1. Summary

Steanes Model 976B & Speaker Combo. Serial No. 2466.

12AX7 microphone gain stage with volume pot to 12AX7 mixer stage, with PU input through volume pot to mixer stage. Output of mixer stage to tone control and then to 12AX7 feedback input stage to cathodyne phase splitter. 6M5 push-pull output stage with common cathode bias. Output transformer secondary with separate feedback winding, and floating 100V distribution. 6V4 full-wave rectifier with two RC droppers.

Excellent condition. Original white plastic Steanes badge on top grill, but 1958-9 manufacture date indicates Philips manufacture with Steanes badging. Green thread lock marked fixings.

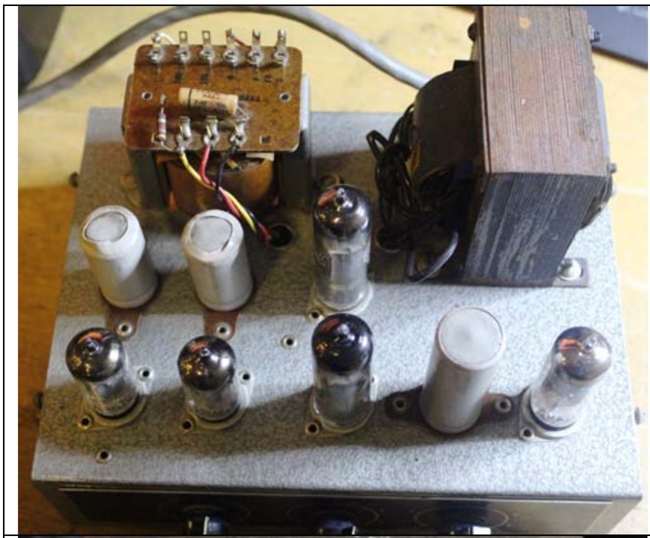
Components

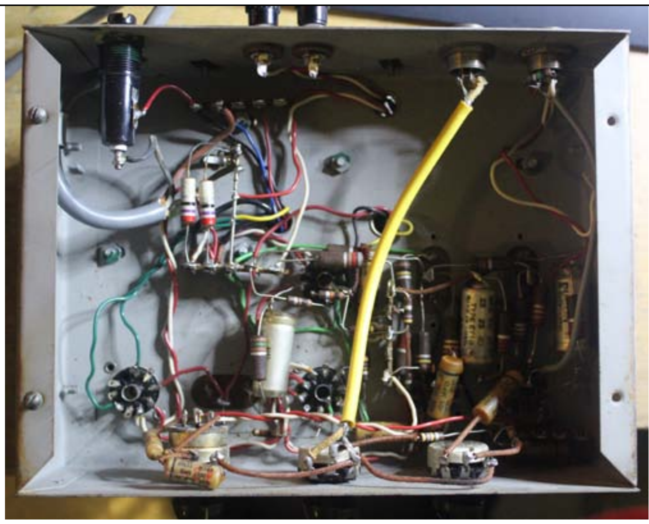
Power Transformer	'344.096', '4x9'. 250-CT-250, 6V3 ~3A, 6V3 ?A.
Output Transformer	'TYPE 903'. 0219 with VSNP stamp. 8k2Ω PP (DCR=190Ω); 0-250Ω-500Ω-1000Ω (50-70-100V); 1.5Ω F-FB.
CAPs	Ducon 24uF 300V 28 48 38
	Ducon ET1B 58 68 58
	Ducon High Seal 118
Pots	IRC 86 or 8G curve C
Tubes (all Miniwatt)	6V4 Miniwatt 8K kC 8J (kC=6X4, 8=1958 or 68)
	6M5 Miniwatt 9A M+ 8L (M+=EL80=6M5; 8=1958)
	6M5 Miniwatt 8H M+ 8G (M+=EL80=6M5; 8G=1958 ??)
	12AX7 Miniwatt 8I mC6 Δ8G (Philips Herlin 1958)
	12AX7 Miniwatt 8K mC6 Δ8I (Philips Herlin 1958)

Two open-backed speaker boxes that join back-to-back with clips, such that amplifier and cables fit inside to provide a single unit with one carry handle. Dark green vinyl with red piping on plywood. Each box with Rola M 8" speaker (7W, 2Ω coil, F57 cone) and Rola (CEL58 8M36B) isocore potted speaker transformer (date stamp 21 Mar 1956) with 2k5Ω:2Ω ratio, with parallel wiring to amplifier (1250Ω loading). Vinyl and speaker cloth in very good condition. A few minor hairline tears near rim of cones.

Issues:

No power switch. Old wax and electrolytic capacitors. Mains wiring close to circuitry. Floating speakers. Spare 6V3 winding. Not the best grounding. Speakers use line transformers.





1.1 Modifications for Guitar Amplifier

- Main fuse changed to 0.5A slow blow.
- Fuse added to PT secondary CT (0.2A Fast IEC127 5x20).
- 1N4007 added in series with each rectifier plate for 6V4.
- Improved grounding scheme.
- On switch added to rear panel.
- Electrolytics and wax coupling caps replaced.
- PU Volume pot replaced with dual gang and used as post-PI volume.
- Grid stoppers added.
- 6M5 cathode 1Ω sense resistors added.
- 6M5 screen stoppers increased, and extra screen supply filtering.

