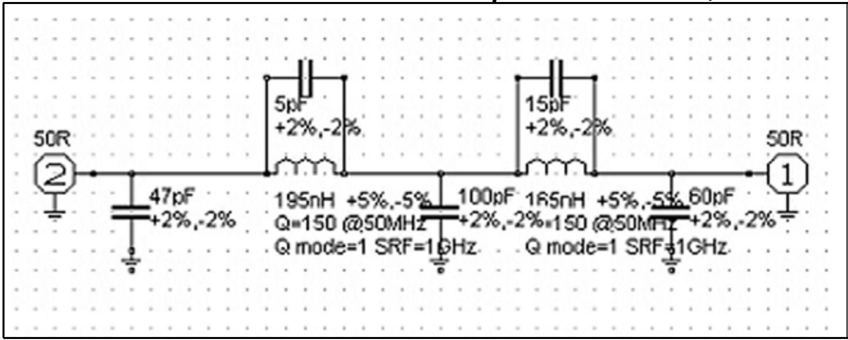

Fig 4.63: Circuit diagram of the lowpass filter for the 50MHz 500W linear amplifier.

mode power supply and the fan. Various attempts to get rid of it proved fruitless, so instead of curing the disease, something had to be done about the symptoms. The noise entered the signal path at several points internal to the amplifier (demonstrated by taking the two coax cables connected by a female-to-female adapter and routing this through the amplifier, with no detectable noise when the amplifier was turned on. The main culprit was determined to be the open (RF) relays and coax joints done on the cheap at various points.

It was decided to completely redo the internal RF cabling, using high quality coax relays, RG400 cable and crimped N connectors throughout. The 25V and 12V power supplies were changed and a transistorised PTT circuit was also added. The rebuild has been a complete success, nothing can be heard or measured in receive mode, it is at least below -100dBm. Fig 4.62 shows the rebuilt amplifier.

Last, but not least, the whole thing, ready to plug in, weighs just under 12.5Kg, ideal for /P use or DXpedition travel. That is with the present heavy duty steel cabinet, 3 to 4Kg could probably be shaved off with an aluminium enclosure. The total costs for all parts (without PSU) were around 250€.

Lowpass filter

The circuit for the lowpass output filter is shown in Fig 4.63. It was simulated with RFsim99 as shown in Fig 4.64. The trace in the left upper corner is RL = 27dB at 50MHz, the 2nd harmonic is -70dB and the 3rd harmonic is -80dB.

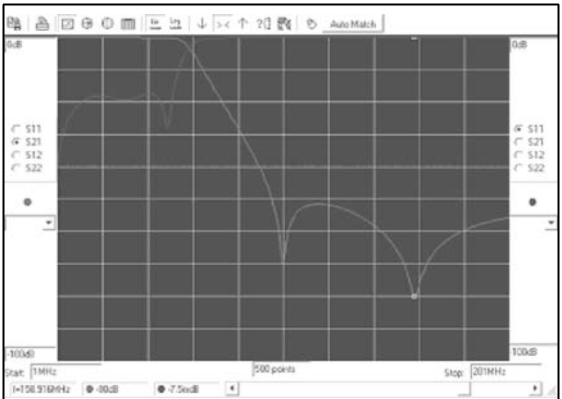

Fig 4.64: RFsim99 simulation of the lowpass filter for the 50MHz 500W linear amplifier.

The insertion loss < 0.15dB. Real life measurement is almost identical to the simulation. The components used were:

- L1 = 165 nH (3mm silvered copper wire)
- L2 = 195 nH (3mm silvered copper wire)
- C1 = 60pF (1000V NP0)
- C2 = 15pF (8pF Johnson trimmer par. 10pF ceramic 500V)
- C3 = 100pF (4 x 100pF/1000V NP0, in series/parallel)
- C4 = 5pF (piece of copper foil on a lead “flapper”)
- C5 = 47pF (1000V NP0)

A picture of the filter is shown in Fig 4.65.

