Technical manual

the Nishiki Amplifier, a DIY Hybrid Amplifier using Tubes and modern components like LAPT Power Transistors

Includes:
Full details 'the Nishiki Amp'
Compound driver circuit
Quasi-complementary power stage
Circuit board layout
Additional Long-Tail based driver stage
Bridge mode suggestion
Datasheets

The Nishiki Amplifier

BY WIM DE HAAN [NL]

" The Nishiki Amp full documentation"

- Tube driver stage
- Transistor output stage
- Low cost
- High performance sound
- Flexibility in component choice

The Nishiki Amplifier

A Tube based Power Transistor Amplifier

BY WIM DE HAAN [NL]

The Nishiki Amplifier

1.1 Introduction

In my opinion a hybrid amplifier is in many ways the ideal amplifier; it combines the sonically favorable tubes and modern semiconductors to drive low impedance loudspeakers.

Design goals of this amplifier project are low cost, low component count, high performance sound, good specs, reliability and flexibility in use of different components.

Using tubes we are able to come up with a less complex design yielding low component count, rather low cost, exceptional sound and good specs. However if we would choose to build an all tubes based amplifier, it is almost mandatory to use an output transformer to drive the loudspeakers. This transformer will make the overall cost high, far too high for a project like this.

So why not use modern semiconductors like a power transistor to replace such a high cost component?

Project can be divided in two parts, the driverstage and the powerstage (a.k.a. currentstage). Main part of this project is the currentstage; this section includes a circuit board. As driver stage a few tubes / circuits possibilities are mentioned, however you could use other tube circuitry as well. Driverstage should be able to supply an output voltage of approx. 20 Vrms into a load of 10K ohm.

As many DIY projects I choose a name for this design as well; because the overall result can be described as refined and colorful I named the amplifier *the Nishiki Amplifier*.

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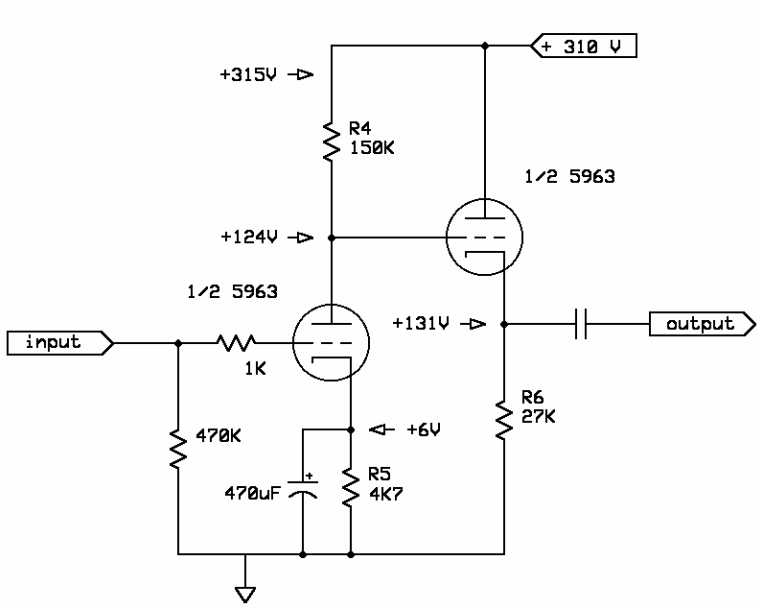
1.2 Driver / input stage

When starting this project a 5965 tube was chosen. I bought several new 5965 RCA's a long time ago, this for just 2 euros each, though this tube was not used before in some kind of project of mine. This 9-pin noval tube is a quite interesting. Its pin setting is conform the ECC83 family and its mu is as high as 47 and the plate resistance Rp is as low as an ECC82/6SN7 tube. So using a single 5965 we could come up with a low component count input / driver circuit.

Fig. 2 Driver stage using the 5963 / ECC82



" A compound amplifier is chosen as driver stage for best results and simplicity "

In a former hybrid amplifier Power MosFets and as driver a paralleled 5687 tube was used, resulting in excellent sound and specs. However this new design I wanted to use power transistors instead of MosFets; I found out that the driver stage needed redesigning. Meaning?

At first the sections of the 5965 were used in parallel as a straightforward grounded cathode amplifier, this resulting in a relative low output impedance of about 3K. Building the first prototype high distortion figures were noticed, the Hewlett Packard distortion analyzer showed up to 3 % distortion at full swing with load. I assume the drive signal is too much stressed by the relative low impedance transistor outputcircuit. These figures don't say all about the sound quality, but this is unacceptable. Distortion was mainly 2nd harmonics.

So a combination of a common and proven grounded cathode amplifier with a direct-coupled cathode follower (a.k.a. compound amplifier) was tried; in this way gain and low impedance is combined using one single tube (fig.2).

The result was very promising. Measuring the prototype the distortion was as low as 0.35 % at 1 watt and this with no overall feedback.
A very acceptable figure also because frequency range measured far above 100 kHz and square waves looked just great. This would be the circuit to go for.
Measuring the amplifier using this tube and the transistor output stage I noticed that the distortion progressively raised with the output power. Lowering the anode resistor to 33K and readjusting the bias voltage didn't improve the situation, it got even worse. Changing tubes from left to right and visa versa or for brand new ones didn't change the situation. Attempt to replace the 27K cathode resistor with a transistor based current source didn't help either, improvement was there but still not convincing to me; using +400VDC and a 68K resistor made the best out of worse, but distortion was still too high. The 5965 seemed not the perfect choice in this application/design. Also because overall sound using this tube was very disappointing.

Driver / input stage

In fig. 3 is shown how the 5965 is used with 10 dB feedback; distortion and sensitivity are acceptable now. In case you prefer the 5965 over the ECC82 and ECC88 I feel you should go for the feedback option.
In this circuit with feedback the amount of feedback is dependable also on the output impedance of the preamp which is used, this because it is in series with the 22K. Unfortunately I don't have any values for different impedances. The value of 350K that is given for approx. 10 dB feedback refers to a low output impedance preamp of approx. 600 ohm or less.

The ECC82 and the ECC88 were tested as well, with these tubes I am familiar and after some fine-tuning trying different values for anode and cathode resistors, I noticed already that using these tubes the amplifier yield much lower distortion figures at all levels.

The ECC88 showed its quality, at 60 watt output only a 0.5 % distortion was measured. You might like to check out the section specifications for the overall results.

" The 5965 tube seemed not the perfect choice in this design "

and is an ECC82 look-a-like, a friend gave some to me to experiment with.

It's worth to try first the ECC82 and the ECC88 next. And not to compare the specs, but the sound. It is interesting how the overall sound and character of the amplifier changes by changing the driver tube. Changes are made easily; just one resistor per channel and the heater wire has to be rewired. My favorite is not clear, I can live with both of them, its all matter of taste. I feel the ECC82 gives a more balanced musically sound and the ECC88 a more technical loudness curved sound.

A Sylvania 6189 was used for the ECC82 and an E88CC by JJ Electronic for the ECC88. The Russian 6N1P is tested as well and I feel its sonic behavior is a combination of the ECC82 and ECC88.

