KT 88 PP project

To the kit:

The circuit was designed so that it also works with electrostats from Silberstatic. Of course, conventional loudspeakers can also be operated just as well. Without having to make any losses.

The circuit board is designed so that different tubes can be used. It doesn't necessarily have to be KT 88. However, it is important to ensure that the pin assignment is the same as that of the KT 88.

Special features:

Controllable negative feedback
EL, 34 6L6, 6550, KT 66, KT 88, KT 99, KT 100, EL 509, 5881 can be used here!
Anode voltage up to max. 900V possible! At 495 uF anode voltage up to max. 450V 1980uF! (Selectable by selecting the wire bridges)
Power supply is integrated with, little cabling. DC heating of the driver and preamplifier. Symmetry can be adjusted

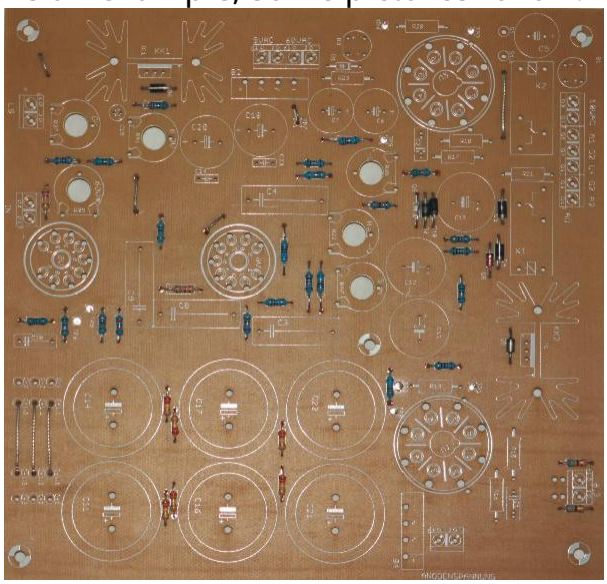
DC coupling adjustable
Bar-read anode voltage of the pre-stages and driver Triodes
and pentodes mode switchable by Rel

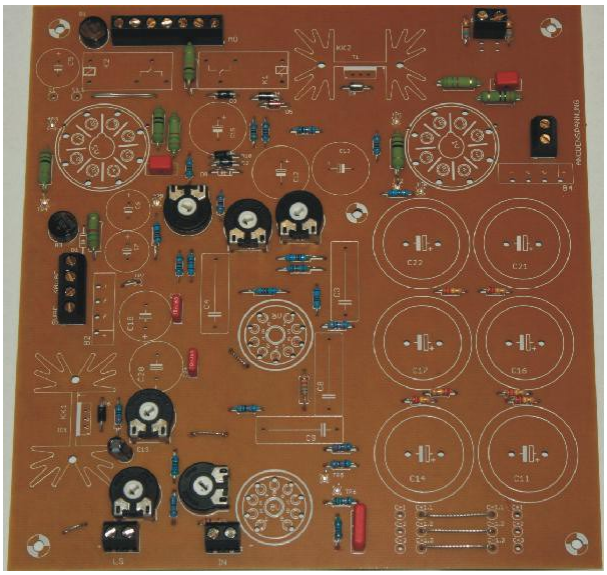
To build:

The circuit board was designed in such a way that it can be used for as many tubes and different voltages as possible, as stated above. The wiring build-up should be minimal. This means that there are fewer sources of error to incorporate ground loops.
The tube sockets are soldered on the butten side. There are holes for the potentiometers. So that the comparison is easier to handle.

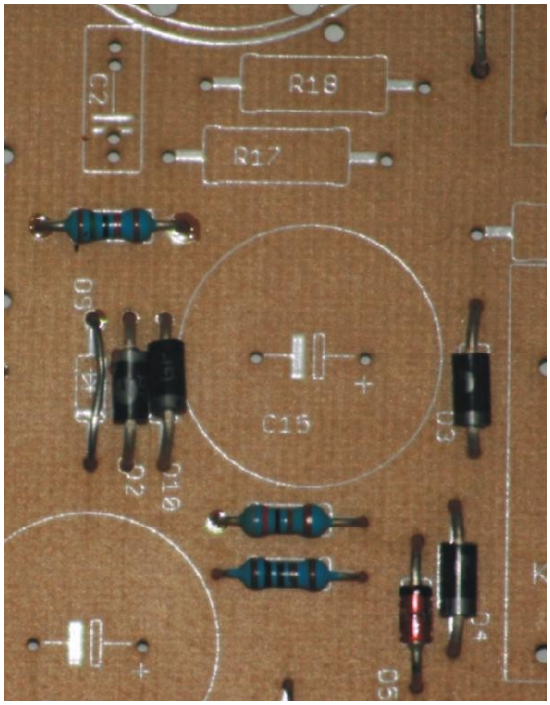
We start with the components that have low heights. Resistors, diodes, solder pins, wire bridges, etc. are built in first.

As an example, some pictures follow.





Supply voltage for the preliminary stages, not all Z diodes are necessarily required. The circuit board has space for 3 diodes. In our case, the KT 88 that we are currently dealing with, we bridge D9 with a wire bridge.

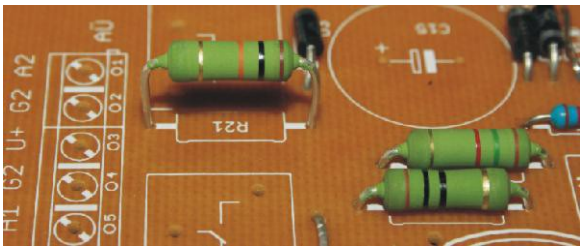


We limit the anode voltage to 280V for the pre-stages. This can be changed as required. But a maximum of 350V or the charging capacitors against 450V types

Replace. But then pay attention to the package!

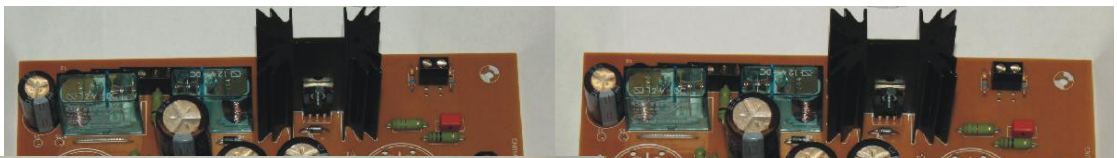
As a rule, 280V is sufficient to generate an amplitude of 100V Vgg, which we probably do not need.

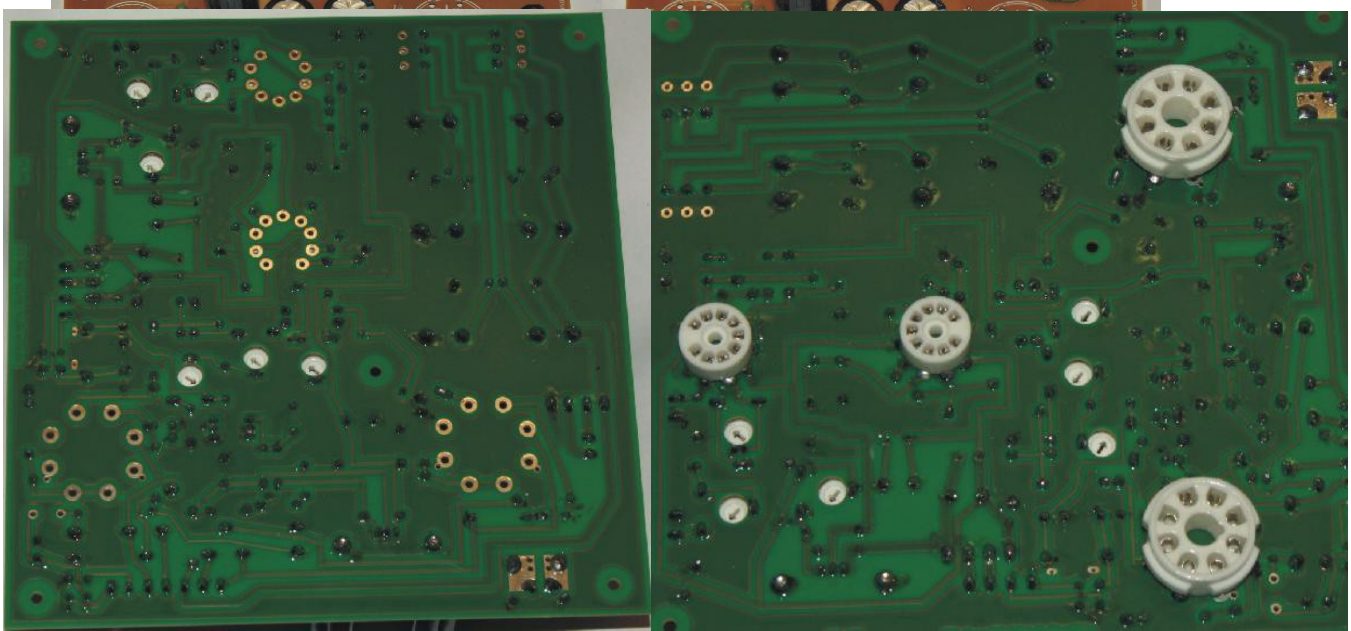
This means that there is always the possibility of modifying as desired, which is what makes the circuit board interesting.



