1. Summary

Fi-Sonic 30WGR amplifier head.
Ebay July 2011, $182.

1.1 Original Amplifier

Made by Phil Dreoni in Sydney circa 1966-7. 2-input normal channel with volume; 2 input brilliant channel with volume; all inputs mixed in common preamp stage; bass & treble fender style tone stack; long-tail pair PI; cathode biased 6L6GC PP output stage of 30Wrms rating; speaker side feedback to PI tail; RC LFO with neon tube, and LDR modulated input to tone stack; separate reverb preamp and volume pot to triode and pentode 6BM8 amplifier stages with output transformer to 300 ohm tank input; reverb tank output to make up amplifier and mixed with normal input.

Valves appeared to have been replaced in 1991. Sticker by 'T.S. Amp Repairs'. Likely Serial Number 2032 written on chassis under pcb.

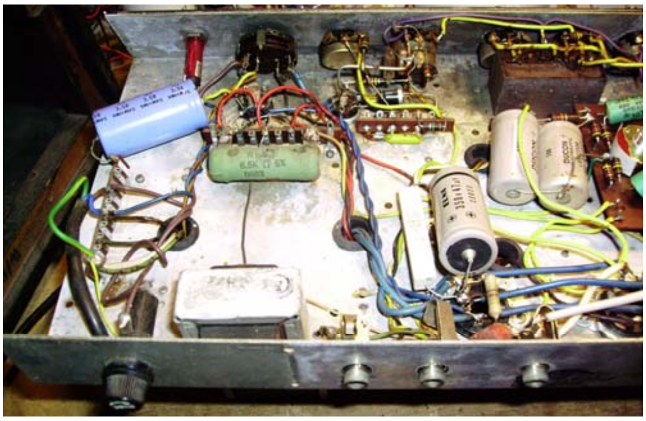
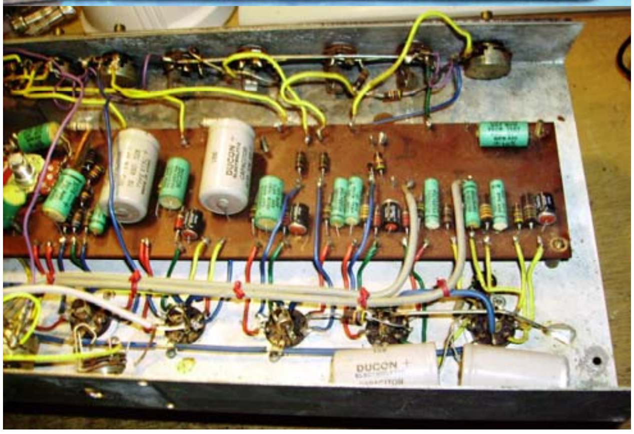
Components

Power Transformer	A&R 5547, Prim; 300-0-300V mA SEC; 6.3V CT ~5A.
Output Transformer	A&R 2783 6K PP; 8R; 15R; 30W rated medium fi
Reverb Transformer	Rola LRH1 dated: 2 May 1966
Choke	Rola CH22 (10.8H at 50mA, 500Ω DCR)
CAPs	Ducon ET5C electrolytics; Ducon DFK 406, 420 and 112 foils; Ebarson electrolytics
Tubes	6V4 (not fitted)
	6L6GC x2
	12AX7 x4
	6AV6
	6BM8

Dating:
Choke Rola CH22 (?) dated: 30 August 1966
Reverb driver transformer Rola LRH1 dated: 2 May 1966
All original Ducon caps appear to have 1966 year date code.

Issues:
Mains cable not secured. Old electrolytics. Heaters not twisted. Common chassis grounding, including the pcb ground, all the pcb mounting bolts, input sockets, output sockets, vibrato socket, and reverb pedal socket. 6L6 sits too close to OT. OT rivets just holding. PT is very heavy to hang upside down. No reverb pan. Missing feet. Overheating damage of wooden cover over output valve bases and cathode bias resistor. Tolex needs a good clean and minor reglueing. Serial Number space covered. Both front badges removed. Screen resistors overheated. 6L6 socket pins slack hold on valve pins. Choke wire over-heated from touching power resistor. Missing reverb pot knob. Vibrato socket too close to 6L6 anode wiring. Can't use 7027A (as pins 1 and 6 are used). No grid stoppers to manage overdrive. Reverb intensity on input of stage (rather than output). Output stage of reverb not filtered to attenuate rumble. Raised cathodes for PI and LFO stages. Valve rectifier overloaded at idle. Grounded input socket actives. Slight differences from nominal FiSonic schematics.



1.2 FI-SONIC information

Designed and made by Phil Dreoni between 1959 and 1969 in Marrickville, when the business was sold to a major company who decided to stop making guitar amps and concentrate on consumer products. pdreoni@bigpond.net.au . Experienced repairers are M B Electronics p/l (02)95683248.

Tone control circuitry was potted to make it difficult to clone the amplifier.

Phil indicates reverb tank should be 200-300 ohm input impedance type, although Plessey data indicates LHR2 would be more appropriate for that type of tank input impedance. The Plessey data indicates LRH1 would be suited for 1.5 to 2.1k impedance. Assessment of the 6BM8 driver circuit indicates a 3.5k loading would give max swing, so the LRH1 would give reasonable matching with a 2k'ish tank input impedance. A 2x2 spring Accutronics 4FB model would be appropriate (1.5kΩ input impedance rating, and 2.25k output impedance).

Replacement pan for the old Hammond/Gibbs C pan is meant to be Accutronics model 4fb2a1b. 4FB2A1B used in Webb amp and Gibson GA-20 RVT.

4BB3C1B replacement tank (150Ω to 2250Ω) would need an LHR2 type 1:3 ratio Tx, to accommodate the lower input impedance.

FROM Nicholson's PTY. LTD.

Fi-sonic amplifiers are manufactured to give long trouble free service. This is achieved by the use of the best components available, also each amplifier is made individually, no mass production techniques are employed. All amplifiers have a very wide frequency range and amplify notes higher and lower than the human ear can hear, this is very important because the higher harmonics are not lost thus allowing a more faithful reproduction of notes. The tone controls on the amplifiers are designed to give an extreme range of sounds to satisfy the perfectionist.
Treble boosters are incorporated in all models. Ninety-day warranty is given on all amplifiers.

5WG—This is an amplifier designed for the learner. It has two inputs, a wide range tone control, a volume control inbuilt 8-inch speaker giving an undistorted output of 5 watts RMS.

10WG—This is the lowest wattage amplifier having all the tone facilities of the big amps. It has an inbuilt twin cone 8-inch speaker giving 10 watts RMS of power. It has two inputs, a volume control, a bass and treble control, a speed and depth control for vibrato, and power on with stand-by switch. (Illustration E)

14WG—This amplifier has two 8-inch speakers, two inputs volume, treble, bass, treble boost, depth, speed, power and stand-by switch. Power output 14 watts RMS.

14WGR—Same as 14WG but with reverb. (Illustration E)

17WG—Same controls and speakers as 14 watt model but has an output of 17 watt RMS.

17WGR—As 17WG with reverb. (Illustration E)

20WB—This model is a compact bass amplifier suitable for small bands and nightclubs, same controls as 17 watt only it has a bass 12-inch speaker similar shape to Figure E. Power output 20 watts RMS.

