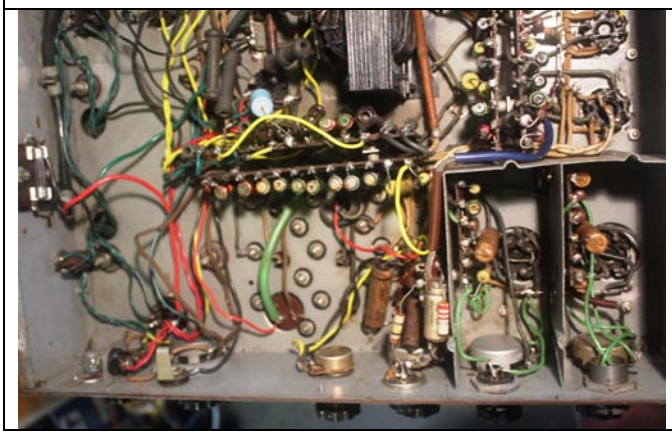
1. Summary

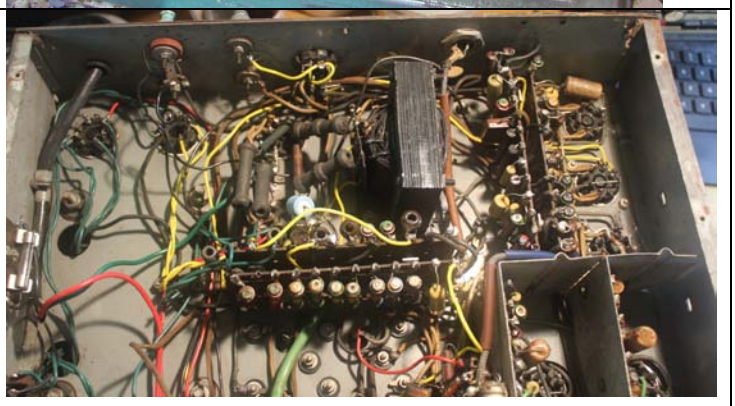
Philips Type 952 valve amplifier. S.N. 4.

Three input (2x MIC, 1x PU) channel PA amplifier. 2x 6J7 MIC amps in screened, isolated enclosure, EF86 MIC amp. 4 input 6J7 mixer. 6J7 amp with output feedback. 6V6 SE driver for inter-stage transformer to feed 807 PP class AB2, and separate screen 100R 5W. Monitor and feedback windings. Power supply transformer with separate plate and screen/preamp windings and 5V4 rectifiers, including low impedance back-bias supply for output stage class B grid-bias.

Output Transformer	Type No. 80W nominal 5,500Ω PP (53+69Ω) Output winding sections 0,30R,75R,125R,200R. Secondary turns pro-rata: 0-387-612-790-1000.
Power Transformer	0-120-220-240-260V; 450-0-450V ?mA; 270-0-270V ?mA; 5V 2A; 5V 2A; 6V3 ~4A (BLK,BLK);
Driver Transformer	231: Pri: Sec with CT
POTs	IRC BHO; PD5
Caps	Ducon Aerovox 10580; UCC superseal; Ducon HS Ducon electrolytic 3669, 127 UCC Superseal 85 type PPS Australian made Mustards 114H, 108H, 125M, 088H, 029H
Resistors	Mix of old cylinder/dot code and carbon comp and WW. IRC WW AA 6811, AA, AB
Valves	807 x2: Brimar brown base : double D getter; 1 cup getter 6J7G x4: Miniwatt 5K 6C; EF86 x1: Mullard ?5F 6V6GT x1: Sylvania 5V4G x2: Philips R54; Radiotron ER

Good general condition. Side handles missing. RC snubber on PP. Shielded and vibration isolated enclosure for input 6J7G x2 (but very difficult to replace valves). Most cable insulation and mounts deteriorated. Added input socket and gain pot, and possible EF86 stage. Two MIC input sockets possibly changed (larger size). Rear PU input socket changed. Many wax caps replaced with mustards. Transformer bolts un-insulated. OT dipped in tar. Main 450V HT too high for 5V4G. 20Ω 5W WW grid stoppers for 807 (only available resistor?). PT bad (shorted windings). Vol pot poor contact. Base plate with rust areas.





