CONVERTING AN HF LINEAR TO SIX METRE OPERATION

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This project was brought about by the frustration of living hundreds of miles out from capital cities and being unable to alert stations occupying 6 metres of my presence.

Melbourne in particular has a very high "crud" level, generated by Channel O, with which operators have to contend; this noise tends to make intrastate communicating on 6 metres difficult to say the least. The extended ground wave paths on east-west circuits can be pushed out to over two hundred miles if good receiving equipment is used, with power levels above 100 watts to at least a four element yagi. So to those who consider any VHF power linear, please look to your receiving department first, as it is quite fruitless for an operator to read you 5 x 5 with your high power, if you have a "deaf" receiver.

There are several good low noise pre-amplifiers for both 6 and 2 metres which give an excellent lift to an ailing front end, also post converter amplifiers as featured in the early VK3 converters can add lift to the transceiver on the 10 metre band and provide a useful pre-amp. for 10 metres during non-six metre activity. At this QTH a 3N210 dual gate FET pre-amp. is incorporated into the transverter, with an RF gain facility adjusting the bias on one of the gates, whilst the post converter amplifier is a 3SK140. High power is not required for most summer sporadic E conditions. This article is for the serious long haul and back scatter, meteor scatter and forward scatter operators.

Well how do you modify a HF linear amp to the VHF 6 metre band? First, I guess, you obtain or have the necessary amplifier, which is now not so easy in Australia. I'm always being told that because the HF conditions are so good you don't need "boots" any more, so why not convert yours to 6 and convert it back when the sunspots die in a few years time? I decided to axe the station FL2100B after months of indecision, and I'll tell you after the first silver-plated capacitor is removed it doesn't hurt a bit. I found out a few truths about construction which are hidden by the green paint and tinsel, but that's another story.

The first things to go were the PA tank circuit components, valves, RF choke, bandswitch and coils; left are the two capacitors for load and tune. The removal of all these components was achieved with very little unsoldering and a small amount of unbolting. After removing the coil assembly the ten metre tank coil, which is a separate air wound inductor, was disconnected and put to one side. For those with queasy stomachs buy a foot of 3/16 in. copper tube. The new final tank coil is about four turns of above size the same diameter as the ten metre tank but with two turns air spaced instead of one. This can readily be achieved by expanding out the ten metre coil to twice its length (you can always squeeze it back again!).

