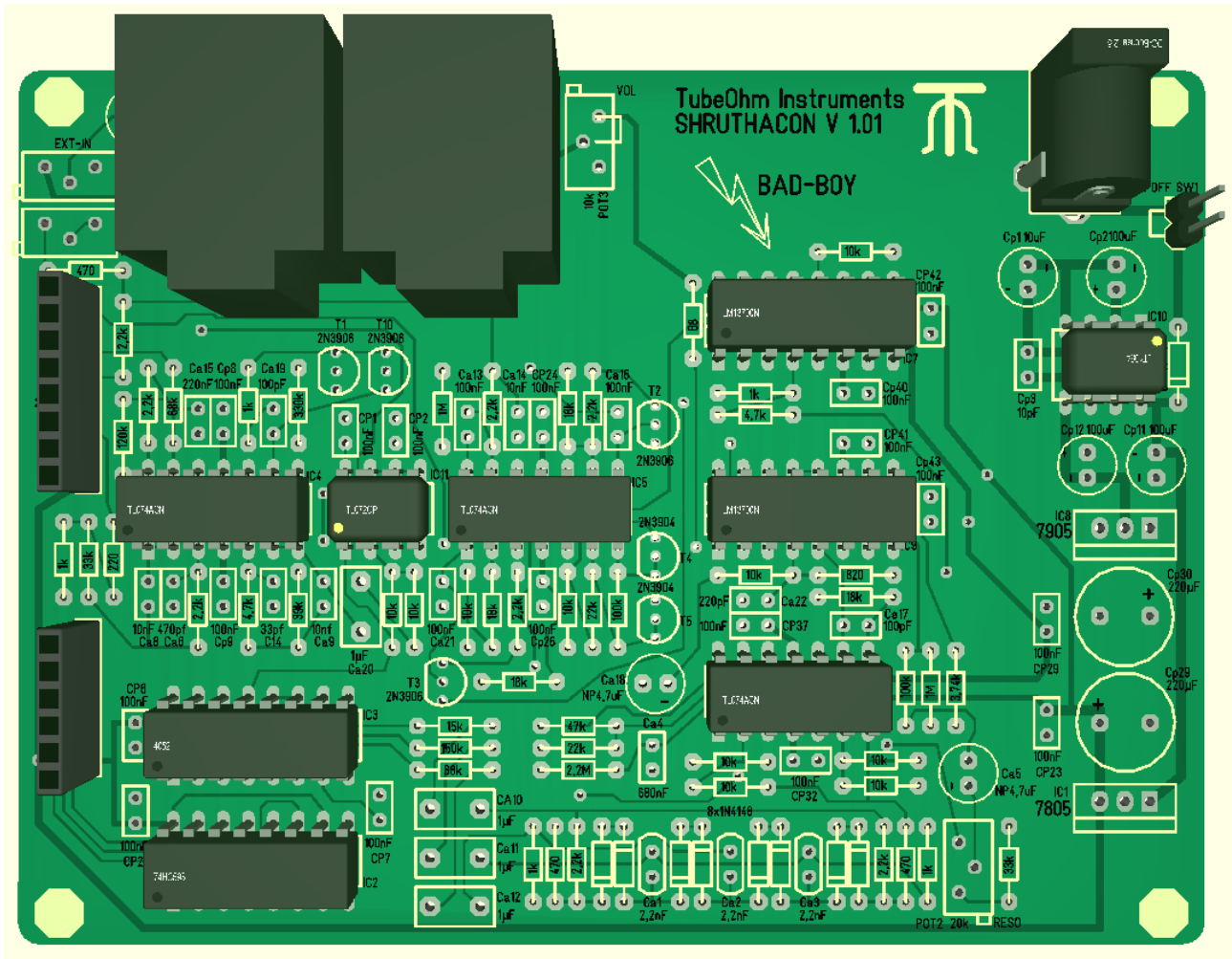
1x 74HC 595 Mark left

SW 1 for on/off switch , or short it

1x Arduino header 8 pol

1x Arduino header 6 pol

1x 9V Buchse



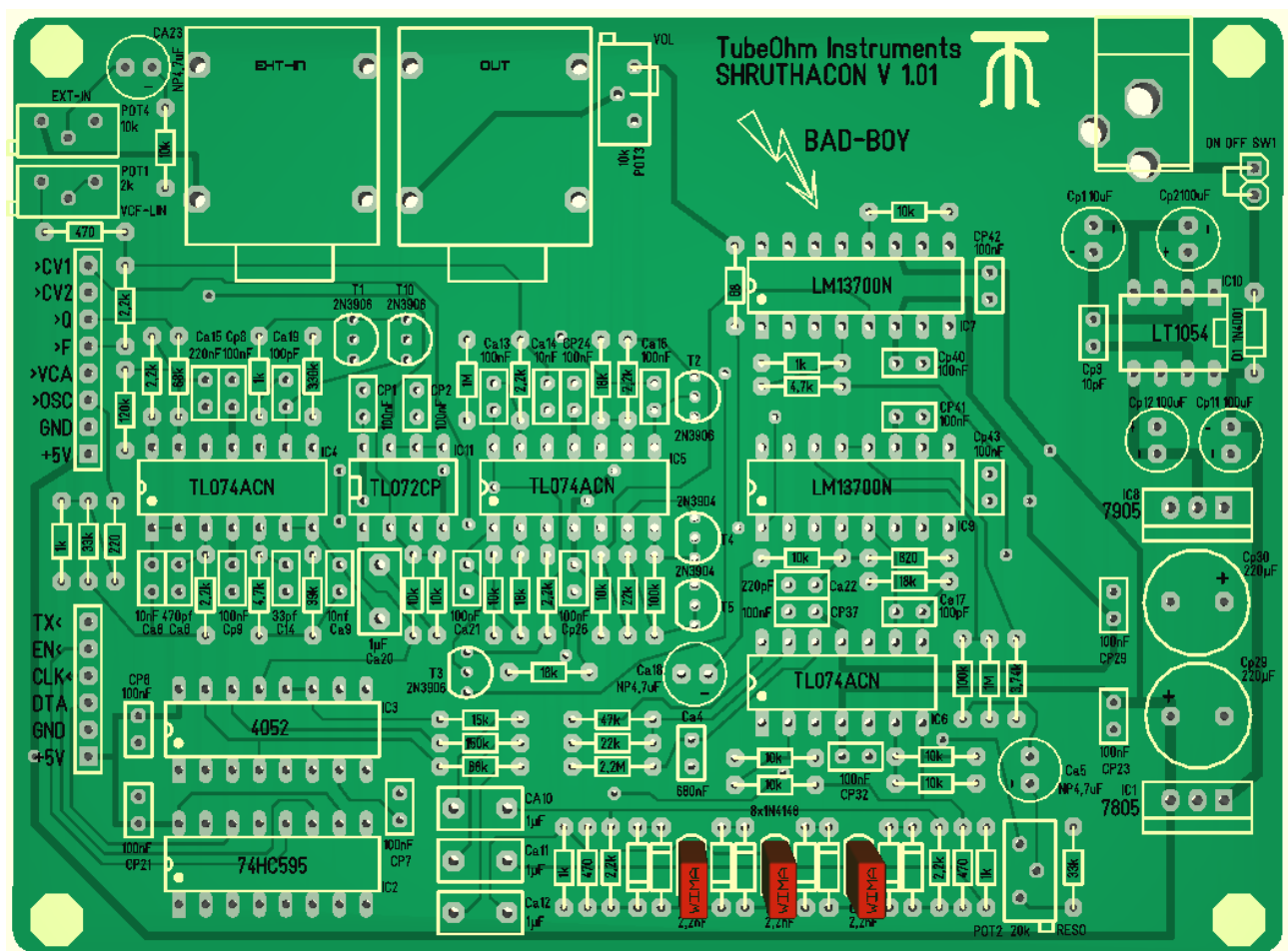
Please only solder the socket. The ICs are inserted after the test of the power supply.

3 x 2.2nF capacitors Styroflex® code 2200 2% tolerance



Note the capacitors should be nich too hot. Quick solder.

**** Modding for a bass machine, the 3x 2.2 nF be replaced by 3x 22nF Wima.
Since then shakes the wall at 5 Hz



Now all components should be fitted.

Before we use now the IC's we do a test of the power supply.

Is the SW 1 bridged?

Well, we now put the first LT 1054 in the socket.

This LT1054 is a charge pump and generates -9V.

These are from the 7905 to - 5 V stabilized.

Measurement points for the voltage.