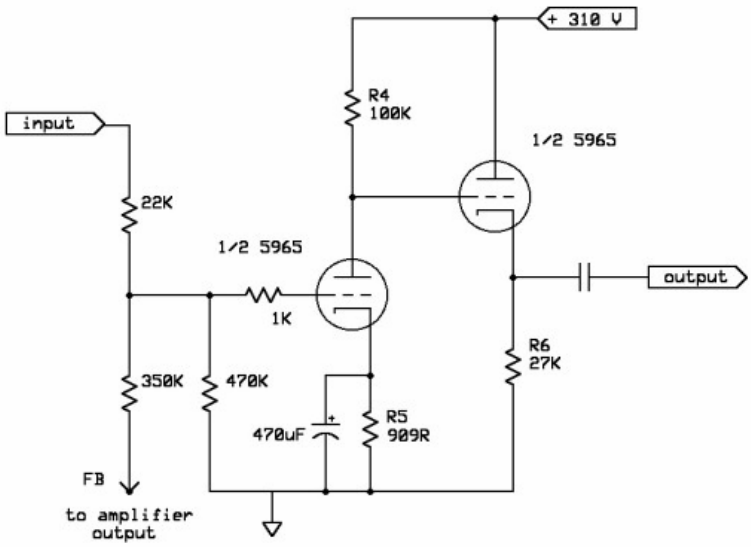


Fig.3 Driver stage using the 5965 and 10 dB feedback

Several driver tubes were used in the prototype. A list with tubes and its specific component value is included (fig. 5). I recommend to start the project with an ECC82, this will give the best balance in specs and sound. Finally I did go for a 5963 tube. The 5963 is a computer tube

Note regarding the 5965 small signal tube:
a recent design showed that the 5965 is able to perform and sound very well; anode current has to be at least 3 mA to 4 mA, this at U_A 170 V DC or so.

Driver / input stage

The 6SN7 equals the ECC82 in almost every aspect and it would be a good choice for this project, however I didn't try this tube; it uses an 8-pin octal socket.

A compound circuit using the ECL82 tube would also be an interesting approach; this tube contains a high mu triode section and a power pentode section, I want to try this tube as well someday.

Because of the relative low input impedance of approx. 10K of the transistor power stage, the coupling capacitors should be at least 4.7 µF. I feel the low cut-off frequency of the amplifier should be around 3 Hz. Using a 1 µF cut-off frequency will be on order of 15 Hz and I feel this is too high. In the prototype I used mainly a 1 µF and changed it in a later stadium to the higher value.

As coupling cap an audio grade ClarityCap capacitor by ICW is chosen over others. B&W is using ClarityCap's in their prestigious Nautilus series. The used SA type gives very good results and compared to other audio grade capacitors they are rather low priced, you might like to check out the e-speakers.com website for pricing.

" ClarityCap SA - type capacitors were chosen over other coupling capacitors "

The ClarityCap capacitors are hand wound using a 10µm (630Vdc) rated polypropylene film. Following a special heat treatment cycle, insulated copper terminals are hand soldered to give the best possible connection. The inherently low dissipation and dielectric absorption factors of polypropylene allied with excellent mechanical stability results in an extremely detailed sonic performance. The construction also results in a low self-inductance and ESR and the devices are highly stable with regard to temperature and frequency.

If you like to keep the amplifier to a minimum cost as I did at project start, you should go for an industrial type film capacitor as the Epcos B32524 series. Epcos is known as Siemens before. Capacitor used is a 4.7 µF rated at 250V DC. Capacitor is available at Farnell.com (order code 400-2179) and priced at only 1.40 Euro each, this including VAT. Though I feel it's worth to invest a little more, using the ClarityCap the overall performance like soundstage and resolution will improve. But again, I feel this Epcos capacitor will do just fine! This cap makes a good budget choice along with the Russian 6N1P tube; I am very pleased with this duo!
Of course you are free to choose any coupling capacitor you like. Please keep in mind the minimal DC voltage of 400V DC; a 250V DC would work safely and could be used as well.

If you want to give the amplifier an exclusive (and far more expensive) look, you could go for the Jupiter Beeswax paper coupling capacitors. These caps are large and expensive and are extraordinary in design. These capacitors are using beeswax and for this reason you can't use them above 43 degrees Celsius, what about this. Though as mentioned they don't come cheap, the four coupling capacitors together are already more expansive than the basic amplifier itself. List price for a 2.2 µF (which was used for evaluation) is about 30 US dollars each. Again, if you just want to enjoy your CD selection, you should go for the 6N1P / Epcos duo.

Switching tubes and coupling caps you can tailor the amp to your personal sonic taste.

Fig. 4 Coupling capacitors a dilemma? Or?

Component values and voltages circuit alternatives

Tube alternatives for driver circuit				
Tube	R anode [R4] gnd cathode amp	R cathode [R5] gnd cathode amp	R cathode [R6] cathode follower	Gain
ECC82	150K	4K7	27K	21 dB
5963	150K	4K7	27K	20 dB
5965	100K	909 ohm	27K	30 dB
5965 10 dB feedback	100K	909 ohm	27K	20 dB
ECC88	150K	2K7	27K	27 dB
6N1P	150K	1K8	27K	28 dB

" You might like to check out the section specifications for distortion figures "

Driver circuit voltages *				
Tube	U psu main DC power supply	U anode [R4] gnd cathode amp	U cathode [R5] gnd cathode amp	U cathode [R6] cathode follower
ECC82	317 V	118 V	6.1 V	126 V
5963	317 V	124 V	6.0 V	131 V
5965	310 V	104 V	1.9 V	109 V
ECC88	317 V	114 V	3.7 V	117 V
6N1P	306 V	118 V	2.3 V	120 V

* notice: actually measured values related to ground,
all measurements approx. values; depends on varieties in tubes and power supply components

1.3 Output stage

As output stage we could use transistors or MosFets. In a former project so-called IGBTs were used, but these are out-of-production now and need a special design approach so these are not a very good choice.

In former hybrid projects Power MosFets as current output stage were used. I noticed that the 2SK1058 family and the BUZ900 family give a different sonically result. Both are expensive if you compare them to power transistors.

Some time ago I did repair a Proton D1200 power amplifier, it uses 8 power transistors per channel and because I had some left over I decided to use these power transistors for the Nishiki amplifier. The Proton uses the high performance multi-emitter LAPT devices as manufactured by Sanken.

As output stage a so-called Quasi-Complementary Output Stage (fig. 6) is chosen over other configurations, so not the more common complementary emitter follower was chosen.
I noticed that solid-state designs using two identical output devices, so a N and a N output device, sounded great. Just a coincidence?
I can recall a contest in the Japanese MJ magazine; beautiful 845, 811 and state-of-the-art transistor designs. First price winner? This was a low-powered transistor amplifier and yes, using an N - N output configuration. In a former project the LM3875 power device was used in a 2-way active loudspeaker, this with great success. The LM3875 was chosen for its N-N output configuration as well.

" NPN & PNP power transistors are only really as equivalent as a man and a woman of the same weight and height "

Amplifier manufacturer Naim uses this topology in all of their designs and their philosophy is N only. To quote Julian Vereker of Naim Audio: 'NPN and PNP power transistors are only really as equivalent as a man and a woman of the same weight and height'.

In the early years complementary P channel transistors were expensive and did not equal the characteristics of an N channel device. These days' complementary transistors are very common and prizes of P channel transistor are as low as the N channel ones. Though as mentioned, I do believe the N only output stage is the better choice and will give better sonic results.

As mentioned the widely used high performance multi emitter LAPT power devices by Sanken, the 2SC3263, were chosen. I bought original devices for less than 4 euros each. However you could choose for the 2SC3519/A, 2SC5200, MJL3281A or for example the MJ15003 as well. The 2SC3263, the 2SC3519/A and the 2SC3284 are identical devices in TO3-P packages, all made by Sanken, only the voltage ratings differ.