2. Aim

- Triode mode 6J7 input stages – either g2 and g3 to anode or g2 to anode and g3 to cathode. Stage gain perhaps around 10x per triode. Operate at about 150V plate, with 250V supply and 100k load and 1mA – needing about 6V bias (5k6Ω with bypass).
- Operate 807 PP as class AB2 with fixed bias, with nominal 280V on screens, and up to 600-700V on plates. Aim for 80Vpp (grid-grid) drive. 807 fixed biasing requires about -30V back-biasing with low source resistance to allow 20-30mA grid conduction. Screen conduction current swings will modulate the resistive back-bias – especially as grid-conduction rapidly increases screen current, and for lower frequencies where the back-bias bypass capacitance is less effective. Regulating back-bias suppresses minor compensation of anode idle dissipation with change in mains voltage. A diode and Zener string is the simplest form of back-bias regulation.
- 6V6 SE inter-stage driver operating in class A, triode-mode at 300V, and about 30mA (about 10W plate dissipation), and needing about 12-20V fixed bias. Plate resistance about

2.4kΩ, and voltage gain about x9. Driver transformer voltage transfer 2.5:2 to 807 Vpp (grid-grid), requires 80x1.25 = 100Vpp across driver primary (35Vrms). Loadline is initially horizontal and transitions to ~ 6kΩ as 807 grid-conduction starts (approx. secondary loading of 20Ω + 20V/20mA ~1k).

- Replace 5V4G with GZ34 or 5AR4, or alternatively add 2x UF4007 in series with each anode for the main B+ supply. Increase first filter cap to 50uF (peak current remains under 3.5Apk). Use steering diode from screen supply to avoid loss of VS1 causing screen 807 distress.
- Use CLC 400V cap filter for approx. 310VDC screen/preamp supply, with Zener diodes to pin the negative end to about 30V below 0V ground for biasing the output stage grids with low impedance, and use a pot to derive bias for driver stage. 6V6 driver VS2 requires about 30mA; 807 screen supply increases from 5mA idle to about 22mA; input stages draw a few mA; so VS2 supply range is about 40mA to 60mA. Output stage bias current increases from 0 to about 20-30mA (estimate). Zener needs to conduct up to 60mA max (no bias supply current), so max dissipation is about 1.8W. Zener will achieve rapid bias turn-on as VS2 starts to rise and draw current.
- Fender style tone-stack using treble pot and bass 3-pos switch.
- Restrict bandwidth – target 60-70Hz stage CR coupling corner frequencies (4N7 & 500kΩ). High frequencies attenuated by tone stack, and then across driver transformer primary.
- Feedback via monitor winding – plugging in monitor jack can then disconnect feedback. Adjust feedback resistor for about 6dB feedback. CR coupling to driver stage, and driver transformer primary shunting can roll-off gain before output transformer effects are seen.
- 10Ω current sense resistors for 807 cathodes. Worst-case current waveform estimated at 200mA squarewave, so 100mArms causing 0.1W dissipation.
- Configure the output transformer speaker windings to present an 8Ω level at speaker terminals. Speaker should be able to handle 100W.
- Check if hum is alleviated by heater elevation.

3. Modifications

- Megger checked transformers ok.
- IEC socket/fuse/switch combo. MOV on PT primary.
- 2x IN4007 in series with each 5V4 plate. PP stage supply CT fused.
- EC13 choke for VS2 CLC supply.
- 30V Zener for back-bias using 15V + 2x 5V6 zeners + 6x 1N4004 in series with output switched back to a Zener/diode node, and 15V Zener always in circuit. Set bias for 20W dissipation (500V x 40mA).
- 6V6 fixed bias taken from pot across back-bias.
- Steering diode (2x 1N4004) from VS2 to VS1.
- Replaced electrolytic and foil caps.
- Replaced isolation mounts.
- 807 grid stoppers replaced by 20Ω 1W.
- Sensing ouputs taken to impedance matching octal on rear panel.
- Power transformer replaced with TEK 120-0117. Although this transformer has multiple spare windings to allow fixed bias, the original back-bias was retained.
- Cleaned vol pot track.
- Added Fender style tone-stack with fixed mid-range, and fail-safe across Bass switch.

