1. Summary

AWA PA30BZ 30W valve amplifier. S.N. X53064. Apr 2019. with PA 835 turntable.

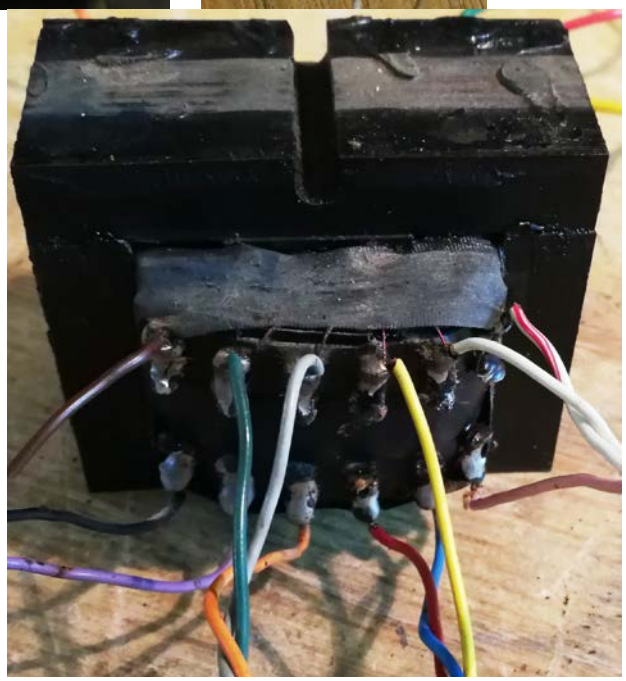
Two MIC input channels, plus phono and Radio PA amplifier. Microphone 12AX7 preamp stages and separate gain pots (ganged), and switched Radio and pick-up inputs with common volume and ganged tone pot – all mixed to 7199 pentode input with bass cut screen filter. Pentode output to triode cathodyne PI stage input with output limiting via bulb (driven from output stage grid-grid signal) optically coupled to LDR. PI top output feedback to pentode input through trimmer cap. KT88 individual cathode biased UL PP stage with no global feedback. Switched monitor speaker off tapping.

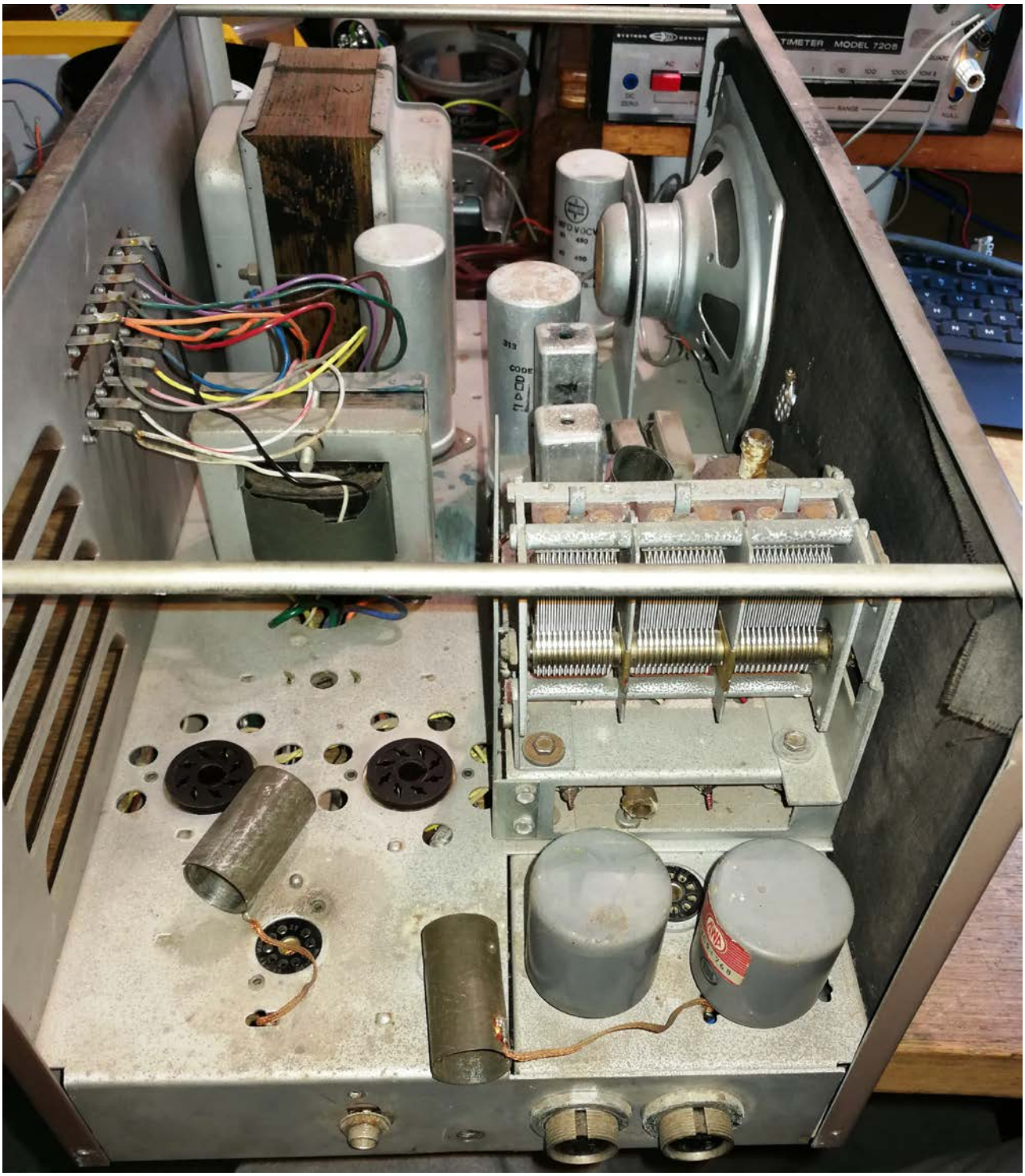
1.5A fuse – no mains switch. Doubler on 155V secondary using 1N1764's; 90uF 450V caps, then 0.375A fuse in ~420V HT DC feed to PP stage. 6V3 with 68R-68R humdinger to one KT88 cathode. Sockets for MIC1, MIC2, Phono, Radio aerial/earth. Bass Normal/Cut switch. Mic Vol ganged pot. Phono-Radio Vol/Tone ganged pot. Tuner sub-chassis with front panel dial and tuning eye. Output limiter trim pot. Monitor speaker front panel switch.