All 2W we assemble like the picture
Shows. Usually it doesn't get that warm. If the circuit changes, the value may have to be adjusted, or 2W for 3W - 5W etc. swap.

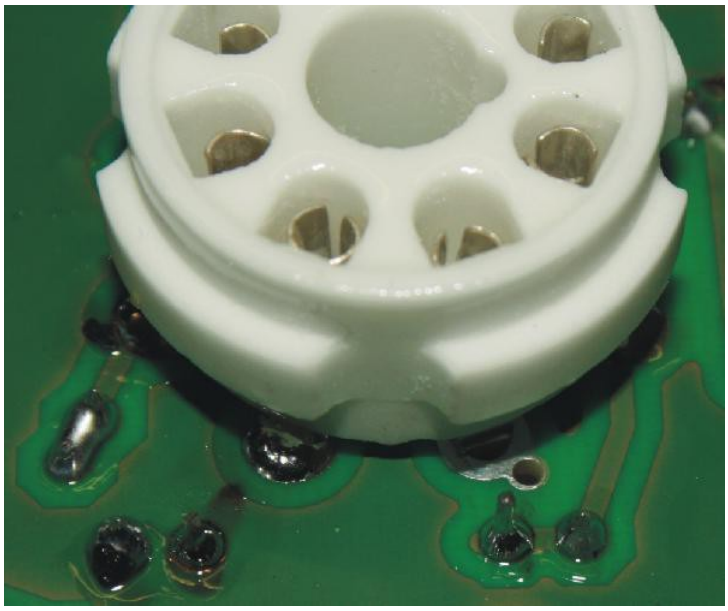
As mentioned, the option is always intended for the experienced professional.





The holes for the potentiometers are clearly visible on the back.
In this way, the potentiometers can also be easily adjusted on the soldering side without having to turn the circuit board. The copper layer is 70 µm.

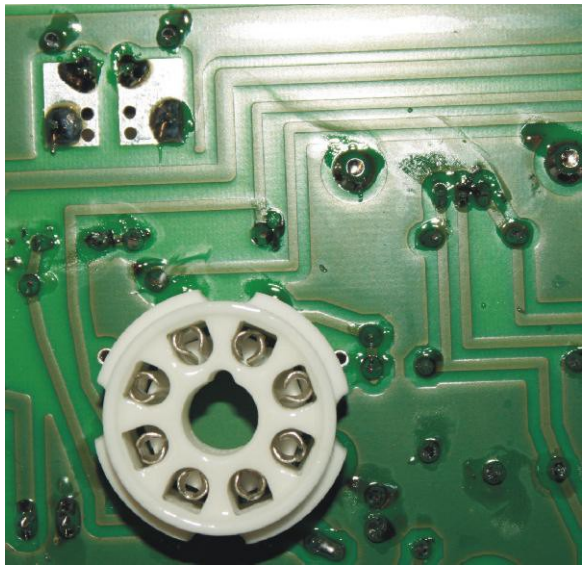
You can also see the position of the frame.



When soldering the socket, make sure that the nose position is correct, so check with care! Finally, pin 2 + pin 7 are soldered. Here we will add the supply line for the heating later. The

Makes soldering easier for us.
In another place there are drawings too!
At the end of the pins there is heat through the tubes! So it is important NO Old lead solder from remnants to use! The melting temperature is lower with lead solder. So solder at least the sockets with silver solder! Pay close attention to the high melting temperature of the solder! This then prevents cold soldering joints during continuous operation.

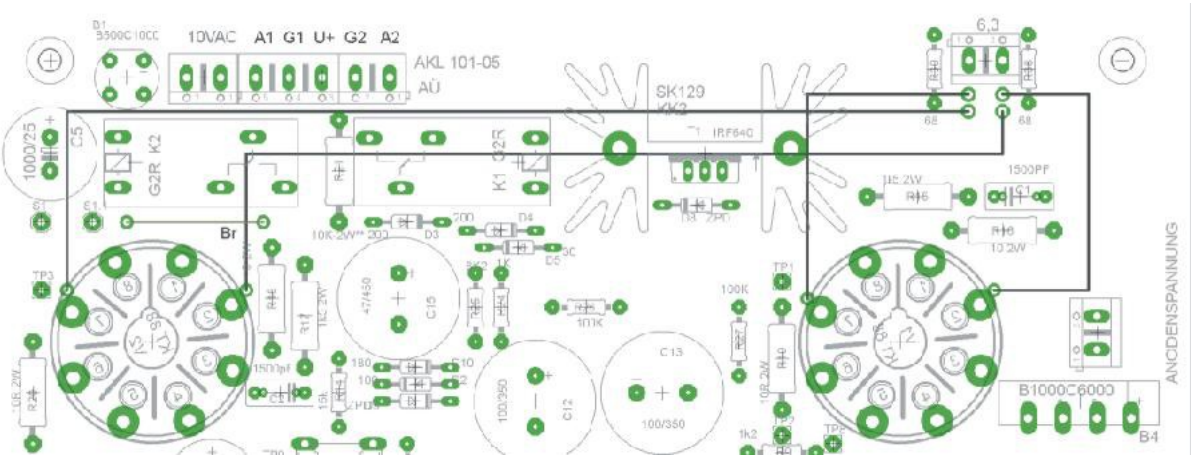
To see the connection above for the heating of the end tubes. And the version below. The nose points upwards to the edge.
Pin 2 + 7 are not yet soldered!
(See also bst.
Plan.) The larger solder pads will then be fully tinned later. Pin 2 + 7 soldered



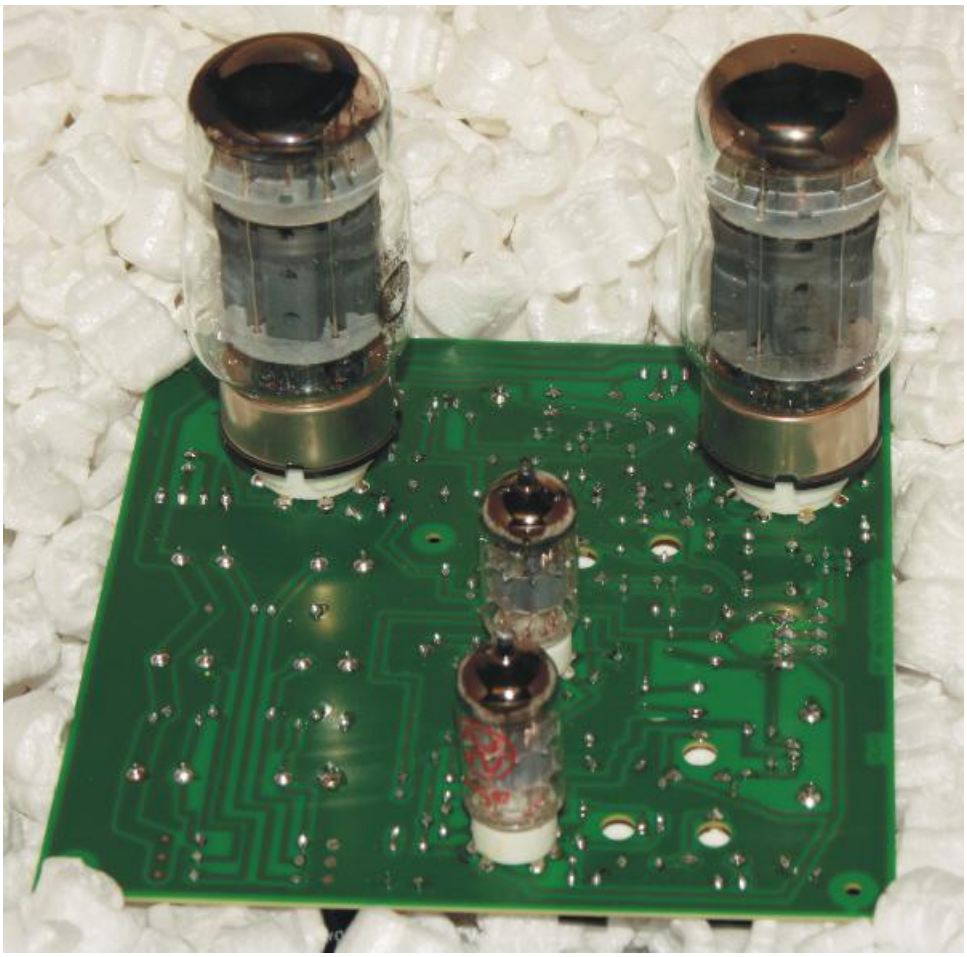
Another photo with soldered
z pad and soldered pin 2 + 7