As driver of the output devices audio grade driver transistors by Toshiba, the 2SA940 and the 2SC2073, were chosen. These devices sell only for something like 1,50 Euro each and these are widely used in many designs, I chose them also because I have easy access to these devices. You could use the MJE15030 and MJE15031 as well; this should work just fine.

A 392 ohm resistor is added in series with the base of the driver transistor, this to enhance stability. I found using a low Zo wave generator as driver source, instead of the tube driver circuit, that the output stage oscillated; using this 392 ohm the current section is stable in all circumstance. For this reason also small resistors in order of 2.2 ohm are placed in series with the bases of the output devices.

The drivers should be using some kind of heatsink; the circuit board is made in such way that the drivers are mounted on the main heatsink. If you don't use the circuit board you want to give them each a small heatsink, a 6 to 8°C/W type will do.

All transistors should be mounted in such way that they are electrically isolated from the main heatsink and from each other; use dedicated isolation pads and isolated rings.

The Baxandall diode D1 is added to create a better output symmetry. I chose for the 1N5060, but you could use either a 1N4001 or 1N4148 as well.

For thermal compensation of the output transistors a darlington transistor is used, this transistor Q1 should be mounted near the output devices on the main heatsink. Using this little circuit the amplifier is very stable at all levels.
Bias current of the output stage is set to 140 mA using P1, with slider P1 to the collector of Q1 you will have minimal bias. You should measure about 30 mV across one of the emitter resistors.
Using P2 we can set the DC output voltage of

Output stage

the amplifier to zero, any value within + and - 50 mV is acceptable. Adjustments should be done without any load attached and should also be repeated after some period of time after the amplifier is switched on.

Distortion of the transistor output circuit is not measurable with the used measuring equipment; the tube driver circuit causes the distortion of the overall amplifier. The two RC combinations (R17/C7 and R18/C9) are added because without these some hum was noticeable at the output, using these extra filters it is really quiet.

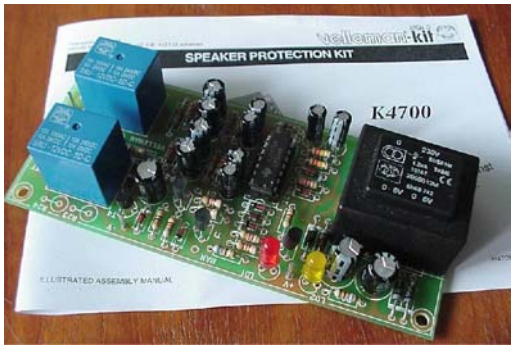
R1 and C 1 form a low pass filter section and in this way amplifier has roll-of at 105 kHz (at -1 dB). I feel this makes the amplifier more reliable and makes the amplifier less critical in use.

To make this amplifier design more versatile you might add a 4 µH coil in series with the output of the amplifier; this output conductor could be 16 turns of 0.75 mm enameled copper wire wound on a 6.3 mm drill bit. A 15 ohm 2 watt resistor should be located within the coil.

You could (and should?) consider the use of a DC protection and power-up circuit. Kits are offered by several manufactures.

" You might use the Velleman K4700 speaker protection kit for safety reasons "

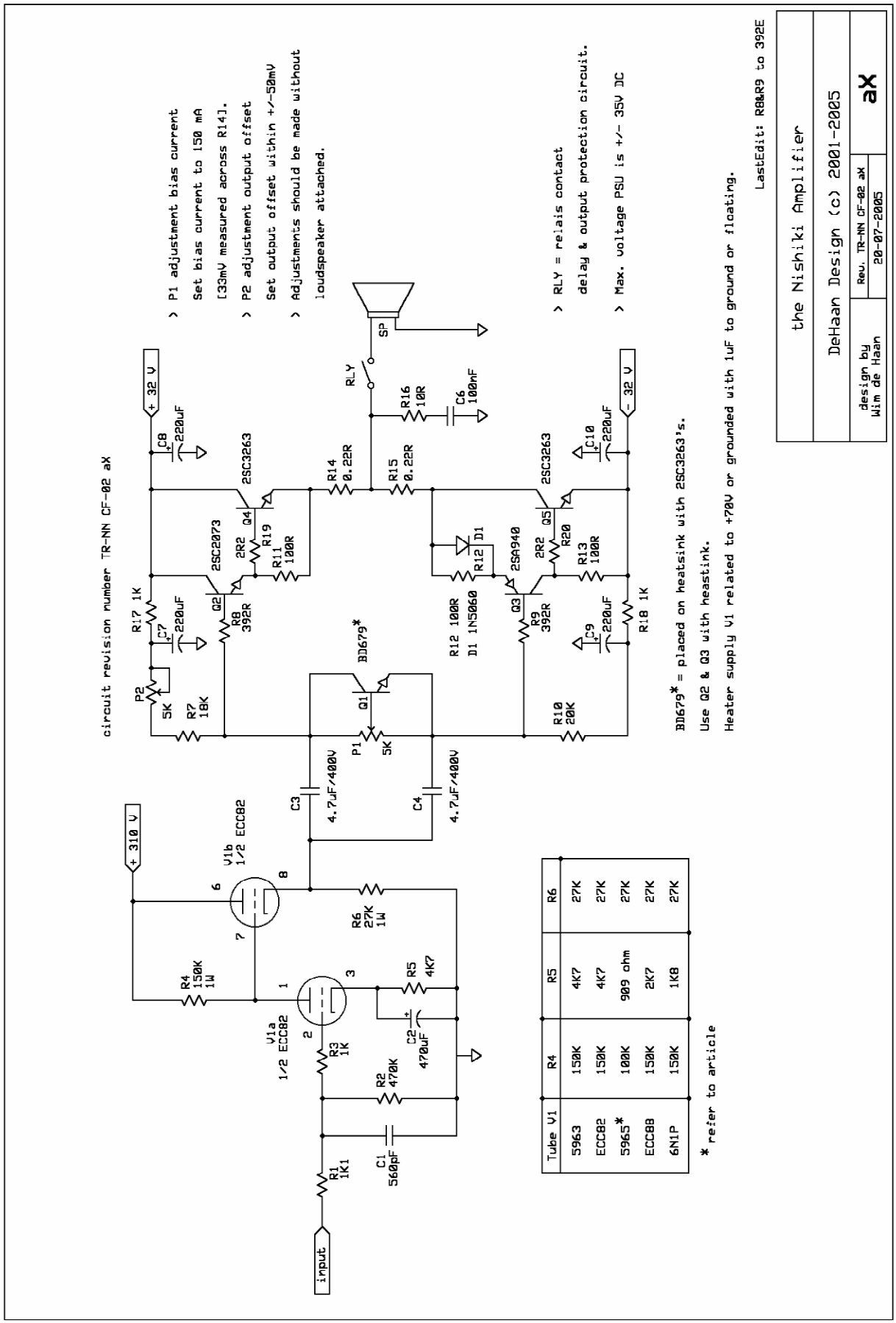
Must say that the amplifier design presented here shows no nasty things at powering up or switching off, this also because of the cathode follower. At powering up the cathode starts at 0



volt and raises to approx. +120VDC.

If you choose for a kit you could go for the K4700 Speaker Protection Kit by Velleman. This DIY kit sells for only 20 Euros; to me astonishingly low priced. The kit provides a 6 second delay after switch on to avoid any thump as the amp comes up and as soon as the amplifier is switched off it disconnects the speakers to prevent any switch off thump. It also provides DC protection by disconnecting the speakers if DC is more than about +/- 700 mV. This kit uses it own mains transformer. The delay time of the Velleman kit is increased to 12 sec by changing C11 to 470 µF.