Output Transformer	Type No. 50581 6K2Ω PP 30W UL (43% TR) CH3 Outputs: 0,20Ω,30Ω,50Ω,80Ω,130Ω,190Ω,250Ω,330Ω (100V).	
Power Transformer	51173. 155V @ ?00mA (RD,RD); 6V3 6A; -10-0-220-240V (BLU,GRY,OR,YEL) Upright with steel bell-ends. 100x50mm core. 120mm high.	
Microphone tx	7XD51768 x 2 Parallel input windings RD/BLK,OR/GRN, and output BLU/BRN with WH screen.	
POTs		
Resistors	IRC WW 66 37 ; 63 13.	
Caps	Ducon cans 313; Ducon cap 491 ; 38 63; Anocap TFA J223	
Valves	KT66 x2 7806 Z ; 7950 Z MOV – brown bases, made Hammersmith (1978, 6th week; 1979 50th week)	
	6BL8 AWV , YE 9 ; R8	
	12AU7A AWV Japan	
Tuner Module	W65907 , dated 28 May 1963	
	6N8 Miniwatt 4R C41 Hendon 1974, Jan	0.3A
	EM81 Telefunken B0312001	0.3A
	OA2 TE British Electric 12	
	6BA6 AWV ML 18	0.3A
	6BE6 AWV KL 28	0.3A
Speaker	AWA elliptical 50230 6 40A/15 RF4	

Electrical test tag dated 2014. Very clean underneath. Very dust covered on top. 2x KT66 instead of KT88. 12AU7 instead of 12AX7. Factory wired for 6BL8 instead of 7199. Microphone Tx's fitted. Possibly replaced KT88 cathode resistor. Replaced 270R screen resistor with 2k7. Added 50uF cap underneath. Feedback cap goes to other side of C209 (to reduce voltage stress on trimmer).

Aim: Reconfigure for one guitar input with sequential gain stages and output gain pots. Aux line input with input vol pot. Tone control moved to mixer input. Parallel all 20Ω secondary windings for nominal 15Ω speaker output. Use front panel Monitor switch for mains AC power switch. Use front panel PU/Radio switch to disable output limiter.




TIMETER MODEL 720B

2. Modifications

- Grounded speaker winding via star ground, with chassis link at output stage 0V star.
- Removed all output tap wires and paralleled at the transformer.
- Replaced aerial terminals with Speakon output connector.
- Removed microphone transformers.
- Reconfigured preamp section and replaced MIC1 socket with isolated 6.5mm switched jack. Bias via amber LEDs. Added MIC 1 pot bright cap. Reconfigured tone control to be after second preamp gain stage output pot, and prior to mixing node. Added attenuator to each mic amp stage to raise sensitivity to circa 10mVrms.
- Reconfigured PU socket as line input to PU Vol pot and then to mixer node. Removed 330k mixer resistors.
- Lowered coupling cap values to output stage to 10nF.
- Heater humdinger pot taken to bypassed ~ +60Vdc as a preload divider on VS2 rail – to avoid accidental loss of bias to one output stage valve, and lower the Vhk stress on 6BL8 triode, and possibly lower hum on 12AX7 stages.
- Replaced 270Ω screen stoppers on output stage with 150Ω 0.4W poor-mans fuse, then increased to 560Ω 2W.
- Output stage valve pin 1 is now disconnected (it is a shield for KT88, and an internal connection for KT66, but is g3 for EL34, and NC for others).
- Replace anode-screen output stage caps with 2502 GEAQ MOVs, and added MOVs from screens to VS1.
- Moved FS202 from B+ DC to AC secondary winding.
- Replaced HT diodes with UF4007.
- Added EC13 choke and 47uF 450V to reduce B+ ripple for UL stage.
- Reconfigured Monitor switch to mains AC on/off.
- Changed output stage cathode bias to 606Ω, with a 16V 5W Zener across one of the 270Ω 3W to constrain bias voltage rise with over-drive.
- Shunted 1nF across PI to lower HF bandwidth.
- Reconfigured EM81 on radio module to indicate speaker output level.

To do:

- Guitar and speaker test.
- Rear panel labels.
- Metal cover for rear panel output socket, or install a DB9 and cover plate.
- Metal baseplate.

Optional:

- DB9 with monitoring connections.
- Speaker connection with switch.

3. Measurements

Megger test 1kV on PT mains and secondary and OT primary – all ok. OT secondary ok.

