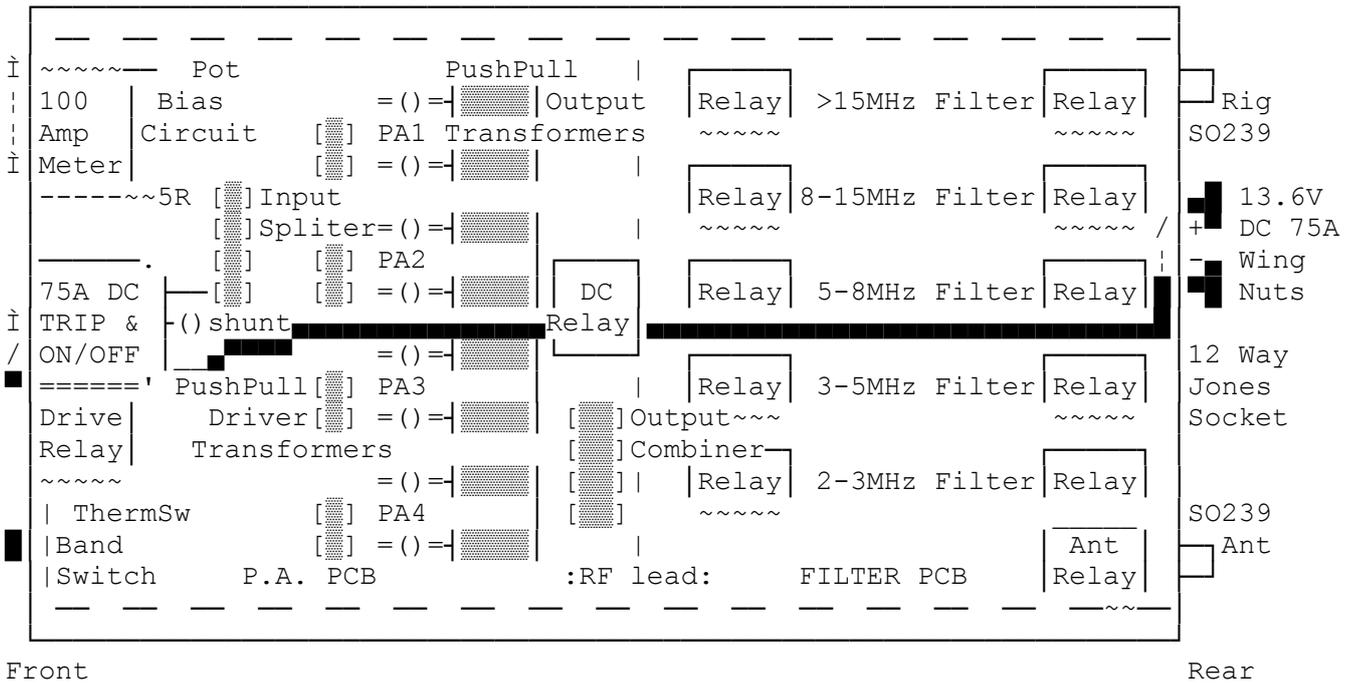


L A Y O U T (Bottom cover off)