- 2x 330VDC 90pF MOVs added across each OT half-winding. RC network removed from across PP.
- OT secondary grounded.
- Neoprene feet pads.
- Replace 12AX7 stages with 12AU7 to reduce gain.
- Added 1.6H choke to VS2 supply.
- Re-biased input stages for better use of 12AU7.

To do:

- Replace rubber feet.
- Methyl cellulose based glue, and thin Kozo paper for speaker cone repair.
- Suspect V3 valve socket – heater sometimes doesn't connect – confirm both 6M5 heaters are on!

2. Measurements

Voltage rail regulation. Modified circuit.

Rail	240VAC mains VDC, VACrms Idle condition (12AX7, no choke)	240VAC mains VDC, VACrms Idle condition (12AU7 changes)
VS1	300, 5.1 (340V turn-on pk)	300, 5.4 (340V turn-on pk)
VS2	288, 1.6	280, 0.3
VS3	250,	250,
VS4	235,	225,
Cathode	9.8 (27+27mA) 7.5W	9.8 (27+27mA) 7.5W
Heater 1	6.6	6.6
Heater 2	?	?
Sec HT	264-0-264	264-0-264
V1A,B	132V, 132V, 1.3V	102V, 108V, 4.8V
V2A	120V, 1.03V	139V, 2.5V
V2B	60, 192 1.35V	88, 168 1.35V

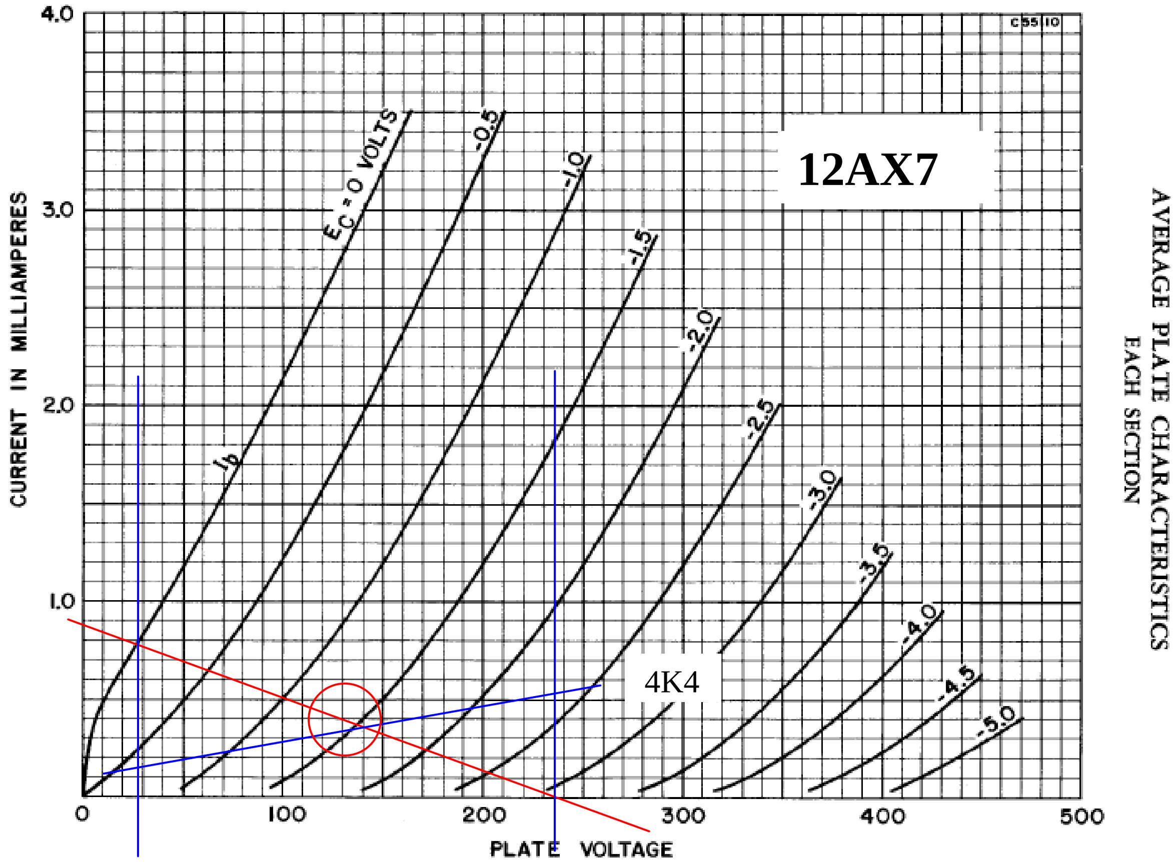
Power transformer primary DC resistance: 30Ω (BLU-BLK); 26Ω (RD-BLK).
Power transformer secondary DC resistance: 185+185Ω.
Heater current requirement is: 2x 0.71 + 2x 0.3 + 0.6 (6V4) = 2.6A indicates a 260-CT-260, 6V3 3A, 6V3 ~0.5A.

OT with 1.1kΩ resistive load:
Cranked output up to 108VAC (10.6W). Hum negligible. Hiss noticeable but minor.