ROT = +5V

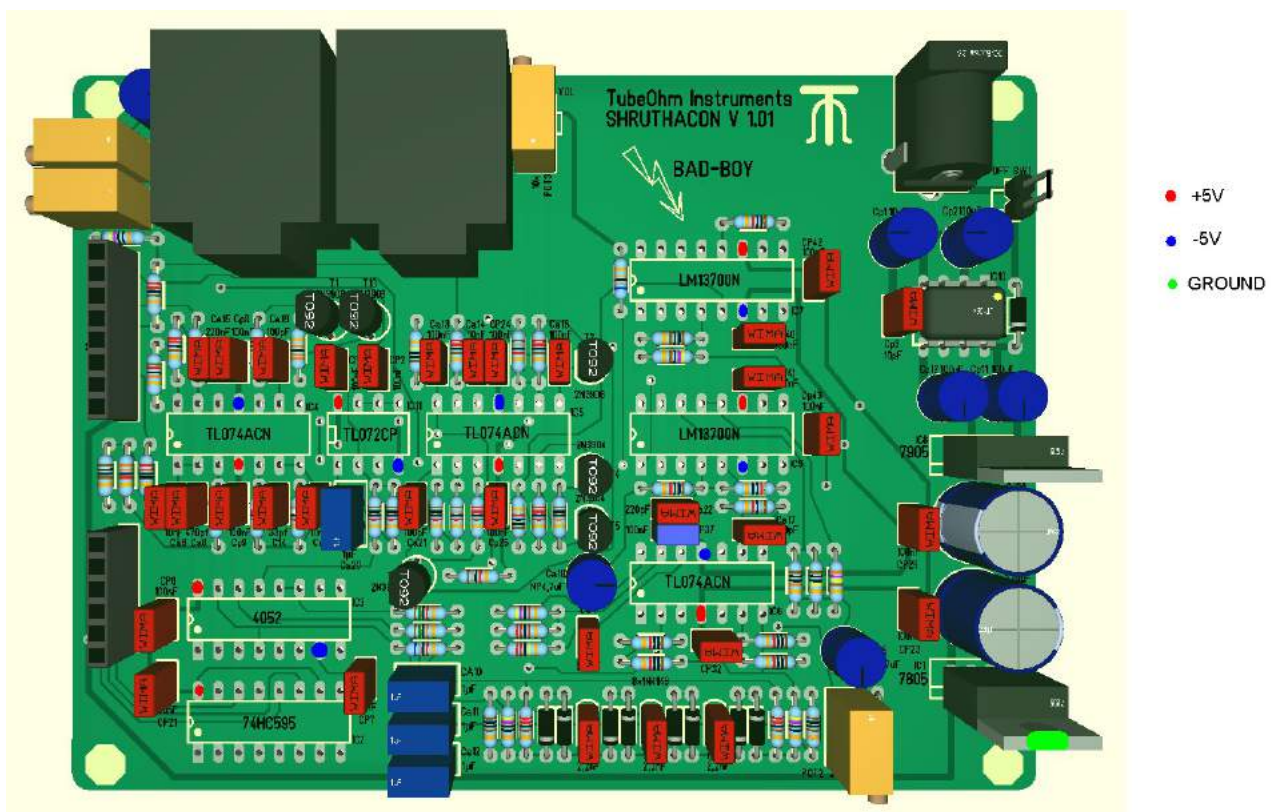
BLAU = -5V

GRÜN = Ground (MASSE)

Please connect a 9V DC 600 mA power supply and measure the voltages without the rest of the IC.
For her GROUND of connecting your multimeter with the cooling fin of the 7805th
The LT1054 has to be plugged in, of course!

Is +5 V at all measuring points?

Is -5V at all measuring points?



All voltages OK ?? The LT 1054 as well as the voltage regulator should not be warmly !!!
There is no current flowing !!! When the circuit is functioning later the 7805 is very warm.
It is normal because he supplies the ATMEL and the LCD display with power.
Now the power supply is disconnected from the circuit board.

Please clean the board from the solder side with alcohol and a soft cloth.

One last check of the solder points, no short circuits on the board?

You can also quietly take a magnifying glass and check all solder points again.

Now all ICs are used. Please pay attention to the label.

All IC's, **except the IC LT 1054**, have the mark left.

Only the LT 1054 has the mark on the right.