Voltage rail regulation. Prim = YE to BL

Rail	240Vac				
VS1	425V 460V turn-on max				
VS2	306V				
VS3	260V				
VS4	63V				
Cathodes	35V (600Ω) 58mA 24W				
Heater	6.5				
Sec HT	160V				

YEL-OR 0.9 Ω OR-GRY 7.3 Ω GRY-BLU 0.4 Ω YEL-BLU 8.3 Ω
160VAC 4.0Ω

12VAC 50Hz nominal applied to output transformer 50581

Winding	Voltage rms	Turns ratio; Impedance for 6.2K pri; Spec level; Notes DCR
Pri P-HT: Or-Bu-Rd	5.45, 12.73	Driven winding
Pri HT-P: Rd-Gr-Yel	5.31, 12.59	UL = 42% of plate voltage (turns)
Sec: Bk to Wh	5.8	; 329 Ω; 12-1 (3-4,6-7,9-10) 330Ω; 1000T
Sec: Bk to Wh		; 251 Ω; 12-1 (3-5,6-7,8-10) 250Ω; 873T
Sec: Bk to Wh	4.35	; 185Ω; 12-1 (2-4,6-7,9-11) 190Ω 750T
Sec: Bk to Wh		; 130Ω; 12-1 (3-4,5-8,9-10) 130Ω 628T
Sec: Bk to Wh	2.9	; 82Ω; 12-1 (1-4,3-10,9-12, 6-7) 80Ω 500T
Sec: Bk to Wh	2.377	; 55Ω; 12-1 (1-4,2-7,9-12, 6-11) 50Ω 410T
Sec: Bk to Wh	1.818	; 32Ω; 12-1 (1-4,3-8,9-12, 5-10) 30Ω 313T
Sec: Bk to Pur; Gr to Gry; Red to Yel Pnk to Wh	1.45	; 20.6Ω; 12-1 (1-4-7-10,3-6-9-12) 20Ω 250T
Sec: Or to Wh	1.45	; 20.6 Ω; 12-10 20Ω; 250T 4.3Ω
Sec: Or to Blk	0.725	; 5.1Ω; 11-10 ; 125T 2.2Ω
Sec: Red to Yel	1.45	; 20.6Ω; 9-7 20Ω; 250T 4.1Ω
Sec: Red to Blu	1.08	; 11.4Ω; 8-7 ; 186T 3.1Ω
Sec: Gr to Gn	1.45	; 20.6Ω; 6-4 20Ω; 250T 3.4Ω
Sec: Gr to Or	0.368	; 1.3Ω; 5-4 ; 63T 1.0Ω
Sec: Blk to Mv	1.45	; 20.6Ω; 3-1 20Ω; 250T 3.1Ω
Sec: Blk to Br	0.927	; 8.4Ω; 2-1 ; 160T 1.6Ω

Output transformer primary DC resistance: 155+165Ω P-(B+)-P. 67+70Ω Sc-(B+)-Sc.
Primaries: Yel, Gr, Rd, Bu, Or

Secondaries in four groups (sections 1-2, 11-12 are the same turns):
1-2-3: Blk, Brn, Pur 4-5-6: Grn, Or, Gry
7-8-9: Red, Blu, Yel 10-11-12: Pnk, Wh/Red, Wh

Use 20Ω secondary configuration for driving 15Ω speaker (100% of secondary turns used); PP primary effective impedance is then 4.7kΩ.

Heater loading: 2x 1.6A, 0.45A, 0.3A, 4x 0.3A = 5.2A plus indicator bulb.

Microphone transformer 7XD51768. 50Ω + 50Ω : 80kΩ 40:1:1 turns ratio36
(9.4mV I/P; 374mV output; 300Hz)
GRN-RD 7.6Ω. 50Ω
BLK-OR 7.6Ω. 50Ω
BLU-BRN 1.72kΩ. 75kΩ
WH shield

With PI bias adjusted (2k7 to 6k8), output symmetric clipping just starts at 19W (17.3V and 16Ω with VS1 drooping from 423V to 420V, and overdrives to 27.5W (21Vrms and 16Ω) with VS1 drooping to 411V, and Vk increasing from 33V to 42V.

Aux in response only:
System LF ON causes about 10dB drop at 25Hz, compared to 80Hz.
HF droops only 5dB by 30kHz, so fairly flat.

Guitar input:
Sensitivity is MIC input level (<5mVrms), so each 12AX7 stage is attenuated.
HF roll off due to pot series resistance. So added 68pF across MIC1 Vol to give some boost.

Some low level, spread spectrum, ringing at 25-30kHz (and 60kHz harmonic) observed on one side of output waveform in the clipped section when over-driving the output in to resistive load.

The ringing appeared to be related to the large 6BL8 pentode gain, where pin 2 pentode input is next to pin 3 PI anode, and pin 2 circuit has a shielded cable connection to a high impedance node at the PU VOL and PU Tone pots. But was also related to PI stage overload grid conduction. Both 6BL8 stages needed rebiasing to provide more symmetric overload capability, and the VS2 supply was considered too high, so was reduced. Changes included:

- Removed vari-cap feedback and pentode grid circuit.
- Lowered pentode anode feed from 470k to 220k, and screen dropper from 2M2 to 1M, and raised cathode bias from 1k5 to 3k3. Screen voltage increased from 50 to 150V, and anode voltage increased from 115V to 198V for 383V VS2.
- Moved 150k/47k attenuator to pentode input pin location.
- Replaced 1M PI stopper (original had drifted to 1M5), and removed 50pF shunt, and lowered coupling cap from 22nF to 10nF, and lowered grid leak from 1M to 330k.
- Increased PI cathode bias from 2k7 to 10k, to increase idle Vak and give symmetric swing.
- Increased 6L6 screen stopper from 150 to 560R.
- Lowered VS2 from 383V to 333V by increasing dropper from 10k to 27k.