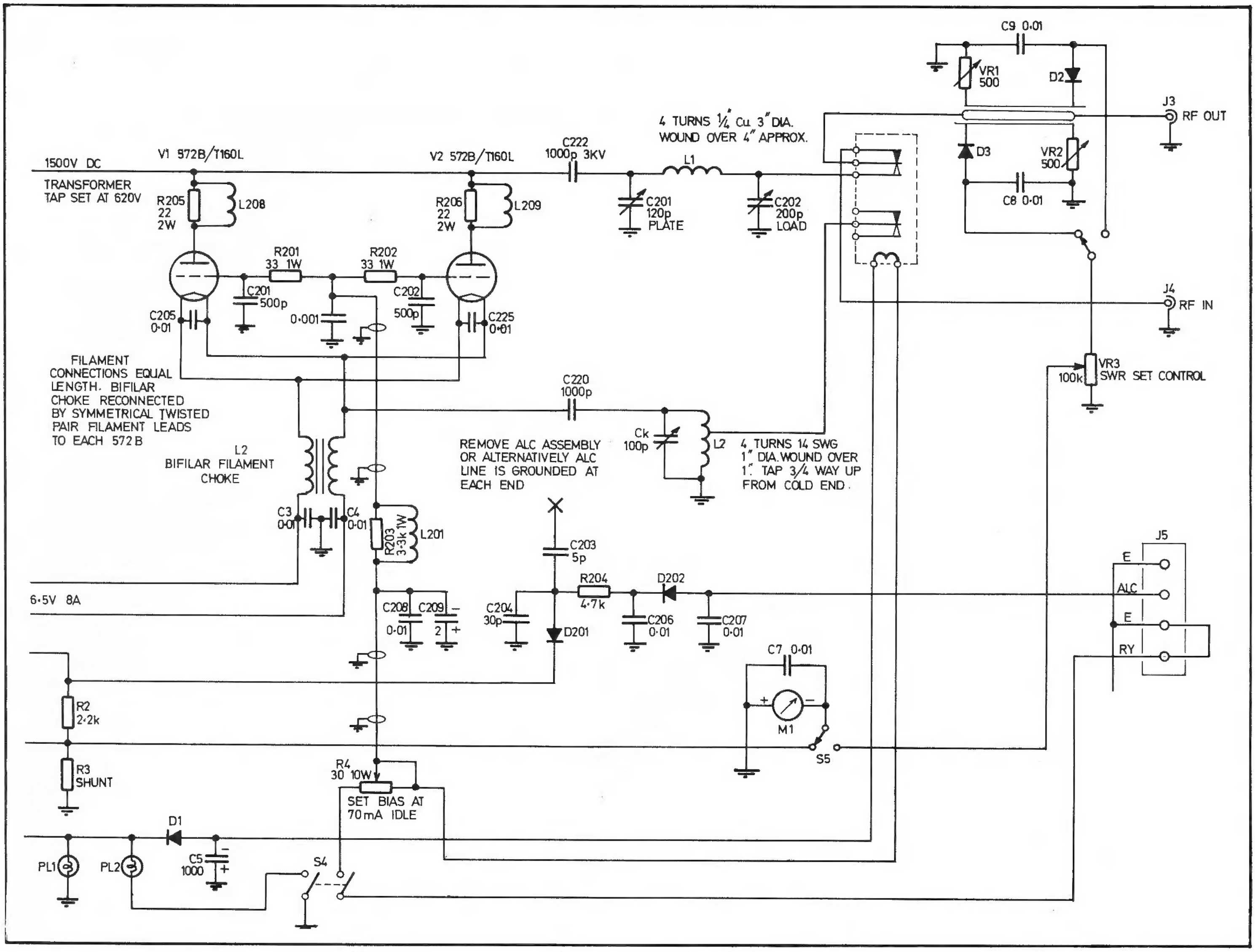

FIGURE 1: Modified FL2000/FL2100B Circuit

Next the RF choke, which is also a mechanical support for the anode leads of the 572B triodes, was replaced. This requires duplicating mechanically the existing structure or remove the windings of the choke and rewind with suitable material to the correct dimensions. I used 30 turns of 18 gauge enamelled copper wire on a ¾ in. ceramic or teflon former wound with one turn spacing over approximately 4 in. The existing choke is a pi wound multiband unit with a top frequency of 30 MHz. It will work in a sense but not for long. The ten metre section will overheat and become discoloured, then the insulation will break down — and 572Bs are $55 each. Enough said. The bypass capacitor, 1000 pF 3000 VDCW fitted below the cold end of the RFC, was retained.

The coupling capacitor can remain the same 1000 pF unit fitted to the end of the RFC. Two 470 pF give a slight improvement in performance because their reactance at 50 MHz is 6 ohms compared

SPECIFICATIONS	FL2100B/6	Gain = 12 dB
	Class B Grounded Grid (RF)	
2 x 572B/T160 Triodes	Carrier	Two Tone
Va = 1500V* DC		
Anode Current = (2 Tubes)	20W PEP	425 W PEP
Power Input (DC)	750 watts†	350 mA
Grid Current (including idle)	75 mA	50 mA
Volts Drive	65 RMS	64 RMS
RF Driver Ouptut (approx.)	20 W PEP	25 W PEP
Anode Dissipation	320 W	310 W
Power Out (average)	430 W	215 W
Power Out (PEP), including Drive	430 W	425 W PEP†
Power In (PEP)	750 W PEP	735 W PEP
% Efficiency, including Drive	57.2%	57.5%*

* This figure due to reduction in duty cycle and regulation of anode voltage which fluctuates between 1700V no load to 1400V full load.

† These figures exceed those allowed by P. and T. regulations.—Editor.)

with about 24 for the 1000 pF unit, however since the PA runs in Class B Grounded Grid, it was not expected to have any regeneration in the circuit.

Unfortunately this was not to be; more on the reasons and remedies later.

The two 572B/T160 triodes were mounted back into the PA cage. A Grid Dip meter showed that the range of the tuning with the parallel tube configuration was 30-70 MHz, depending on the setting of the load and tune capacitors. The cathode circuitry was modified by removing all the bandswitching components and bypass capacitors to reveal the filament wiring and ALC circuitry.

It was found necessary to remove all of this circuitry. I did not do this initially and found that C203 of the original circuit introduced instability due to a positive feedback path through the ALC system. The driving stage should be carefully adjusted to minimise overdriving and distortion. The whole plate with all the HF coils was removed; all the capacitors whether soldered or bolted were also taken out. The filament wiring was removed due to its unbalanced configuration. A new loom was made up from heavy insulated wire, twisted equal lengths, soldered to the socket pins and returned to the bifiliar RFC filament feeds.

A four turns airspace coil wound over one inch was constructed of 18 gauge wire followed by the mounting of an Eddystone 100 pF silver-plated variable capacitor in the hole vacated by the bandswitch.

The coil was soldered into place and a 1000 pF coupling capacitor connected between the variable capacitor and the filament choke. See Fig. 1.

The frequency of resonance was checked with a GDO to see that it covered the required range. A fibreglass shaft coupled through to the front panel was fitted with the original band change knob. You cannot tell what changes are inside, that's for sure.