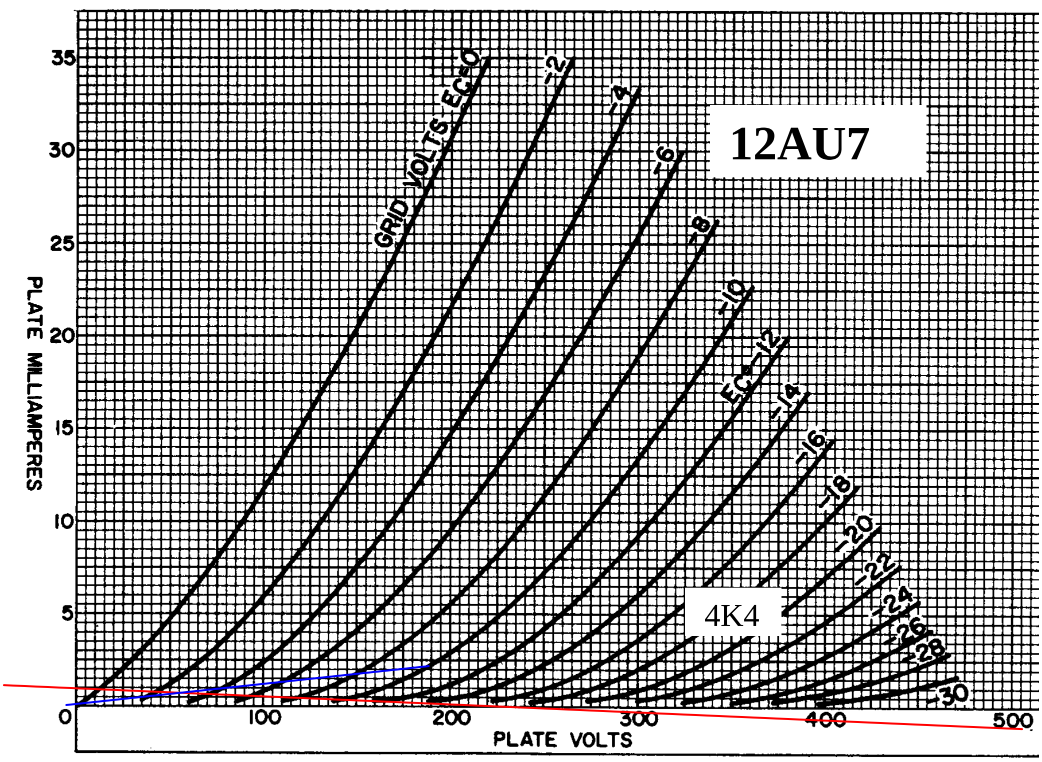
3. Design Info

3.1 Input stages 12AX7

For the first two 12AX7 stages have a common 2k2Ω cathode bias; V1A-V1B; VS4 = 235V; Va=132; Rk=4k4; Vk=1.3V; Ia=0.37mA; RLdc=270kΩ.

