1. Summary
Small 5W Stereo Valve Amplifier with radio and selector strip.
eBay $23, Jan 2014.

1.1 Original Amplifier
Front panel strip for GRAM, RADIO, POWER OFF. 6AN7A and 6N8 radio valves. 12AX7 preamp. Dual gang volume, bass and treble pots. Balance pot. Chassis stamped 1569.

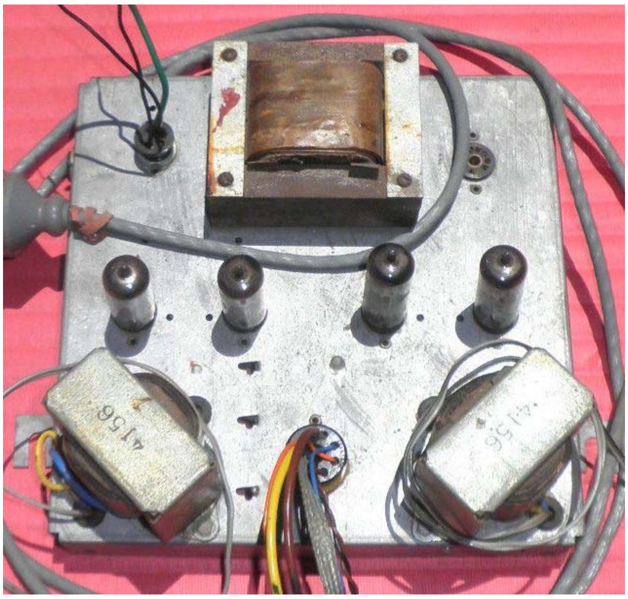
Amp chassis with 1707 marking. Rectifier tube (likely 6V4) with 10nF suppressors across secondaries. Stereo 6DX8 (ECL84) PP amps, common cathode biased and bypassed. Input triode with feedback to part cathode. Capacitor coupled to split load PI.

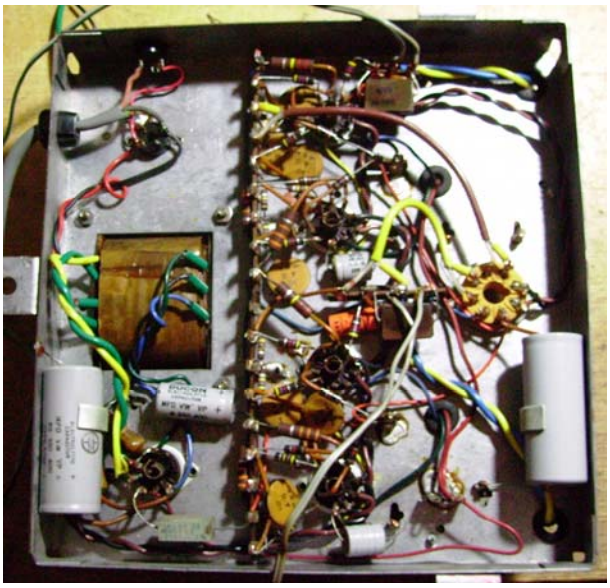
Components

Tubes	6AN7A x1, VZ C8C 454 Mullard Australia (Hendon Works; 1968 Mar) 6N8 x1, 4R 5H N4 AWV (EBF80; 1965 Aug) 12AX7 x1, OH 27 N4 AWV
Output Transformer	4156 0C8; 16K PP; 16Ω secondary..
Power Transformer	3261 0C8 ; 0-240V; 260-CT-260 ?mA, 6V3 5A.
Tubes	6DX8 x4, f4 7K (T5, T5, 640, ?) AWV (Hendon Works; 1964)
CAPs	Ducon ET6F, ET7B, dated 1965

Issues:
No mains fuse; primary winding through connectors and cableforms. Leaking electrolytics. Chassis grounding. Wax caps. No pre-load.