Now the exciting part comes !!!! (Sweat)

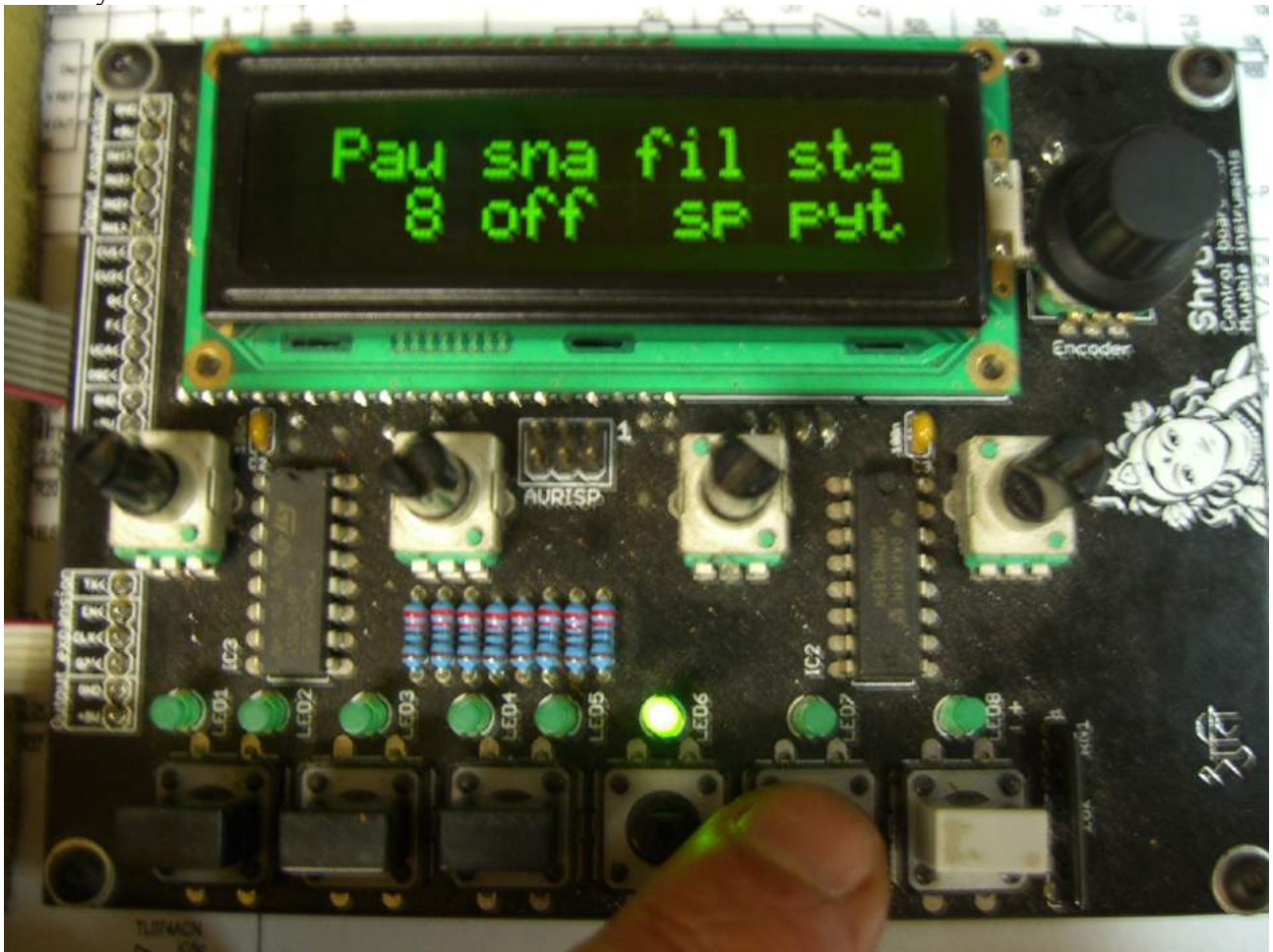
**Attention, on the motherboard must be installed the latest firmware V 1.0x
In the menu for the filter selection is now a menu item for the S-P Shruthacon filter.
Older firmware versions do not have this menu. Thus, the analog multiplexer, the signal does not switch to the filter on and ... it does not work.**

Does the MOBO Shruthi the latest firmware ??? For real ??
Good, good. Then now connects the motherboard to the filter board.

Turns Shruthi one now. The display should show values.

Now the Shruthi motherboard is set to the SP filter board.
To do this you press the 5th button after the start of the Shruthi.

*** My shruthi I should dust off times.



Then lit LED 6th with the 4th button then are ye come into the setup menu.
You may have to the 4th button press several times.
As FILTER (fil) <(Steiner-Parker) is now set with the third Poti> SP.
Then you can save the setting. To do this you press the last key on the right and select YES .



Now the Shruthi is connected with MIDI and you should have heard a sound if you play on the keyboard.

If no sound coming, or only very softly, then first checks the volume POT 3 right next to the audio output jack !!

Thus, the Shruthi comes running and sound too? Now it goes to the BALANCE of the CUTOFF and linearity .