Without 6L6 in, the 6L6 grid drive was up to 41Vrms in a smooth overloaded waveform, with no sign of PI triode grid conduction.

16Ω resistor load response at ~0.4W is from 90Hz (-3dB) to 12kHz (-3dB) for guitar input with Tone at min, and rear panel LF switch ON. Tone at max cuts treble from about 500Hz, and is down about 30dB at 12kHz. Rear panel LF response OFF cuts LF to -3dB at 200Hz.

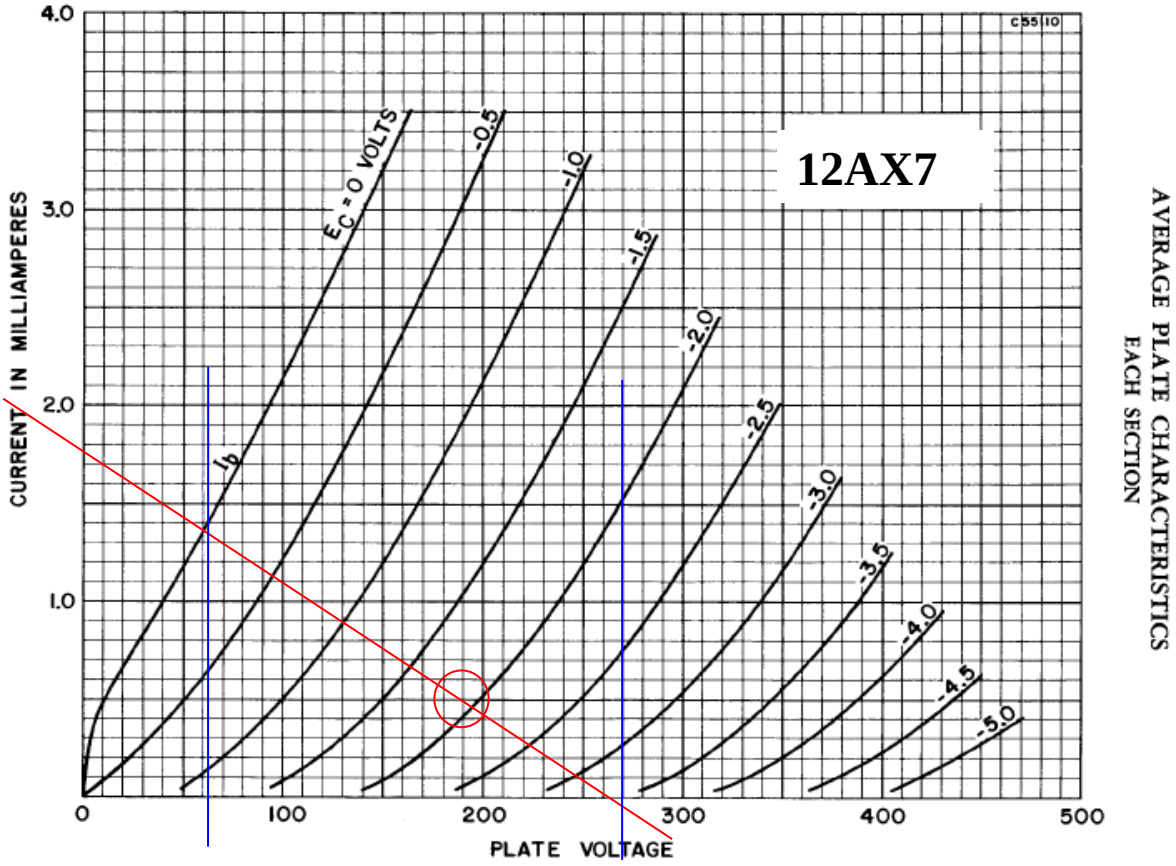
Guitar input sensitivity is 7.6mVrms for 16.6Vrms in to 16Ω (17W) at onset of clipping. Max overdrive of 19.6V (24W) at about 11mVrms input.

Aux input sensitivity is 670mVrms for 10Vrms output, so about 1.1Vrms for max clean output.

Limiter has no effect at clipping level or up to cranked level.