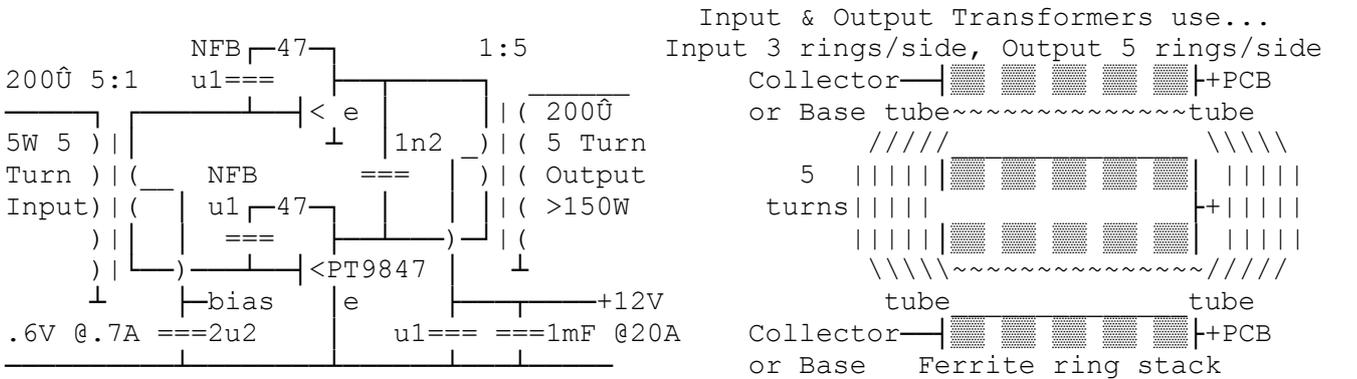


PA protection is from a 75A fast magnetic trip for bad SWR & over drive, it has an external calibrated shunt, & a thermal 70°C auto resetting cut off switch. The 100A ammeter uses 10cm of the thick DC lead as it's calibrated shunt.

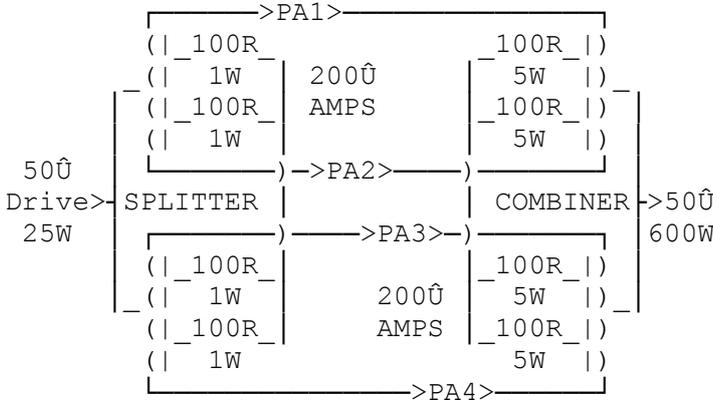
The bias supply is a simple 2 transistor thermally tracked circuit provides up to 2.2A of current @ 0.69V for the 4 class AB push pull amps. Excluding other currents, PA quiescent current should be 1.6-2A, (which gives the best two tone linearity results at around that level. See 5/)

P A R A L L E L A M P S

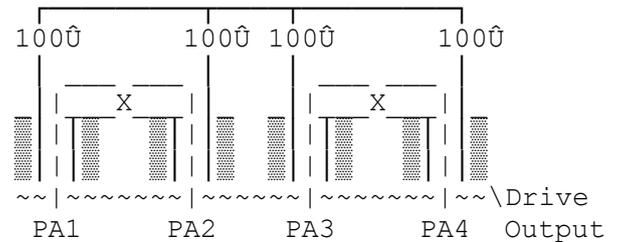
Four identical push pull Amps (>150W/Amp) use 2x PT9847 100W HF transistors with large well rated input & output matching transformers consisting of 5 or 3 ferrite rings stacked on each of the 2 brass tubes for the low Z side of the 5:1 turns ratio, smaller ones are used for the driver & much larger ones for the outputs. Large amount of RF NFB is (for good linearity) provided by 47Ω 5W & u1 collector to base on each of the 8 transistors.



The inputs & outputs are wired up from the drive splitter & output combiner with staggered wire lead lengths, so all the RF signals ends up exactly in phase.

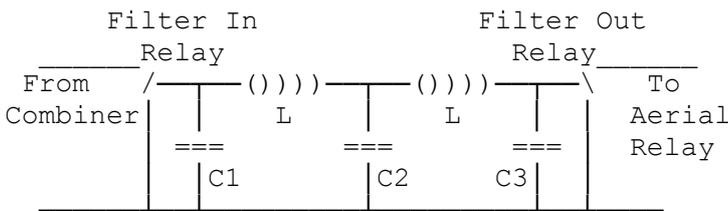


Splitter & combiner both have out of balance dump 100R to soak up any amp differences for best stability & linearity. Ferrite ring & tube construction like transformers.



F I L T E R S

There are 10 relays that in pairs, switch in 1 of 5 QRO 2 section PI low pass band filters, & reduce the quite high PA harmonics to > -43dB. N.B. there is no PA RF output path, without a pair of band relays operated!