VMOS Solid State 2m Power Amplifier

The circuit diagram for the VMOS power amplifier designed by Dragoslav Dobricic, YU1AW [n], is shown in Fig 4.66. There are two identical amplifiers connected by wideband baluns operating in a symmetrical anti-phase or push-pull. The input of each amplifier is fed via a wideband balun made from 95mm of 50Ω Teflon coax cable wound into a coil around three ferrite beads as shown in Fig 4.67. Each amplifier is matched using C1 and L1 and balance between the input circuits is achieved with C2. The gate bias for each amplifier is fed from a 5V regulated supply with bias adjustment by 2k2 potentiometer. The drains are fed from the 28V – 29V supply via an RF choke, which is open wound from 0.8mm copper wire, 8 turns, 6mm diameter and 12mm long. The output is matched with L2 and C3 and balance between the output circuits is achieved with C4. The outputs are combined with a wideband balun made from 95mm of 50Ω thick Teflon coax cable, such as RG142, wound into a coil around three ferrite beads as shown in Fig 4.67.

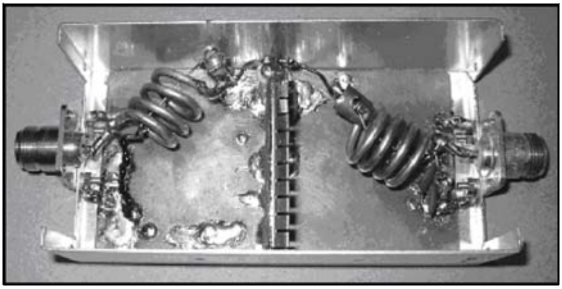

Fig 4.65: Picture of the lowpass filter for the 50MHz 500W linear amplifier.