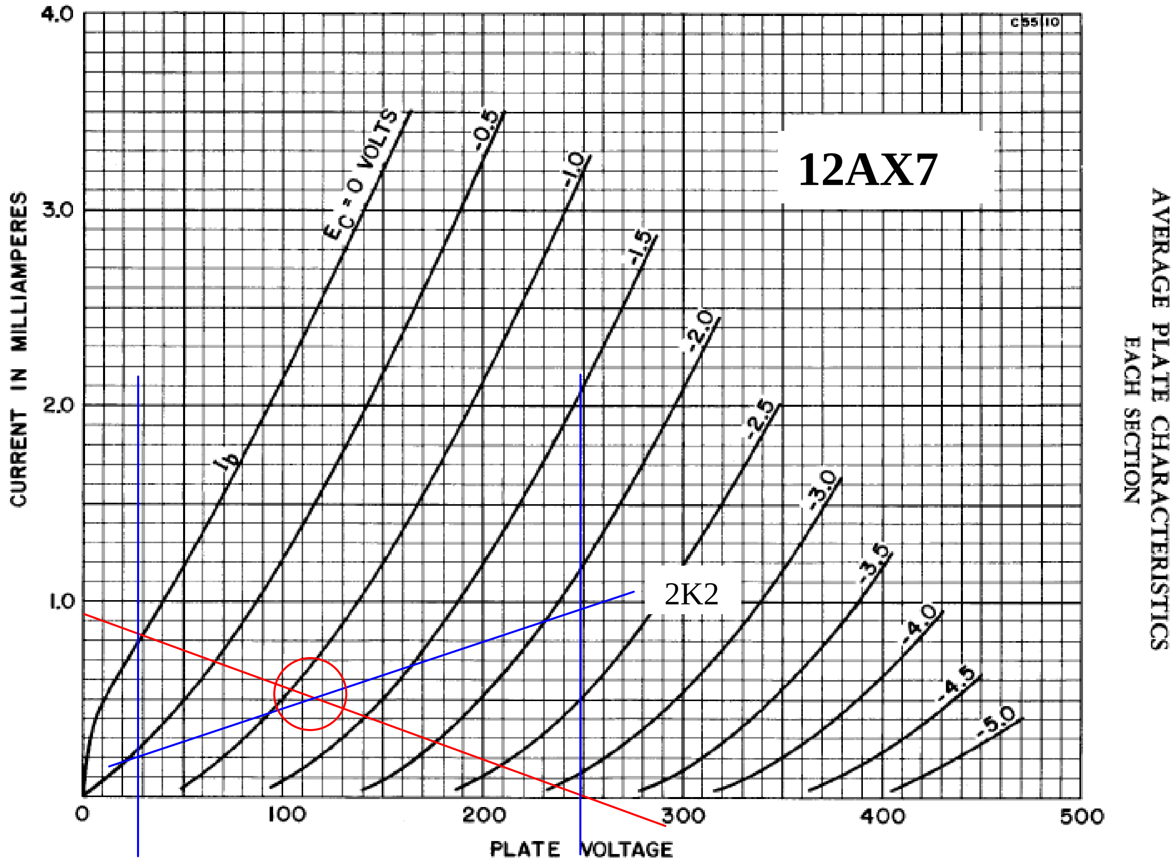


Changing to a 12AU7 will draw more current, and raise the cathode bias to ? The anode load should be reduced from 270k to about 100k, and the supply dropper reduced from 27k to 15k.

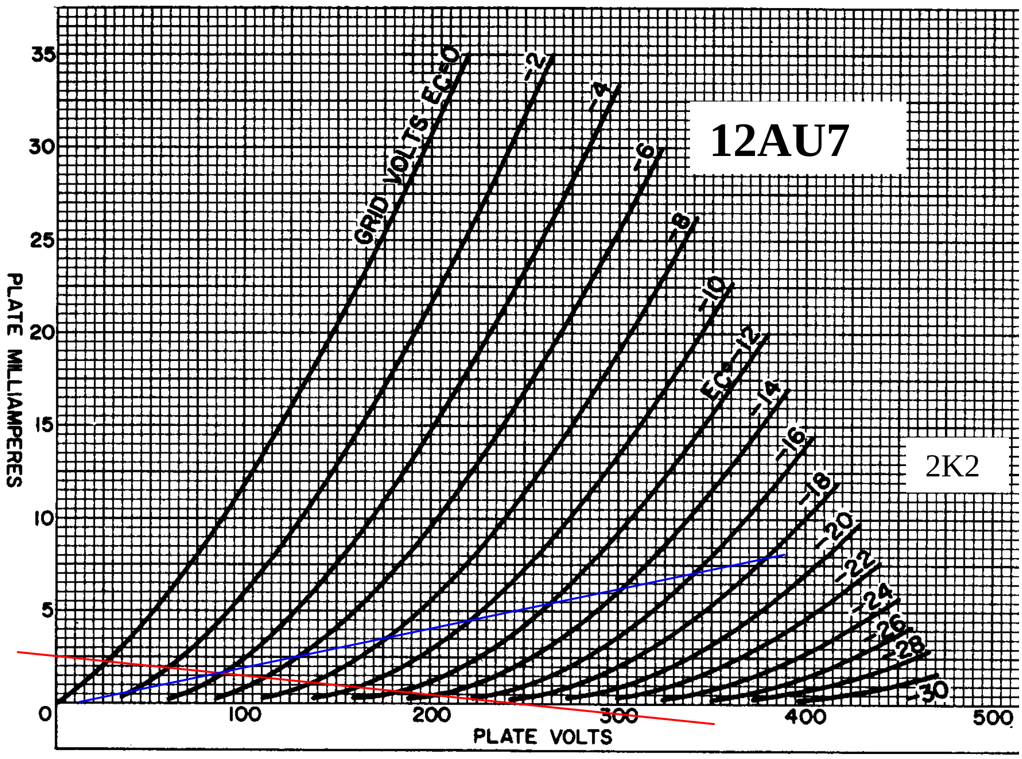


3.2 Feedback stage 12AX7

The feedback 12AX7 stage; V2A; VS3 = 250V; Va=132; Rk=2k2; Vk=1.03V; Ia=0.37mA; RLdc=270kΩ.