Replacement power transformer - TEK 120-0117-00 Power Transformer for 502A Oscilloscope

Primary: 110,117,124,220,234,248V (50 or 60Hz)
Main windings 1,2,3,4 are 117V and 234V, with A,B,C,D buck/add windings.

Heaters (loadings from tubes identified in 502A schematic)

terminals;	voltage;	heater current loading
12-13	5V	2A [large terminals]
27-28	5V	2A [large terminals]
5-6;	6.3V	~0.6A
22-23	6.3V	3A
24-25	6.3V	?A (probably <1A) 3kV elevated
18-19	6.3V	9.7A [large terminals]
10-11-21	9.5-0-9.5V	0.6A at 6.2VDC heaters

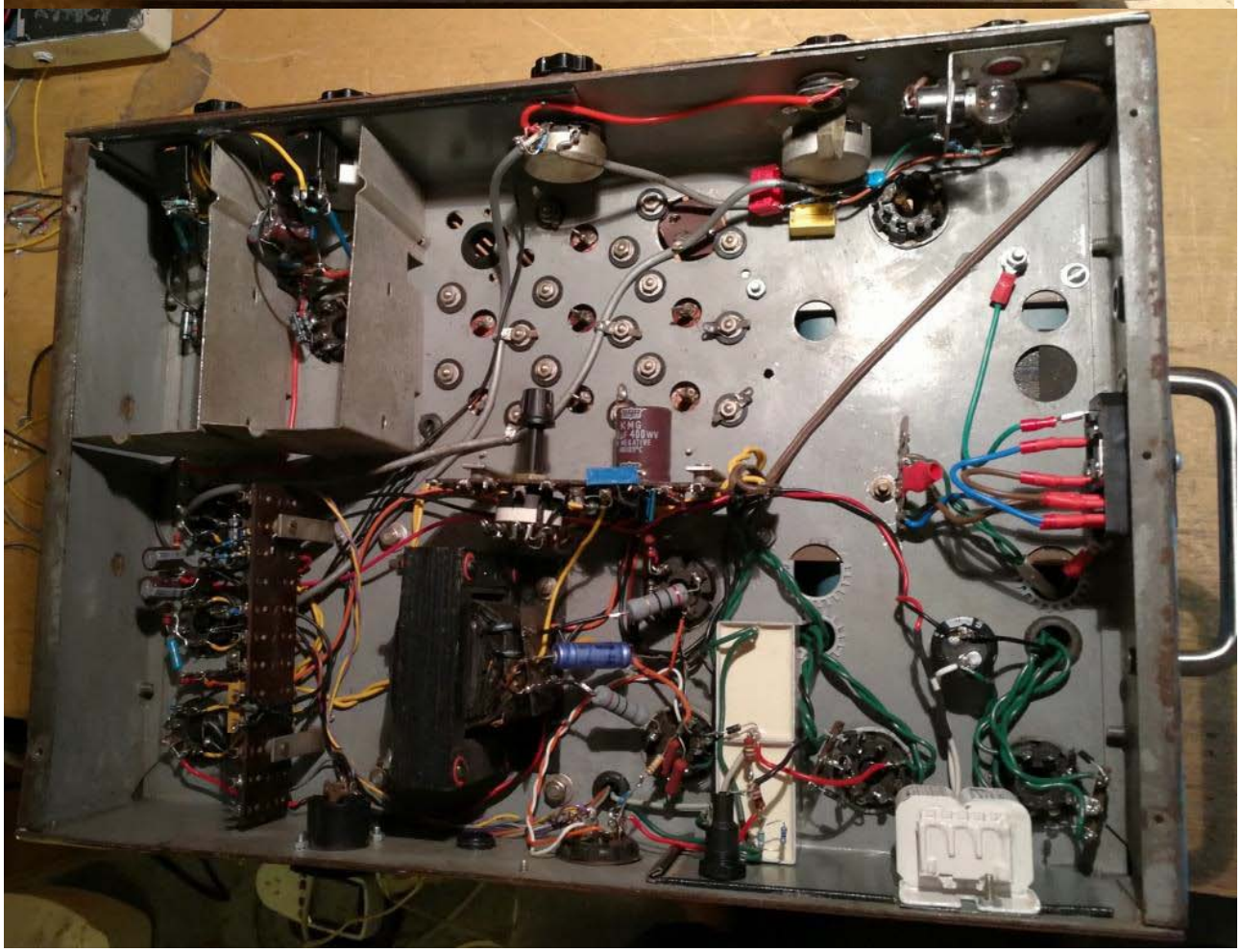
HT windings

29-17-30:	395-0-395V	~200mA	DCR=88
7-8-9:	175-0-175V	~100mA	DCR=176
14-15-16:	220-0-220V	~150mA	DCR=86

[anticipated ratings based on comparison with other transformer ratings and DCR]
Screens

20:	primary side earth screen.
26:	not connected.

Core size: 95x115mm, 65mm stack.



4. Measurements

Megger test 1kV on PT mains, and 500V on OT primary and secondary – all ok. PT has a shorted turn(s) – draws abt 0.7A on primary winding.

TEK PT: 245V, 30mArms. 405-0-405; 224-0-224: 5.66; 5.66; 6.8.

Voltage rail regulation.

Rail	245Vac mains	45W output	60W cranked
	Bias set for 20W per 807		
VS1	540V to 487V idle, 7.7Vac 41+42mA, 20W + 20W VS5: -20.3V	445V	435V
VS2	(250V, 1.7Vac) 246V	242V	223V
V3	238V Vak, 28mA, 6.7W VS6: -15.7V		
VS3	227V		