20WBP—This is the piggyback version of the above, it has two 12-inch speakers, it has the same power as the 20WB but the twin speakers make it more efficient. (Illustration D)

30WG—This amplifier has four inputs, two normal and two brilliant, two volume controls with treble boosters, bass, treble, depth, speed, power and stand-by switch, speaker and extension speaker outlet and vibrato foot switch outlet. It has two heavy duty speakers and a power output of 30 watts RMS. Speaker box as in D and top section as in A.

30WB—As 30WG only designed for bass use.

30WGR—As 30WG only with reverb.

40WG—As 30WG but power output of 40 watts RMS.

40WB—As 30WB but power output of 40 watts RMS and larger speaker box as Illustration A.

40WGR—As 40WG with reverb.

60WG—Controls as 30 watt, this is by far the most popular of all models, the high efficiency twin cone speakers and the wide range controls together with the high power reserve make it one of the best and useful amplifiers. Total power output 60 watts RMS.

60WGR—As above with reverb.

60WB—Same power as 60WG but designed for bass (Illustration B)

PUBLIC ADDRESS SYSTEMS

All PA systems have the same controls, that is four microphone inputs, two volume controls, a bass and treble control, power and stand-by switch and outputs for speaker columns.

30WPA—A 30 watt output PA amp complete with two columns with one 12-inch speaker in each column a 30-foot lead is supplied with each column. Suitable for audiences up to 700 people.

30WPAR—As above but with reverb.

40WPA—This is 40 watt PA system complete with two columns with two 12-inch speakers in each column. Each column is complete with one 30-foot lead. Suitable for audience up to 1200 people.

40WPAR—As 40WPA but with reverb.

60WPA—A 60 watt unit complete with four columns with two 12-inch speakers in each column. Each column is complete with a 30-foot lead. Suitable for audiences up to 3000 people under normal teenage conditions.

MIXER—A four input transistorised mixer allowing the mixing of four separate microphones. Mixer has a volume control for each input, and an on/off switch.

30WPA and 40WPA are illustrated in Picture C.

REVERB—This unit is designed to add reverberation to an amplifier not already equipped with reverb, it is the preamp type of reverb and plugs directly in the input of the amplifier and no other connections are made to the amplifier, this enables it to be used with any brand or type of amplifier.

TAPE MI—This is a moderately priced one-speed tape echo giving a numerous variety of lengths of echos. Sequence and staggering of the echos is variable. A green ray indicator is inbuilt to check at a glance for overload.

TAPE M3—As above but has three tape speeds.

FUZZ—This little unit, shown Fig. F, is used in conjunction with an amplifier to give a fuzz tone effect. The amount of fuzz is continuously variable so that the desired effect is obtained.

TREBLE BOOSTER—This transistorised unit is used to boost the treble on an instrument, the amount of boost is regulated by a control and a switch to turn boost on or off. Ideal for use with amplifiers with little treble.

FI-DRUM—This is one of the most revolutionary electronic devices ever made. This unit enables drums to be played trough an amplifier so realistically to fool even the most experienced drummer. It is operated by 12 piano keys each giving a different drum sound. Some of the effects are bass drum, tom tom, claves, bongoes, marachas and woods. The keys are so located the drum rolls are easily achieved, it takes approximately an hour for the average person to master its use. The unit is small enough to be clamped to a piano or an organ or used as a solo instrument.

NICHOLSON'S PTY. LTD., 416 GEORGE ST., SYDNEY. 25-1641

2. Modifications

Partial star grounding – B1; B2; B3; PP stage cathode bias; PCB gnd; heater humdinger; looped pots; reverb driver cap; reverb pedal socket. Separate mains ground; tuned humdinger with +50VDC elevation (to offset raised PI and LFO stage cathodes, and reduce peak negative heater cathode voltage on rectifier tube).

275V 431KD10 MOV on PT primary. NTH13D160LA NTC in series with primary (16Ω cold). PT secondary CT fused (0.4A). 2x330V and 3k3 MOV-R across each OT half-primary.

Replaced electrolytics, and screen resistors.
Input sockets – disconnected one socket switch from being grounded to give either 1M input, or 100k input with 2:1 divider.
2M7 bleed on volume wiper to minimise wiper noise.
Vibrato socket screened, and 6L6 anode wiring placed at max distance.
Added 10k grid-stoppers to V4a, V4b, V3a, and V8 6BM8 triode and pentode.

6L6GC 500Ω screen stoppers, and choke plus 4k7 B2 supply (to limit max supply current to 170mA, and 6L6 dissipation to 23W).
15Ω OT winding to SPEAKER socket; 8Ω OT winding to EXT. SPKR socket.
Drilled 4 vent holes in chassis to assist airflow from front fascia through chassis to rear slot with top board.

To do:
Add 2x RCA in/out sockets for reverb tank on rear chassis.
Tone frequency curves
Vibrato envelope plot
Output waveforms
Noise level

Schematic inaccuracies: 10k grid-stoppers to V4a, V4b, V3a, and V8 6BM8 triode and pentode; 50k at base of 250k depth pot; NTC on mains; 0.4A fuse rating.

3. Measurements

Primary PT to earth meggers ok.

Rail	Idle 9k4 (reverb off)	Idle 9k4 (reverb on)	Idle 4k7 (reverb off)	Idle 4k7 (reverb on)
B1	350 / 11 / 120mA	338 / 13 / 143mA	345 / 13.5 / 145mA	335 / 15.5 / 171mA
B2	256 / 0.19 / 7.5mA	242 / 0.18 / 7.6mA	292 / 0.08 / 7.5mA	281 / 0.18 / 7.6mA
B3	216	194	246	225
B4	205	175	234	203
B5	199	161	226	186
V8 screen		134 / 0.15 / 31mA		132 / 0.18 / 31mA
Heater	6.9		6.9	
Sec HT	325-0-325		325-0-325	
V1-2 cathodes	16.7 (2x 56mA, 18W)	15.6 (2x 52mA, 17W)	18.5 (2x 71mA, 23W)	17.6 (2x 68mA, 17W)
V3 cathodes	18.3		18.3	
V4 cathodes	1.3		1.3	
V5 cathodes	1.4		1.4	
V7 cathodes		0.88 / 0.57		0.88 / 0.57
V8 cathodes		.036 / 5.0		.036 / 5.0

Power transformer primary DC resistance: 0V brown; 12Ω, 230V, yellow; 14Ω, 240V, blue.
Power transformer secondary DC resistance: 80 + 83 = 163Ω, red, red. 0V, black. Earth screen, white & green.

Rola CH22 (10.8H at 50mA) DCR=500R
16.6H @ 26mAdc: 14.4H @ 45mAdc; 9.5H @ 93mAdc; DCR = 366Ω.

A&R 2783
12VAC 50Hz nominal applied to output transformer secondary

Winding	Voltage rms	Turns ratio;	Pri Impedance;	Spec level; Notes
Pri P-P: VI to OR	250.6	-;	6,000Ω;	N/A
Sec: BLK to YEL	9.1	27.5;	6,000 Ω;	8Ω;
Sec: BLK to WH	12.41	20.2:	6,000 Ω;	15Ω;

Output transformer primary DC resistance: 86+110=196Ω plate-to-plate.