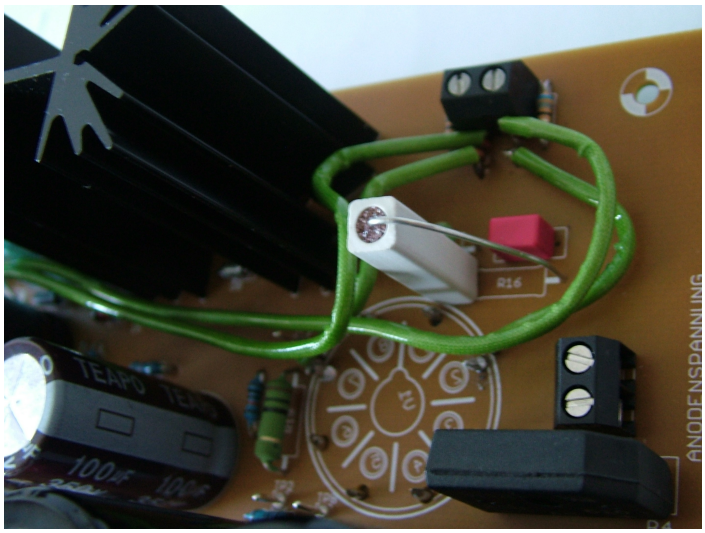
We use a 1.25Cu wire. and sheath him. So it is protected from the heat. Alternatively, a wire with a heat-resistant silicone coating can be used. The wire can also be soldered on the soldering side. It is important that the coating is heat resistant

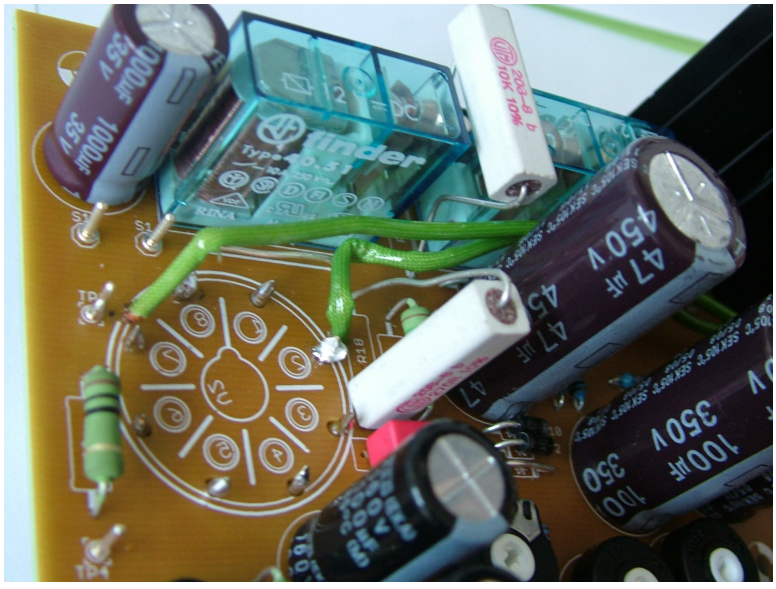
The drawing shows how the heating is connected. Insulated wires are used for this, they should not be so close to the power resistors!




450V 330µF
ANODENSPANNUNG



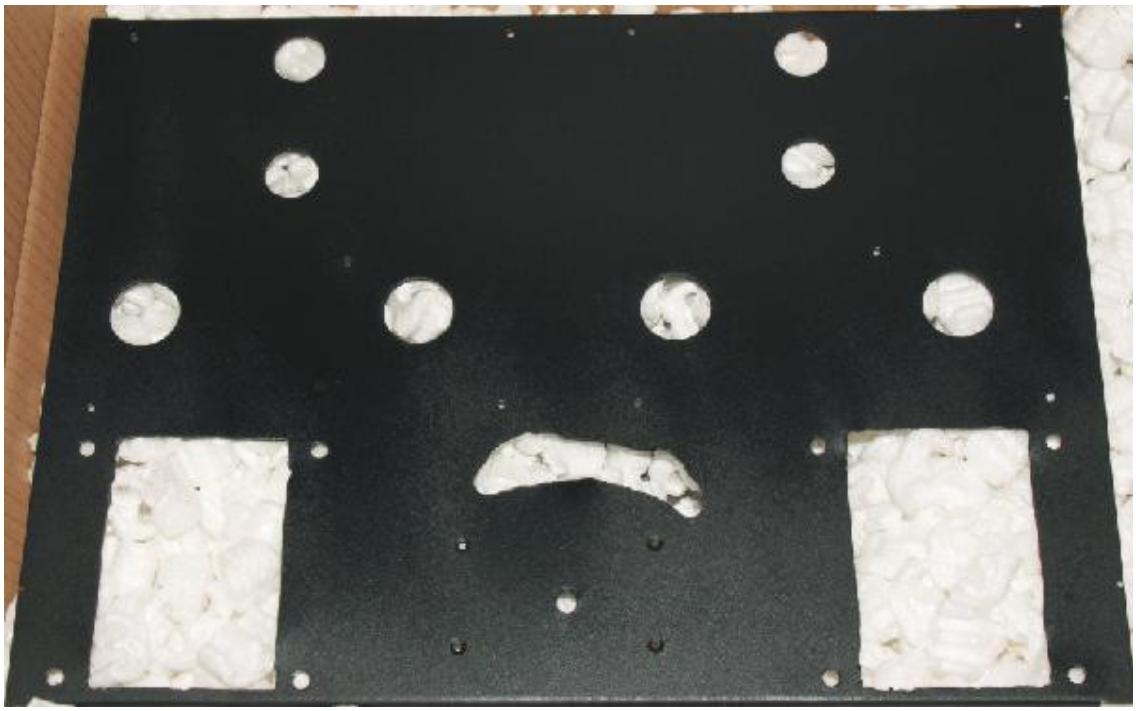




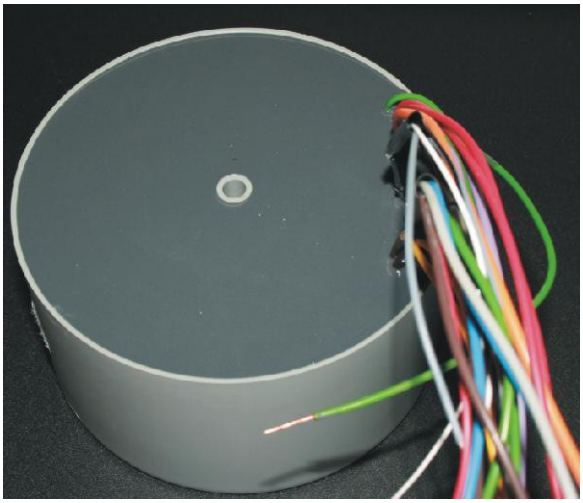
In the KT 88 version, the 5 watts are installed here as shown. For tubes with lower g2 currents, these can also be exchanged for 2 watt metal (note the data sheet of the tubes!)