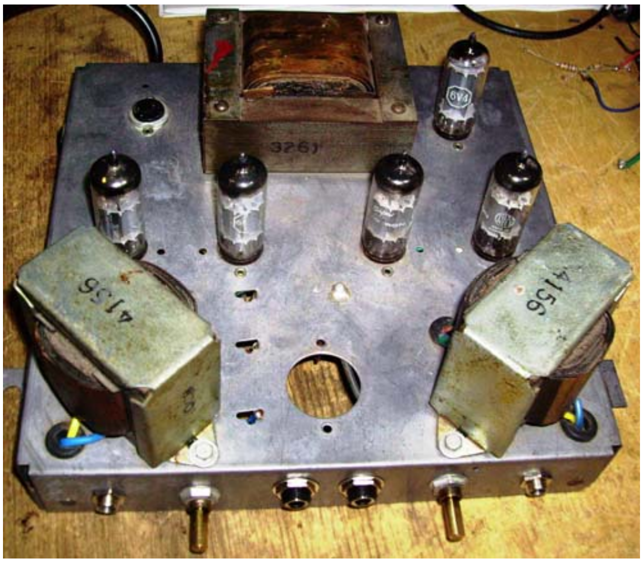
Dating of 0C8 on magnetic, 1569 on chassis, valve and cap dates, appear to indicate 1969 manufacture.

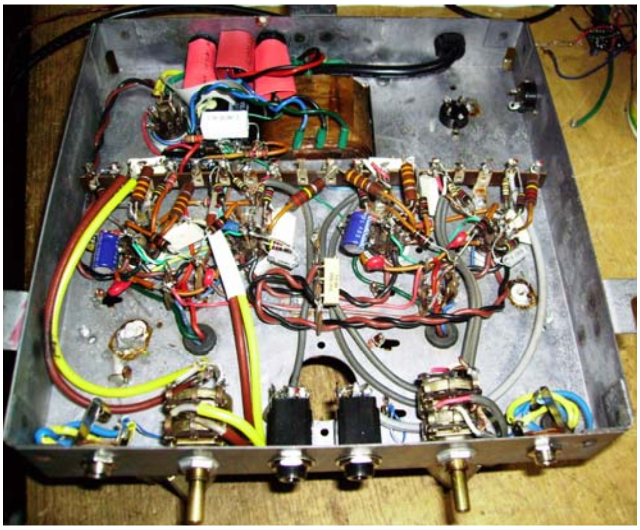




2. Modifications

- New mains cord and earthing, and 431KD10 MOV across primary winding. Mains fuse (0.5A) and DP switch added.
- Fused PT CT (0.5A).
- Replaced all caps (electrolytic, ceramics, paper). Removed 10nF PT secondary bypasses. Reduced VS2 to 15uF. Increased VS3 to 15uF.
- Distributed grounding, using spigots on valve bases.
- MOVs across OT primary halves – 330VDC (2502 GEAQ).
- Removed output feedback circuitry and increased bypass on input triode to 4.7u.
- Added 47kΩ grid stopper to PI.
- Heater through poor-man's fusing humdinger pot.
- Raised common cathode bias resistor to 180Ω, and added individual cathode 10Ω sense resistors.
- VS1 to VS2 dropper increased from 2k to 3k3 5W to target 200V screens. VS2 to VS3 dropper lowered from 120k to 10k to target 200V supplies.
- Switched input and Speaker ¼" sockets.
- Post-PI volume control – dual gang 250k.
- Removed control octal socket.





3. Measurements

Transformers megger tested ok.

Rail	Idle	Idle	Cranked
VS1	280V (140mVrms)	285V (1.7Vrms)	278
VS2	208V (20mV)	250V (45mVrms)	230
VS3	181V	216V	200
Cathode	4.0 (11+11mA) 3W	4.6V (13+13) 4.3V (11+13)	
V2A cath/anode			
V1A cath/anode		38/173V	
Heater		6.2	
Sec HT		250-0-250	