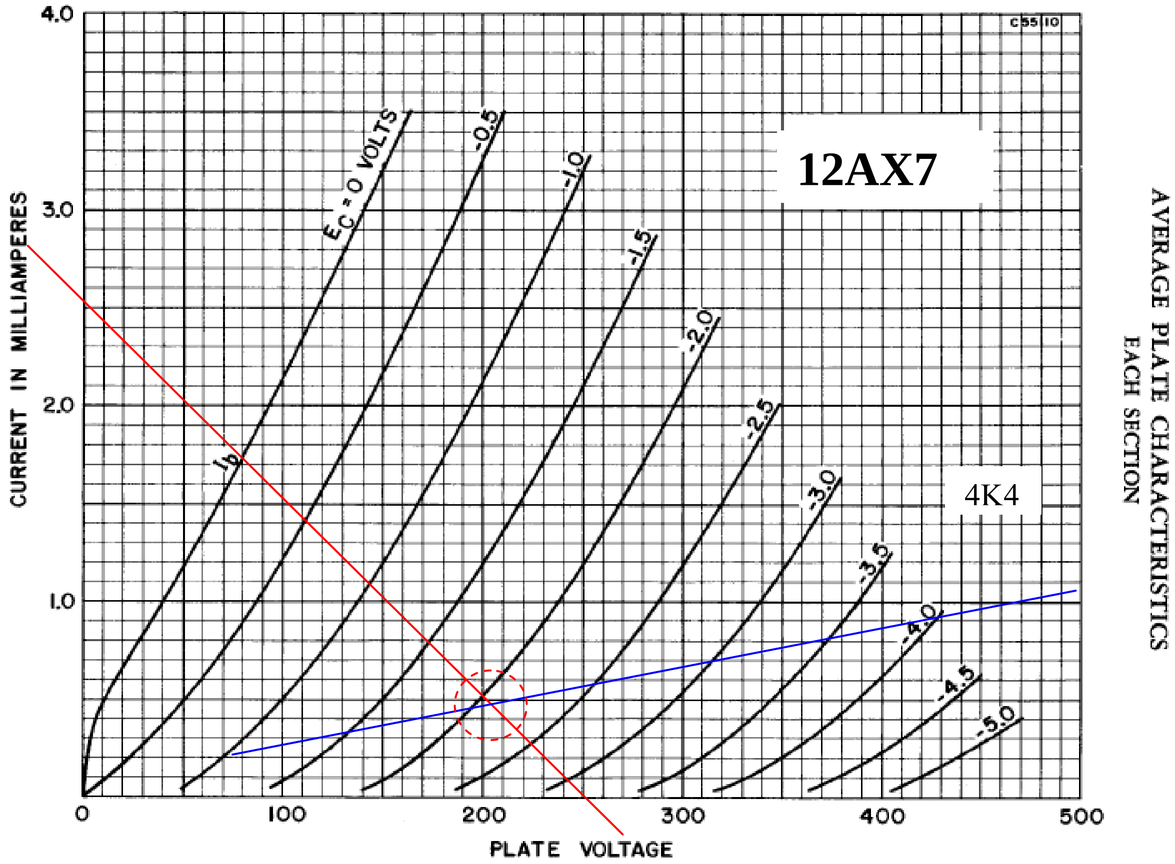
ROLA LHR1 transformer (L refers to 3W open-lamination core; R refers to reverb)
Primary: 130 ohm DCR ; Secondary: 70 ohm DCR ; Turns ratio ~1.0;

Reverb pan: 2k input; 2k output; 2 x 2 springs. Gibbs unit full length.

4. Design Info

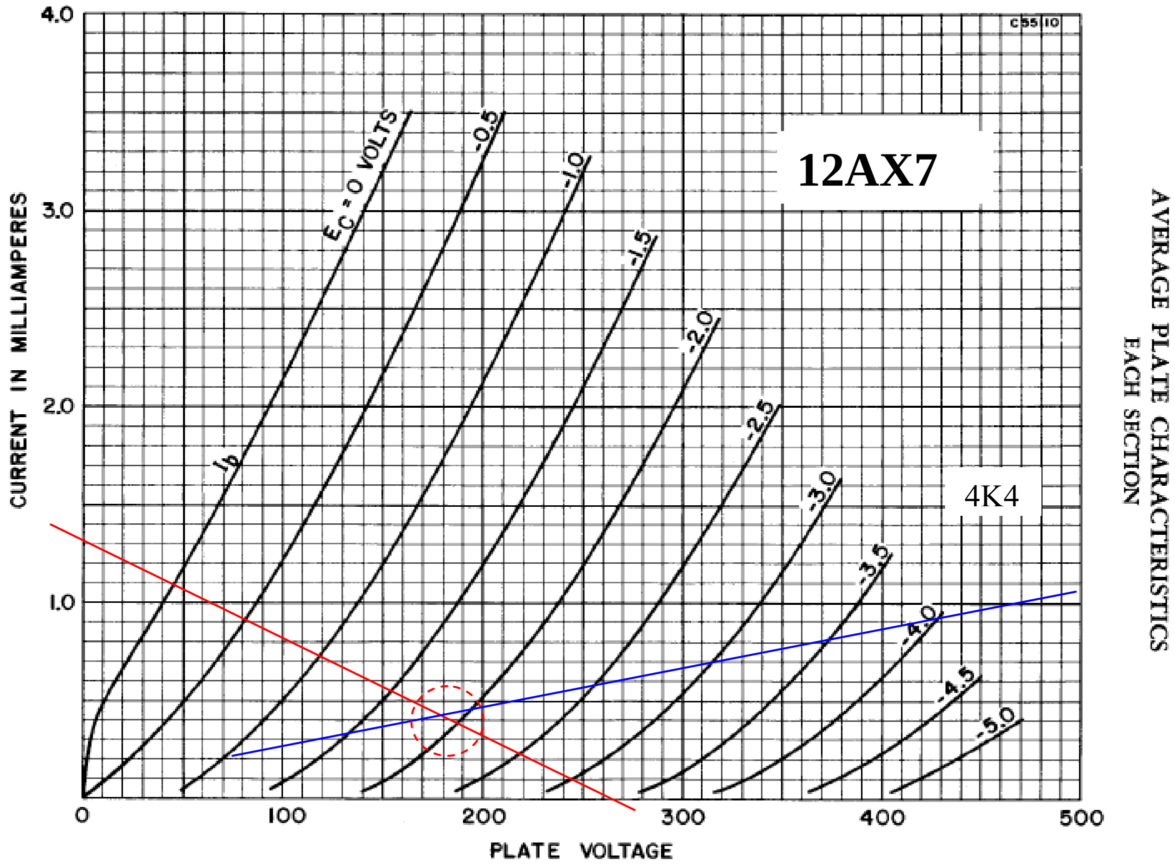
4.1 Input stage – 12AX7

B5=250V; plate=200V; cathode=2.2V; cathode current = 2x0.5mA. Cold biased.