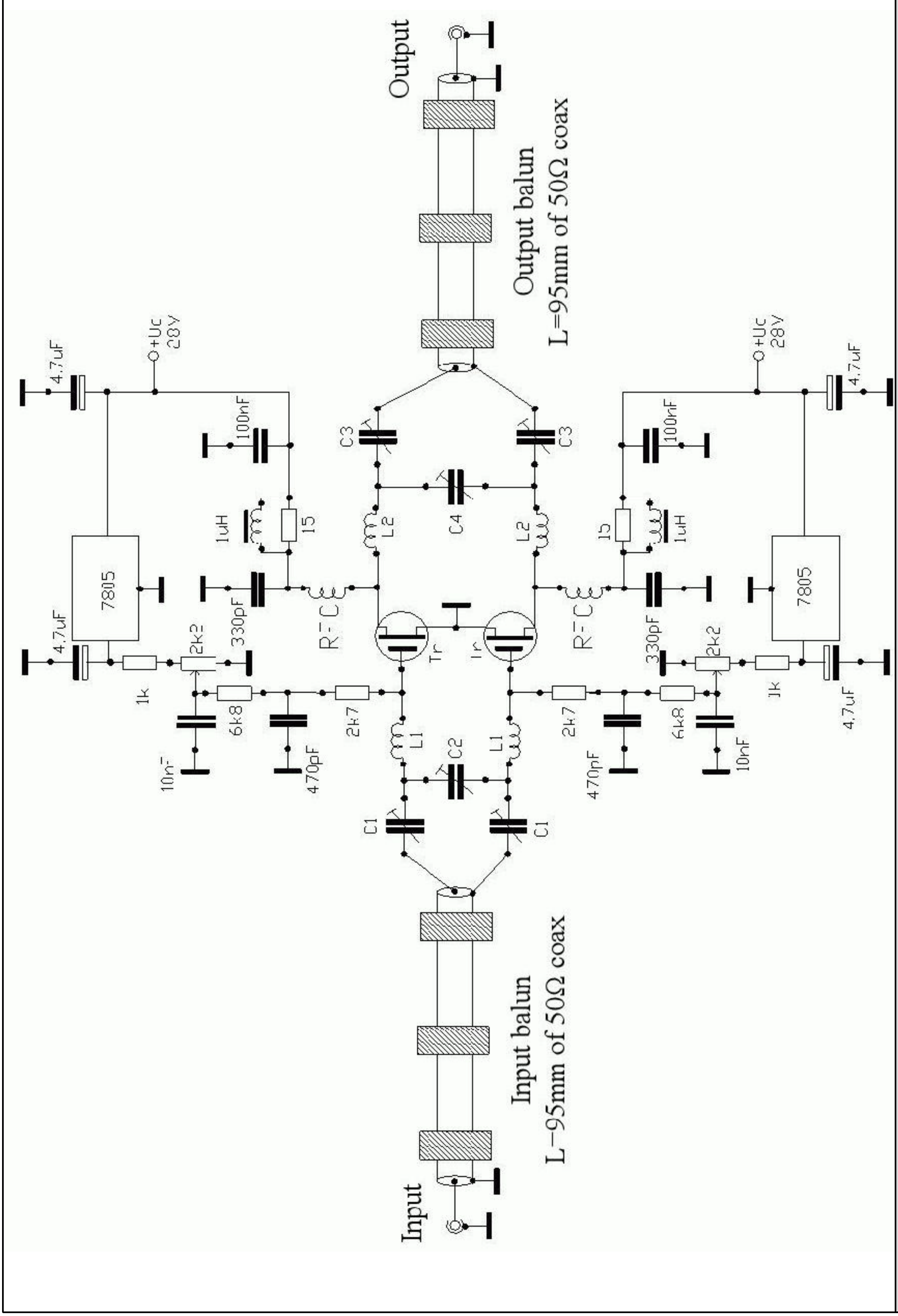

Fig 4.66: Circuit diagram of the VMOS solid state 2m power amplifier.

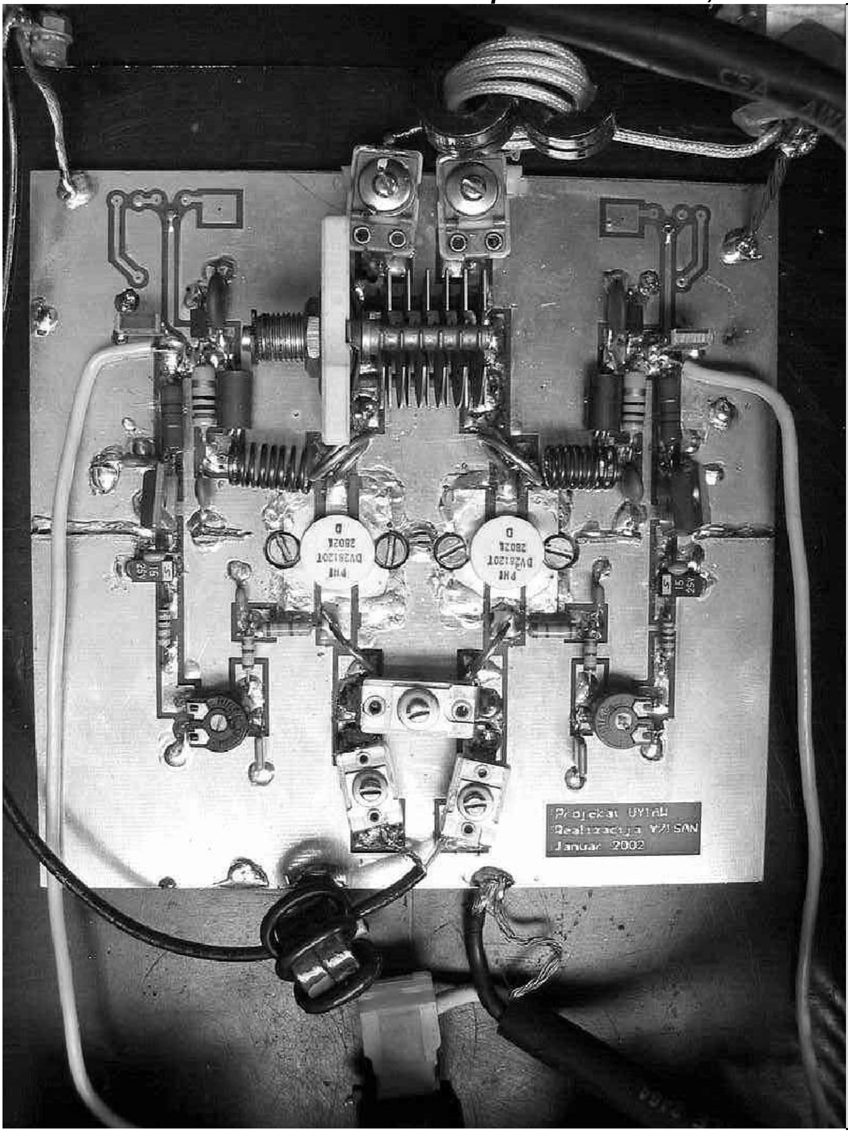

Fig 4.67: Picture of the assembled VMOS solid state 2m power amplifier.