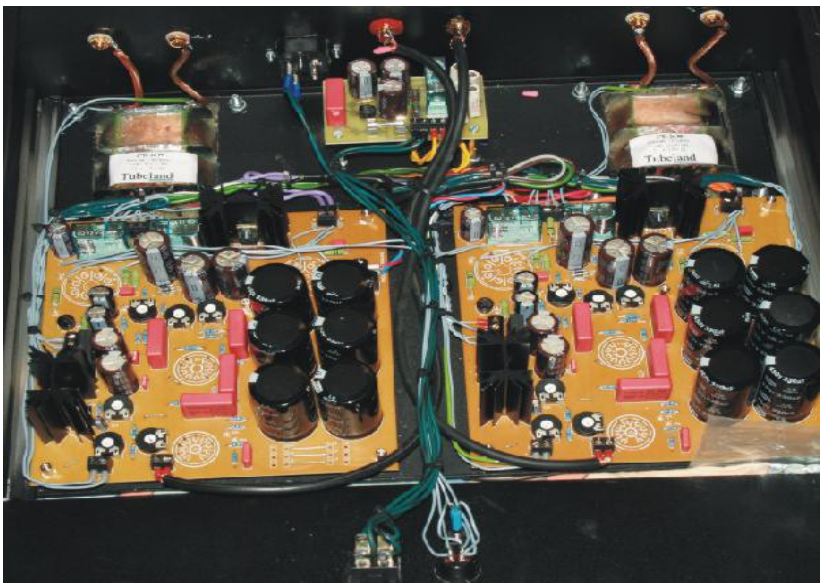
Should R 31 be exchanged for a higher value, R 21 could also get by with a lower performance. (Calculate!)

I will document a construction proposal for the housing and describe the adjustment of the output stage. The circuit is then described at the very bottom.
Of course, everyone can design their own case here. Whether mono block or stereo.
I just made it plain and simple so as not to create additional confusion.



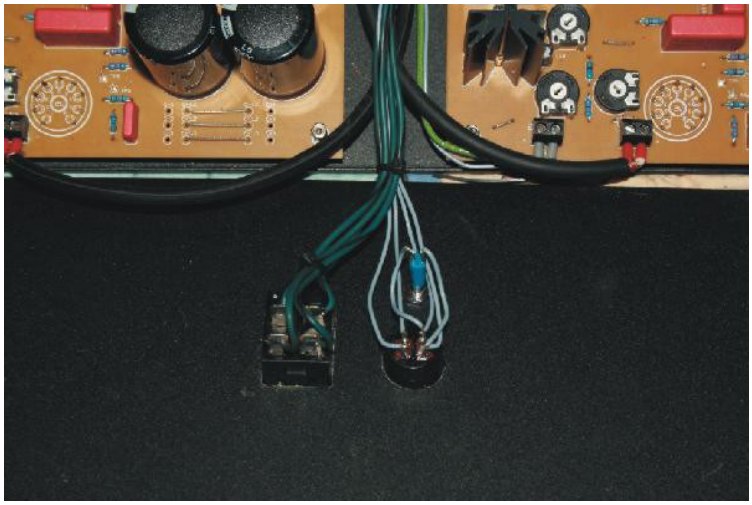
The cover plate is made of metal. The holes for the tubes were made with a hole punch.
The recess for the transformers with the jigsaw. Numerous holes were milled further for the toroidal tape core. All required assemblies attached from below. As a result, everything is then clearly assembled and also repair-friendly. Not was built.



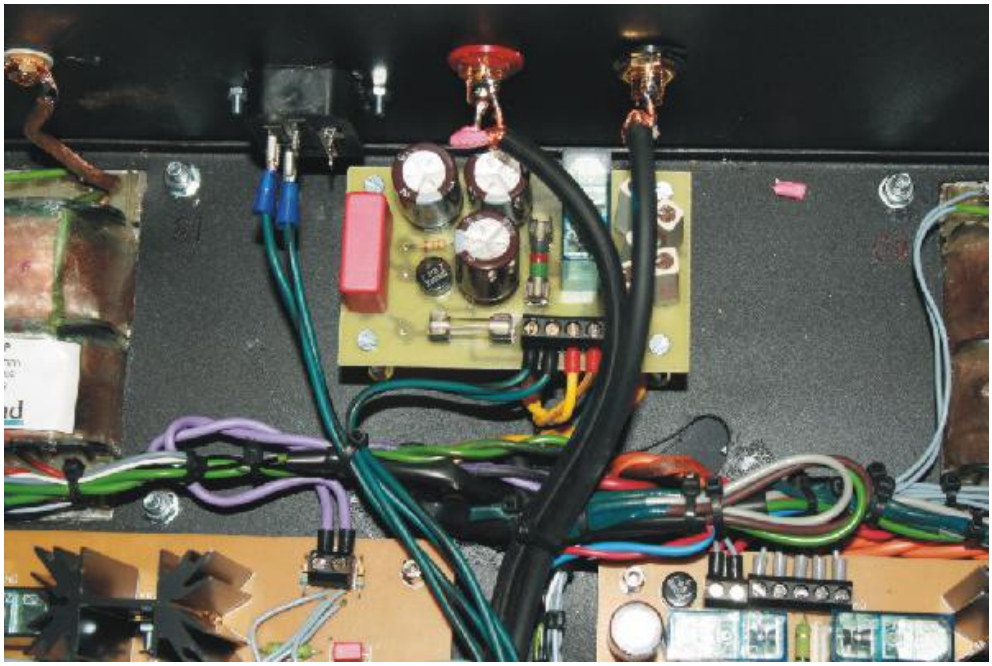


The toroidal core was sprayed black with a heat-resistant paint from the spray can because of the optics.
Unfortunately, the black hoods are not always available in the program. The 9V heating voltage was passed on with the 10V Rel. Control via a tap, so that a winding on the Nt. Saved.

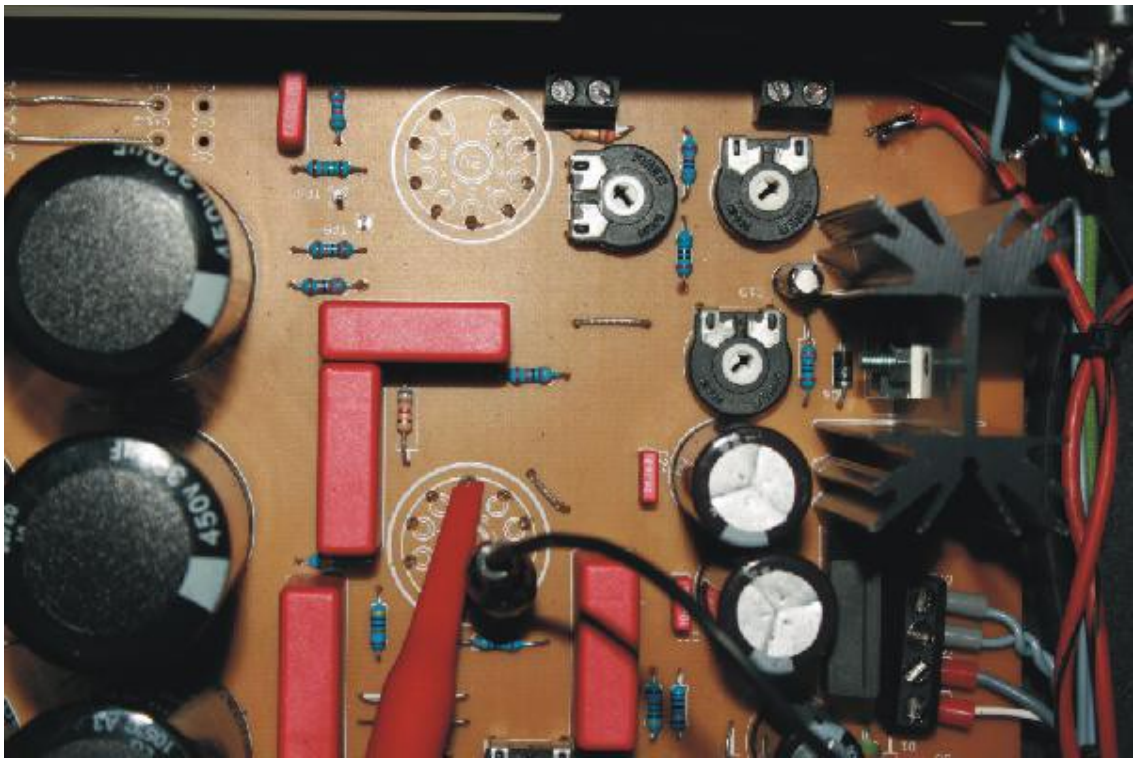
Install the lead to the switch for pentode operation. Then install everything and wire it to each other. As a craft pad, something soft to take to avoid scratches would be good.



Connection to the switches has been established.



The complete wiring including the inrush current limitation for the toroidal tape core can be seen here. As a result, the microfuse can then be selected to be smaller without melting through. In this way they achieve their effect more efficiently.
There are no interfering noises in the signal. The input sensitivity is higher than that of the EL 84 Amp



When calibrating, the measurement setup is installed first and only then is the mains voltage switched on. To protect yourself from the tension.The anode voltage and its currents are not exactly harmless.