The adjustment

To do this you need the following.

Our Filtercalibrator or a guitar tuner. (The Filtercalibrator is 4free to download from our website).
A small screwdriver.

Default setting for the Shruthi

1 :) all oscillators and the Subozillator must be turned off.

2 :) make the LFO and ENV to 0 in the filter menu

3 :) cutoff to 0

4 :) resonance at 63

5 :) is now available for the Shruthancon filter, a second filter menu. In this you come when you press the button for the Filter a second time.

Here are the parameters MOD (Filter Mode (LP) Low-pass (BP) band-pass (HP) High-Pass and AP (Phaser).

Furthermore, there is now a parameter >>> <<< fdb. This sets the basic gain / distortion limiter.

6:) MOD=LP

7:) FDB = 0

Adjustment of the resonance

Cutoff = 0

Resonance = 63

MOD on LP

FDB = 0

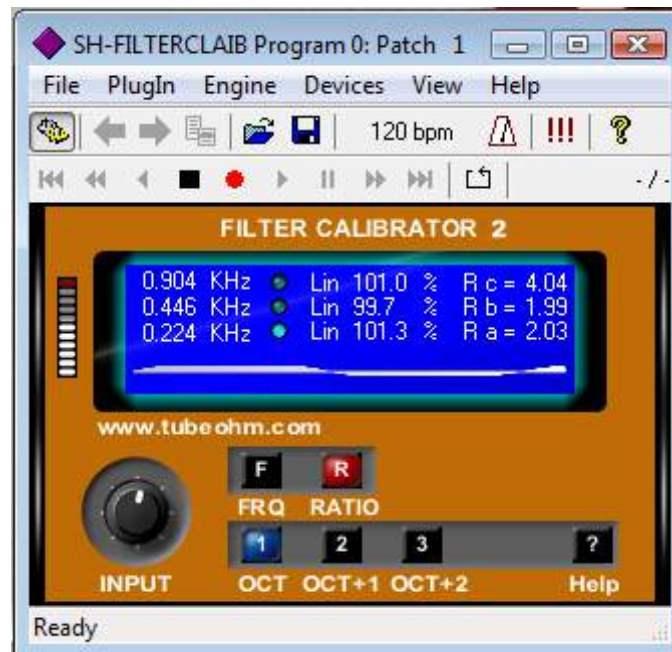
** It should be heard no oscillation with this setting.

The trim pot Pot2 on the filter board is set to maximum resonant >> left stop
Left stop only when you use the potentiometers specified in the BOM !!

Now CUTOFF is slowly turned up from 0.

At about cutoff= 40 now the resonance begins to oscillate.

Then you start the filter Calibrator, the lowest frequency is 220 Hz, turn the reso so far back that the resonance is just barely be heard in all three octaves. Is with me Reso = 48
220,440 und 880 Kz +/- a few HZ.



Then the linearity potentiometer Pot1 is adjusted on the filter board, so that the linearity is so good as possible. Importantly, the root should always be 220 Hz.

Because the SP filter is very non-linear this (see picture are the optimum settings)

The lowest note should be doing the keynote 220 Hz +/- 5..10 Hz.

Here are my values:

Cutoff =65, Reso =48, LP, Feedback=0

Bei Reso 46 the Resonanz goes down.

That was the adjustment.

Adjustment again in summary:

Pot 2 turn to the left (maximum response).

Cutoff to turn 65.

Response so far turn back just you can hear the resonance over three octaves

With P1 set the linearity so good as possible.

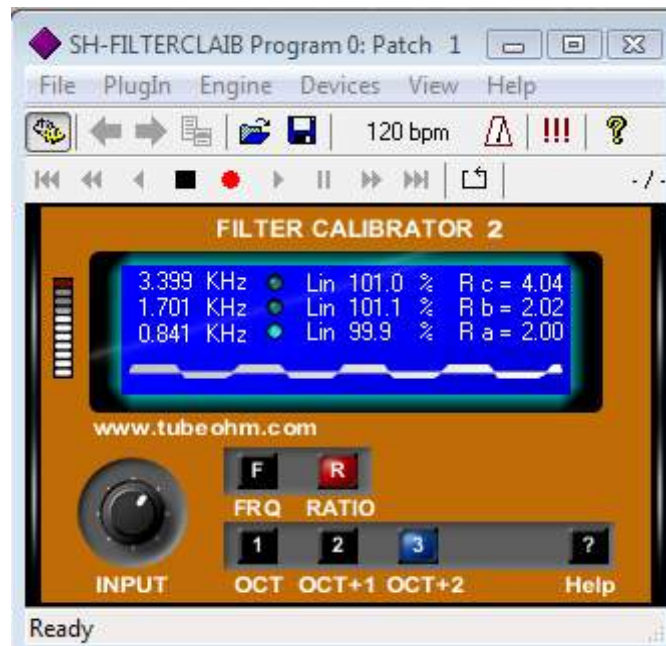
The lowest note (the root) is 220Hz and has from time to time with the cutoff Pot in the MOBO be adjusted .