3.1 Input 12AX7 microphone stages

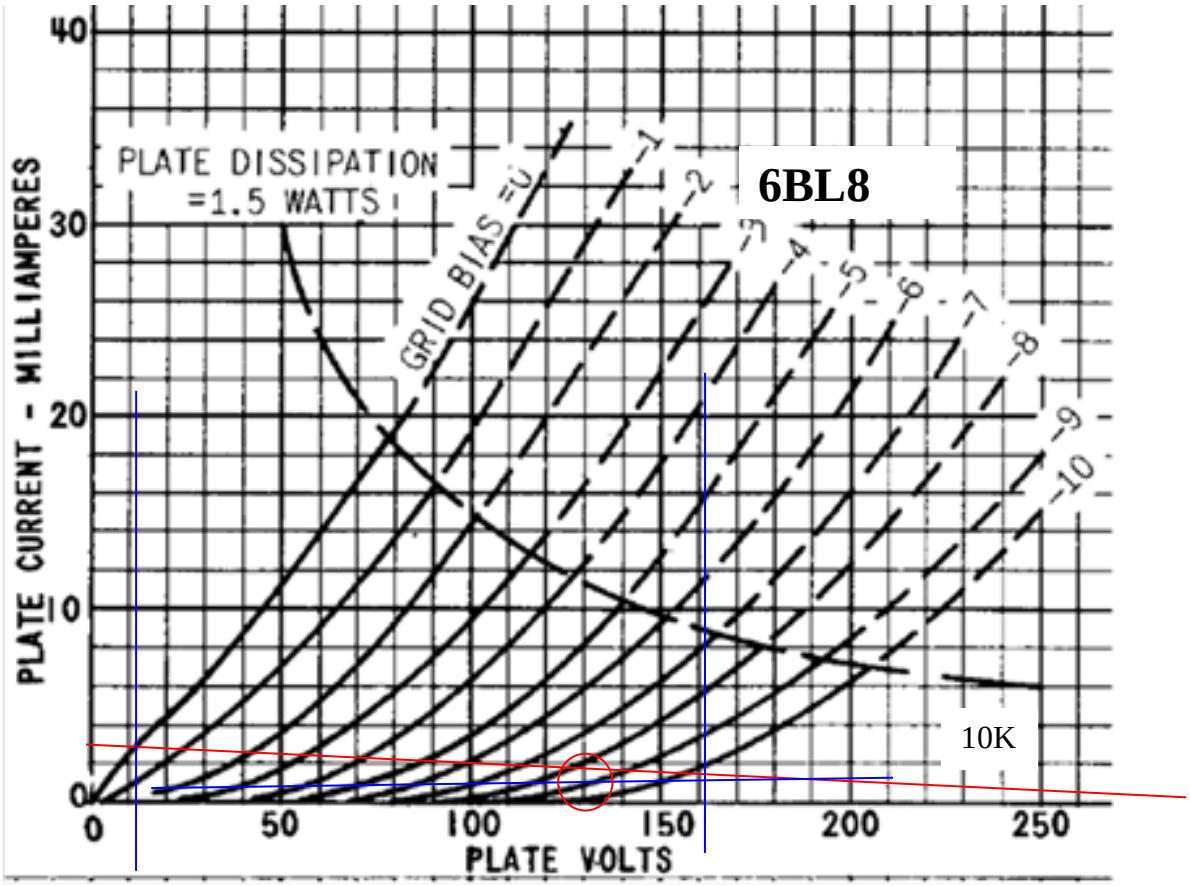
Input 12AX7 stage, B+= 260V; Va=190V; Vk=1.75V LED; Ia=0.47mA; RLdc=150k.



3.2 7199 Mixer and PI sections.

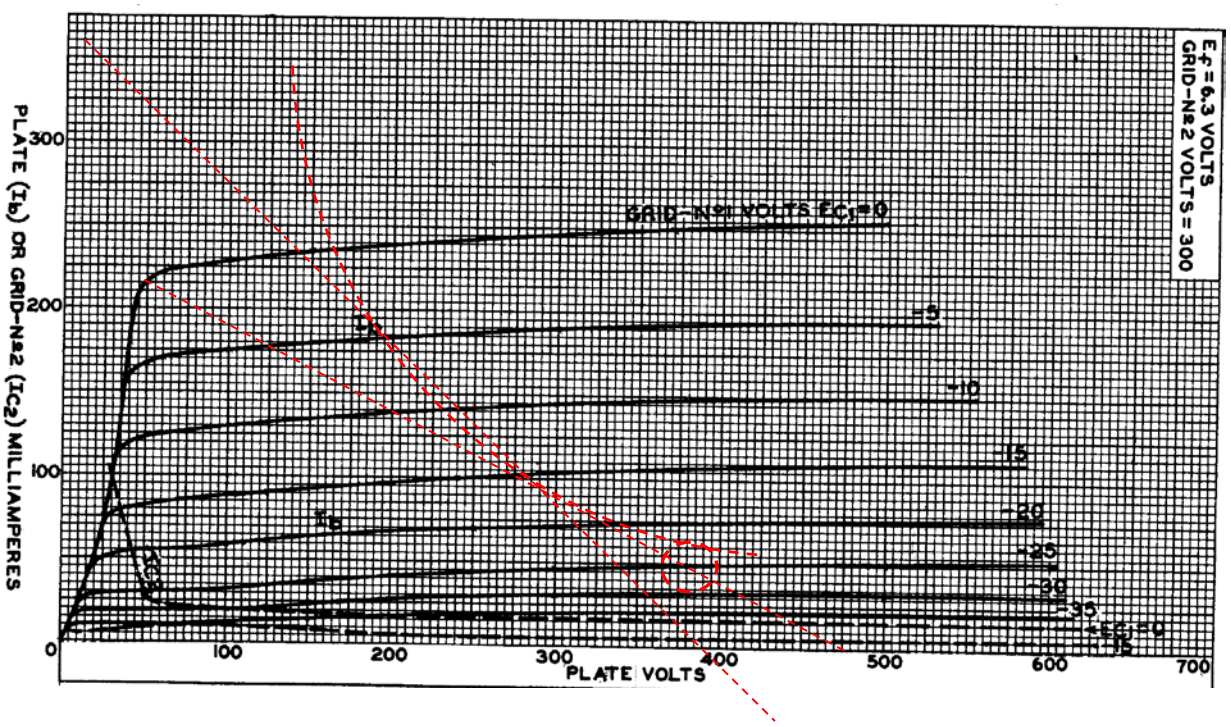
6BL8/ECF80 are a common replacement for 7199, although heater-cathode voltage rating is reduced from 200V to 100V. A 6AN8 may be an easier choice, but requires rewiring.

PI 6BL8 triode stage V3: VS2= 306V; Vk=81+12=92.6V; Vak=130V; Rk=10k; Vgk= ~12V; Ia=1.2mA; RLdc=146k. At idle, Vhk ~ 93-60 = 33V.