The adjustment should only be carried out by a specialist with the appropriate training. With each procedure the mains plug should be disconnected and wait until the electrolytic capacitors have discharged.
Even if it takes longer, life is more valuable than the time saved. In any case, the tensions are deadly.

This means that the author assumes no responsibility for failure to respect and not comply with the regulations when working under voltage.
If possible, use protective equipment that complies with the regulations. Rubber gloves that are approved for work under tension. It is important to ensure that all parts of the housing are earthed, including the circuit boards and the AŰs, otherwise the negative feedback will not work.

There is no coupling capacitor at the entrance. It is advisable to install it. If you want to do without it, you have to be aware that in the event of a short circuit between the grid and the anode, the anode voltage is applied to the cynch socket and consequential damage to the HIFI chain or personal injury cannot be ruled out.

The tubes should also be protected from contact. Risk of
burns from the heat generated by the tubes.
The metal collar of the KT 88 is often connected to the cathode, they carry the cathode voltage and must not touch the housing! Protect from touch.

The author assumes no liability in any form!

Adjusting the assembly:

Once everything is installed and properly wired, let's start to check whether all voltages are present. Before all the negative grid bias is applied to pin 5 of the power tubes. Are all tensions present? The preamp tubes are plugged in first.

1) Insert the ECC 82 in the sockets
2) Set the measurement setup for pins 5 and 9 DC voltage to a good 6.3 V (R41)
3) Mute input Bypass R29 Set Tp. 6 against GND to 80 V or at your own request, taking into account the anode power loss

4) R22 in middle position. Plug in the end tubes. Transmitter with an 8 ohm 11 watt resistor. Bridge KT 88 and do a 0V adjustment using Tp. 1 + 3.

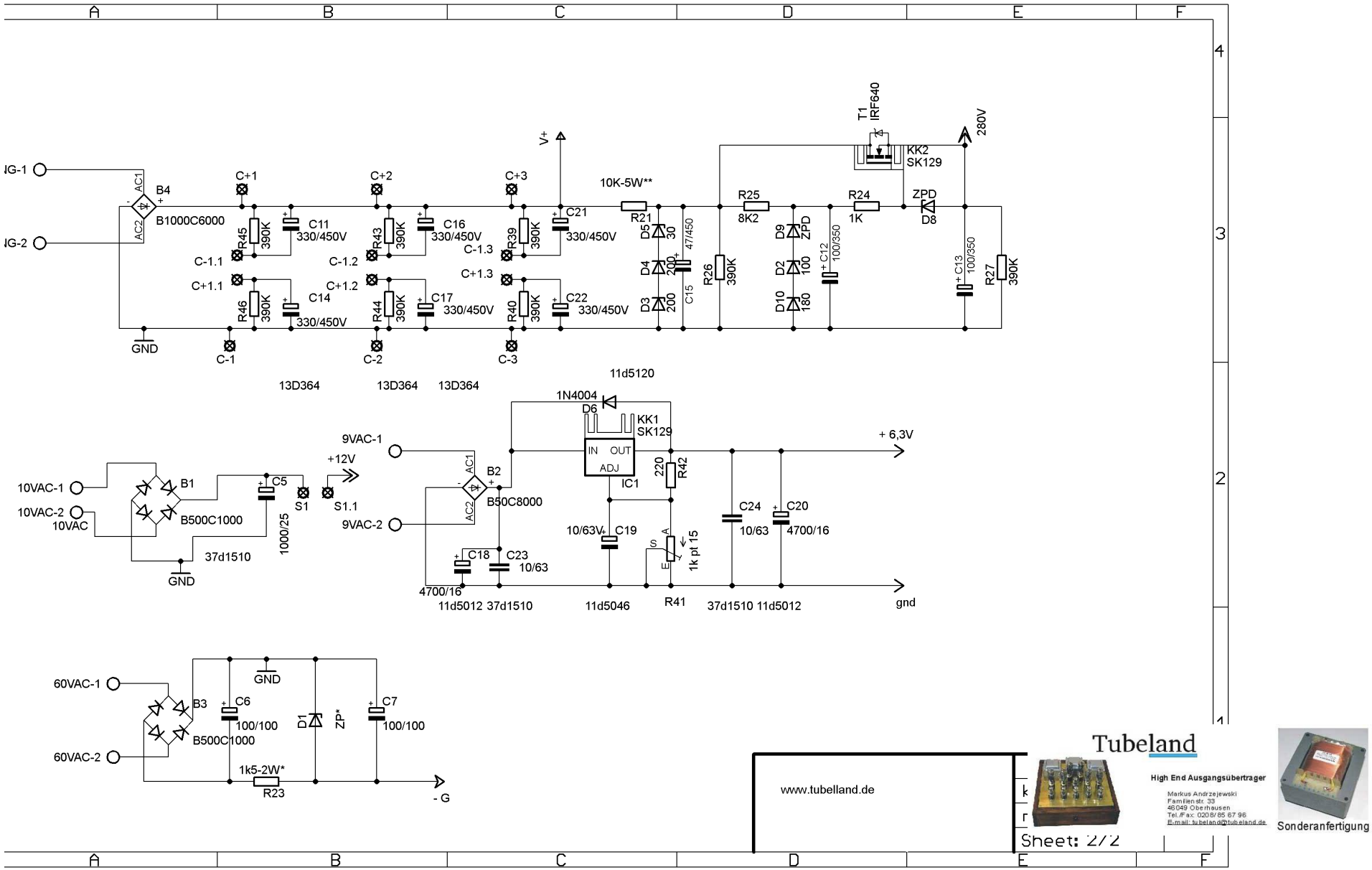
5) Desired anode current with R28 (approx. 0.6 V depending on the anode voltage and the tubes used. Take anode power loss into account!) Using Tp 1 and 2, set 30 min. Wait for items 4 and 5, repeat until the values remain stable, even in later operation check whether the set currents are stable

6) About TP. 8 against ground and TP 9 against ground with R47 set the symentry in the AC area of the measurement. So TP 8 and TP 9 both display the same voltages against ground. To help, use a sine wave signal from a frequency generator. If this is not available, you will definitely find a 1000Hz sine tone or similar frequencies on the Internet. Then connect the amp to the sound card in this case. But be careful that the protective resistors at the AÜ do not melt away. Finally check all values again.

The input voltage should not be higher than the output tubes can handle. Otherwise the end tubes will probably be overloaded and destroyed. Because the driver stage also gets a higher voltage swing. For this reason, the circuit was designed in such a way that the input signal for full control already has to be 725 mV as a minimum voltage, so the pre-amp should not have any problems with higher output voltages of + 3db or + 6db.

The semiconductors are screwed to the heat sink beforehand and only then soldered in. A little heat dissipation paste won't hurt either.

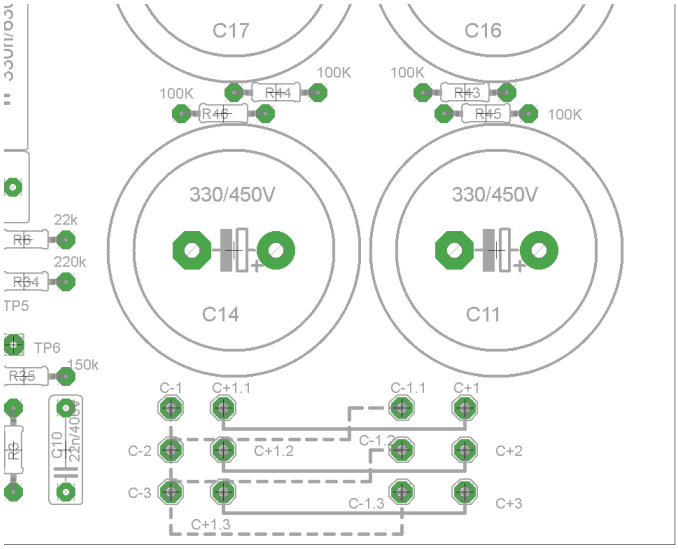
To the power supply:


A
B
C
D
E
F
1
2
3
4
IG-1
IG-2
B4
B1000C6000
AC1
AC2
C+1
C+2
C+3
V+
10K-5W**
R21
T1
IRF640
KK2
SK129
280V
R25
8K2
R24
1K
ZPD
D8
C11
330/450V
C16
330/450V
C21
330/450V
R45
390K
R43
390K
R39
390K
C-1.1
C-1.2
C-1.3
C+1.1
C+1.2
C+1.3
C14
330/450V
C17
330/450V
C22
330/450V
R46
390K
R44
390K
R40
390K
D5
30
D4
200
D3
200
47/450
C15
R26
390K
D9
ZPD
D2
100
D10
180
C12
100/350
C13
100/350
R27
390K
GND
C-1
C-2
C-3
13D364
13D364
13D364
11d5120
1N4004
D6
KK1
SK129
IN
OUT
ADJ
IC1
+ 6,3V
9VAC-1
9VAC-2
+12V
S1
S1.1
10VAC-1
10VAC-2
10VAC
B1
B500C1000
C5
1000/25
37d1510
B2
B50C8000
220
R42
10/63V
C19
C18
4700/16
C23
10/63
C24
10/63
C20
4700/16
1k pt 15
R41
11d5012 37d1510
11d5046
37d1510 11d5012
gnd
60VAC-1
60VAC-2
B3
B500C1000
C6
100/100
D1
ZP*
C7
100/100
1k5-2W*
R23
- G
www.tubelland.de
Tubeland
High End Ausgangsübertrager
Markus Andrzejewski
Familienstr. 33
46049 Oberhausen
Tel./Fax: 0208/85 67 96
E-mail: tubeland@tubeland.de
Sheet: 2/2
Sonderanfertigung

As you can see on the circuit diagram, C11, C16,
C21, C14, C17, C22 are not completely connected!