1.4 Complete circuit diagram



1.5 Component list

Amplifier component values			
R1	1K1	600 mW	metal film 1%
R2	470K	600 mW	metal film 1%
R3, R17, R18	1K	600 mW	metal film 1%
R4	150K	1 watt	for ECC82 only, refer to article
R5	4K7	600 mW	for ECC82 only, refer to article
R6	27K	1 watt	
R7	18K	600 mW	metal film 1%
R8, R9	392 R	600 mW	metal film 1%
R10	20K	600 mW	metal film 1%
R11, R12, R13	100 R	600 mW	metal film 1%
R14, R15	0.22 R	4 watt	Intertechnik MOX resistor
R16	10 R	1 watt	
R19, R20	2.2 R	600 mW	metal film 1%
P1, P2	5K	0.5 watt	3/8" trimmer TY type
C1	560 pF		polystyrene
C2	470 µF	16 V	Panasonic FC
C3, C4	4.7 µF	400 V	ICW ClarityCap SA-type
C5	not used		
C6	100 nF		Vishay MKP 1837
C7, C8, C9, C10	220 µF	50 V	Panasonic FC (ØD 10mm)
V1	ECC82	for 5963, 6189, 5965, ECC88 or 6N1P refer to article	
Q1	BD679	darlington transistor used for temp. compensation	
Q2	2SC2073	can be replaced with MJE15030	
Q3	2SA940	can be replaced with MJE15031	
Q4, Q5	2SC3263	can be replaced with 2SC5200, 2SC3519/A or 2SC3284	
D1	1N5060	can be replaced with 1N4148 or 1N4001	

Power supply PSU component values			
T1	12V + 12V	30 VA	mains transformer
T2	8 V	12 VA	mains transformer
T3	25V + 25V	M:160VA S:300 VA	mains transformer
		M: mono S: stereo	
D1, D2, D3, D4	HV diode	1200 V	
B1	400 V – 20 A		bridge rectifier
R1, R2, R3	n/a	to be determined in circuit - refer to article	
C1	220 µF	450 V	
C2	100 µF	450 V	
C3	22 µF	450 V	
C4	1 µF	250 V	
C5, C6	10.000 µF	63 V	BC 051 series
L1	8H - 60mA	Choke	Hammond 156L or 156M type

1.6 Circuit board

The tube driver stage could be hard-wired using a little tagboard; a printed circuit board for the transistor power output section should be mandatory, this in term of reliability.

The prototype stereo circuit board shows a section for the coupling capacitors, but there are so many different shapes and sizes so the final board is made without any space for the coupling capacitors. The final circuit board is intended for one channel only (fig. 8 & 9).

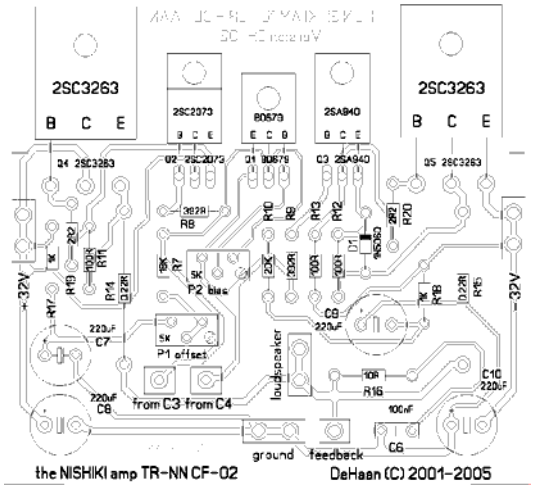
For local bypass capacitors C7/C8/C9/C10 are added to the circuit board. Space for these capacitors is limited, so go for the 10mm or less in diameter types; these will fit nicely.

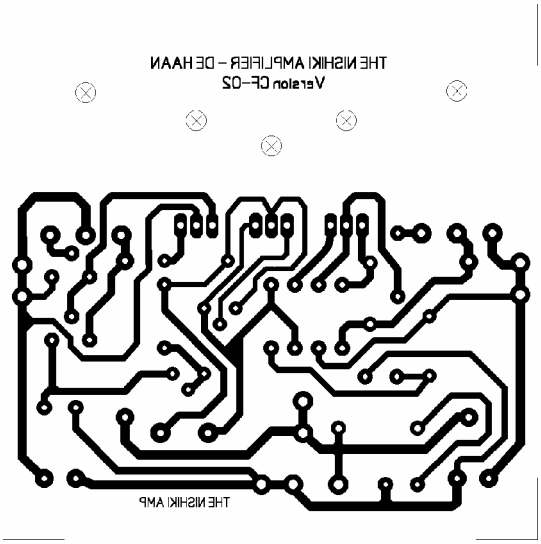
The heatsink I used was taken from a 20-year old amplifier. In fact almost any heatsink can be used provided it is not too small, a 0.7 K/W would be a good choice. Bias current is limited for this Sony heatsink to 130 mA [28 mV measured across an emitter resistor], this to reduce heat dissipation.

The original layout of this circuit board is available to you. Please install the so-called Sprint Layout Viewer on your computer. This program can be found on the CD. Using this Viewer you can read and print the original circuit board file as shown right.

" Using the Sprint Layout Viewer you can print the circuit board layout on your own printer "

For those who are interested a professional made circuit board is available, please do inquire at the above-mentioned website. For stereo you will need two boards.





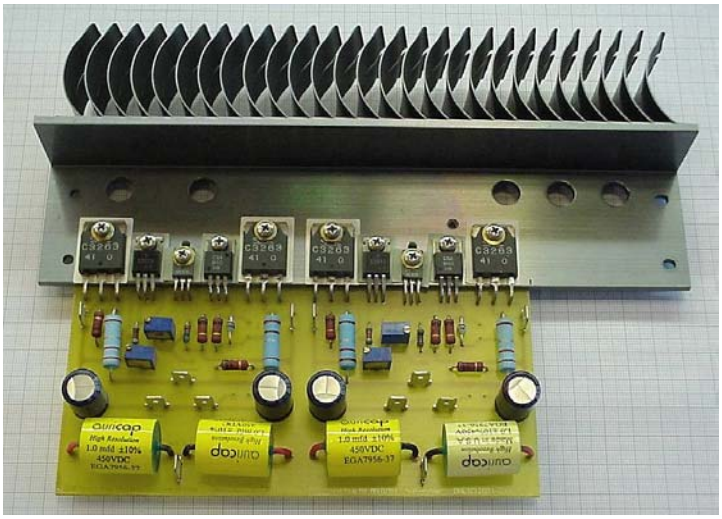
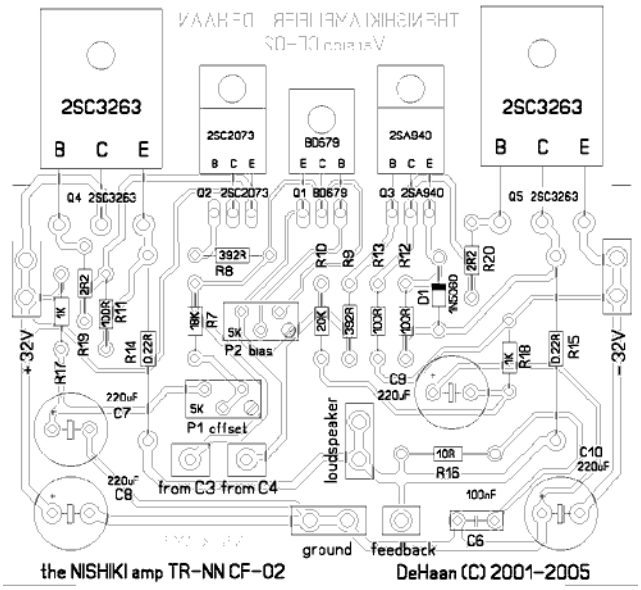
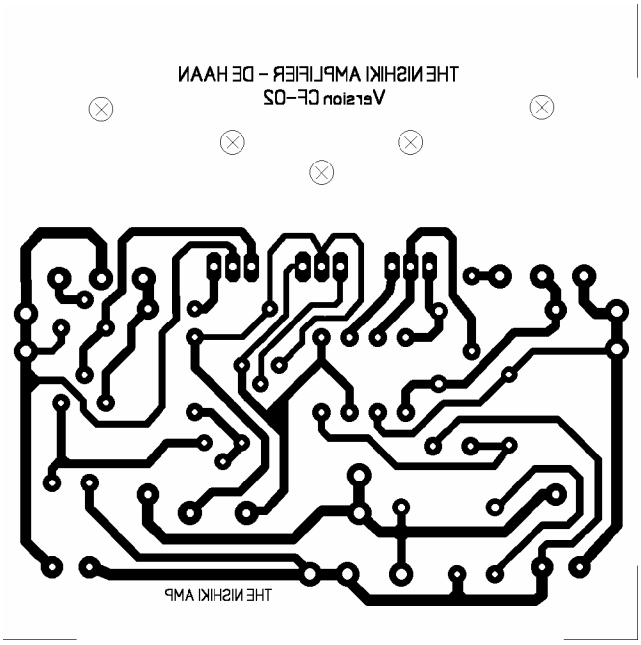