Band	C1/C3	C2
2-3MHz	390+430p	750+680+270p
3-5MHz	390+120p	750+270p
5-8MHz	270+47p	430+200p
8-15MHz	82+82p	200+150p
15-30MHz	82p	56+120p

The Cs are all 2-3kV RF types. The Ls are wound 2cm ferrite rings, or air for the highest range. Using several Cs in parallel not only gets the odd filter value, but also gives greater current handling & reduced lead inductance.

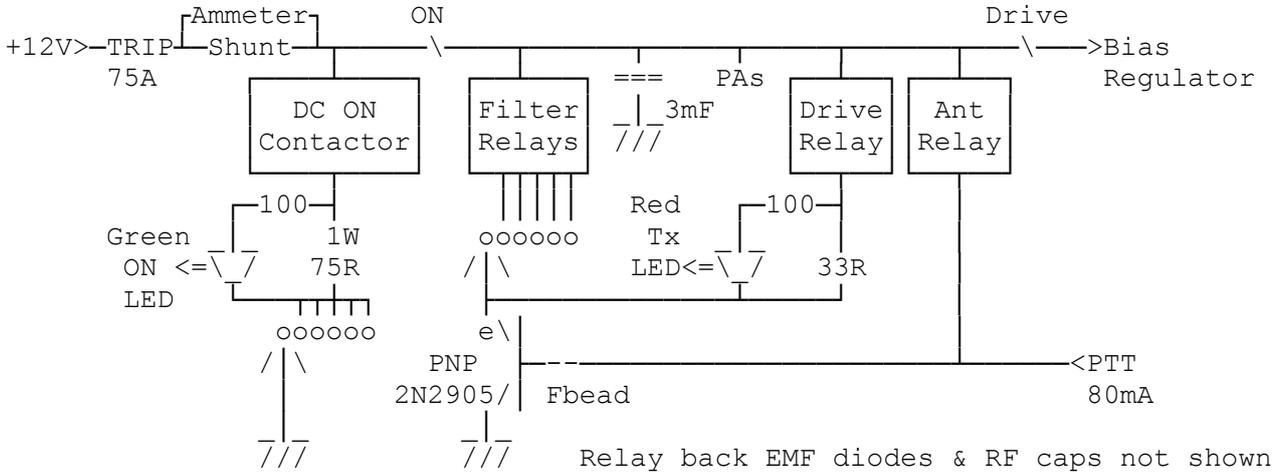
H E A T S I N K

At 25°C ambient in free air, the very large heatsink does not need a fan on 30% duty SSB Tx cycle, despite only the front part getting quite hot. But carrier modes are to be avoided (input attenuator overheats on lower bands!) or the temperature might rise above the thermal 70°C auto resetting cut off switch.

MODIFICATIONS

1/ LED INDICATORS, REDUCED STANDBY CURRENT & GIVE RELAY SEQUENCING.

Rx mode current was quite high, I found all the relays would operate OK down to 7V. So I added series Rs to reduce the currents by 30% for the slow to operate ones, & I used the R's added voltage drop to light 2 status LEDs too.

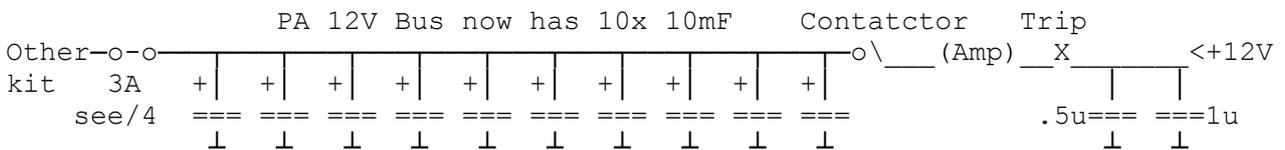


Added components mounted on or near the band switch.