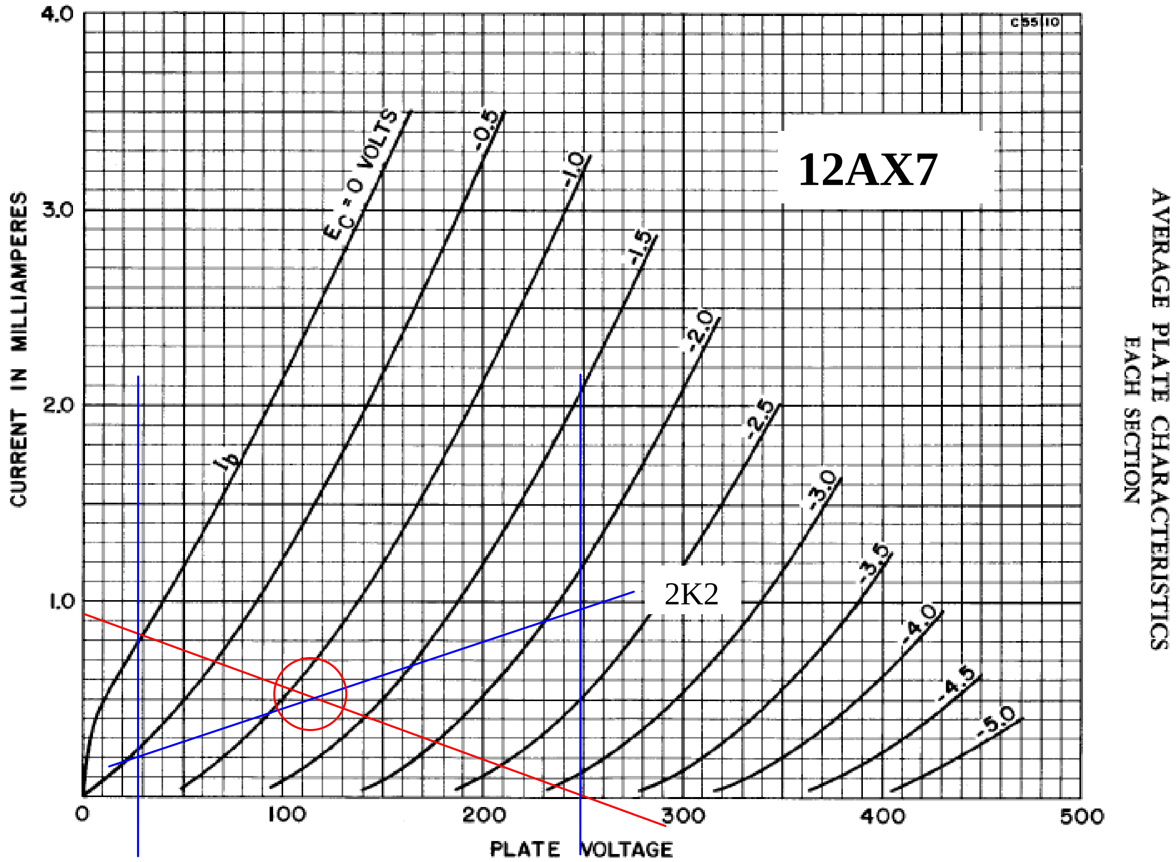


Changing to a 12AU7 will draw more current, and raise the cathode bias to ? The anode load should be reduced from 270k to about 100k, and the supply dropper reduced from 27k to 15k.

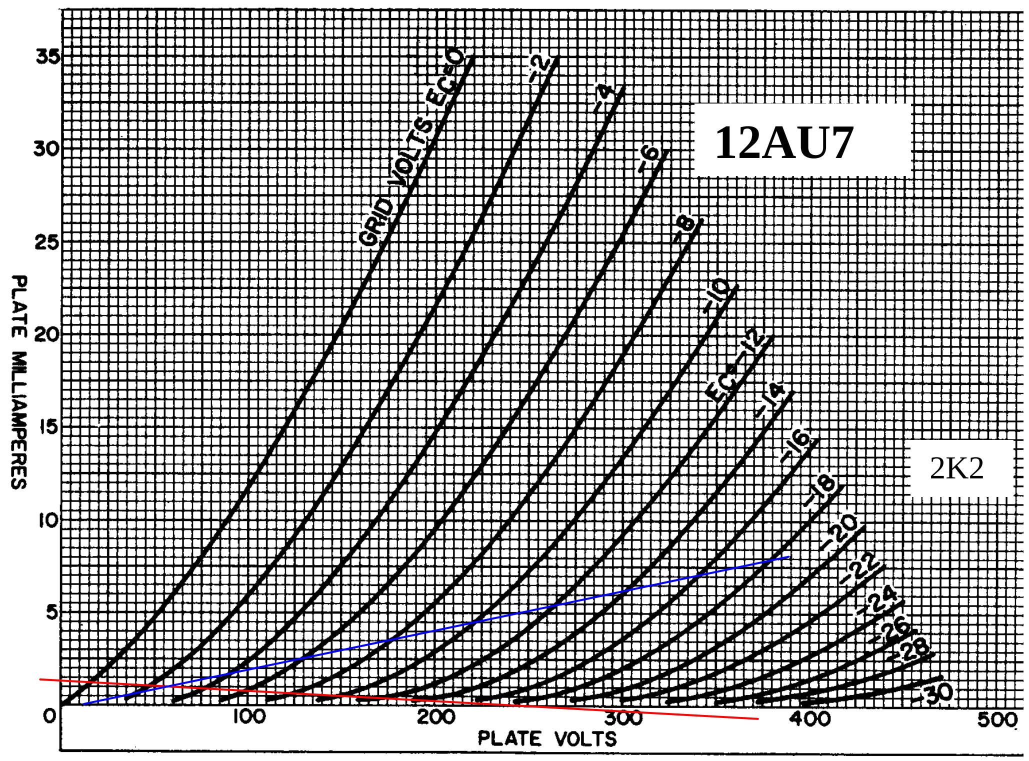


3.3 Phase Inverter stage – 12AX7 in split-load (cathodyne) config

VS3= 250V. Rk=2k2. Vgk=1.3V. Vk=61.3V. Va=192V. Vak= 130V. Anode current = (250-192)/100k=0.6mA.