3.3 PP Output Stage

The max design output valve bias current allowed is dependent on the maximum recommended plate dissipation of 30x0.8 = 24W for 6L6GC: Ibias(max) = Pd / Vb = 24W / 400V = 60mA. The 600Ω cathode voltage is ~34V for 57mA. Voltage across winding section ~ 160Ωx0.06A=9V.



3.4 Powering

Mains fuse reduced from 1.5A to 1A, with about 0.4A at idle.

Doubler rectifier with 120mA hot load on 440V VS1. Max anticipated continuous VS1 load current about 200mA. IEC60127-2 1A Time-delay fuse, as max continuous winding current could reach about 830mArms.

Simulate period in PSUD2	20ms	40ms	100ms	500ms	continuous
Simulated RMS current	6A	4.3A	2.8A	1.5A	0.83A
Multiplier (based on 1A fuse rating)	6	4.3	2.8	1.5	0.83
IEC60127-2 Time-delay min limit multiplier	10	~7	~4.8	~2.9	1

Only had 1A F 3AG fuses, so used them for both.

Capacitor ripple current about 550mArms max. KMF 220uF 160V has a 1.37 x 0.35 = 480mArms at 100Hz and 105C, so is borderline ok.

3.5 Output level indicator

The EM81 tuning indicator on the PA449Y radio module was re-purposed to indicate output signal level. Wiring for heater, B+, signal input and ground are connected to a new tag strip under the chassis.
A 10Meg pull-up resistor allows the EM81 display level to be reduced a titch during idle. The grid has a 1Meg leak and parallel 39nF cap to act as filter for any AC signal.

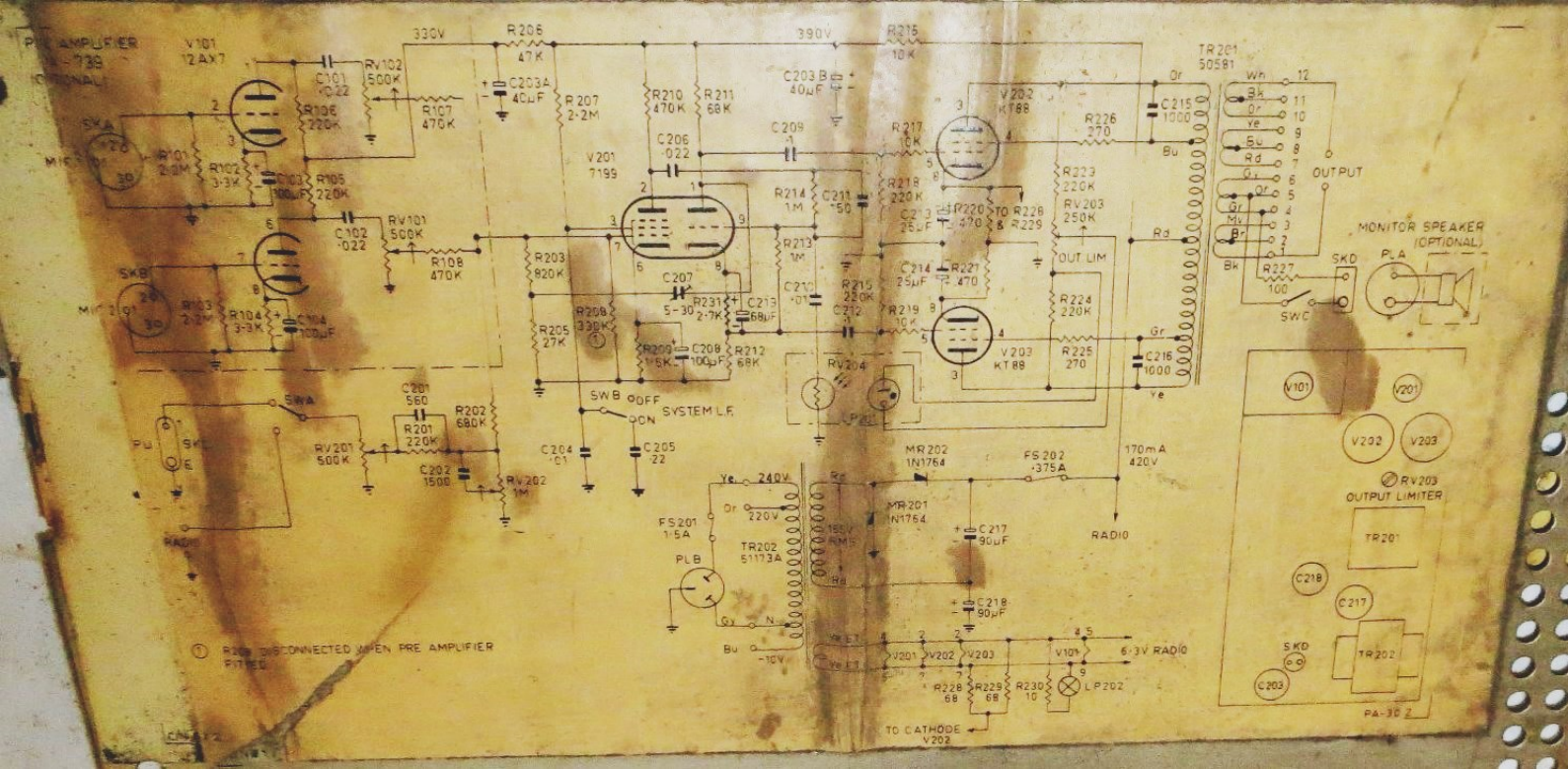
The B+ load changes with signal, and is about 1.5mA, so need to use a VS1 take-off, as it loads down even VS2. A 400V 10nF cap was used so rather than swap that out, a 300V Zener was installed.
Signal is full-wave doubler rectified to generate about -40Vdc at max output. A 1 Meg trimpot allowed display FSD to match output level. Different EM81 would likely require adjustment.