From the 48 resonance filter with 220Hz begins to oscillate. Under 46 is an end to the resonance.

About 48 resonance frequency goes high, therefore the response should be precisely adjusted .

In this setting, the resonance of the filter runs almost linearly to 3.5 KHZ.

However, only at a resonance of 48 over 48, the filter can oscillate well over 10 KHZ.



Shield for the Plexiglas housing:

Reason, it can result in a slight hum when all oscillators are turned off and cutoff is set to 0-40. Although it is only 5 mV at 90 mV max signal, but still annoys me.

the Plexiglas housing has not really a good shield. Since the Styroflex® capacitors are very hum sensitive and the amplifier operates with very high impedance should the amplifier stage around IC 6 have a shield from below and above.

For this purpose, please see the print template at the end of this manual.

First, the shield is printed and cut on thicker cardboard.

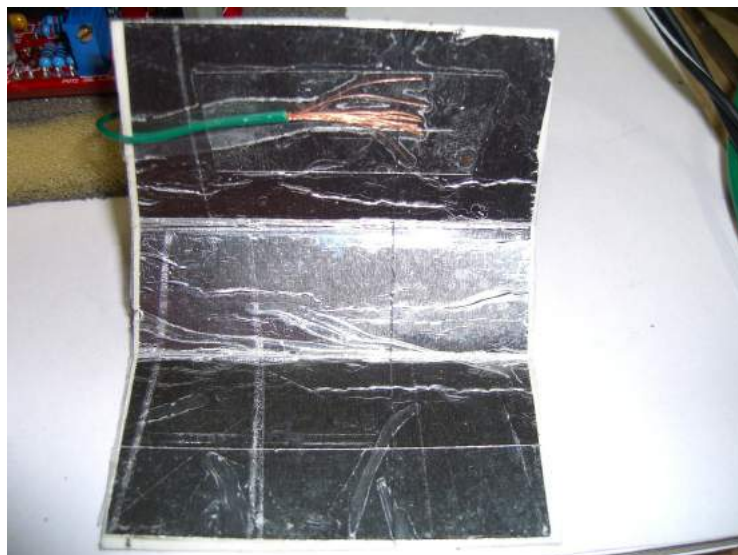
Then aluminum foil is adhered to the board from the rear.

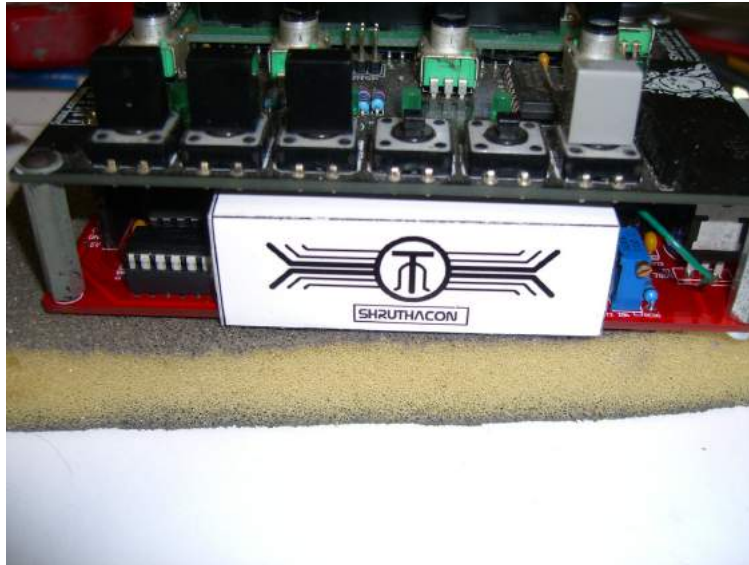
Now, a cable is stripped and glued with adhesive tape on the back of the aluminum foil.

AFTER is the complete aluminum foil over the entire surface again covered with transparent packet tape or Tesa film.