V4, V5	128Va, 5.6Vk; 123Va, 5.7Vk		
VS4	209V		
V6, V7	114Va, 5.3Vk; 114Va, 5.3Vk		
Heater	6.5V		
Sec HT			

12VAC 50Hz nominal applied to output transformer

Winding	Voltage rms	Turns ratio; Impedance for 5.65K pri; Spec level; Notes			
Pri P-P:	49.2				
Sec: 200Ω	9.26	;	Ω;	200Ω;	1000T
Sec: 125Ω	7.4	;	Ω;	128Ω;	800T
Sec: 75Ω	5.56	;	0Ω;	72Ω;	600T
Sec: 40Ω	3.7	;	Ω;	32Ω;	400T
Sec: COM	0				0T
Sec: FB	1.86	;	Ω;	8Ω;	200T
Sec: 0Ω	0				0T
Sec: MON	0.124	;	Ω;	0.04Ω;	13T

Output transformer primary DC resistance: 55+50Ω.

Output transformer tap locations: Anode; B+; Anode; space; Mon; 75Ω; 200Ω
COM; space; FB+; FB-; space; 40Ω; 125Ω

Five sections of windings have 20% turns for 8Ω, but can't be separated in to independent windings (only the 0-40Ω section can be completely separated). The FB and 125-200Ω (or 40-75, or 75-125 sections) are connected in parallel (FB+ to 125, and FB- to 200) to provide an 8Ω output. The Mon tap is relative to the FB-, which is connected to signal ground.

Measured stage gain: V7, V6 each about +22dBV (13x). V5 gain with tone at max and bass at max is about +15dB (6x).

Frequency response has LF roll-off from coupling caps of around 80-100Hz corner, and HF roll off above about 10kHz. Tone and Bass switch have reasonable variation. Preamp frequency response extends from abt 70Hz to 22kHz at -3dB.