Rms to dc voltage converters typically operate at low input levels. An opamp could provide a crude linear to log conversion, that could drive the EM81. But this is all too complicated to provide scaling and polarity conversion to make it worthwhile.

The front panel PU/Radio switch is used to switch both the heater and B+ feed to the EM81, to allow it to be unpowered unless needed.

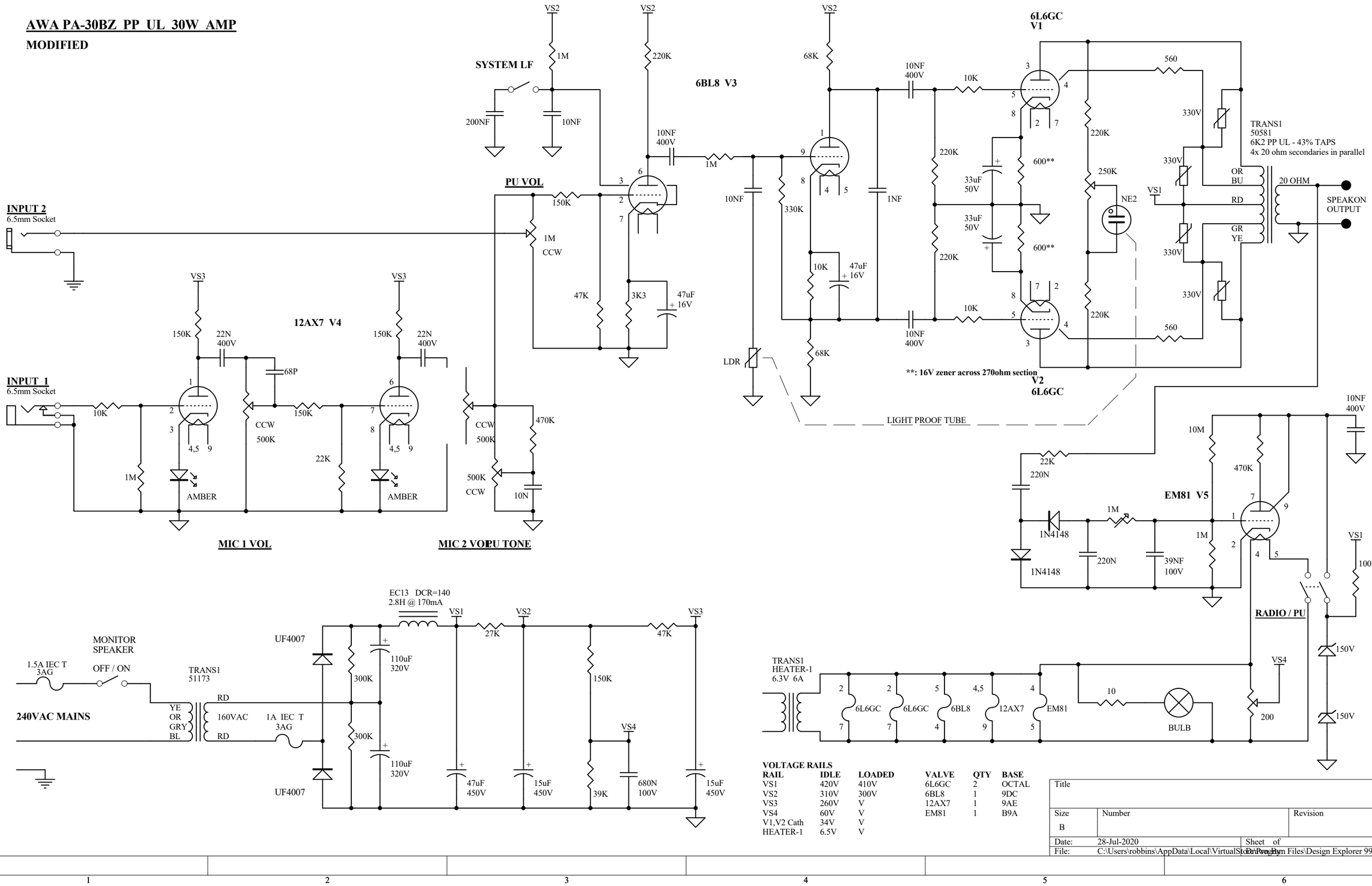
3.6 Maintenance

Use 5 pins of the female DB9 on the rear panel to sense VS1/100, VS2/100, Cathode sense 1 / 10, Cathode sense 2 / 10, with respect to 0V ground.