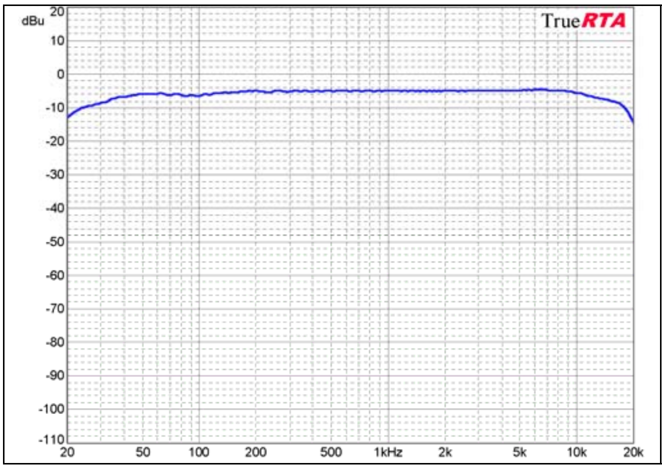
Power transformer primary DC resistance: 0V black; 36Ω, 240V.
Power transformer secondary DC resistance: 107Ω + 115Ω.

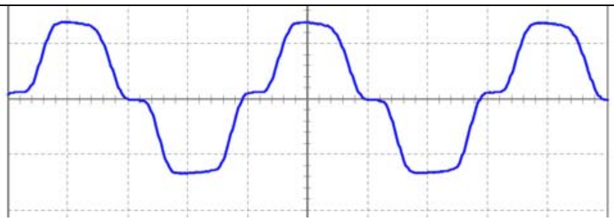
4156, 10VAC 1kHz nominal applied to output transformer primary side

Winding	Voltage rms	Turns ratio;	Pri Impedance; Spec level; Notes
Pri P-P: GRN to BLU	32+32	-;	16,000 Ω;
Sec: BLK to WH	2	31.7;	16 Ω;

Output transformer 16k primary DC resistance: 614+667=1281Ω plate-to-plate.

90mVrms input for 3W (16.5Ω load) just before noticeable waveform distortion.
380mVrms input for start of PI clipping.
Flat frequency response.