Relatively clean out to 45W in to 8Ω (4.4% THD), with <28mVrms input (couldn't max out all pots – tone at max). Cranked to 60W continuous with clipping. See measurement waveforms and spectrums.

Output noise floor (Keithley 197):

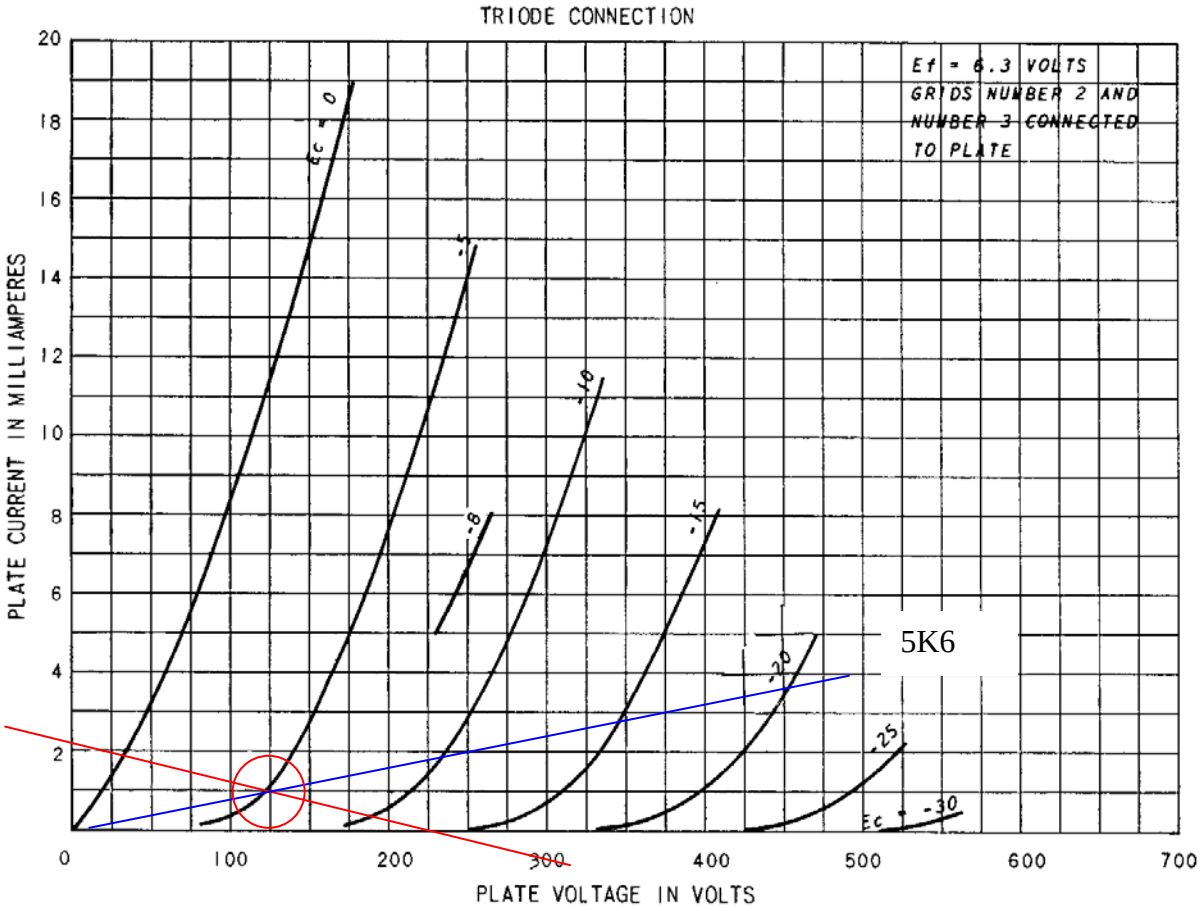
1.7mVrms with all pots at min	1.9mVrms with Vol at max
9.4mVrms with MIC2 and Vol at max	144mVrms with MIC1, MIC2 and Vol at max.