Input & output filter relays (not in Rx path) are NOW only operated when the PTT is active, from a PNP emitter follower. The drive relay that also puts on the PA Bias, is last to operate with a series LED too is also buffered. But the Ant relay must be faster, so it is left directly on the PTT line! These modification save about 300mA on standby & helps keeps the filter relay contacts clean! It also reduces the PTT current to 80mA (limited PTT current on my exciter's reed relay). And the slight voltage differences on identical relays is all that is needed to ensure the relays all operate in the right sequence order, so no QRO RF contact splats.

2/ RIPPLE SMOOTHING & RF on DC LEADS

Only 3x 1000uF was fitted on my PA's +12V rail, the diagram showed 3x 2200uF, & having a large bag of similar 1000uF caps, I added 7 more symmetrically stacked up around the 4 amplifiers to give 10,000uF in all, much more than that might weld up the DC contactor! Each of these Caps gives a few amps at audio, reducing some of the battery lead AF ripple current.



To stop RF on the DC leads (don't want any in the shack), I also added a 1uF non eletrolytic internally across the DC terminals & another 0.5uF from +12V to the nearby "RF In" ground.

3/ DC LOSSES

This QRO amplifier has very high currents, & a drop of 1V = 100W less peak RF power! DC lead losses & the use of unsoldered crimp connectors all adds up. So with the amplifier into a dummy load, I use a DVM on 2V range from battery -ve & +ve to highlight where the voltage was being lost... drops on the leads, contactor, & tags. (If RF gets up your meter use 1k R in series as RF stopper at probe end.)

Metal case connection of the -ve terminal had not been used, it could reduce

the internal earth wire loss to near zero. It was just bolted on the painted panel. So I ground off the paint around the earth post, greased the bare aluminium to keep the air away, & bolted it up tightly. I did the same to back panel to heatsink screws with lock washers etc.

External DC cables, I use short "starting grade cables" to a large battery, or 30A leads to 2 small 24AH batteries & a 30A PSU, see "battery leads" below,

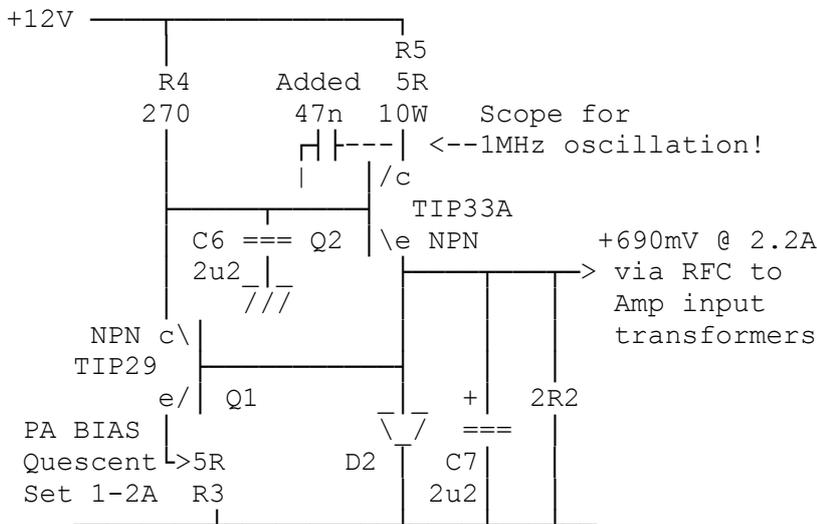
4/ DC FUSE

There was no low current fuse, so I soldered in a 3A one in the small wiring feed (to the band switch) to reduce the risk of an internal fire!

5/ BIAS

R4 turns on Q2, when Q2 emmitter > 0.6V, Q1 turns on reducing Q2 base drive. Value of R3 is used to set the exact bias voltage, R4 & supply voltage also affect the bias slightly. R5 limits the max current, D2 is a safety feature. Q1 & D2 are thermally connected to the PA (on the same heatsink).