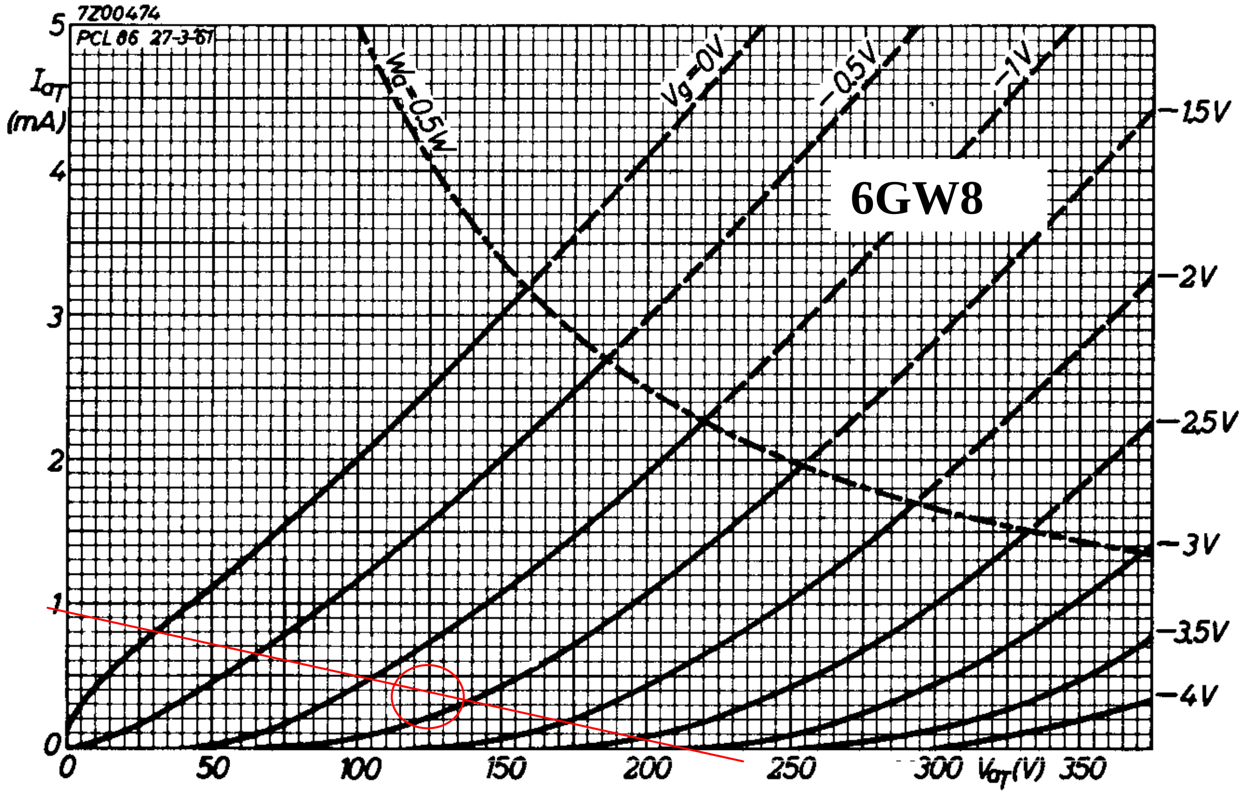


500Hz sine input to amp. 4.3W cranked output waveform to 16.5 ohm resistive load.

4. Design Info

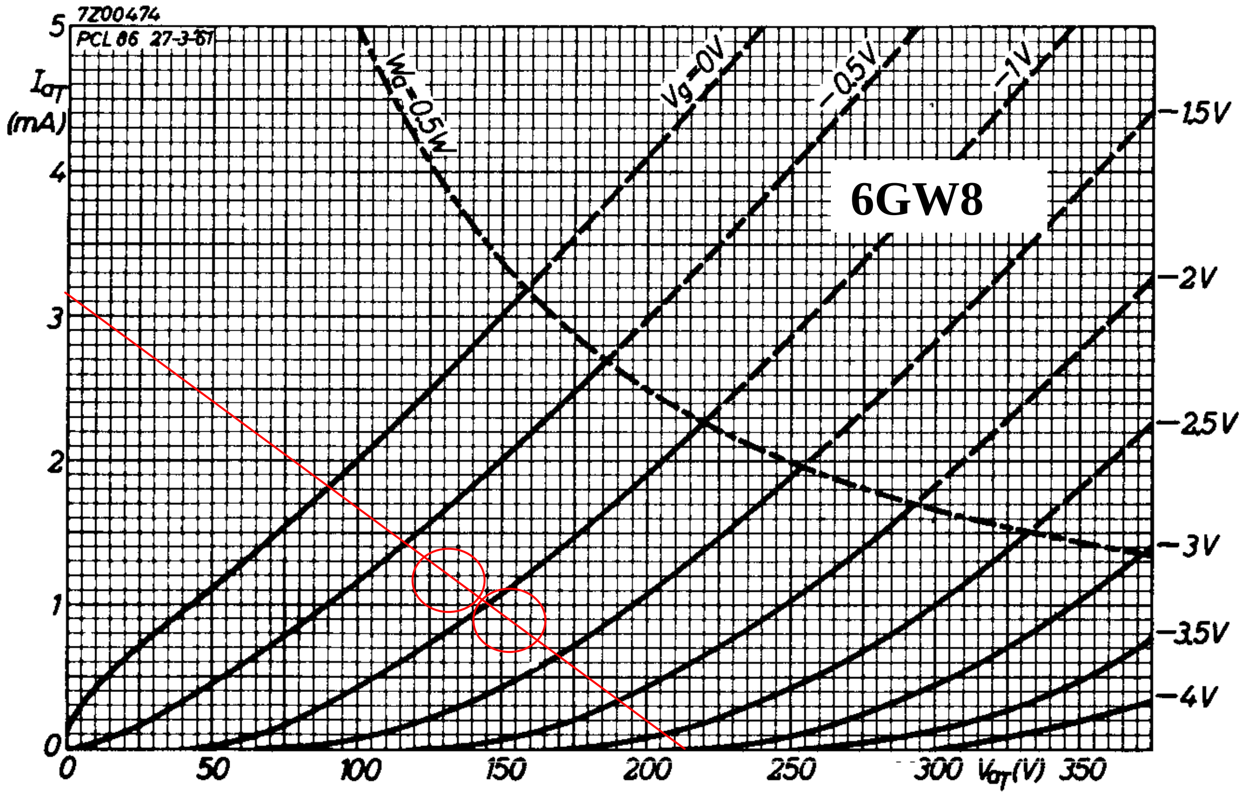
4.1 Input stage – 6DX8 triode

VS3=210V; Plate=125V; cathode=1.8V; 4k7=0.38mA.
No triode curves available, so 6GW8 curves used.