The detailed view of the circuit board shows how it is wired.

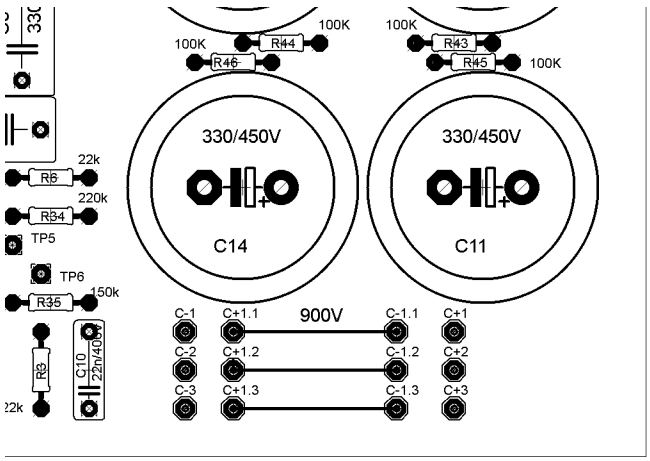
There are two options for selecting the maximum anode voltage
(operation up to 450V or up to max. 900V)



C-1 is connected to C-1.1
(dashed line)

C + 1.1 is connected to C + 1
(solid line), etc.

This option is used for
voltages up to max. 450V !!



This is how the 900V option is wired! The
free pins remain unused.

In general, it is advisable to stay at least 10% below the voltage specifications of the capacitors.

The voltage is limited to a maximum of 430V via R21 and the Z diodes D 3,4,5 in order to prevent the destruction of C15. As soon as the tubes are heated, this will vary depending on the operating voltage. So that this can also be below 430V! This is also completely normal. It should just not be below 300V. Otherwise the following stabilizer circuit would not work properly! If necessary, R 21 will then be adapted.

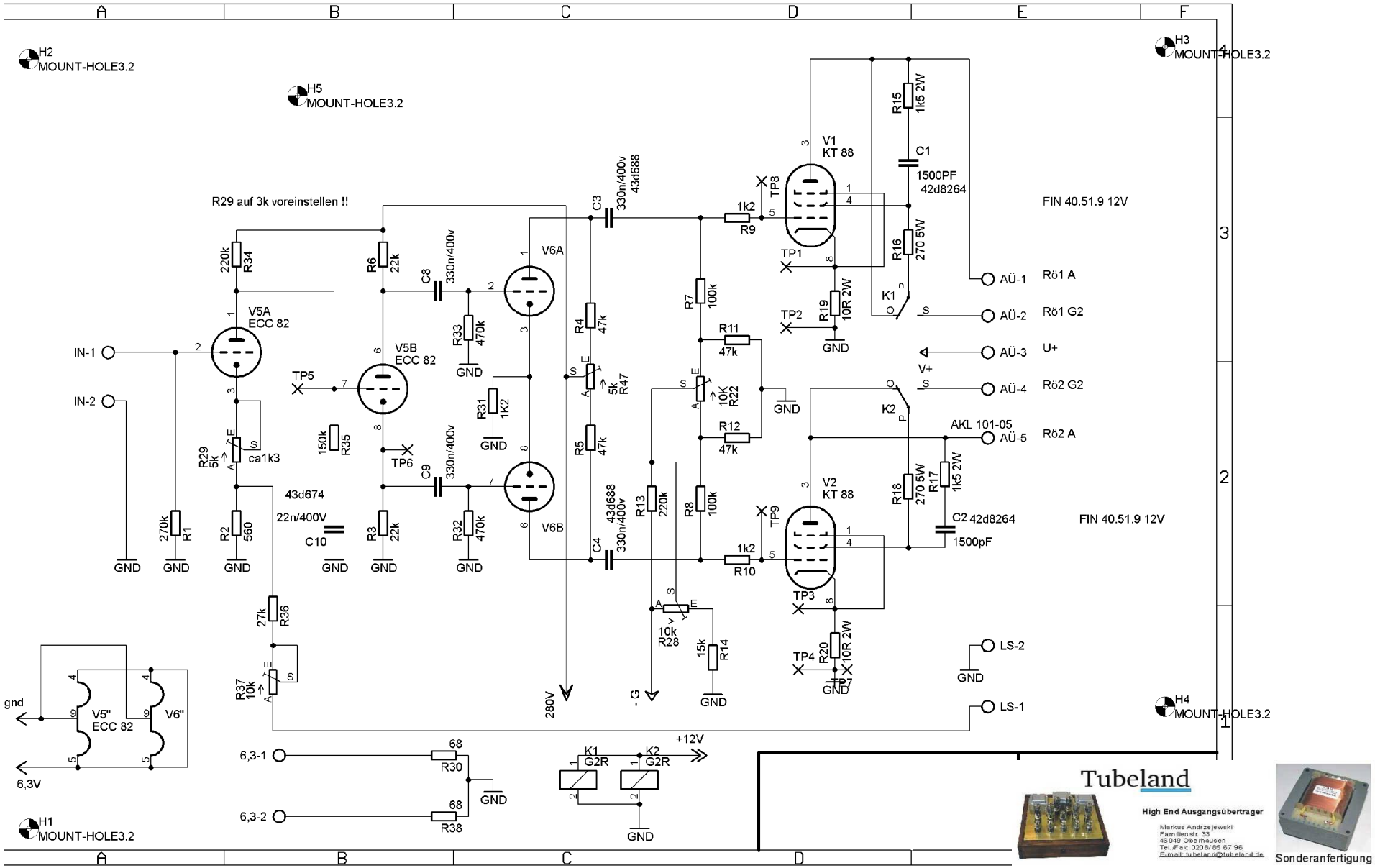
If, for whatever reason, you need a different anode voltage for the pre-stages, you can determine this via ZD2,9,10.