Changing to a 12AU7 will draw more current, and raise the cathode bias to ? The anode/cathode loads should be reduced from 100k to about 47k, and the supply dropper reduced from 27k to 15k



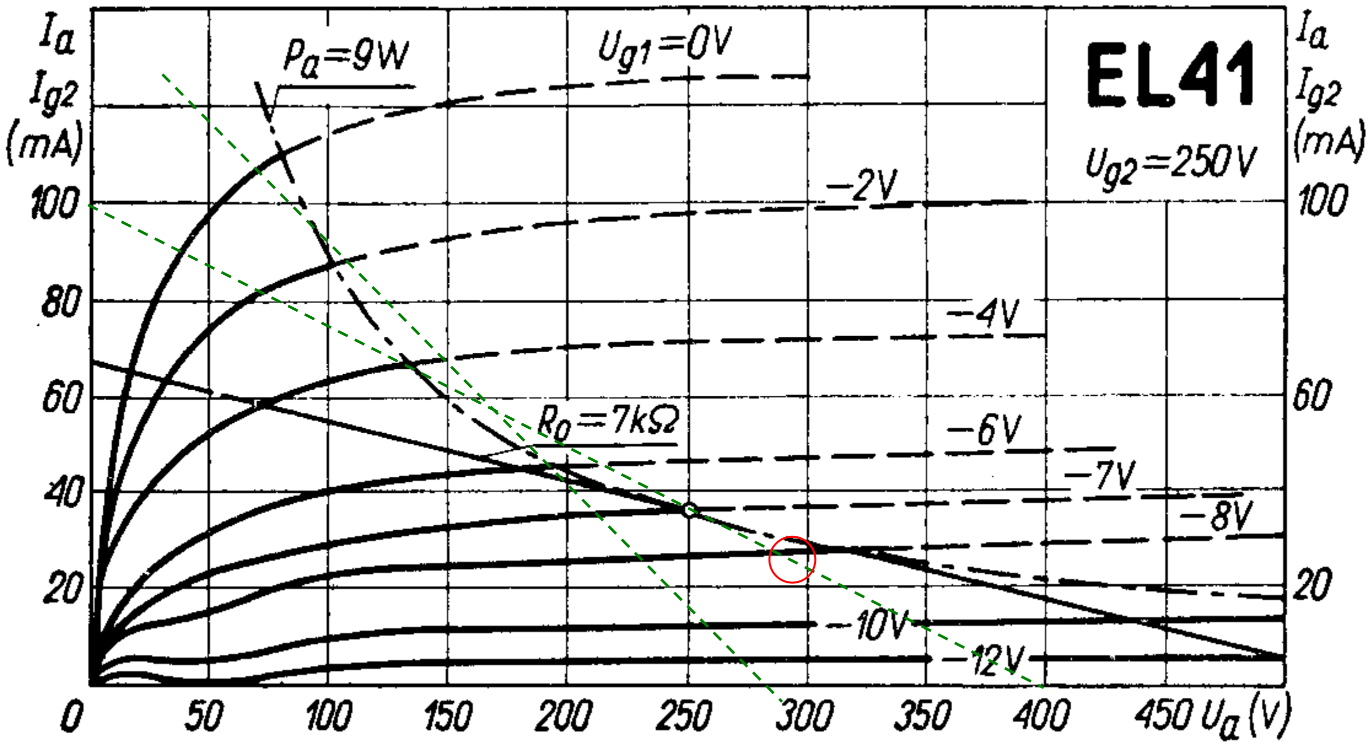
3.4 Output Stage

Class AB push-pull output stage, common cathode bias. The 8KΩ impedance plate-to-plate OPT presents signal currents into each tube with a 4KΩ impedance with both tubes conducting, to 2KΩ load impedance at higher levels. No pentode characteristic curves are available for 6M5, and similar EL41 curves are shown but at a lower 250V screen (actual screen is about 280V at idle so bias voltage is close to 10V).

As the output loading increases, the supply voltage VS1 to the output valve plates sags from about 300-10=290V towards 290V. Plate DC voltage will be lower than VS1 by an amount up to ~28V (ie. plate-cathode sags to about 260V) due to OPT half resistance of about 95Ω with a peak current of up to about 0.1A, and cathode bias drop of 18V. Screen voltage will vary from about 280 towards 265V under steady-state heavy load (ie. screen-cathode sags to about 265-18 = 245V).

The maximum output valve bias current allowed is dependant on the maximum recommended plate dissipation – assume 75% of 9W = 6.8W: Ibias(max) = Pd / Vb = 6.8W / 290V = 23mA, or about 25mA of cathode current.

For a peak plate current of 100mA, then the nominal output power of the amplifier would be: (Ipk)2 x Rpp / 8 = 0.1 x 0.1 x 8k / 8 = 10W. For this maximum signal condition, the rms OPT current draw is likely about 64mA (64% of peak), and the average VS1 power consumed is about 260V x 0.064Arms =17W, and the OPT loss is about $(0.064)^2$ x 190Ω = 0.8W, so the tube plates dissipate 17 – 9.4W – 0.8W = 7W, or just under 3.5W each, which is well below max design level.