4.2 Splitter stage – 6DX8 triode in cathodyne config

VS3=213V. Plate/cathode resistors 33k. Load line resistance of 67k. Cathode bias 1k. Min plate-cathode voltage ~90V. Max swing ~(213-90)/4 = 30Vpk.
Initially measured: plate=173V; cathode=38V; cathode current ~1.15mA.
So cathode biased increased from 1k to 1k8.
Measured: plate=184V; cathode=29V; cathode current ~0.87mA.



4.3 Output Stage – 6DX8 Pentode Push-Pull

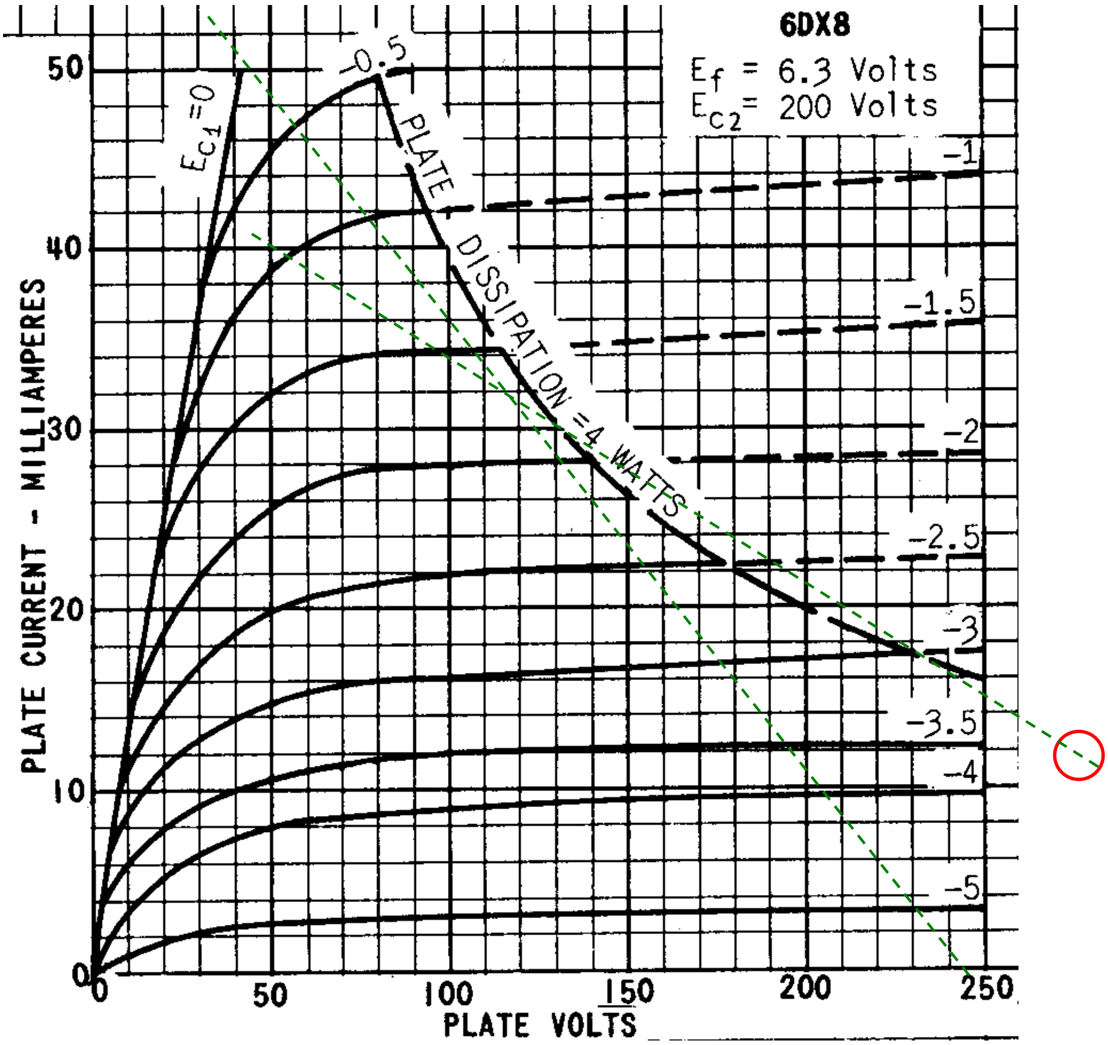
This Class AB push-pull output stage uses the 6DX8 pentode with common bypassed cathode bias. The 16KΩ impedance plate-to-plate OPT presents signal currents into each tube with an 8KΩ impedance with both tubes conducting, to 4KΩ load impedance at higher levels.