Attention, the complete Aluminium foil must be isolated in order afterwards to get any shorts on the bottom of the PCB. Then the Shield is bent at the edges to bend a U and pushed centrally under the board. The cable of the shield will now be soldered to the ground of LM7805 (pin 2 center).

After this all hum and spikes are away..





Metal case. If you use a housing made of metal, you should connect GROUND to the Metal of the housing.

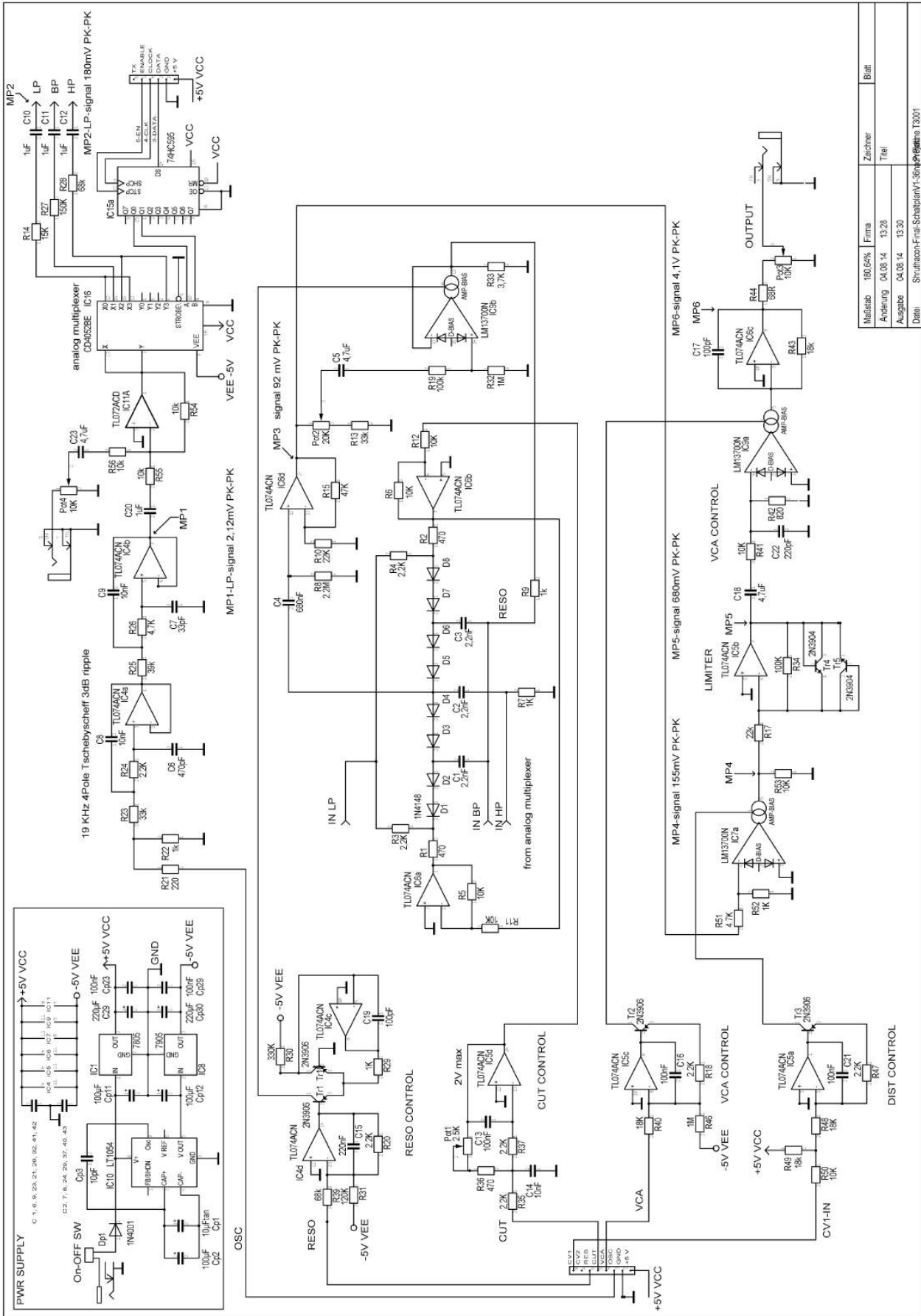
Everything runs ?? Hurrayyy , well, now it's time for the Victory Candy.

Andre'
TubeOhm

Modding for a bass machine.

If you low frequencies like it, simply replace the 2.2nF 22nF Wima Styroflex® by 5%
Then the wall wobbles at 5 Hz.