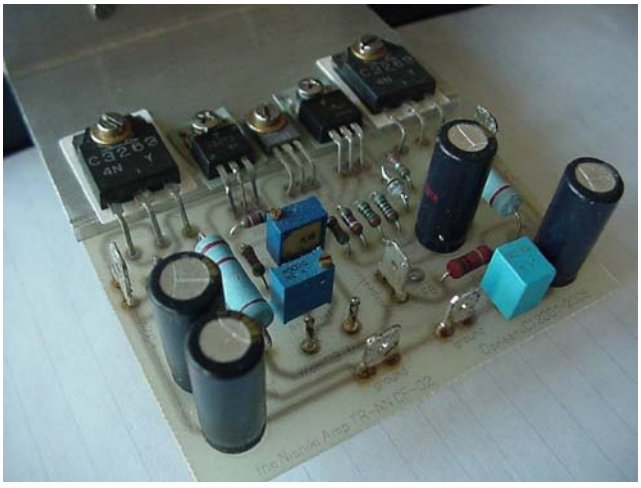
Fig. 7 Prototype circuit board using an original Sony heatsink

Component layout





" Mono circuit board measures 86x86 mm "



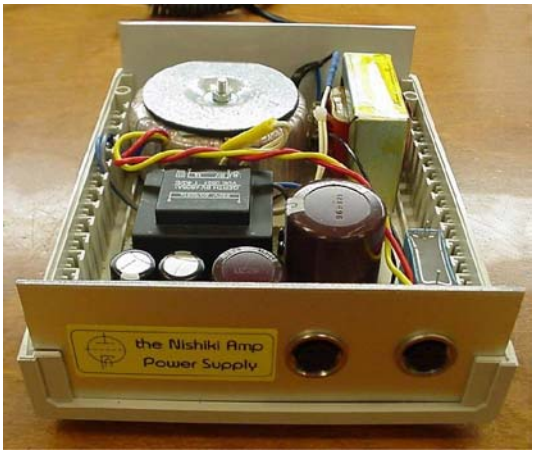
1.7 Power Supply Unit [PSU]

The driver circuit runs at +310 V DC and a 6 or 12 V as heater supply. The output power stage runs at +/- 34 volt DC, this because of the original Sony mains transformer; at full load the DC voltage will be as low as +/-30V DC using this mains transformer. I am not familiar with the power ratings of this transformer.
In case you need to buy a new mains transformer you should go for a 25V + 25V AC type. This voltage will yield a +/- 32V DC voltage, which is perfect. I would not recommend a higher voltage than approx. +/- 35V DC with +/- 40V DC as maximum; this because power limitations and heat dissipation with a 4-ohm load will be more critical.

As heater voltage 12V is chosen instead of the more common 6.3V. The power supply circuit will make clear why this was done (fig. 11). Two small mains transformers in cascade provide both the high voltage we need and the heater voltage. Of course you could use a dedicated mains transformer intended for tube use. The used mains transformers T1 & T2 are very common and rather cheap. I used an 8V transformer because this one was available to me, a 9V works fine as well.

" Power supply can be straightforward and simple. "

Fig. 10 External power supply



One section of transformer T1 is used for the high voltage section and the other section as heater supply. The 5965, the ECC82 and 5963 tubes do use pin 4 en 5 for 12 V heater voltage use. In case the ECC88 or the 6N1P is used the two 6.3V heater wires of the tubes can be wired in series for 12V use. The heater is grounded by a 1µF capacitor; in this way the maximum cathode-heater voltage is not an issue and its grounded. You might consider the use a voltage resistor divider to relate the heater to say +70V instead of capacitor grounding.

For choke L1 you could use a Hammond 156L or a 156M type, these are only 11 US dollars. C1 and C2 could be lower in value, at time of building nothing else was available.

R1 and R2 are used to trim the DC high voltage to + 310V. I used for R1 a link (zero ohm) and for R2 a 1K resistor and this with the tubes working. This is also the case for R3 this resistor is used to trim the heater voltage to 12.6 volt.

The powersupply for the current transistor power stage is straightforward. One single bridge rectifier and 2 large capacitors are used. It is up to you to decide if you use one PSU for two channels or to give each amplifier its own power supply. For mono you could choose for a 160VA transformer with a 120VA as minimum, for stereo a 300VA will do just fine.

Circuit power supply

" Straightforward High Voltage power supply and +/-32 V DC supply "