As the output loading increases, the supply voltage VS1 to the output valve plates sags from about 285V towards 278V at about ?mA average [tbd]. Plate DC voltage will be lower than VS1 by an amount up to ~32Vpk; ie. OPT half resistance of about 650Ω with a peak current of up to about 0.05Apk. Cathode voltage has an idle bias of 4.5V and a peak of about 5V. So effective plate-cathode voltage sags from about 285-9-4=272V to about 278-32-5=241V.

With 8k2 for VS1 to VS2 dropper, VS2 droops from 212 to 198V when cranked, with VS1 staying at 290V, indicating additional 2mA average drawn by screens on one amp. Screen voltage will droop from about 205V towards 175V as grid reaches 0V, with screen current reaching 10mA at 0.5V grid and 100V anode, and 16mA at 0V grid and 50V anode. VS1-to-VS2 dropper lowered to 3k3, VS2 droops from 250 to 230V when cranked, with VS1 dropping to 278V, indicating additional 10mA average drawn by screens on one amp. Screen voltage will droop from about 240V towards 210V as grid reaches 0V, with screen current reaching 10mA at 0.5V grid and 100V anode, and 16mA at 0V grid and 50V anode.

The maximum output valve bias current allowed is dependant on the maximum recommended plate dissipation of 4W for the 6DX8/ECL84: Ibias(max) = Pd / Vb = 4W / 280V = 14mA. With a common cathode resistance of 180Ω, and gate-cathode voltage of 4V, the plate idle current is 27mA, which is a bit high.

Assuming the loadline sags to about 278V plate level and a peak plate current of 50mA is achieved, then the nominal output power of the amplifier (ideal class B2) would be: $(Ipk)^2$ x Rpp / 8 = 0.05 x 0.05 x 16k / 8 = 5W. For this maximum signal condition, the rms OPT current draw is likely about 32mA (64% of peak), and the average VS1 power consumed is 280x0.032 =9W, and cathode bias loss is <1W, so the tube plates dissipate 9 – 5 = 5W, or about 2.5W each. 10Ω sense resistors added to each cathode.