At this stage I did a little detailed reading on how to set up G-G linears and found out that you don't run drive without plate voltage applied so I left the matching of the driver till later. I fitted four capacitors from the original parts back into the cathode enclosure for bypassing the grid. Bias is applied for normal standing current, and I had to make sure that it was down to earth for RF at 6 metres. This was achieved by using two of the 250 pF and two of the 200 pF coaxial chassis mount capacitors. The two 33 ohm grid stoppers were left in but their junction was bypassed with another 1000 pF disc ceramic. C205 and C225 were changed to 1000 pF disc whilst C200 and C202 in the grids were removed and replaced with the coaxial combinations. I noticed the bias feed wire was an unshielded piece of hook-up wire so I used the shielded ALC wire to feed the cathode enclosure with the bias required. The tag-strip containing the ALC diodes was removed and the one containing the grid stoppers and bias feed choke was altered to allow better symmetry in the layout.

I dipped the cathode coil again and then set about hooking up the transverter feed tap. With the help of Orr and Johnstone I discovered that the cathode impedance is about 150 ohms for grounded grid and that a suitable driver tapping point would be about ¾ of the way up the input coil. With this done the rear section enclosure was boxed up to avoid coupling and possible feedback. I then set the secondary tap to the lowest position, 425V AC, which gives around 1100 volts on the anodes.

The top cover of the PA cage operates a HT interlock, so it has to be replaced before any testing is done. It also removes the temptation to prod, which is unnecessary if you've done your ground work; dangerous, too.

The first turn on showed no shorts or other gremlins, so an SWR meter was connected between the transverter and the linear amp and drive applied with HT. A check showed about 2 : 1, so the unit was switched off and the tap in the cathode coil accessed and moved a quarter of a turn down. Several adjustments later resulted in a 1 : 1 match with the loading control of the FTV650B about mid-scale (50 ohms).

Next the operate switch was pressed and the PA current idle checked at about 60 mA. Slowly a little drive was applied and the output current showed a rise to 200 mA. A bit of a fiddle with the plate tuning showed a dip and some power in the watt meter connected to the output socket. The load control gave a rise in output but reached the clockwise stop; investigation showed minimum capacity but two sections in service. One lead was snipped off leaving 250 pF across the output of the Pi. A further run up showed a better figure at mid-scale for maximum output and the rest is history. The darn thing tuned up like any HF linear and was giving about 200 watts of carrier into the watt meter. Adjusting the cathode tuning cum bandswitch control gave a very lazy increase, peaking about 2/3 scale (15 metre band).

Next some two tone was supplied to the transceiver and the output viewed on a scope. It was quie clean and showed about 200W PEP on the scale — not bad for the low tap.

The medium tap gave 1700 volts to the plates at an idle of 80 mA and this with drive gave the magic numbers at two tone application 400 watts PEP on six metres for about 500 mA at 1500 volts. The regulation of the power supplies in those so-called super linears is very poor and would cause a few linearity problems in a tetrode stage.

A check on the highest tap showed only a 50 per cent power increase but considerable extra heating of the final tubes. At 550 watts out the tubes were looking like the evening sun. On the 1700 tap with a single tone at 400 mA with the lights out the tubes were black, and that looked good for continuous service.

So there it sits on the table, a small unobtrusive box about ¼ the size of the old 3ZAZ monstrosity with no noise and the magic numbers out on six metres.

The bandwidth of operation was good for the 500 kHz of the transceiver without retuning, which I think is a product of the low impedance cathode circuitry.

I found that 750 watts input could be achieved from 25 watts of excitation. Efficiency was 52 per cent after subtracting the drive power, and the transformer taps were 234V AC and 620V AC respectively. The maximum DC input power achieved was a little over 800 watts in the cherry red, so as to speak, so it is recommended that SSB modes only be used with this configuration.

I ran under test at 400 PEP for lengthy periods with no ill effects or over-heating, and found out not just how much power it put out, but how clean it was.

The third order products on the analyser were the same as those of the transverter, approximately 30 dB down, which means the linear contributed nothing to degrade the products. Second harmonic was an expected 45 dB below. These tests were at full output. Remember to tune for maximum output and then reduce drive to keep within legality. Two tone tuning with a scope is the only way to correctly tune any linear amplifier, and this one is no exception. It is the only way to achieve correct loading conditions and clean operation. I have fitted a small pot to the transverter drive supply to accurately set for full 400 PEP performance and the results on air are very encouraging. The dip in PA current at peak output is very shallow and not readily noticed. Maximum output should occur at minimum plate current and, if you had a grid monitor, maximum grid current.

The antenna changeover relay leaves a lot to be desired. However, due to the facility of linear/barefoot operation at the flick of a switch, I am yet to find a suitable coaxial combination that would not be cumbersome and yet still do the trick.

All in all the project was successful and relatively cheap if you discount the cost of the linear amp. Any HF amp could be modified, it's only the layouts which present any problems. The SB200 and Dentron Superamp would also be suitable; however a bit more thought would have to go into converting the 4 tube FL200 using 6KD6s.

Eimac 8875 triodes are obviously the next choice, but after using and hearing the silence of the Yaesu fans, I would not ever tread the high speed blower path again.

If anyone blows up the tank circuit of their FL2100b I know someone who has a box of spares; see you on 6m. ■