V101 12AX7
330V
390V
R206 47K
R215 10K
TR201 50581
V202 KT88
V203 KT88
V201 7199
C203A 40µF
C203B 40µF
C209
R210 470K
R211 68K
C206 ·022
R214 1M
C211 ·50
R213 1M
C210 ·01
R215 220K
C212 ·68
R217 10K
R218 220K
C213 25µF
R220 470
TO R228 & R229
R226 270
C215 1000
R223 220K
RV203 250K
OUT LIM
R224 220K
R225 270
C216 1000
C214 25µF
R227 470
R219 10K
RV204
R207 2·2M
C207 5-30
R231 2·7K
C213 68µF
R209 5K
C208 100pF
R212 68K
R208 330K
R205 27K
R203 920K
C202 1500
RV202 1M
C204 ·01
C205 ·22
SW B OFF ON SYSTEM L.F.
SW A
SK A
SK B
RV101 500K
RV102 500K
RV201 500K
R101 2·2M
R102 3·3K
R103 2·2M
R104 3·3K
R105 220K
R106 220K
R107 470K
R108 470K
C101 ·022
C102 ·022
C103 100µF
C104 100µF
C201 560
R201 220K
R202 680K
RADIO
PU
E
OUTPUT
MONITOR SPEAKER (OPTIONAL)
SKD
P.A
SW C
R227 100
V101
V201
V202
V203
RV203 OUTPUT LIMITER
TR201
TR202
C218
C217
C203
PA-30 2
MR202 1N1764
MR201 1N1764
FS202 ·375A
170mA 420V
C217 90µF
C218 90µF
RADIO
FS201 1·5A
TR202 51173A
PLB
240V
220V
15V RMS
-10V
6·3V RADIO
LP202
R228 68
R229 68
R230 10
TO CATHODE V202
① R226 DISCONNECTED WHEN PRE AMPLIFIER FITTED

AWA PA-30BZ PP UL 30W AMP

MODIFIED



VOLTAGE RAILS

RAIL	IDLE	LOADED
VS1	420V	410V
VS2	310V	300V
VS3	260V	V
VS4	60V	V
V1,V2 Cath	34V	V
HEATER-1	6.5V	V

VALVE	QTY	BASE
6L6GC	2	OCTAL
6BL8	1	9DC
12AX7	1	9AE
EM81	1	B9A

Title		
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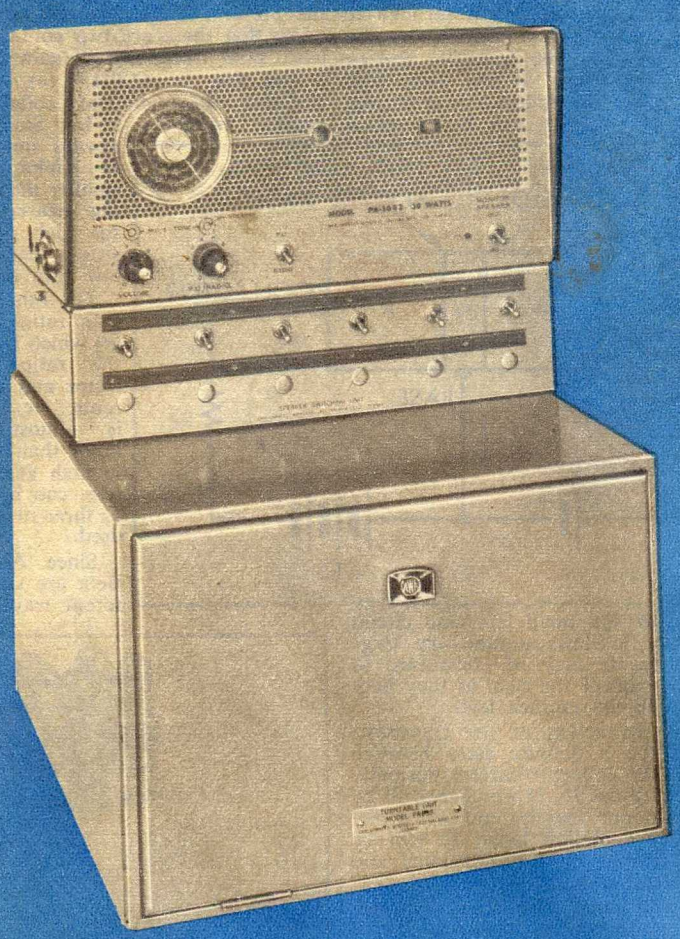
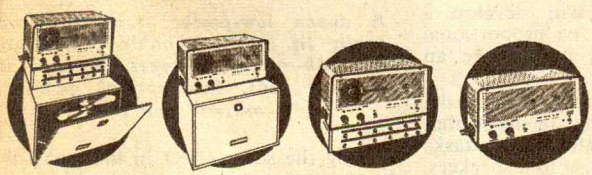


foremost in sound



A. Amplifier, radio, turntable and speaker switching unit
B. Amplifier, radio and turntable unit
C. Amplifier, radio and speaker switching unit
D. Amplifier unit

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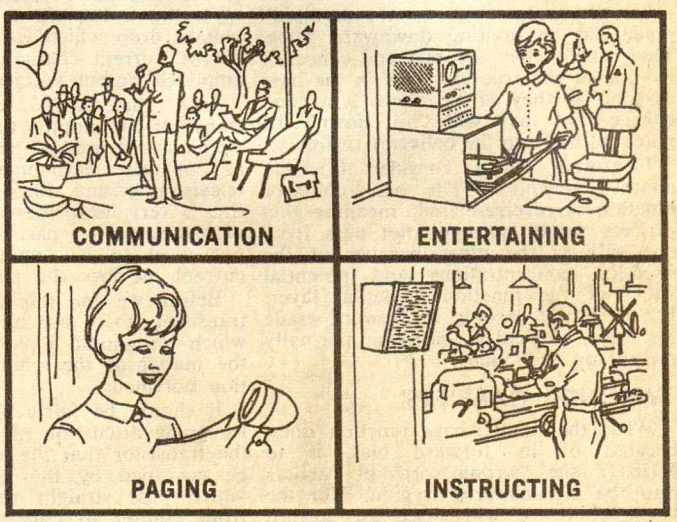

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