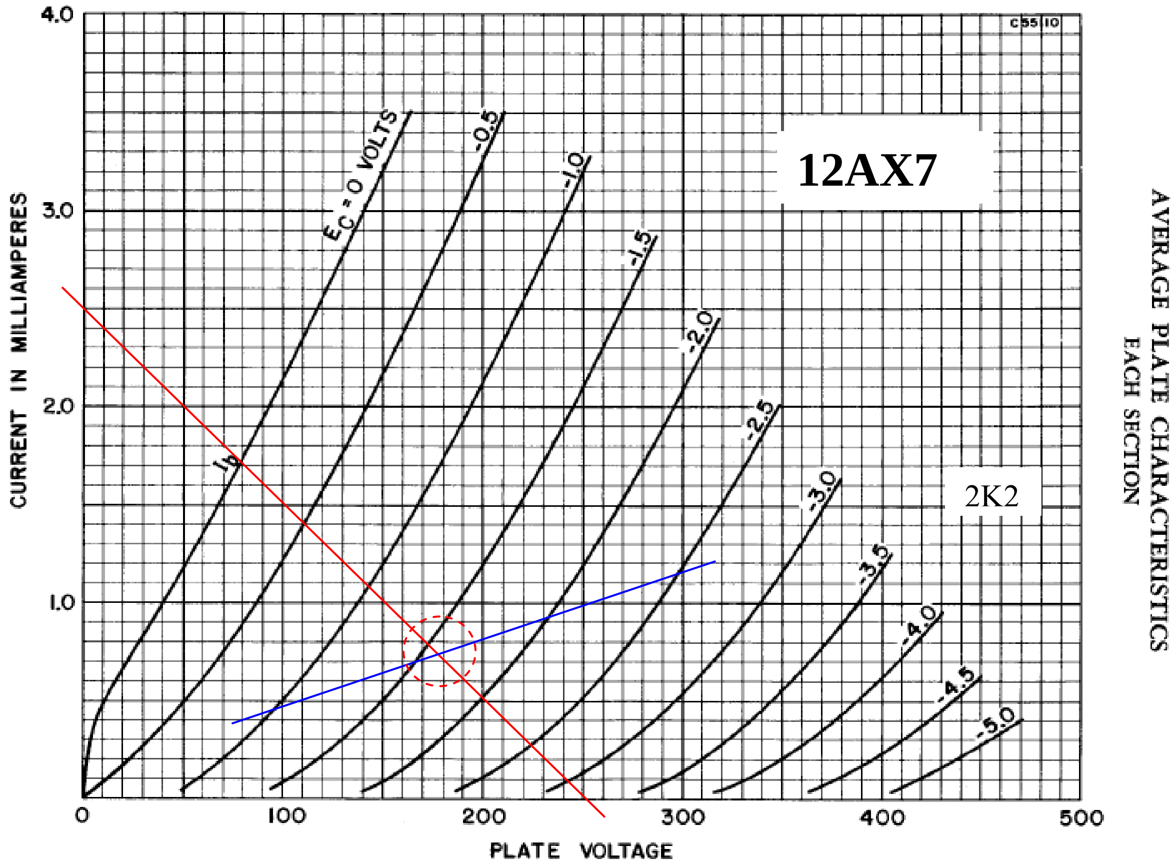
4.2 Mixer stage – 12AX7

B4=260V; Plate=180V; cathode=2.0V; cathode current = 2x0.4mA. Cold biased.



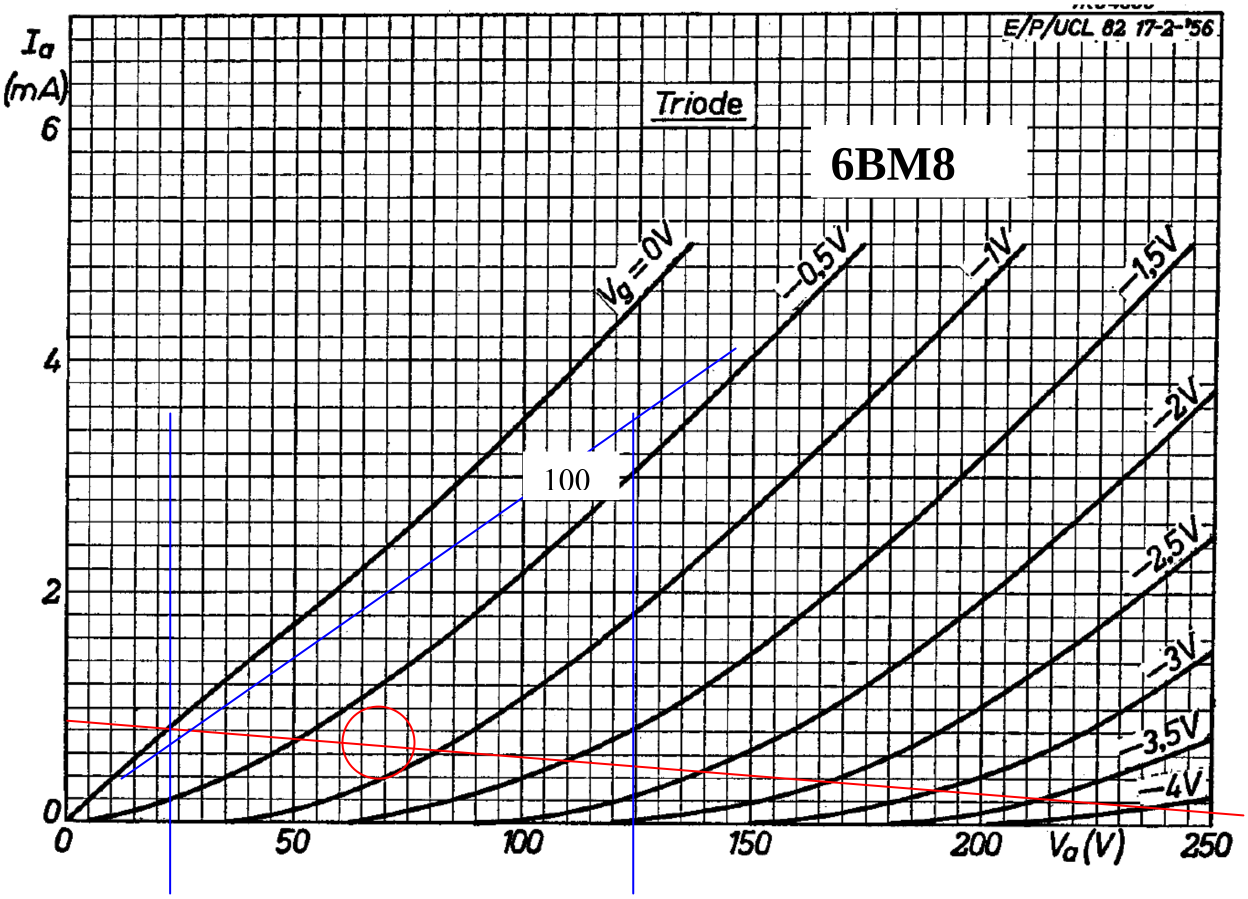
4.3 Reverb preamp stage – 12AX7

B4=250V; Plate=180V; cathode=1.6V; cathode current = 0.7mA.



Reverb 6BM8 triode stage. High grid leak resistance raises grid bias level above just the nominal 100R cathode bias level (which is probably only ~0.2V). B6=250V; Plate=75V; cathode=1.0V; cathode current = 0.5mA. Worth adding a grid stopper to manage over-drive.