4.4 Power Supplies

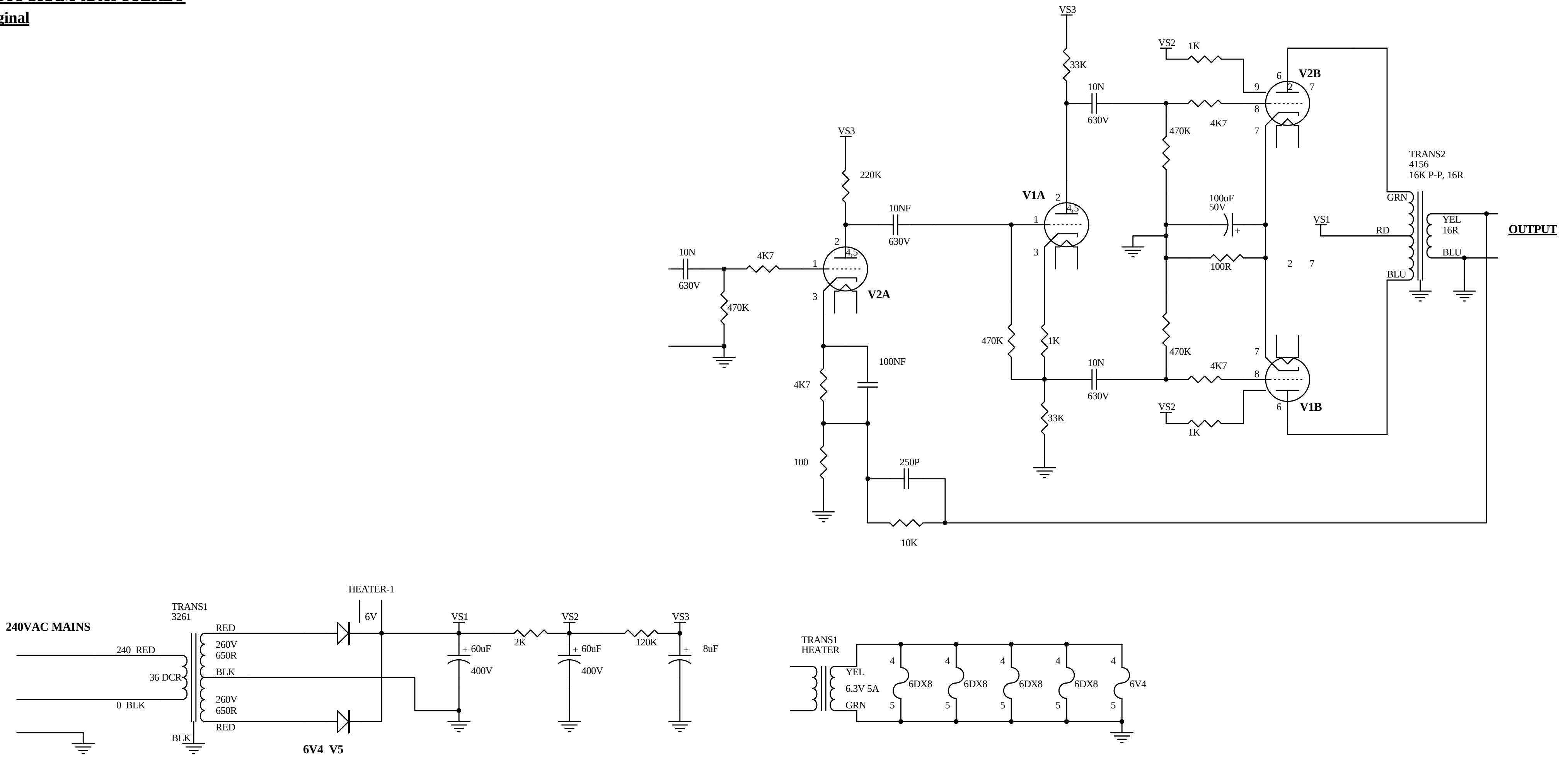
A standard CT full-wave rectifier circuit with 6V4 is used with 260V secondary HT windings with centre-tap to 0V. A 60uF filter is used to generate VS1 and ripple on VS1 is ~1.7Vrms. VS2 and VS3 are obtained by independent RC filtering from VS1. VS2 set to 250V, so that sagged screen level gets close to 200V.

The 6V4 has limits on the effective source resistance when feeding a capacitor-input filter. The effective source resistance is comprised of the reflected power transformer primary resistance = $36\Omega \times (260/240)^2 = 42\Omega$; plus the secondary resistance = 110Ω; which sums to 150Ω. The effective source resistance should be 125Ω for a secondary supply of 250Vrms, based on 50uF capacitor input filter. For 260V secondary and 60uF, the output DC level will sag from about 320V to about 290V.

Heaters: 4x 0.72 + 3x0.3+ 0.6 = 4.4A. PI operates cathode at about 30V.