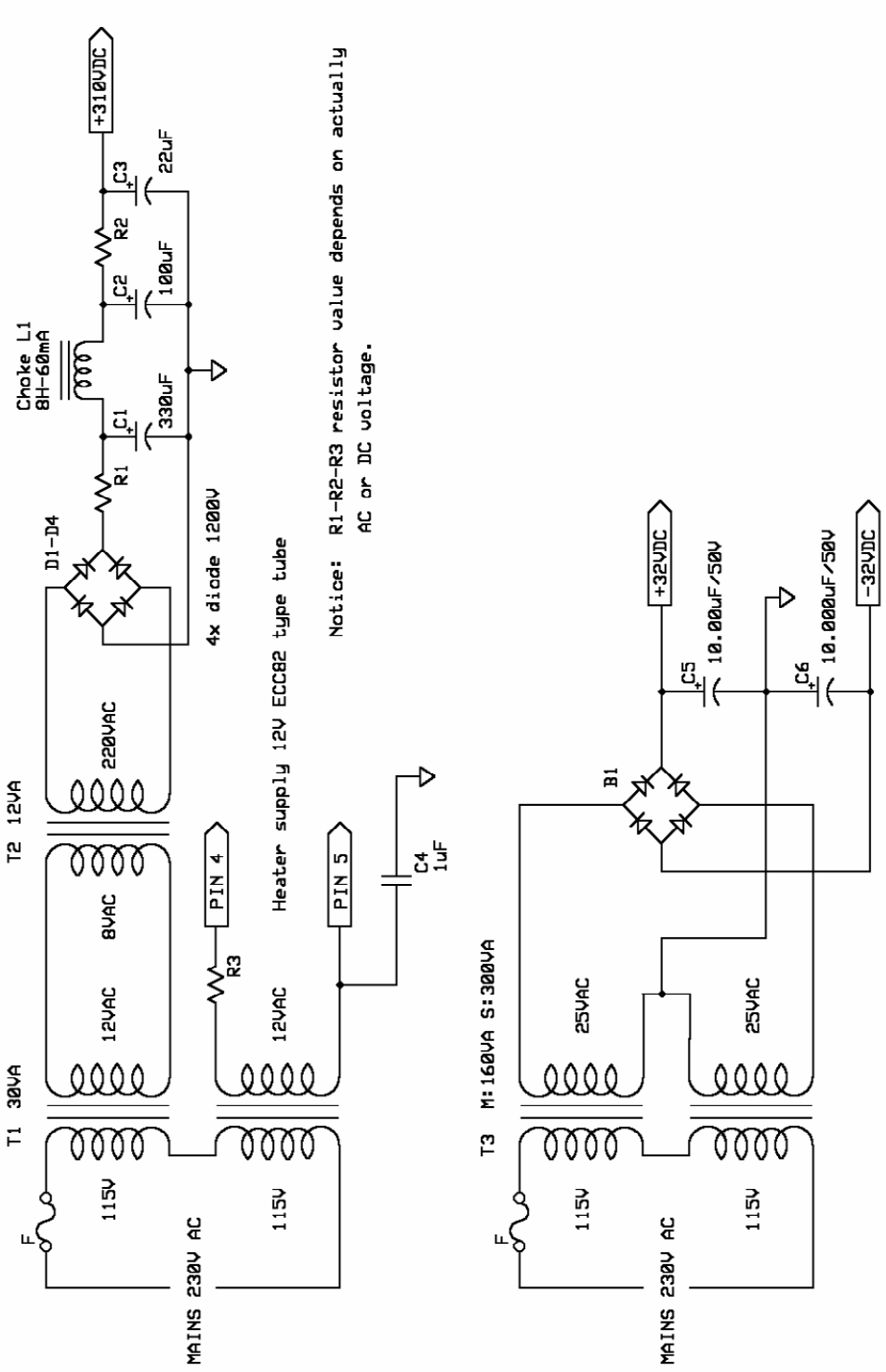


Fig. 11 Complete Power Supply

1.8 Specifications

Distortion @ 5 ohm load * using original Sony mains transformer and 2x 6800UF PSU capacitors							
Tube	1 watt distortion in %	5 watt distortion in %	20 watt distortion in %	45 watt distortion in %	51 watt distortion in %	60 watt distortion in %	Total Gain
ECC82 Sylvania	0.18	0.15	0.12	0.22	-	0.66	21 dB
5963 RCA	0.18	0.12	0.14	0.32	-	0.70	20 dB
5965 RCA	0.48	0.42	0.74	0.8	0.9	-	30 dB
5965 10 dB feedback	0.12	0.16	0.32	0.40	-	0.44	20 dB
ECC88 Lorenz	0.17	0.18	0.20	0.22	-	0.5	27 dB
ECC88 JJ Electronic	0.18	0.18	0.20	0.22	-	0.32	27 dB
6N1P SED / Svetlana	0.3	0.32	0.5	0.54		0.58	28 dB
	Frequency range: 10 Hz – 105 kHz @ –1dB / 1 watt						
	Damping: 10						
	Sensitivity: depends on tube, check out the Total Gain section						
	* notice: at 60 watt output power the DC voltage of the power supply measures approx. +/-30V DC						

" The JJ Electronic E88CC outperforms all other tubes including the highly acclaimed 6N1P "

	Equipment used:
	Philips PM2454B AC millivoltmeter 10Hz – 12 MHz
	Fluke 187 True RMS multimeter & Fluke 45 Dual Display Multimeter
	Philips PM 5125 sine/square wave generator 10Hz – 1 MHz
	Philips PM3055 oscilloscope 50 MHz
	Hewlett-Packard 333A distortion analyzer

Prototyping and testing

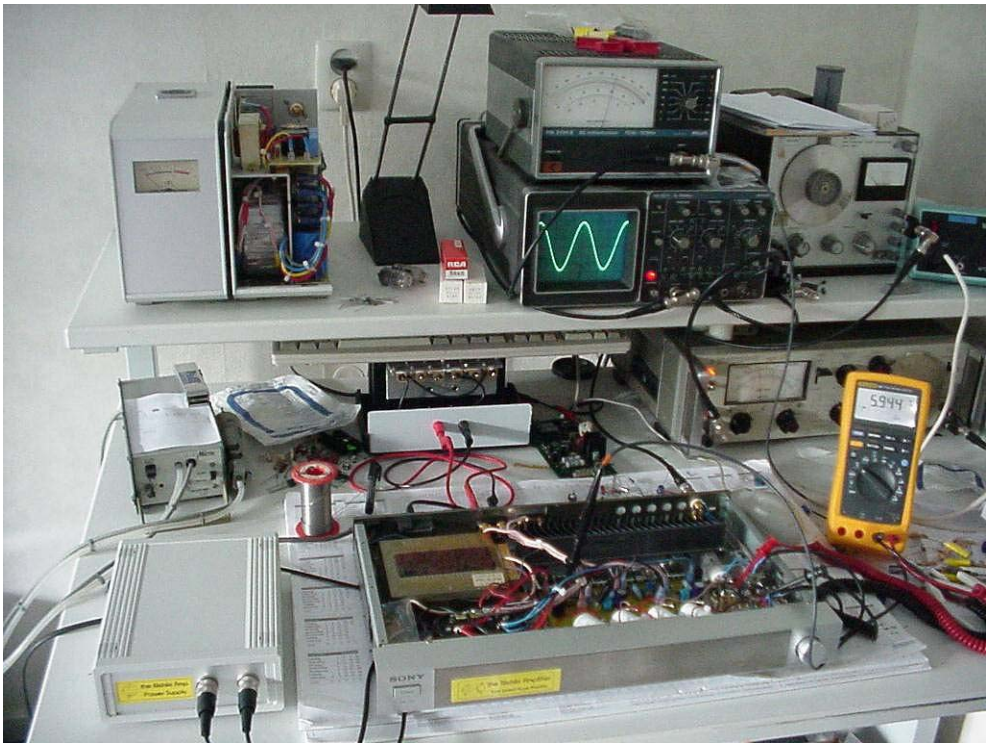


Fig. 12 Amplifier under test

" Bridge mode idea "