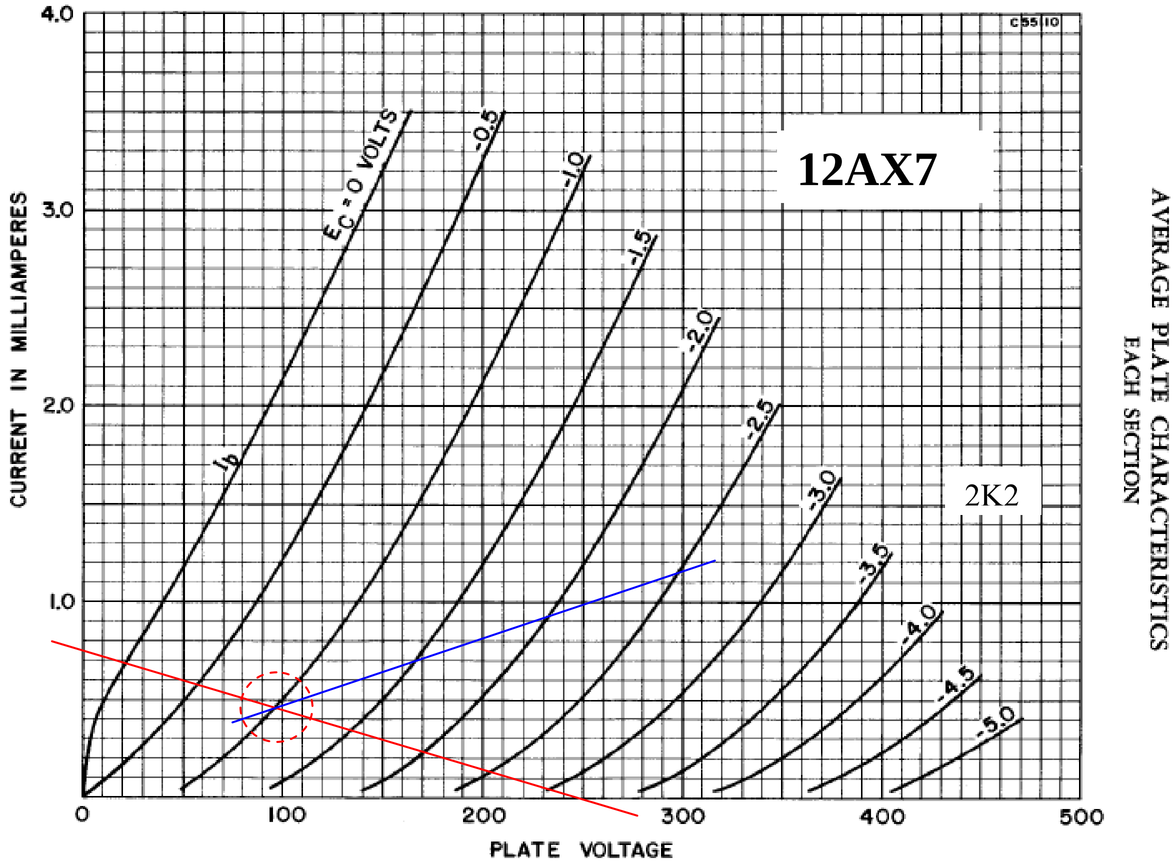
The 3N3 coupling caps in the 6BM8 triode and pentode stages may be a bit high (100Hz corner with 500k loading) if bass frequencies below about 200Hz need filtering out, or if the aim is to use a rising drive voltage with frequency to compensate the rising load impedance of the reverb (where the corner frequency could be set up say 1kHz).



Reverb make-up stage. B6=250V; Plate=100V; cathode=1.0V; cathode current = 0.5mA.

Cathode bias bypass corner frequency 3Hz. Could raise this to provide some low-pass filtering to attenuate rumble.

The 47k grid leak will provide an LR high-pass corner frequency.



Reverb driver is cathode biased 6BM8 pentode. 6k5 dropper from 400V B1 to filtered 150V screen supply dissipates 10W at 40mA. Filtered screen supplies LRH1 primary winding, with plate to driven end of primary, in single-ended mode.

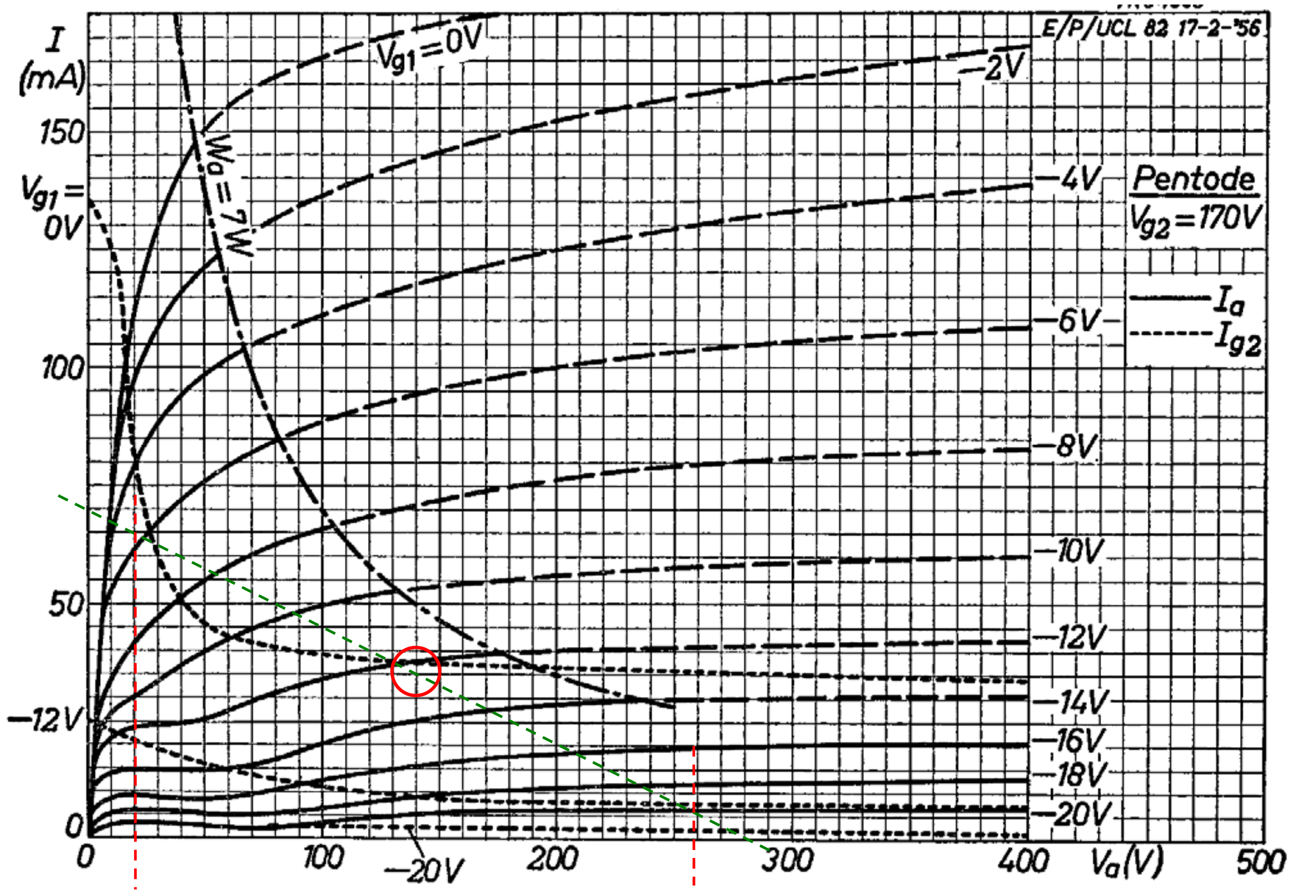
Loadline with 140V B+ and 170V (26V high) screen. Bias point will always be at nominal 140V, and with approximately 40mA through the 6k5 dropper – the anode current will be about 35mA. The 130 ohm DCR of primary drops about 5V. The cathode bias voltage is about 6V across the 150R. So anode-cathode voltage at idle is about 140V, and screen-cathode voltage about 144V.

LRH1 has 1:1 turns ratio. A 2k reverb tank input impedance is shown on the loadline, as 2k loadline, and valid for 1kHz. Max swing would be about 20V anode-cathode, up to 260V, or 240Vpp (85Vrms). A 4F Accutronics tank has a nominal drive current rating of 2mA, so the nominal drive voltage required is 2k x 2mA = 4V at 1kHz. Assuming drive voltage needs to double per octave to at least 4kHz, then swing needs to reach 16V, which is well within the capability even if loadline Z increases significantly.