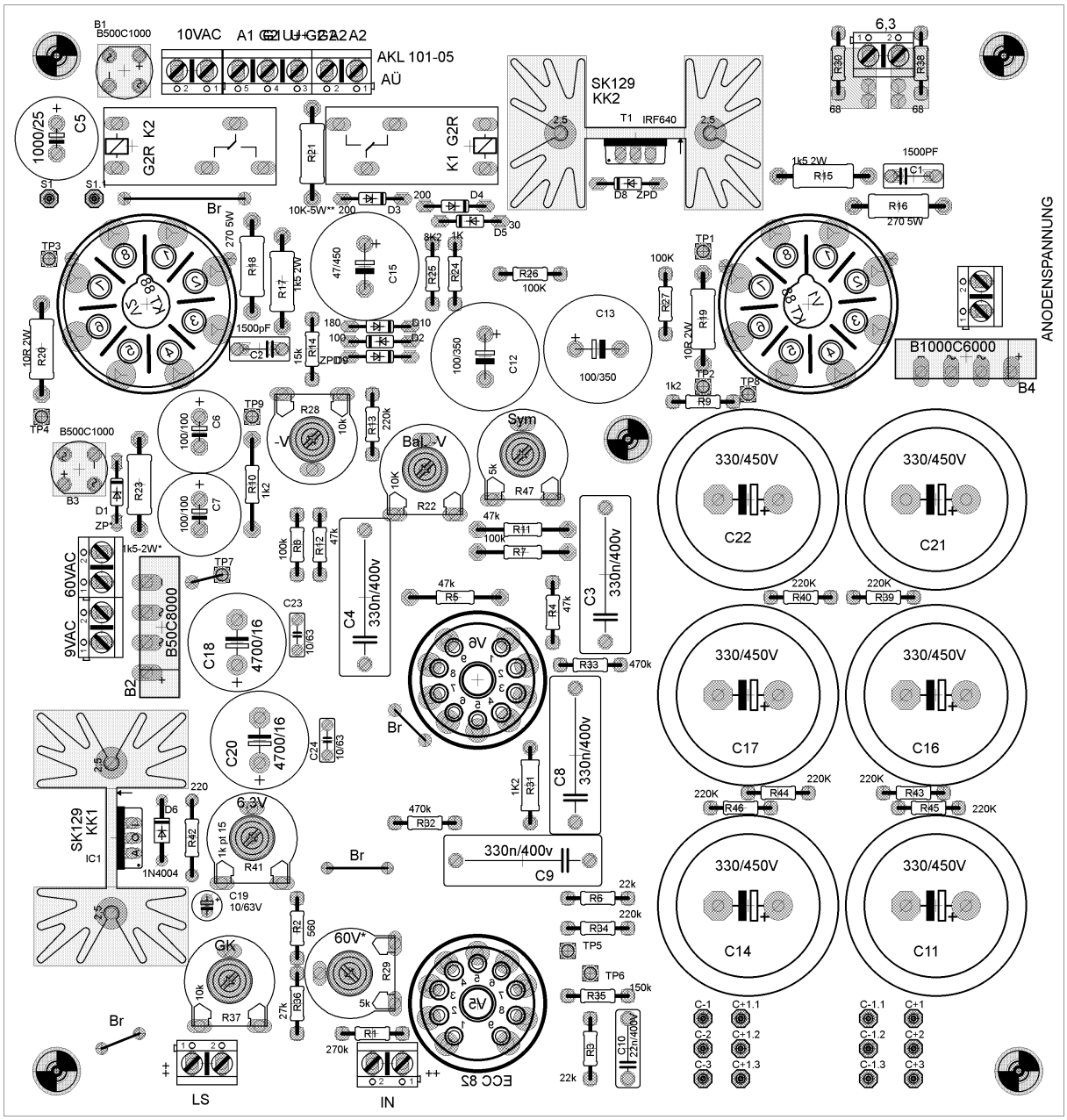
To the toroidal transformer:

Was a type used with the following data:
0-247-282-353-400-V 1.1A
6.3V 5A
6.3V 5A
9V 2A (for the DC heating and the rel. Control) 9V 2A
(for the DC heating and the rel. Control) 0-60-80V
100mA
0-60-80V 100mA
This transformer is designed for a stereo power
amplifier. For mono blocks the total output is halved.
Taps were also inserted here in order to be able to use it universally. We use the 353V tap in the circuit. The taps that are not required are then best isolated with shrink tubing. For the grid preload we take 60V, the taps should not be twisted and soldered. This must be made up for!

The output stage:

Why the power amplifier sounds so excellent may be due to the fact that there are only a few capacitors in the signal path.
Which anode voltage, quiescent currents, which tubes can be set,
please refer to the system!
In the closed state, the pentode mode is activated via S1 - S1.1. I have an LED soldered to the switch of a channel with it then lights up when the switch is open and gets the
Power supply via the Rel. Do not worry, it does not attract. The current is too low.


A
B
C
D
E
F
H2 MOUNT-HOLE3.2
H5 MOUNT-HOLE3.2
H3 MOUNT-HOLE3.2
H4 MOUNT-HOLE3.2
H1 MOUNT-HOLE3.2
R29 auf 3k voreinstellen !!
FIN 40.51.9 12V
IN-1
IN-2
V5A ECC 82
V5B ECC 82
V6A
V6B
V1 KT 88
V2 KT 88
V5" ECC 82
V6"
ca1k3
43d674
22n/400V
AKL 101-05
AÜ-1 Rö1 A
AÜ-2 Rö1 G2
AÜ-3 U+
AÜ-4 Rö2 G2
AÜ-5 Rö2 A
LS-2
LS-1
280V
-G
+12V
gnd
6,3V
6,3-1
6,3-2
K1 G2R
K2 G2R
Tubeland
High End Ausgangsübertrager
Markus Andrzejewski
Familienstr. 33
46049 Oberhausen
Tel./Fax: 0208/85 67 96
E-mail: tubeland@tubeland.de
Sonderanfertigung



TP7 is not fitted, but a wire bridge is soldered in to connect DC F to GND.

DND to the central point: Here on the bridge a cable is soldered which then leads to the central ground point. R16 + R 18 Are with the KT 88 270R 5W Please take the values from the parts list!

Parts list as of December 1st, 2011

Pc.	value	Letter no	
8th		08f140	TP1, TP2, TP3, TP4, TP5, TP6, TP8, TP9 R24
1	1K	1/4 W metal	
3	1k2	1/4 W metal	R9, R10, R 31
2	270R	5W 39e872	R16, R18
1	8K2	1 W metal	R25
1	15k	1/4 W metal	R14

2	22k	1/4 W metal	R3, R6
1	27k	1/4 W metal	R36
4th	47k	1/4 W metal	R4, R5, R11, R12
2	68R	1/4 W metal	R30, R38
2	100K	1/4 W metal	R7, R8
1	150k	1/4 W metal	R35
1	220R	1/4 W metal	R42
2	220K	1/4 W metal	R13, R34
8th	390K	0.6W metal	R39, R40, R43, R44, R45, R46, R26, R27
1	270k	1/4 W metal	R1
2	470k	1/4 W metal	R32, R33
1	560R	1/4 W metal	R2
2	4700/16	11D5012	C18, C20
1	1000/35	11D5028	C5
1	10 / 63V	11D5046	C19
2	100/350	11D5094	C12, C13
1	47/450	11D5120	C15
2	100/160	12D5232	C6, C7
6th	330 / 450V	13d364	C11, C14, C16, C17, C21, C22
1	1N4004	1N4004	D6
1	LM350	41s4410	IC1
1	1500PF	42D8264	C1, C2
1	22n / 400V	43D674	C10
4th	330n / 400v	43D688	C3, C4, C8, C9
2	SK129	65 b 4834	KK1, KK2
5		akl101-2	
1		akl101-4	
1		akl101-5	
Pc.	value	Let. No	
2	ECC 82	ECC82-P	V5 V6
1	ZP *	not applicable	D1
2	ZPD	not applicable	D9
2	LSL9279	Version	
2	LSL8280	Version	
2	G2R	FIN 40.51.9 12V	K1, K2
1	IRF640	IRF640	T1
1	B1000C6000KBU6M		B4
1	B50C8000 KBU8A		B2
2	KT 88 KT 88 EH		V1, V2
1	PCB KT 88 PP V1,4 100/63		
2	MKS-2-10N		C23, C24
1	1k pt 15 PT 15-1K		R41
3	10k PT 15-L 10K		R28, R37, R22
2	5k PT 15-L 5K		R29, R47
2	1k5 2W 2W metal		R15, R17
1	1k5-2W * 2W metal		R23
2	10R 2W 2W metal		R19, R20
1	10K-5W ** 5W axial		R21
1	30ZD		D5
1	100ZD		D2
1	180ZD		D10
2	200ZD		D3, D4
1	ZD 13	ZD	D8
2	B500C1000		B1, B3

Enclosed in Appendix N in which the data can be found.