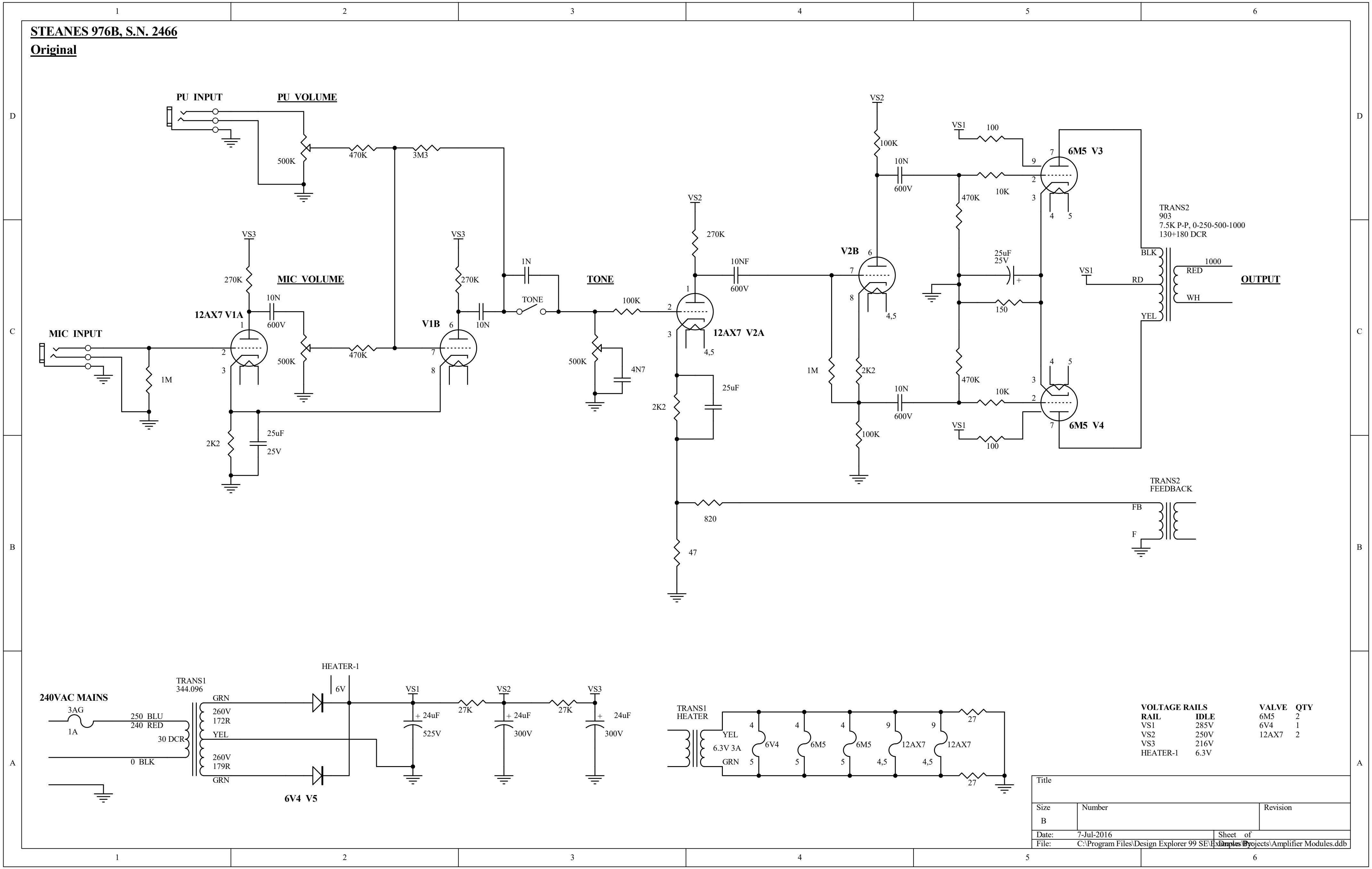
3.5 Power Supplies

The 6V4 is rated to feed 50uF with secondary winding resistance >125Ω from 250VAC, and 90mA loading for a 265VDC output, and has a hot switch peak current rating of 900mA, and a continuous peak current rating of 270mA.

The effective series resistance is 30Ω x $(260/250)^2$ +185Ω = 220Ω, which is fine.

PSUD2 indicates a hot switched peak of up to 900mA, and a steady-state continuous of 240mApk at idle, which appears to be fine for cranked output. The steady-state PT secondary CT current at idle is about 110mArms, and rising to 570mArms for a 10ms period for a hot switch event, which would allow a 200mA Fast IEC127 fuse to be used (min rating of 50ms at 2.75x rating multiplier).

A 1.6H @ 60mAdc, DCR=430Ω (Wurlitzer 500409) choke is added in series with 1k dropper from VS1 to VS2 to reduce screen voltage ripple from 1.6Vrms to 0.3Vrms.