Corner frequency of cathode bias is about 35Hz. Cap voltage rating should be higher than 12V.

Worth adding a grid stopper to minimise chance of instability. May be worth adding a screen stopper to slide screen voltage during high signal level. Worth reducing 3N3 coupling cap and checking drive response.

Tube dissipation should be fine with reactive load as bias point is well below continuous limit.



4.4 Splitter stage – 12AX7 in long tail pair config

The plate current versus plate voltage load line for each triode is given by the equation:

$$Ip = \frac{V_p}{R_L + 2(R_K)}$$

where R_k = 680+10k+4k7 = 15.4kΩ. Hence a load line resistance of about 100K + 2x15k = 130k. With B3=280V, the gate-cathode voltage varies with plate current through the 680Ω gate-cathode resistance, but with a 1k4Ω characteristic. The bias operating point of 1.3V and 0.9mA per side.

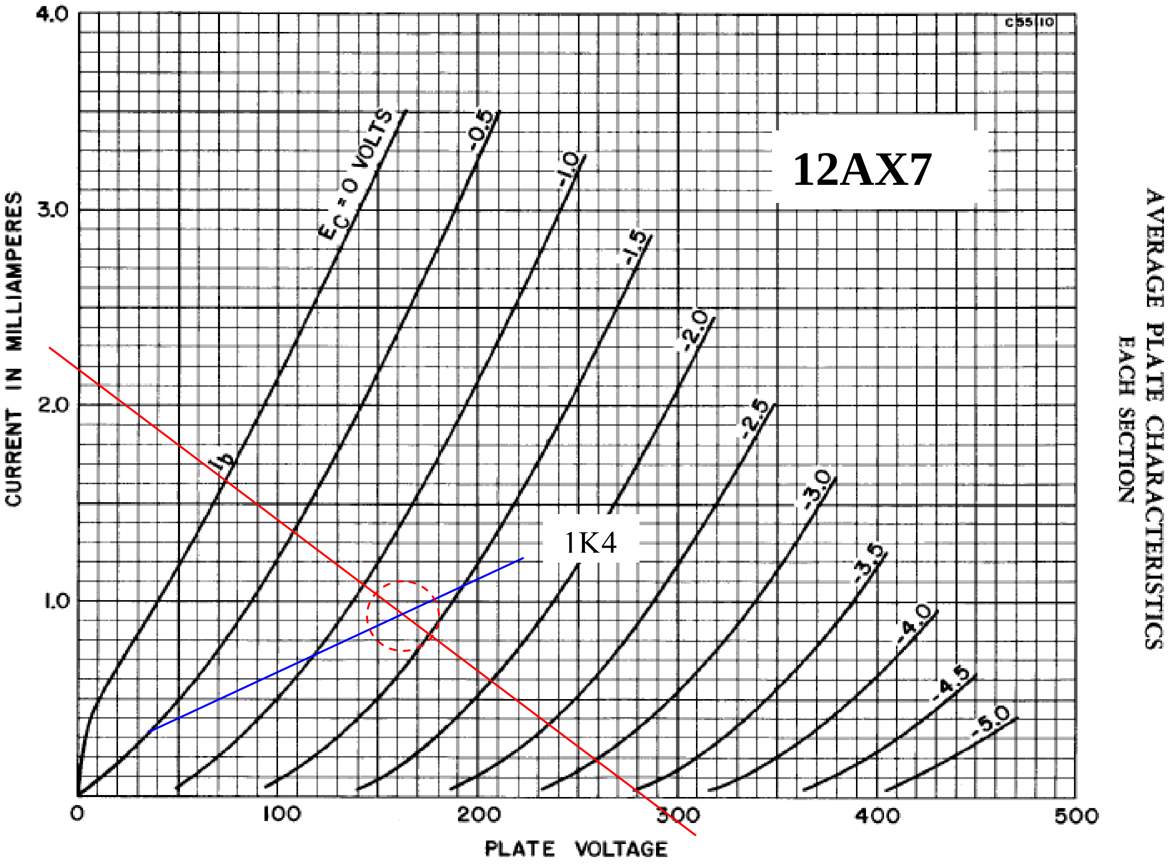
Voltage drop across tail is 15k x 1.8mA = 27V. Hence plate-cathode voltage is about 280 – 90 – 1 – 27 = 160V. Plate load resistance dissipation is about $(90)^2$ / 100k = 0.1Wpk. Plate dissipation at idle is about 160V x 0.9mA = 0.15W. *[Measured Va=291V & 285V; Vtail=74V]*

The nominal operating point levels of Vgk=-1.3V and Vp=160V are used to determine the parameter values of r_p and gm and μ from the 12AX7 average transfer characteristics graph (note that Eb is Vp).

The analysis by Kuehnel shows that the gain of each triode is slightly different, due to a small level of common-mode gain adding to the out-of-phase output but subtracting from the in-phase output, which could be compensated by lowering the load resistor for the out-of-phase output. The input voltage swing limit is from the bias point at Vgk=-1.3V to Vgk=0V, which is about 2.6Vpp or 0.9Vrms. Referring to the loadline, the plate voltage would swing about 200V, from about 75V to 280V, with a mid point of 160V [160-75=85V; 280-160=120V] which is a bit asymmetric. This gives a nominal gain of 200/2.6 = 77, but the small signal gain is about *x13 with a good headroom*.

Parameter	**No signal**	**Notes**
R_L	100k	
Vsupply	280V	= V_{RLoad} + V_P + Vk
I_P	0.9mA	From bias position
V_{gk}	-1.3V	From bias position, = I_P x 2 x 680Ω
Vk	27V	= 15KΩ x 2 x I_P
V_P	160V	= 280V – 27V - (100KΩ x I_P)
r_p	120-130kΩ	= ΔVpk / ΔIp
Gm	0.4-0.54mS	= ΔIp / ΔVgk
μ	*? [78]*	*Graph [= gm x r_p]*
G	*~13*	*= (u/2) x R_L / (R_L + r_p)*
Headroom	*14Vpp(rto)*	*= 2x((G x Vgk) – 14Vpk)*

Table 1. Phase Splitter Analysis Results for 12AX7



12AX7
AVERAGE PLATE CHARACTERISTICS
EACH SECTION
CURRENT IN MILLIAMPERES
PLATE VOLTAGE
EC = 0 VOLTS
-0.5
-1.0
-1.5
-2.0
-2.5
-3.0
-3.5
-4.0
-4.5
-5.0
Ib
1K4
C55110
0
100
200
300
400
500
1.0
2.0
3.0
4.0

4.5 Output Stage – 6L6GC Pentode Push-Pull

Class AB push-pull 6L6GC output stage with common cathode biasing. The 6KΩ impedance plate-to-plate OPT, presents each tube with a 1.5kΩ load impedance (with a matched secondary load) for larger signal currents, and 3k loading for small signal levels.

The supply voltage B1 at idle current of 145mA is about 345V with 6CA4 diode. Plate-cathode idle voltage will be lower than B1 by ~25V; ie. an idle current of 70mA, and OPT half resistance of about 95Ω (7V), and cathode bias across 130Ω (18V).

From the plate characteristics, to operate in to the knee, the screen needs to be about 250V or lower as Vg1 approaches 0V. A lower screen B2 voltage will require a series resistor with the choke – adding 4k7 will drop about 50V.