Weight 21.4kg

To do:
Rewire monitor socket for feedback – need new socket.

4.1 Pre-driver Stage

6J7, V5; VS3 = 230V; Va=125V; Rk=5k6; Vk=5V; Ia=1.0mA; RLdc=100k. Available swing is 220-30=190V, ie. >50Vrms.



4.2 Power Supply – secondary DC side

6.3V heater loading: 2x 0.9A, 4x 0.3A, 1x 0.2A, 1x 0.45, 1x 0.32A= 4A
5V heater loading: 2A each.

The power supply is typical full-wave rectified type using double diode 5V4G and a 450-0-450VAC centre-tapped secondary, which is just above the max specified voltage for capacitor input. The effective input resistance of the transformer is about 7Ω x $(450/240)^2$ + 105Ω = 130Ω.

Two UF4007 in series with each anode would be needed to allow 450VAC supply. 20uF first filter capacitance has hot-start peak current of 2A (below 3.5A). VS1 is about 560VDC with 60mA idle (9.4kΩ load) with 17Vpp ripple, sagging to 520V at 120mA (4.3k load) with 31Vpp ripple.

VS1 fuse in CT; idle load at startup; max load continuous IEC F fuse

Simulate period in PSUD2	10ms	50ms	continuous
Simulated RMS current	1.1A	0.54A	0.21A
Multiplier (based on 0.315A fuse rating)	3.5	1.7	0.67
IEC60127-2 Quick-acting F min limit multiplier	4	2.75	1

VS1 fuse in CT; idle load at startup; max load continuous IEC T fuse

Simulate period in PSUD2	20ms	150ms	600ms	continuous
Simulated RMS current	0.84A	0.37A	0.26A	0.21A
Multiplier (based on 0.25A fuse rating)	3.4	1.5	1.1	0.84
IEC60127-2 Quick-acting F min limit multiplier	10	4	2.75	1

The 0.25A T is preferred as it has a lower continuous current rating.

Idle voltage of VS2 is about 470V with 83mA from 6L6, and about 9mA from preamps.

The choke drops 33V at 100mA, and the 5V4 drops about 16V, and with capacitor ripple, VS2 will droop to about 465V at 100mA continuous.