PTT Switched

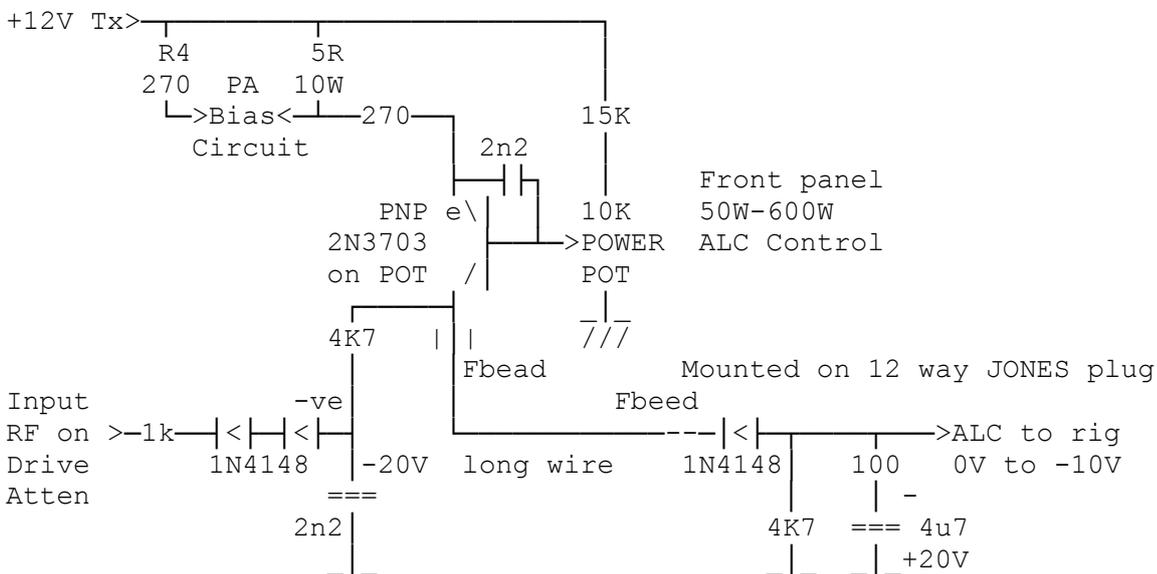


This circuit was slightly unstable when scoping R5 (5R) so I added a small capacitor base to collector on the large MPN to stop it.

Components were not the same as original diagram!

6/ ALC

There is no ALC system on this AMP, & I am used to old Valve amp with a power front panel ALC control. With PA ALC, the driver power is automatically set to the wanted level, & with the PA turned off you are back to full bare foot power. So I designed this ALC circuit for this PA...



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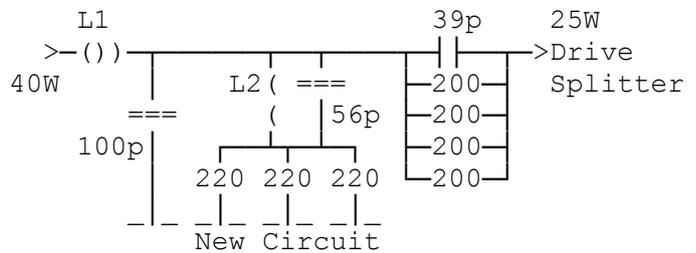
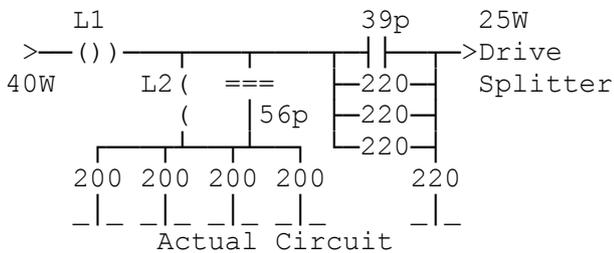
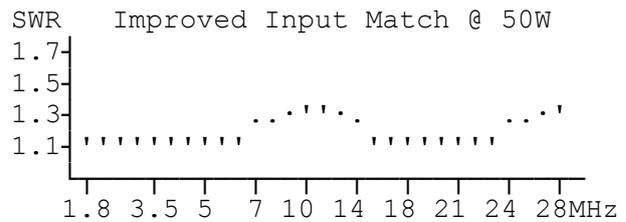
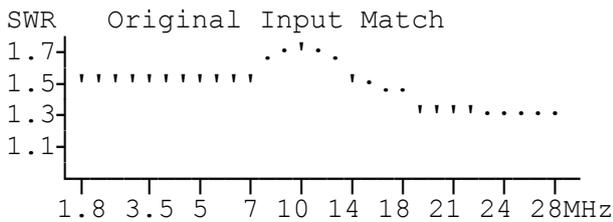
The -ve supply for the ALC is derived from the RF on the attenuator after the DRIVE relay. The -ve after the 4K7 it is normally clamped to +ve by the PNP. But when the PA bias current (limited to 2.2A by 10W 5R) reaching the 8 PA bases, gives a voltage lower than that set on POWER POT & the clamping stops, letting the -ve through. The series diode & 4K7 load mounted on the rear Jones socket ensures only -ve voltages are given to the exciter to reduce power drive. The 4u7 & 100R give a sensiable ALC time constant action.