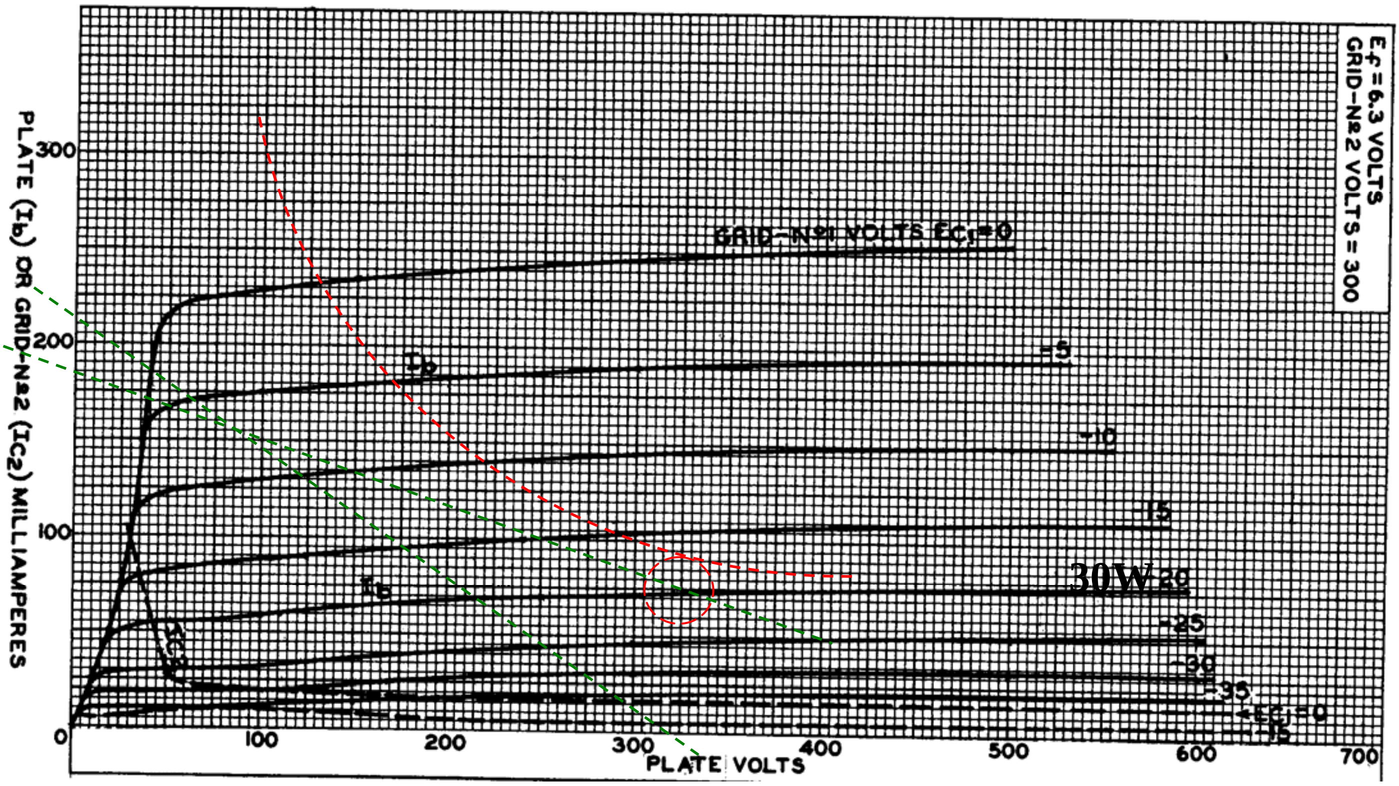
Screen current reaches about 20mA, with dropper voltage of 10V, and power dissipation of 0.2W, but will rapidly increase if grid conduction starts. Cathode bias peaks at about 130x0.18=23Vpk so not much bias change is likely across bypass capacitor.

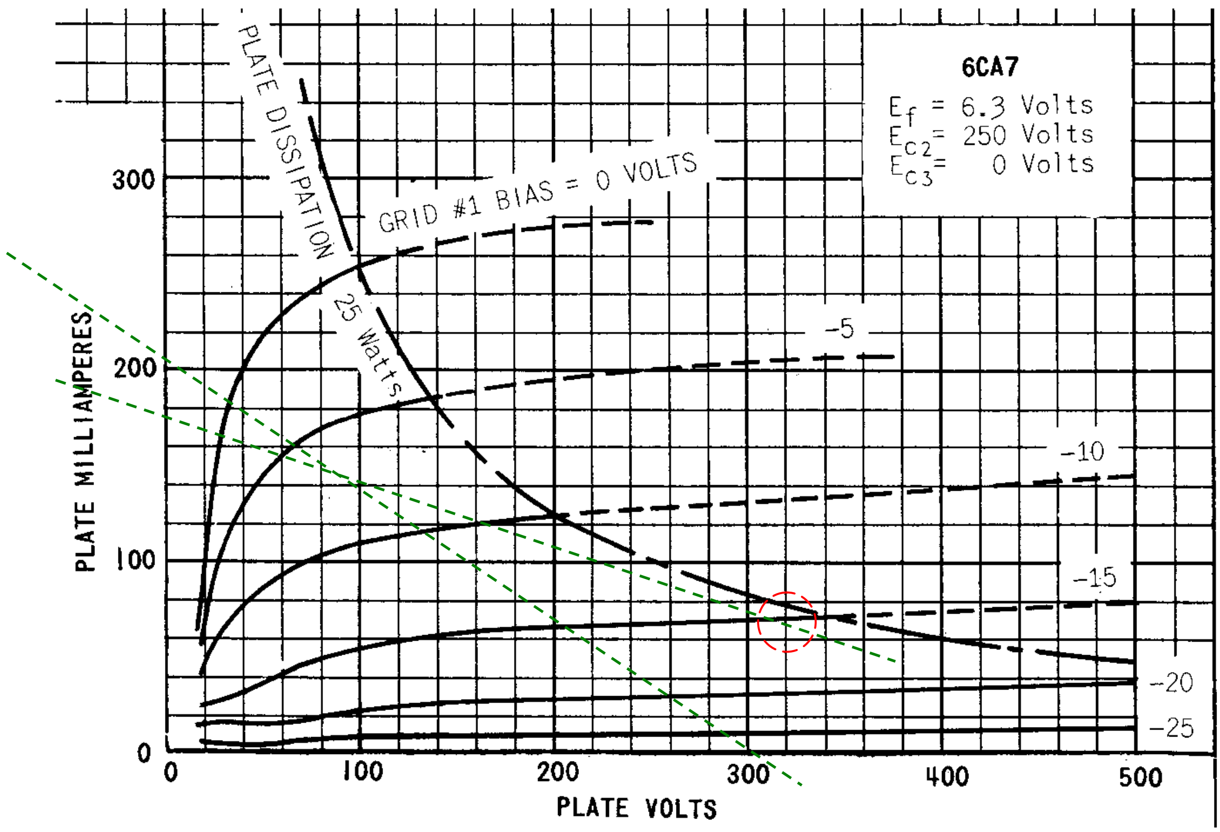
The nominal design output valve bias current for the 6L6GC: Ibias(max) = 0.7 x Pd / Vb = 0.7 x 30W / 325V = 65mA. The 130R common cathode resistor idle loss is about 2.6W at 18.5V.

The nominal output power of the amplifier will then be:
(Imax)2 x Rpp / 8 = 0.18 x 0.18 x 6k / 8 = 24W

The maximum signal average plate current is ~120mA, and with a 345V supply, the average supply power consumed is 41W, and so the tubes dissipate 41 – 2W = 39W, or 20W each.