The list can be expanded or changed. The current version is located at www.tubeland.de

Appendix N

tube	Output power	Circuit AÜ impedance	U +	I.	R16 / R18 G1 -U
EL 34	36 W	Pentode 3k8	350V	35 mA	470R - 32
EL 34	44 W	Pentode 2k8	375V	35 mA	470R - 32
EL 34	45 W	Pentode 4k	400V	30 mA	1K - 38
EL 34	55 W	Pentode 3k4	425V	30 mA	1K - 38
EL 34	58 W	Pentode 5k	475V	30 mA	750 R - 36
EL 34	70 W	Pentode 4k	500V	30 mA	750 R - 36
EL 34	90 W	Pentode 11k	750V	25 mA	750 R - 39
EL 34	100 W	Pentode 11k	800V	25 mA	750 R - 39
EL 34	15.5 W	Triode 5 K	375 V		
6L6	14.5 W	Pentode 5K	250V	60 mA	- 16
6L6	26.5 W	Pentode 6K6	360V	44 mA	- 22.5
6L6	47 W.	Pentode 3k8	360V		- 22.5
6L6	55 W	Pentode 5k6	450V		- 37
6L6	1.4 W	Triode 5K	250V	40 mA	- 20th
6550	77 W	Pentode 3K5	450V		- 29.5
6550	100 W	Pentode 5K	600V		- 32.5
KT 66	4.5 W	Triode 2k5	270V		- 19th
KT 66	14.5 W	Triode 5k	440V		- 38
KT 66	50 W	Pentode 8K	525V	35 mA	- 67
KT 66	50 W	Pentode 5k	475V		- 80
KT 77	34 W.	Pentode 6k	430V		22R
KT 77	45 W	Pentode 4k5	400V		22R - 31
KT 77	67 W	Pentode 5k5	500V		22R - 43
KT 77	72 W.	Pentode 9k	600V		22R - 56
KT 77	18 W	Triode 5K	430V		22R - 30
KT 88	50 W	Pentode 6k	500V		270R - 50
KT 88	100 W	Pentode 4k5	560V		270R - 80
KT 88	15 W	Triode 4k	400V		270R - 38
KT 88	37 W	Triode 4k	485V		270R - 48
KT 88	30 W	Pentode 5K	375V		270R - 35
KT 88	70W	Pentode 4K	485V		270R - 59
KT 90	Unfortunately no data available at the moment				
KT 100	Unfortunately no data available at the moment				

As you can see there are a few options. I decided on the KT 88 485V DC under load and an AÜ with 4K for the EL 34 50W from my program. Who did his service well. I am satisfied with it. In which mode you want to run the power amplifier you can freely choose.

I have collected the data from tables and here I almost exclude a guarantee of correctness despite careful revision.

And another thing. I would allow the circuit to have a switch-on delay in any case! When switching on the amp, the machine could fly out. In addition, the fuses would not optimally protect the transformer

Circuit board for switch-on delay is treated separately.

Wiring diagram:

As you can see, there is also a small circuit board that is also available in the shop. This ensures that the inrush current is far lower. Only now does the fine fuse also show its effect. Since this turns out to be far less with the help of the small circuit. Without the auxiliary circuit it could happen that the 16A house machine flies out. And of course the protective fuse would be much too big and would hardly protect the toroid from destruction properly. That's why I decided to put on a series. The fuse for the toroidal tape core is on the PCB. As indicated on the wiring diagram, a central ground point is selected. The protective conductor from the network also comes on here. (The housing MUST also be earthed!!!)

Negative feedback:
To make sure that it is really coupled against. Use the following test:

First let the power amplifier run WITHOUT negative feedback.
A sine wave signal or something from a CD can serve as the audio source. The speakers are connected. Setting the output level to room volume is sufficient. The GK is switched on during operation.

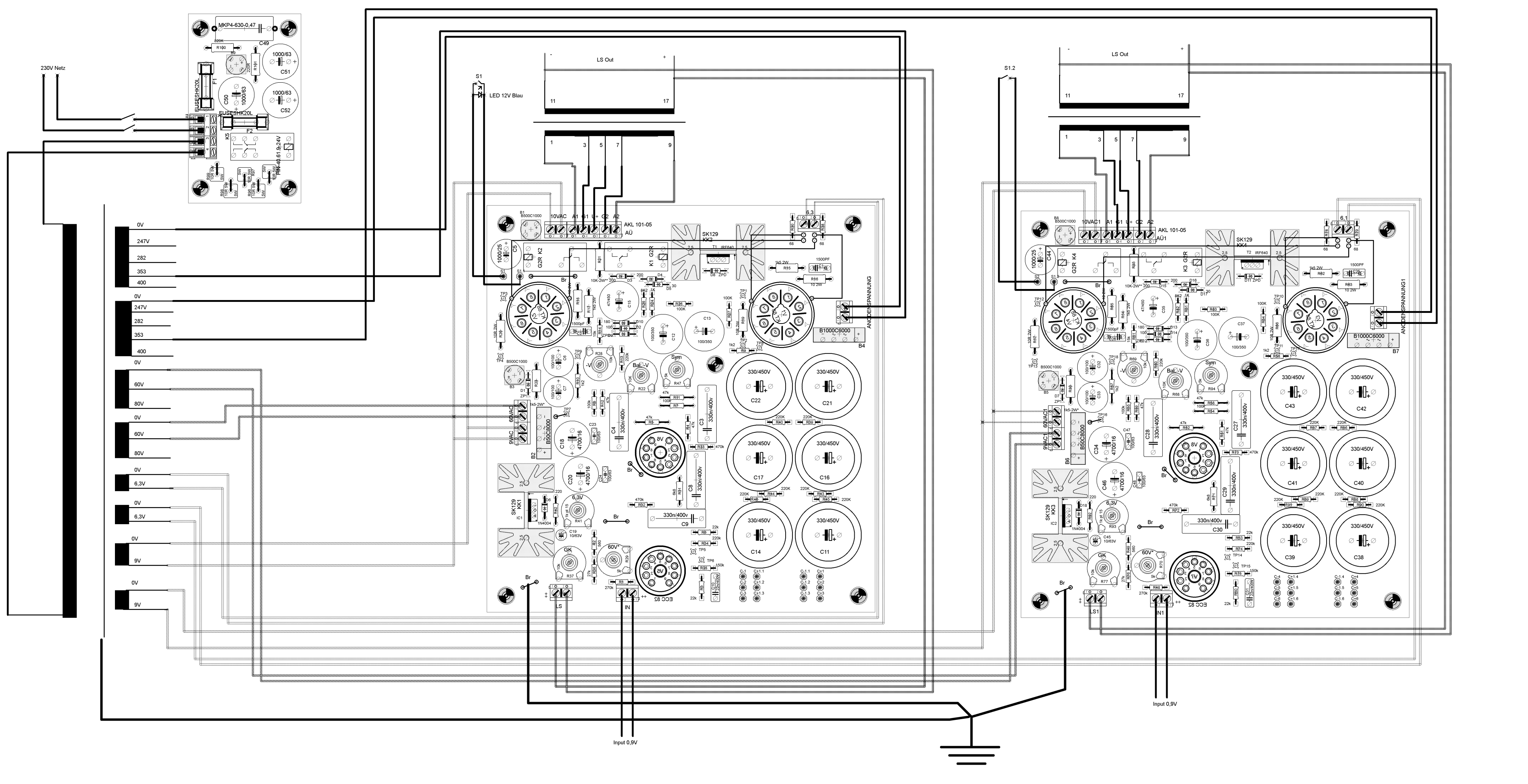
Pay attention to the difference in volume.
Is the music quieter now than before? Was the GK wired correctly. The amp would then be ready.

Should the music playback not be quieter but louder. Then let's talk about positive feedback!

In our case, the coupling is not desired.

Countermeasures:
Then swap output 11 and 17 on the AÜ. The counter is now coupled as desired.

GND is always LS - and the soldering lug that is also used for the GK is LS +



230V Netz
MKP4-630-0,47
FUSESHK20L
F1
C50
1000/63
C51
C52
S1
LED 12V Blau
S1.2
LS Out
AKL 101-05
ANODENSPANNUNG
ANODENSPANNUNG1
B1000C6000
B50C8000
SK129
ECC 85
Input 0,9V

The amplifier works with high voltages which can be life threatening if the general regulations are not followed. The author assumes no responsibility for damage to property or personal injury resulting from the reproduction of the device described above. Use is at your own risk. Observe all safety rules! Tubeland assumes no liability in any way. If necessary, wear out an insurance policy and seek out an authorized specialist.

I am happy to publish your project to build this amp yourself on my website. For suggestions, changes or for photos to build your own amp, I would be happy.

Technical specifications:
Anode voltage under load 485V
Tubes used: 2 * ECC 82 JJ 2 * KT 88 EH
transformer 2 * EL 34 4K 8R

Triode operation:
Power 36W
Input sensitivity 0.931V at full scale
F gang measured at 20 watts 12.5 Hz 0 db, 35 kHz 0 db 54 kHz - 3 db
gain factor 25.2 db

Pentode operation:
Power 70 W
Input sensitivity 0.947 V at full level
F gang at 35 watts Measured 15 Hz - 0.2 db, 35 kHz 0db, 45 - 3db
F output at 70 watts Measured 15 Hz - 1.6 db, 20 Hz - 0.4 db, 25 kHz - 3db
Gain factor 28 db

Interference voltage 0.9mV at 8 ohms

Errors and changes excepted!

Tubeland
Markus Andrzejewski
Familienstrasse 33
46049 Oberhausen, Germany