STEANES 976B, S.N. 2466
Original
PU INPUT
PU VOLUME
500K
470K
3M3
MIC VOLUME
MIC INPUT
1M
12AX7 V1A
VS3
270K
10N
600V
500K
470K
2K2
25uF
25V
V1B
270K
10N
1N
TONE
TONE
100K
500K
4N7
VS2
270K
10NF
600V
12AX7 V2A
4,5
2K2
25uF
820
47
TRANS2
FEEDBACK
FB
F
V2B
100K
1M
2K2
10N
600V
100K
VS1
100
6M5 V3
10K
470K
25uF
25V
150
470K
10K
6M5 V4
TRANS2
903
7.5K P-P, 0-250-500-1000
130+180 DCR
BLK
RD
YEL
RED
WH
1000
OUTPUT
240VAC MAINS
3AG
1A
250 BLU
240 RED
0 BLK
TRANS1
344.096
30 DCR
GRN
260V
172R
YEL
260V
179R
HEATER-1
6V
6V4 V5
VS1
24uF
525V
27K
VS2
24uF
300V
VS3
24uF
300V
TRANS1
HEATER
6.3V 3A
6V4
6M5
6M5
12AX7
12AX7
27
VOLTAGE RAILS
RAIL IDLE
VS1 285V
VS2 250V
VS3 216V
HEATER-1 6.3V
VALVE QTY
6M5 2
6V4 1
12AX7 2
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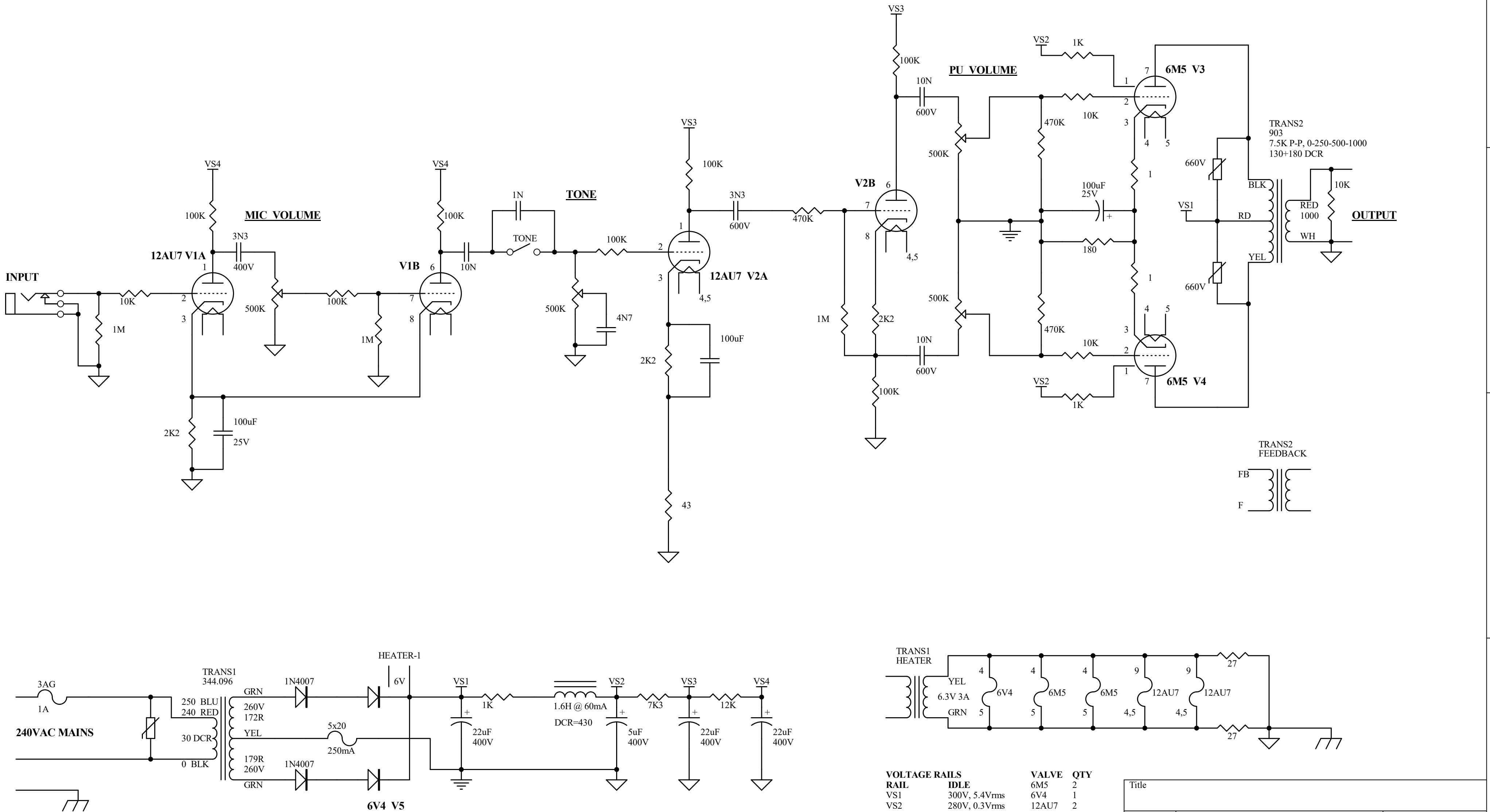

VOLTAGE RAILS			VALVE	QTY
RAIL	IDLE		6M5	2
VS1	300V, 5.4Vrms		6V4	1
VS2	280V, 0.3Vrms		12AU7	2
VS3	250V			
VS4	225V			
HEATER-1	6.5V			

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