If you have questions please email Kontakt@TubeOhm.com
(deutschsprachige Länder)
international 0049 2368 57164
national 02368 57164



Maßstab	180:64%	Firma		Zeichner		Blatt	
Änderung	04.08.14	13.28					
Ausgabe	04.08.14	13.30					
Datei	Strukturicon-Final-SchaltplanV1.36n14.dwg						

SHRUTHACON BOM				Reichelt	Farnell
Pos	Name	Units	Wert		
1	D2	8	8x1N4148	1N4148	
2	Audio1,Audio2	2	neutric		4169244
3	C14	1	33pf	KERKO 33P	
4	CA10,Ca11,Ca12,Ca20	4	1µF	MKS-2 1,0µ	
5	CA23,Ca5,Ca18	3	NP4,7uF		1236689
6	CP1,CP2,CP6,CP7,CP21,C	20	100nF	X7R-2,5 100N	
7	Ca1,Ca2,Ca3	3	2,2nF	Styroflex 2,2N 2%	
8	Ca4	1	680nF	MKS-02 680N	
9	Ca6	1	470pf	NPO-2,5 470P	
10	Ca8,Ca9,Ca14	3	10nF	MKS-02 10N	
12	Ca15	1	220nF	Z5U-2,5 220N	
13	Ca17,Ca19	2	100pF	NPO-2,5 100P	
14	Ca22	1	220pF	NPO-2,5 220P	
15	Cp1	1	10uF	Tantal 10/16	
16	Cp2,Cp11,Cp12	3	100uF	RAD 100/16	
17	Cp3	1	10pF	Kerko 10P	
18	Cp29,Cp30	2	220µF	RAD 220/35	
19	D1	1	1N4001	1N4001	
21	IC1	1	7805	Ua 7805	
22	IC2	1	74HC595	74HC595	
23	IC3	1	4052	74HC 4052	
24	IC4,IC5,IC6	3	TL074ACN	TL 074 DIL	
25	IC7,IC9	2	LM13700N	LM 13700	1651866
26	IC8	1	7905	Ua 7905	
27	IC10	1	LT1054	LT1054 CN8	1648667
28	IC11	1	TL072CP	TL 072 DIL	
29	K1	1	DC-Buchse_2.5	HEBW 21	
30	K3	1	K1X06_BUCHSE	Arduino 6	
31	K7	1	K1X08_BUCHSE	Arduino 8	
32	ON OFF SW1	1	1X02	2Pin ST	
33	POT1	1	2k	64Z-2,0K	
34	POT2	1	20k	64Z-20K	
35	POT3,POT4	2	10k	64Z-10K	
36	Ra1,Ra2,Ra36	3	470	Metall 470	
37	Ra3,Ra4,Ra18,Ra35,Ra37,	8	2,2k	Metall 2,20k	
38	Ra5,Ra6,Ra11,Ra12,Ra41,	11	10k	Metall 10,0k	
39	Ra7,Ra9,Ra52,Rx22,Rx29	5	1k	Metall 1,00k	
40	Ra8	1	2,2M	Metall 2,20M	
41	Ra10,Ra17	2	22k	Metall 22,0k	
42	Ra13,RX23	2	33k	Metall 33,0k	
43	Ra19,Ra34	2	100k	Metall 100k	
44	Ra25	1	39k	Metall 39,0k	
45	Ra26,Ra51	2	4,7k	Metall 4,70k	
46	Ra27	1	150k	Metall 150k	
47	Ra28,Rx39	2	68k	Metall 68,0k	
48	Ra32,Ra46	2	1M	Metall 1,00M	
49	Ra33	1	3,74k	Metall 3,74k	
50	Ra40,Ra43,Ra48,Ra49	4	18k	Metall 18,0k	
51	Ra42	1	820	Metall 820	
52	Ra44	1	68	Metall 68,0	
54	Rx14	1	15k	Metall 15,0k	
55	Rx15	1	47k	Metall 47,0k	
57	Rx21	1	220	Metall 220	
60	Rx30	1	330k	Metall 330k	
61	Rx31	1	120k	Metall 120k	
63	T1,T2,T3,T10	4	2N3906	2N3906	
64	T4,T5	2	2N3904	2N3904	
65	Platine PCB	1	TubeOhm Shruthacon V 1.01		TubeOhm
66	IC-Sockel 8-pol	2	Socket 8 pol	GS8	
67	IC-Sockel 14 pol	3	Socket 14 pol	GS 14	
68	IC-Sockel 16 pol	4	Socket 16 pol	GS 16	

Shield for print