RADIOGRAM 6DX8 STEREO

Original



VOLTAGE RAILS	
RAIL	**IDLE**
VS1	285V
VS2	250V
VS3	216V
HEATER-1	6.3V

VALVE	QTY
6DX8	4
6V4	1

Title	RADIOGRAM		
Size B	Number		Revision
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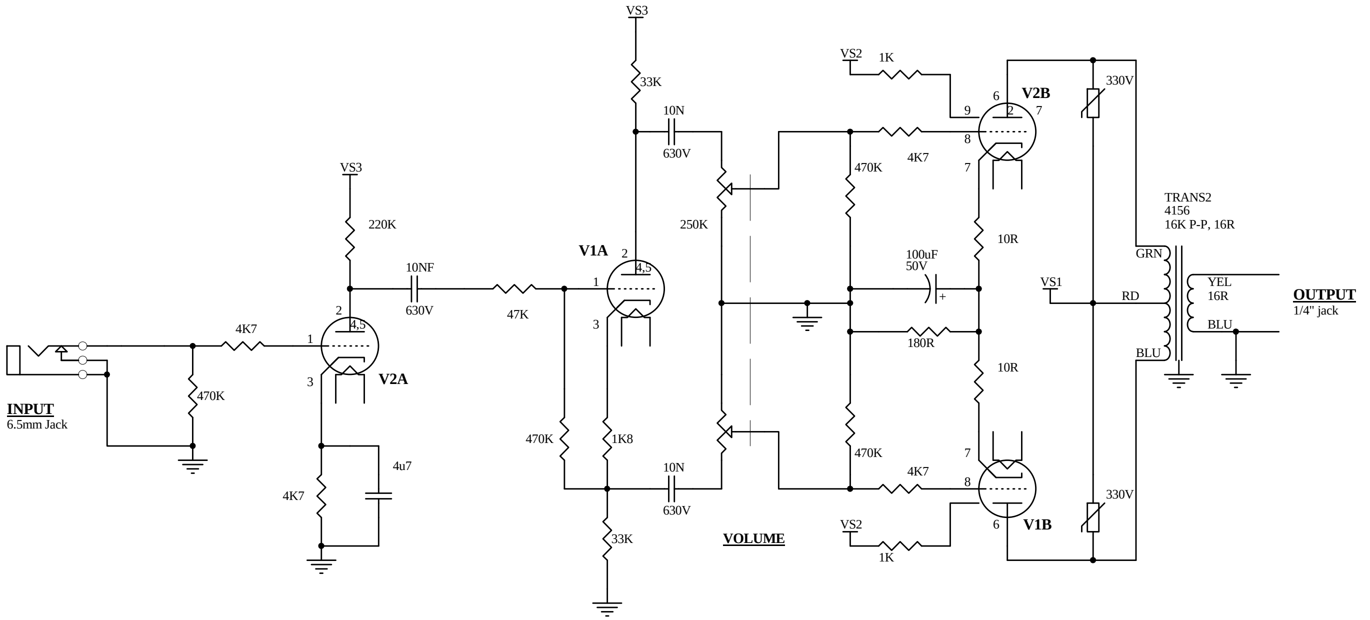
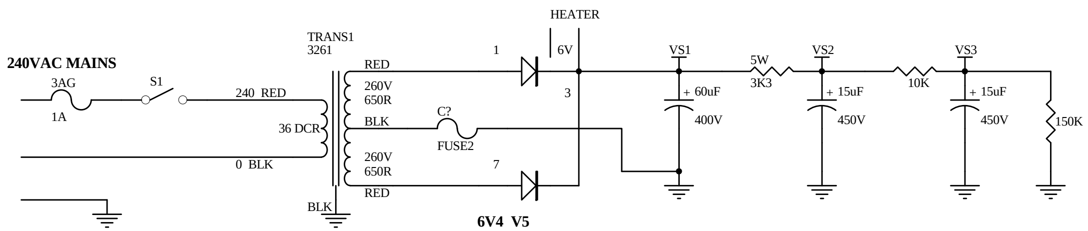
File:	C:\Program Files\Design Explorer 99 SE\Examples\Projects\Amplifier Modules.ddb	Drawn By:	

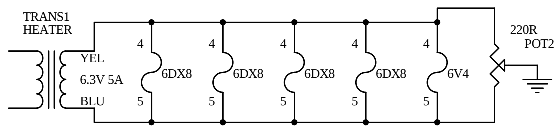
6DX8

6V4 base

RADIOGRAM 6DX8 STEREO
Modified







VOLTAGE RAILS

RAIL	IDLE
VS1	285V
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VS3	216V
HEATER-1	6.3V

VALVE	QTY
6DX8	4
6V4	1

6DX8 base

6V4 base

Title	RADIOGRAM		
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