Using self-resonant baluns gives an improvement over the wideband balun made from 95mm of coax cable. A 144MHz resonant balun can be made from 620mm of 5mm diameter PTFE coax cable, RG142 or similar. Close wind into 6 turns with 30mm inner diameter and about 30mm long with no space between turns.

Table 4.10: Main parts for the VMOS solid state 2m power amplifier.

C1	22pF Arco trimmer
C2	65pF Arco trimmer
C3	19pF Arco trimmer
C4	27pF Arco trimmer
L1	8.5nH, 0.8 turn, 8mm dia of 1.2 - 1.5mm copper wire
L2	16nH, 1 turn, 10mm dia of 1.5 - 2mm silver plated copper wire
RFC	8 turns, 6mm dia, 12mm long of 0.8mm copper wire
Tr	DV28120T

It is very important that the entire amplifier has to be totally symmetrical with regards to the mechanical layout of components and electrical parameters (values of elements, currents and voltages, etc.), so that more power, amplification, efficiency and suppression of even harmonics can be achieved. While adjusting, it is very important to maintain the same capacitances of C1 and C3 in both amplifiers.

Mechanical Construction

The whole amplifier has to be built on a relatively small piece of a single layer FR4 printed circuit board (Fig 4.67). Source leads are soldered as short as possible onto the ground of the board. The transistor should be mounted onto a large heatsink using thermal paste. The details of the main parts are shown in Table 4.10.

Table 4.11: Operating parameter for the VMOS solid state 2m power amplifier.

Supply voltage	28 - 29V
Supply current	2 x 9A
Quiescent current	2 x 600mA
Output power	2 x 120W
Drive power	2 x 10W

Once everything is connected, check once again to ensure that there are no mistakes and short circuits to the ground, and adjust the potentiometers for maximum resistance. Connect the supply to one transistor and adjust the collector current to 600mA. The same procedure should be carried out with the second transistor. Even more important than the exact value of quiescent current is that they are identical in both transistors! Then connect both transistors to the supply and connect a 50Ω dummy load to the output via a wattmeter or SWR meter. If you do not have a dummy load, a good aerial with low SWR can be used. Supply minimal excitation and by measuring the output power alternately adjust trimmers until maximum output power is achieved. Repeat the adjustment several times, gradually increasing the excitation power. Finally, with full excitation, which should not exceed the permitted output power, adjust all trimmers to the highest output power. At the same time the transistor's current should be measured so as not to exceed the maximum allowed value. The typical parameters for the amplifier are shown in Table 4.11. If input trimmers, C1 or C2, need to be at maximum or minimum capacity during adjusting, it is necessary to change the length of the cable between the exciter and the amplifier itself. The optimal length of the cable should be determined experimentally to obtain adjustment with approximately the same values of C1 and C2. This experimentally determined cable should always be used when operating the amplifier. A change of exciter could occasionally require a new length of cable to be determined. In push-pull amplifiers it is extremely important to perform adjustment so that the corresponding trimmers on each transistor are adjusted simultaneously to ensure that they have approximately the same capacity during adjustment. By maintaining symmetry during adjustments, extremely dangerous situations are avoided which can cause the amplifier to self-oscillate.

A non-stabilised supply can be used, but it should be constructed so that it has very good voltage regulation. It should be well specified with good quality electrolytic capacitors. The transformer should be slightly over specified. To avoid blown fuses caused by the charging current of electrolytic capacitors, it is necessary to build in a delayed switching device. It is performed simply by a 220V relay connected as shown in the circuit. At the moment when power is switched on, the transformer is connected to a power supply via a resistor that limits high charging currents. When the capacitors are charged and transients in the transformer settle down, the current through the resistor decreases, the voltage on the primary increases and the relay that bridges the resistor with its contacts is switched on. It is also possible to use relays that switch on via some electronic timer after a couple of dozen seconds. Although this appears to be a more elegant solution, it is a far worse solution, for two reasons: first, in the case of a very short interruption of supply voltage the timer has not been reset, voltage is switched on without delay; and second: in the case of a fault that causes high current consumption, when the relay would not be switched on, the entire system would protect itself, whereas the timer would switch on the relay and subsequently full power.