The 20uF bypass cap on the common cathode provides a high pass filter to minimise the level of low frequency signal available to the OT. Similarly, HF low-pass filtering is appropriate to roll off signal before the OT starts entering resonances.





4.6 Power Supplies

A standard full-wave CT rectifier circuit is used with 325V secondary HT windings with centre-tap to 0V, and a 6V heater winding for tube diode. B1 is taken from main filter cap and powers OT and reverb driver (when connected). An LC filter is used with 11H 50mA rated choke to generate B2 for low screen supply ripple. B3 onwards are isolated with further RC filtering off B2 using 10kΩ droppers.

The loading on B1 is output stage idle (say 2x 60mA), plus about 40mA when reverb connected, so B1 idle current can increase to about 160mA.

A 6V4G is rated to feed 50uF with secondary winding resistance >215Ω, and 90mA loading for a 310VDC output. But the effective series resistance is $14\Omega \times (325/240)^2 + 81\Omega = 105\Omega$, which is too low to support 50uF. So a 6V4 is under-rated for 30W output. 6X4 is even more under-rated. The 6CA4 has 1A heater (extra 0.4A) and may be a risk, but can support 170mA load with 40uF input cap but needs about 190Ω effective supply resistance.

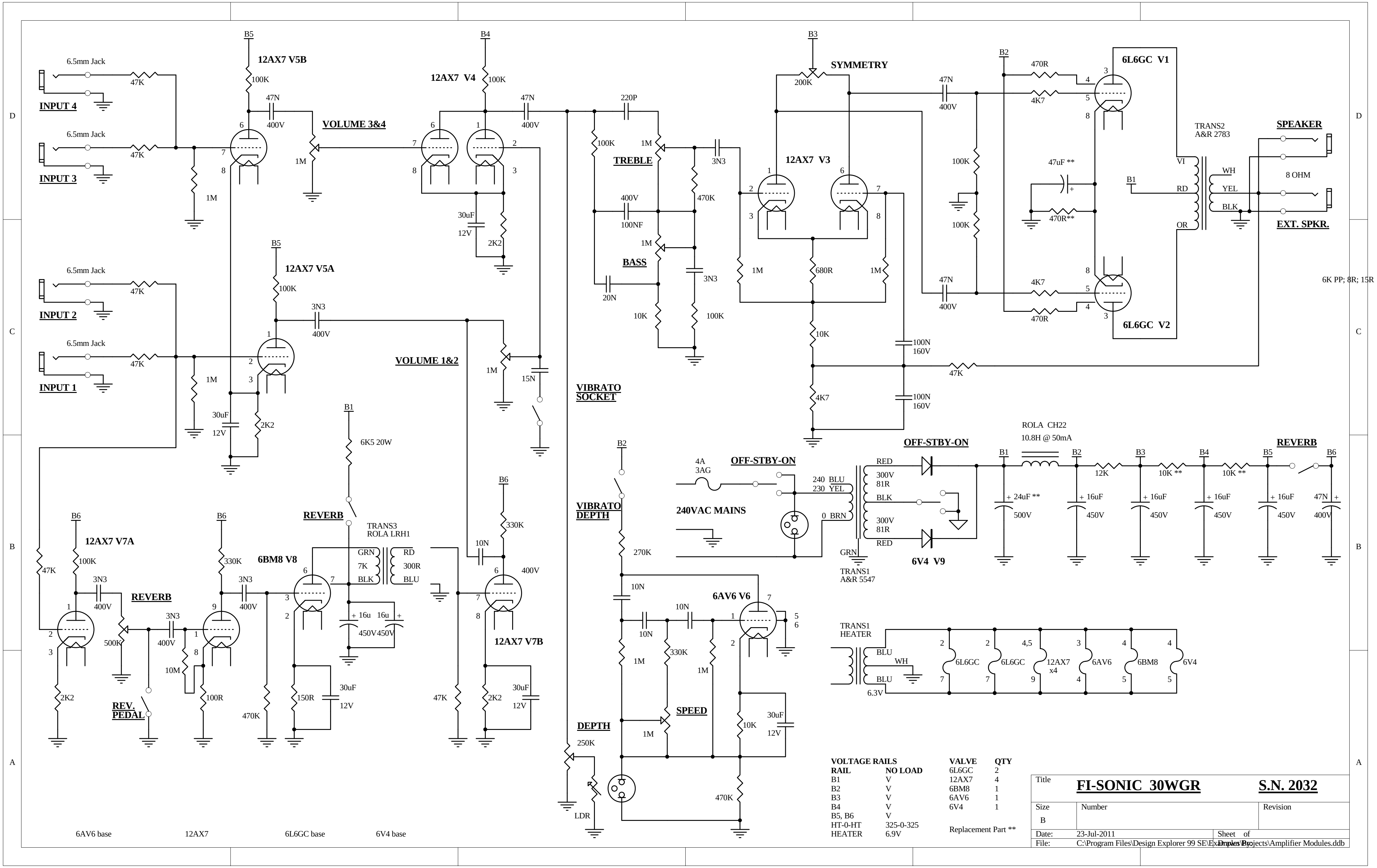
Keeping 6CA4 within rating could be achieved by limiting capacitance, minimising in-rush, and adding series resistance. 16Ω cold NTC increases initial series resistance by about $16\Omega \times (325/240)^2 = 30\Omega$. A standby bleed is used to raise B1 voltage to about 50V. A 20uF main cap is used.

Loading is dependent on reverb switch and vibrato switch. Vibrato (tremolo) LFO draws around 0.25mA, so its influence is negligible.

Nominal current draw is: B6~[0.7+0.5+0.5=1.7mA]; B5~1mA; B4~0.8mA; B3~1.8mA; B2~5mA screens; B1~180mA [+40mA].
Voltage drops are: B1-B2 DCR ~4V ; B2-B3~43V [63V]; B3-B4~18V [35V]; B4-B5~10V [27V]

Choke current is relatively low for its 50mA rating, and would even cope with the reverb driver current if needed.

Heater current requirement is: 2x 0.9 + 4x 0.3 + 0.3 + 0.78 + 1.0 (6CA4) = 5.1A.


FI-SONIC 30WGR
S.N. 2032
INPUT 1
INPUT 2
INPUT 3
INPUT 4
6.5mm Jack
12AX7 V5A
12AX7 V5B
12AX7 V4
12AX7 V3
12AX7 V7A
12AX7 V7B
6BM8 V8
6AV6 V6
6L6GC V1
6L6GC V2
6V4 V9
VOLUME 3&4
VOLUME 1&2
TREBLE
BASS
SYMMETRY
VIBRATO SOCKET
VIBRATO DEPTH
DEPTH
SPEED
LDR
REVERB
REV. PEDAL
TRANS3
ROLA LRH1
TRANS2
A&R 2783
TRANS1
A&R 5547
TRANS1 HEATER
SPEAKER
8 OHM
EXT. SPKR.
6K PP; 8R; 15R
240VAC MAINS
4A 3AG
OFF-STBY-ON
ROLA CH22
10.8H @ 50mA
Replacement Part **
VOLTAGE RAILS
RAIL NO LOAD
B1 V
B2 V
B3 V
B4 V
B5, B6 V
HT-0-HT 325-0-325
HEATER 6.9V
VALVE QTY
6L6GC 2
12AX7 4
6BM8 1
6AV6 1
6V4 1
6AV6 base
12AX7
6L6GC base
6V4 base
Title
Size B
Number
Revision
Date: 23-Jul-2011
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