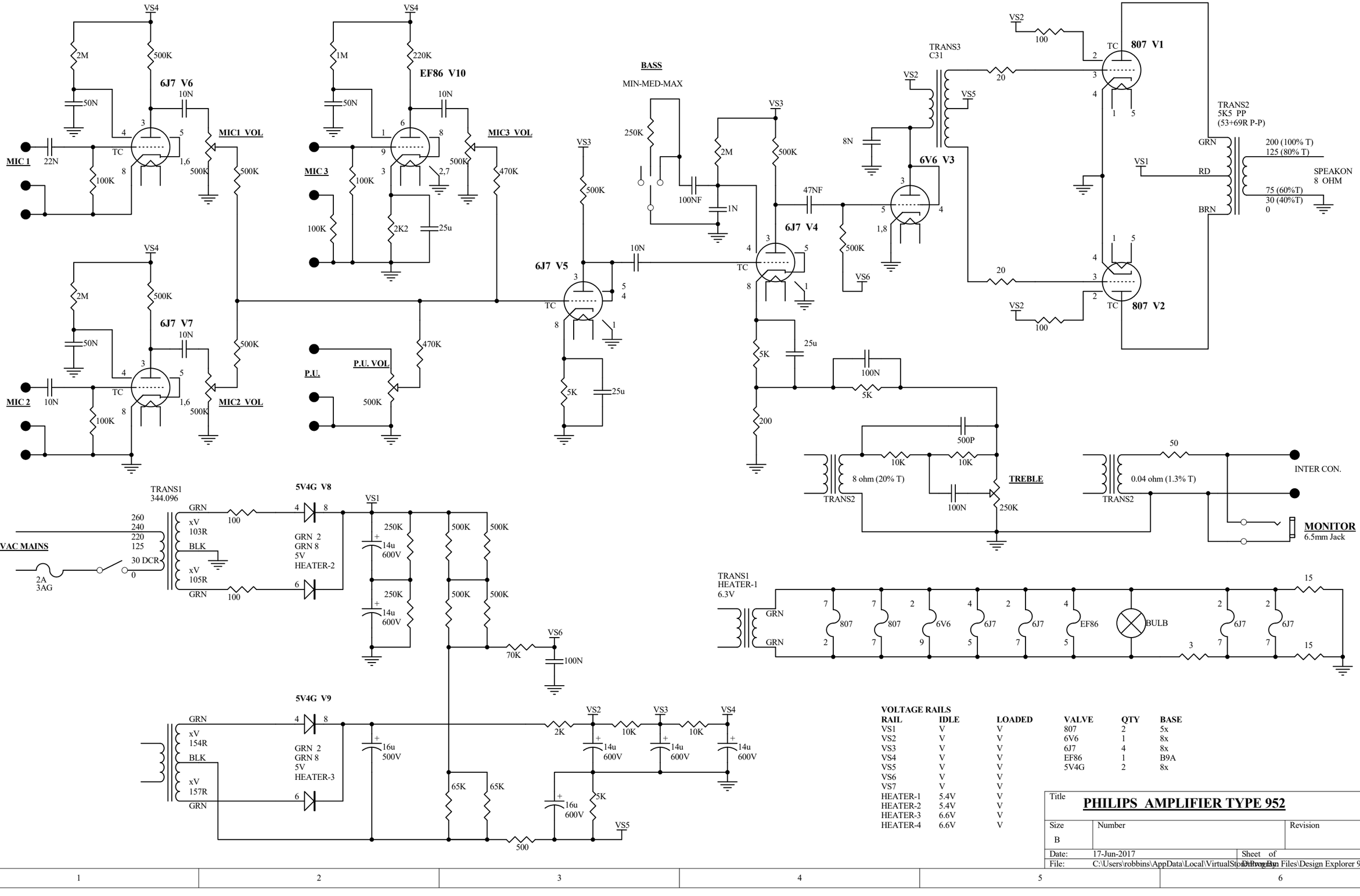
VS3 screen voltage dropped from VS2 using 24k and 47uF 400V with 11x33V zener to limit peak. Screen stoppers initially at 1k.

Heater loading is 2A on 5V 3A winding; 2x0.9+0.3=2.1A on 6V3 3A winding; and 0.3+0.3+0.3+0.3=1.2A on 6V3 3A winding.

Idle loading from VS4 is ~1.2+1.2=2.4mA; VS3 is ~ 1.2+1.2+1.7=4.1mA; VS2 is ~ 90+4.1=94mA, (84V drop from VS3 to VS4 via 30k; 139V drop from VS2 to VS3 via 24k; and 33V drop from VS1 via 330).

4.3 Power supply - AC primary side

Primary fuse: initially use IEC 2A T time-delay (VBS UTE 250V) – T2AL250V.



VOLTAGE RAILS

RAIL	IDLE	LOADED
VS1	V	V
VS2	V	V
VS3	V	V
VS4	V	V
VS5	V	V
VS6	V	V
VS7	V	V
HEATER-1	5.4V	V
HEATER-2	5.4V	V
HEATER-3	6.6V	V
HEATER-4	6.6V	V