1.9 Suggested Bridge Mode configuration

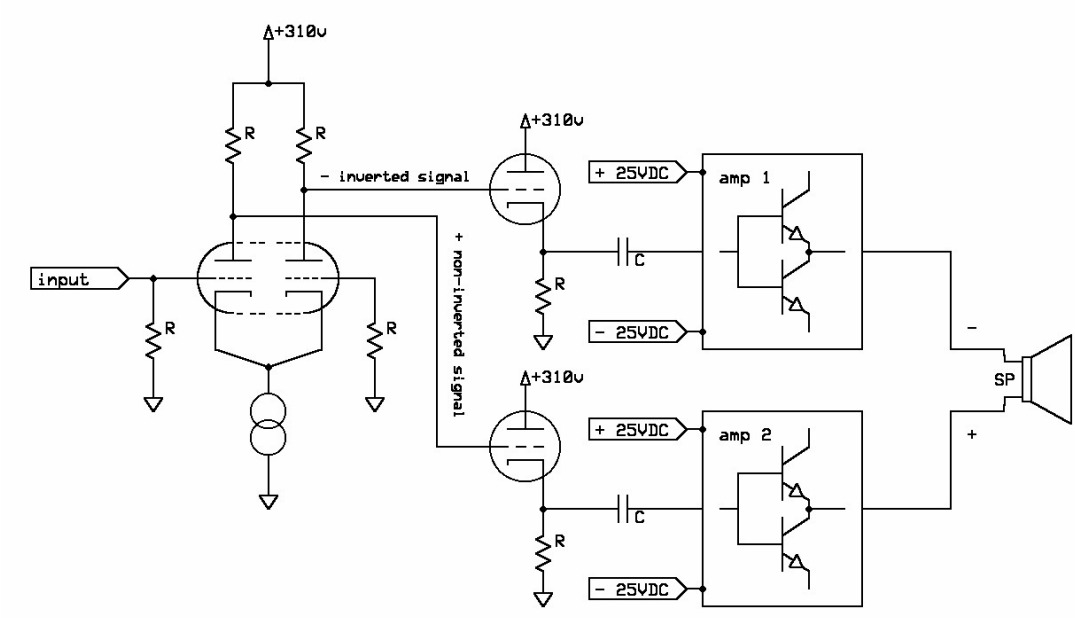


Fig. 13 Suggested bride mode configuration. Prototype yields 145 into 5R @ 0.7 % distortion.

1.10 The Real World

A 20-year old Sony TA-AX2 integrated amplifier was used to be 'donor' for this project. This 2x35 watt amplifier was a welcome need; using the original enclosure, the original buffer capacitors, the heatsink and the mains transformer overall costs of this amplifier is more than acceptable. It reduced the cost price of this project enormously.

Fig.14 The Nishiki Amplifier using a Sony enclosure and external PSU

Original Sony circuit board was taken out, including the STK module. Front was modified by using a stainless plate to cover the original holes of the switches and potentiometers. The volume potentiometer was left in place, though it was not used yet. This Sony amp was bought for just 10 euros, not knowing if it was working yes or no.

" A 20-year old Sony amplifier is used for enclosure and other main parts. "

Because of it's very slim design (height front is just 4,5 cm, inside just 4 cm), heater and high voltage supply had to be external.

I did use a Sony, but of course you could use almost any 2nd hand amplifier. A 35 to 50 watt into 8 ohm amplifier will do, this amp will run at approx. the required +/- 32VDC. Amplifiers with higher output (and this into 8 ohm) run at higher DC PSU voltages and this is overdone, this because the driver stage has its limitations.

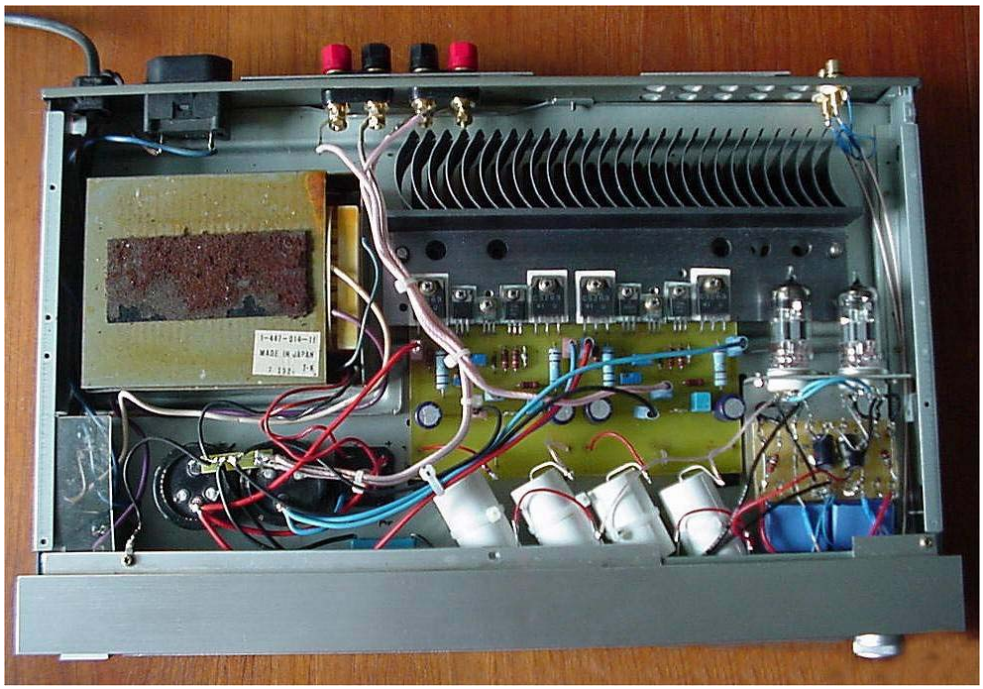


Fig. 15 Inside of the Nishiki Amplifier

1.11 Final word

The amplifier turned out to be very reliable. During testing and prototyping it showed its reliability, though shorting the outputs is not recommended. The final amplifier is running now for a long period of time without any problems. In spite of a low component count design like this, specs and sound are convincing.

I am very pleased with the final result. Using an old amplifier for enclosure and several main parts; overall costs are kept very low to approx. 100 euros, to me a not to be underestimated detail.

Sound is found to be pleasant and entertaining. Balance and soundstage are good. Voices and for example percussion are clear and never nasty or bright. It's fun to listen and the slimline Sony enclosure looks good too.

Somewhere during the prototyping I used the 5965 and Audyn Cap Plus coupling capacitors and I was very disappointed with the sound results; bright, no dynamics, no drive.

" Sound is found to be very pleasant and entertaining. It's fun to listen. "

My DIY Dynaudio loudspeaker using the Esotar tweeter and the 17W75XL04 can sound great, but they can also sound not that pleasant, boring and can sound like 'please switch me off'. My favorite Keith Jarrett music is a difficult job for many systems; to revolve all the magic it needs some attention. For example in *Ecstasy* from *Changeless* there was simply no magic and in matter of fact it was not pleasant to listen, changing tubes and coupling capacitors I ended with something I can really go for.

Other example is *Young and Foolish* from *Live at The Village Vanguard* by jazz pianist Brad Mehldau. Strange recording I thought, and it is, with the Audyn caps and the 5965 tube a typical 'please switch me off' sound. However it contains too many pleasant and good elements that this would be not possible to do so; using the final configuration I do understand so much more of this live recording. A beautiful concert, even at the end you hear the hammer mechanism very clearly without making a string sound. Great! I love music in this way!

Audiophile CD tip is Warren Bernhardt's Ain't life grand [DMP CD-478], track 2 + 8 shows what this amp is capable of.

Mentioned positive comment refers to the combination of an ECC82, a 5963, an ECC88, the 6N1P using ClarityCap's or the mentioned Epcos capacitors.

The DAC which is used is based on a Crystal CS4329 evaluation board with an Arcam 170.3 CD transport using a balanced digital interlink connection. Monster M1000MK3, IXOS 1004 and OCOS cables for the analog sources.

Amplifier that is used at the moment in daily life is using JJ Electronic E88CC tubes and ClarityCap coupling capacitors.

1.12 References

· John Linsley Hood - Valve & Transistor Audio Amplifiers (ISBN 0750633565).

· Electronics World + WW magazine [UK] - issue Nov. 1993 - Distortion in Power Amplifiers Chapter 4 by Douglas Self.