MY CLEVER ALC DESIGN!

My ALC works very well compaired with manually keeping the drive power always low enough at all times so the PA never clips. By using bias current demand, it is quite effective at keeping the PA operating in it's linear region by reducing the driver power. This is because the large amount of NFB used in this commerial PA, that increases the PA's drive power, as the amp gain falls off at full power. This sudden increase in bias current, occures just before the PA actually clips. So a usefull & accurate maximum drive threshold point that caters for any SWR, supply voltage, or Rig power setting etc!

7/ INPUT SWR

The input frequency compensating attenuator circuit was not as the diagram & the SWR was not all that good, dispiste all components testing out OK.



There was a bump @ 10MHz & that is from the drive splitter load. L2 & 56pF disconnects the added load, as the 39pF bypasses the series attenuator Rs on the higher frequencies, to flatten the amp gain. The original diagram did not have 220R to ground, but had 20pF to ground @ the L1/2 junction. I found making this a 100pF (Tx grade) was better on 10m band & changing the load Rs around gave a better lower band input match.

Flat gain is less important than driver rig linearity, due to poor load. The input SWR will change with drive level (higher Z at more power), as the RF NFB level reduces, correcting each amplifier gain, as each amplifier works harder.

T E S T I N G

At a club meeting, 2 of these amplifiers (modified & unmodified) were tested with 2 tone linearity test & with a spectrum analyser for harmonics. Both amps performed well to the sudden (like AF Amps) 600W clipping level. This due to the effective NFB keeping good linearity until it fails. But even brief full carrier testing on lower bands did provide smoke from the underrated input attenuator!

The 2 tone test showed very good linearity to 400W PEP, so I think the quoted

High Power RF:

At these powers RF leakage from loose PL259, high Filter & Aerial voltages are dangerous! Double checking connectors & everything is SAFE before keying up, & testing is essential. Otherwise you will soon learn about deep RF burns & gain "Respect for the RF" the hard way!

RF Chokes:

Wind coax or balanced aerial leads to make "RF chokes" near shack end, this helps keep shack RF fields & RF lead currents down!

I N U S E

Running it /P for 8 days at a summer camp on HF with autocaller & plenty of pile ups, I did find a fan system was useful, to cool the front part of the PA (used a small Germanium transistor to sense temp & a high gain Tip Silicon to operate fans in series.)

A 25A linear PSU floating batteries worked well. The rig was floated on another battery & PSU. This did allow a much smaller petrol generator (650W 2 stroke) to be used rather than a 2.3kW 4 stroke & QRO Valve Amp. (That was used for cold night to keep the operating tent warm!)

In my shack I now use a DEL 13.8V 75A SMPSU with thick short leads for this PA.

Reports were all pritty fantastic, good clear comms quality AF from the old IC735 with its hard AF clipper mic processor, 2.4kHz SSB filter & a strong signal. A local looked at the remote Hack Green SDR website radio, only to comment "my /P station much was stronger than his & narrower!"

See my Tech buls on "AF 2 Tone Test Osc Design", "Transistor PA Biasing", "Lead Acid Batteries", "Variable Speed Thermal Fan", "12V 75A Del SMPSU Mods", "2nd Car Battery for /M & /P", "Rig DC Power & RF Hazards", "Using 2 HF PAs" & "NORTHERN 650W 2 Stroke Genny".

Why Don't U send an interesting bul?

73 de John, G8MNY @ GB7CIP