VALVE	QTY	BASE
807	2	5x
6V6	1	8x
6J7	4	8x
EF86	1	B9A
5V4G	2	8x

Title: **PHILIPS AMPLIFIER TYPE 952**

Size	Number	Revision
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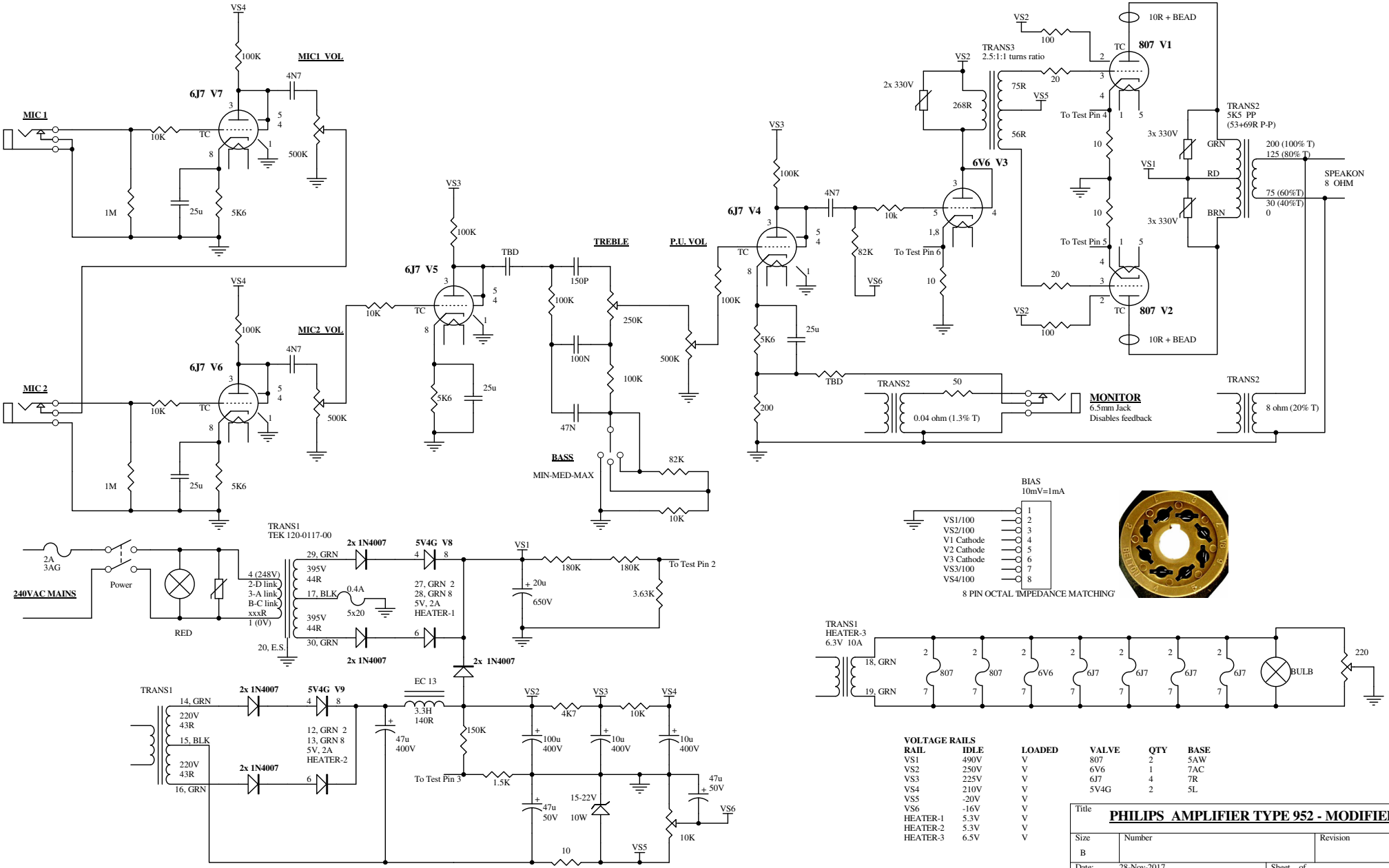

VOLTAGE RAILS

RAIL	IDLE	LOADED	VALVE	QTY	BASE
VS1	490V	V	807	2	5AW
VS2	250V	V	6V6	1	7AC
VS3	225V	V	6J7	4	7R
VS4	210V	V	5V4G	2	5L
VS5	-20V	V			
VS6	-16V	V			
HEATER-1	5.3V	V			
HEATER-2	5.3V	V			
HEATER-3	6.5V	V			

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