· Velleman Kits - www.velleman.be

· ClarityCap capacitors - www.icwltd.co.uk and www.e-speakers.com

· ExpressSCH - all circuits / schematics drawn using this freeware program - www.expresspcb.com

· Sprint-Layout 4.0 - Circuit board layout drawing program - www.abacom-online.de

- Wim de Haan, author of this document.
e-mail: wim@wdehaan.demon.nl
website: http://www.wdehaan.demon.nl/

1.13 Datasheets

Following datasheets are included:

Power transistors
- 2SC3263
- 2SC3519/A
- 2SC3284
- 2SC5200
- MJL3281A

Driver transistors
- 2SA940/A
- 2SC2073/A
- MJE15030
- MJE15031
- MJE15032
- MJE15033

Temp compensation transistor
- BD679
- BD139

Tubes
- 5965
- ECC82 JJ Electronic
- E88CC JJ Electronic
- 6N1P
- 6N3P

Capacitors
- ICW ClarityCap SA type
- ICEL PHC Capacitor
- Vishay MKP1837

Resistors
- Intertechnik MOX resistor

Thermal Pad
- Sil-Pad 2000 TO3-P

Aluminum Profile
- Angled aluminum profile

"Datasheet section"

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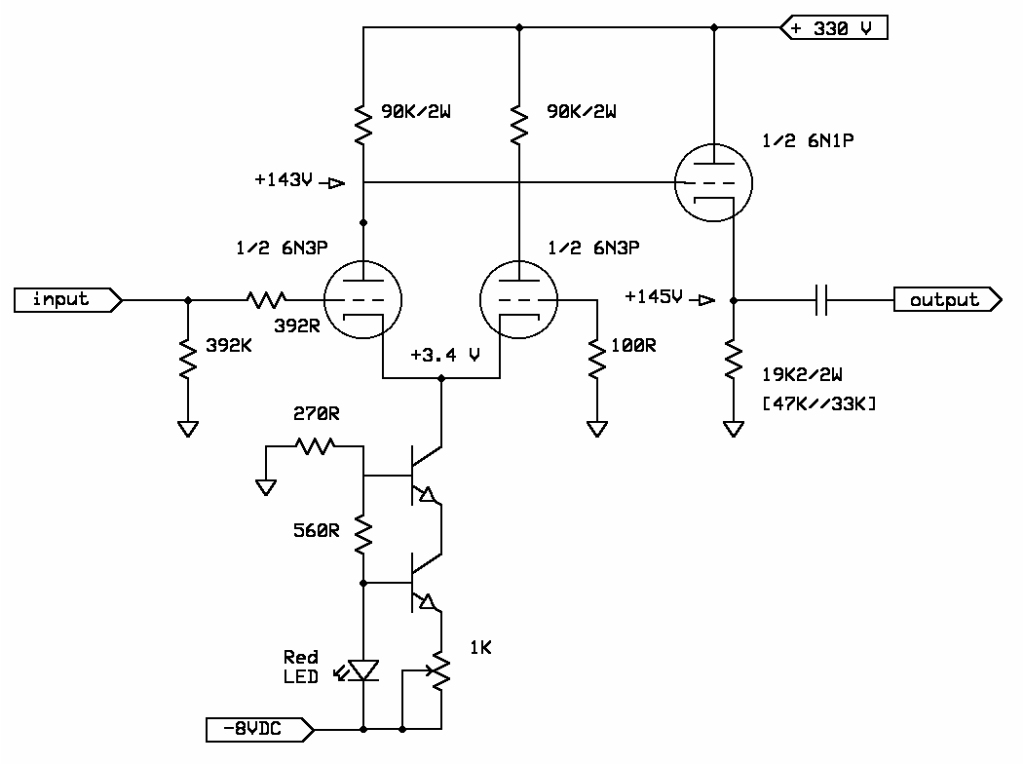
Updates / modifications

Circuit 2: Improved 6N3P driver stage for power output stage set to +/-40 VDC.
This driverstage is of course suitable for use with +/-32 VDC as well.



" Improved 6N3P based driver circuit optimized for output power stage set to +/- 40 VDC "

Distortion @ 5 ohm load *							
Tube	1 watt distortion in %	5 watt distortion in %	20 watt distortion in %	50 watt distortion in %	88 watt distortion in %	100 watt distortion in %	Total Gain
6N3P russia	-	-	-	-	0.2	0.3	20 dB
	Voltage PSU power stage +/- 40 VDC; at full load +/-36.6 VDC						
	* notice: care should be taken in heat dissipation and min. load						

Updates / modifications

Circuit 3: info on a 6N3P based driver stage for bridged configuration use.

Be sure to read the extra instructions.

Distortion @ 5 ohm load *
using a 300 VA mains transformer and SlitFoil 2x 10.00UF PSU capacitors

Tube	1 watt distortion in %	5 watt distortion in %	20 watt distortion in %	45 watt distortion in %	50 watt distortion in %	105 watt distortion in %	Total Gain
6N3P russia	-	-	-	-	-	0.45	28 dB
	* notice: PSU amplifier stages set to +/-25 VDC, with full power +/-21.3 VDC						

Distortion @ 5 ohm load *
using a 300 VA mains transformer and SlitFoil 2x 10.00UF PSU capacitors

Tube	1 watt distortion in %	5 watt distortion in %	20 watt distortion in %	45 watt distortion in %	50 watt distortion in %	145 watt distortion in %	Total Gain
6N3P russia	-	-	-	-	-	0.7	28 dB
	* notice: PSU amplifier stages set to +/-28VDC, with full power +/-25 VDC						

" BRIDGED version using a 6N3P as Long-Tail and a 6N1P as cathode follower "

For one bridged channel you will need 2 Nishiki Amp power stages boards, this with 4 coupling capacitors. So for stereo use you will need 4 boards and 8 coupling capacitors.

Using this application some extra care has to be taken. For mono use you will need 1 mains transformer of 300VA. Power transistors should be changed to the more robust 2SC5200 type, or even better the MJL3281A. Heatsink should be more than adequate.

The Zobel RC network circuit should be removed from the two output boards. Place a RC combination of 10 ohm and 47 nF over the output connectors of the amplifier. Choose for this resistor a 3 Watt version.

The bridged amplifier can not be connected in any way to ground, be aware of this.

One of the output boards is connected to the + terminal of the loudspeaker connector and the other output board is connected to the – terminal of the loudspeaker connector.

Using +/-32 VDC output power will exceed the 190 watts at 0.8% distortion; due possible dissipation problems this application is not recommended.

This bridged version is not suitable for impedances less than 4 ohm and should not be used for continuous high output applications.

No further details / updates available. Information is as is.

Additional information

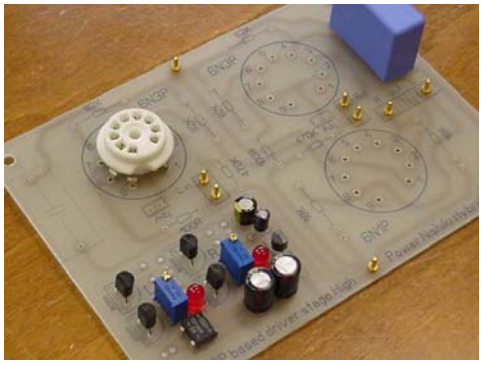
The Nishiki Amplifier using an Electrocompaniet amplifier.

Electrocompaniet AW65 housing

Inside overview

" the Nishiki Amp using an Electrocompaniet amplifier as donor "

Driverstage + output boards overview



Custom made 6N3P / 6N1P driver board

This additional version out performs the original idea and approach in many ways.

This approach is powerful and precise. Sound-stage is enormous.

Amplifier is using a Russian duo, the 6N3P and the 6N1P; no other tubes should be used. Coupling capacitors are provided by a high-performance ICEL PHC capacitor. Powersupply is using a single 300VA toriodal transformer for the two channels; power supply capacitors are high-performance BH Slit-Foil 15.000µF/63V types.