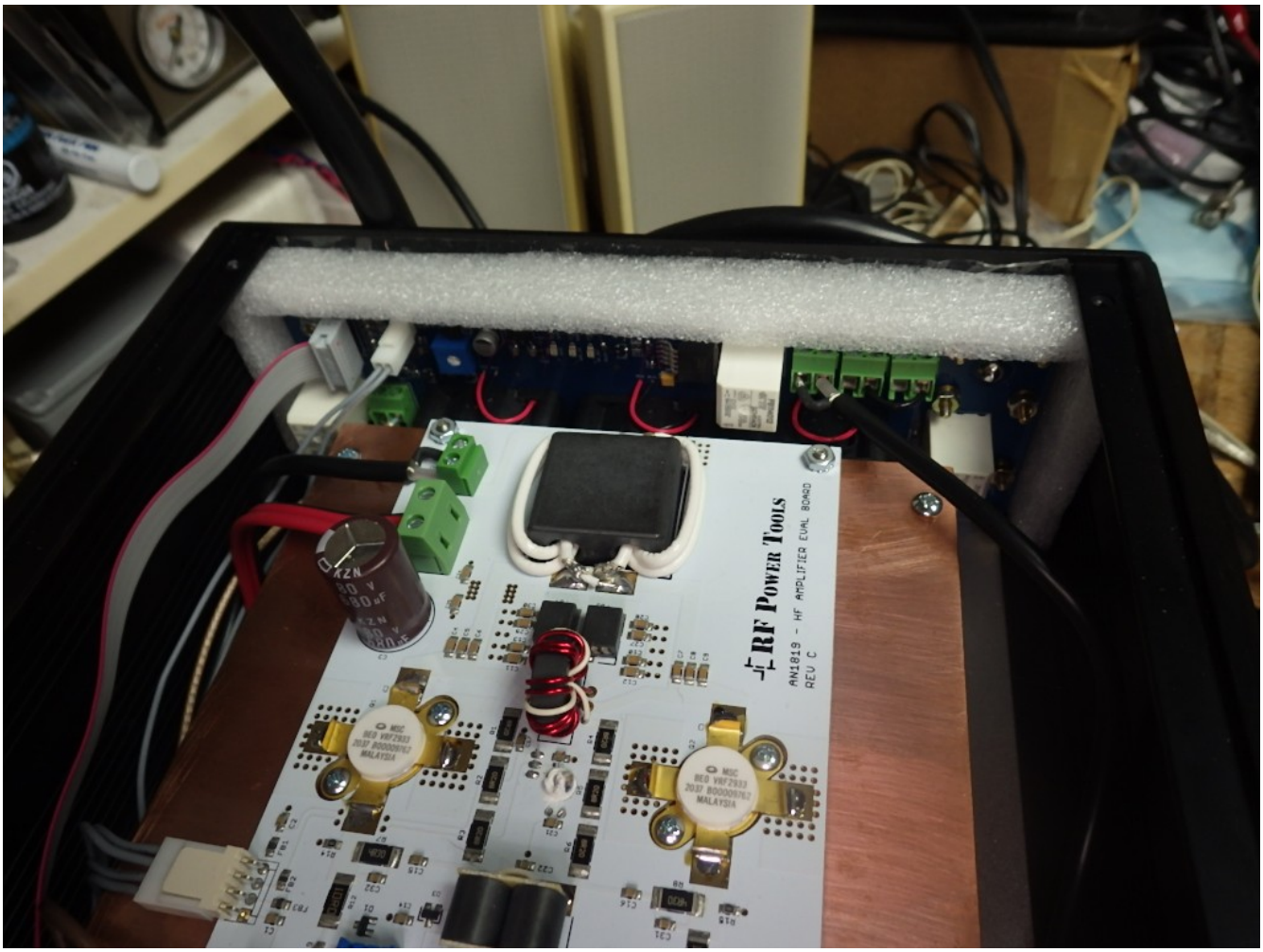
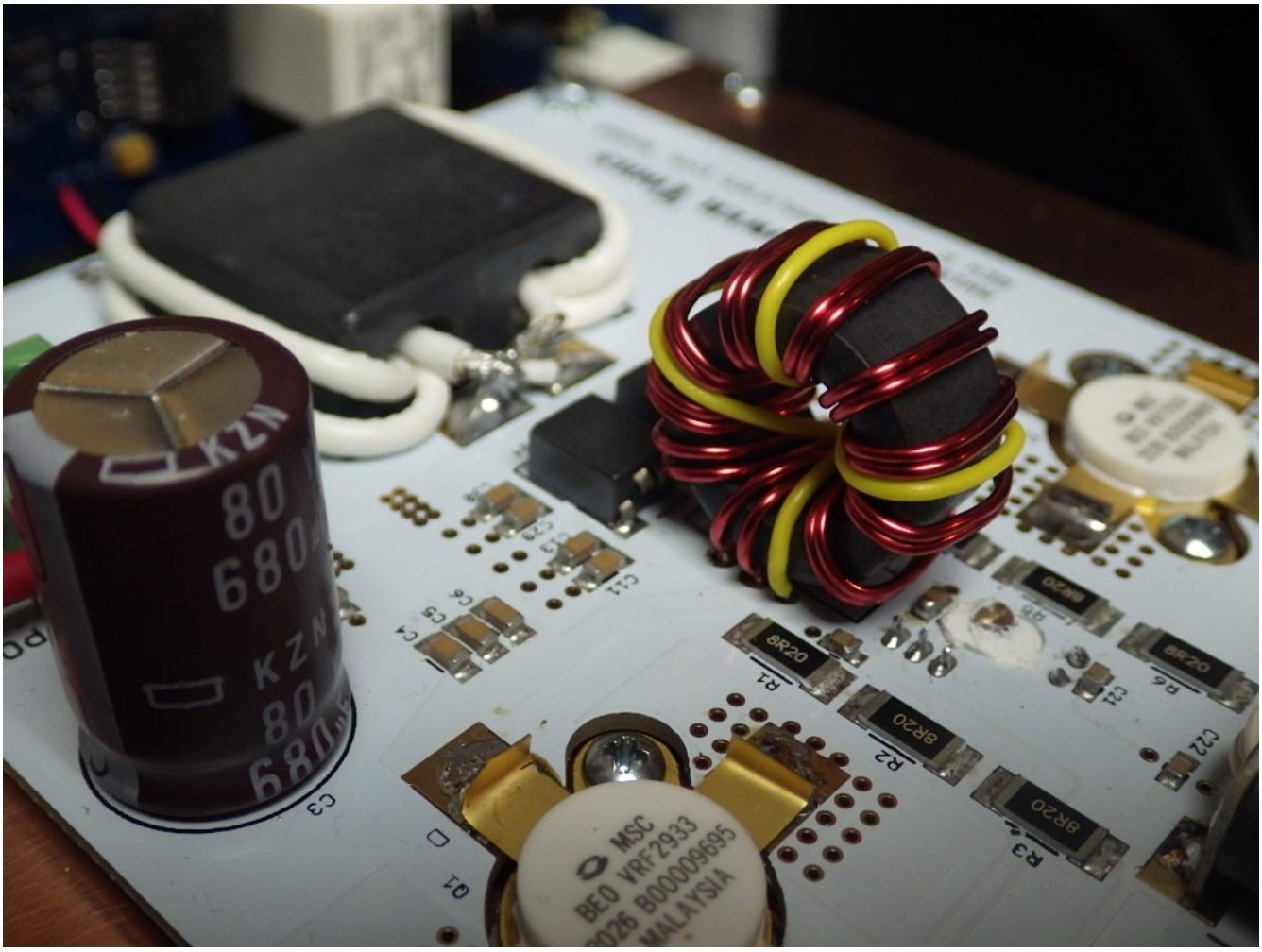
HR-500 Modifications

for 160m

Below is a photo of the amp as built per the original specs. Note that the output transformer used a single binocular core with the 25 ohm white coax wrapped unconventionally on the outside with 3 half turns each side. I say half turns because turns are counted on a binocular core as on turn equals a pass through both holes. Some might point out that this is essentially equivalent to using two ferrite beads side by side to make a transformer which is sometimes done, but in my opinion is inferior to using both holes of two binocular cores as was done in the original Microsemi AN1819 application note. Why? The part of the turn which runs on the outside of the core adds length to the transmission lines but that length is not loaded by the ferrite and not contributing to transformer action. Therefore this approach adds resistance and line delay for no benefit. Also note in the original design the feedback resistors marked R1,2,3 and R4,5,6 are 8.2 ohm 2 watt chip resistors which will be replaced by R1,2 and R4,5 which are 12 ohm 3 watt chip resistors freeing up space at the R3 and R6 locations to put a solenoidal inductor to reduce negative feedback at higher frequency. This air core inductor is 3 close wound turns of 18ga magnet wire on a 1/4" former which provides 62nH of inductance giving a reactance of 11.7 ohms at 30 MHz.



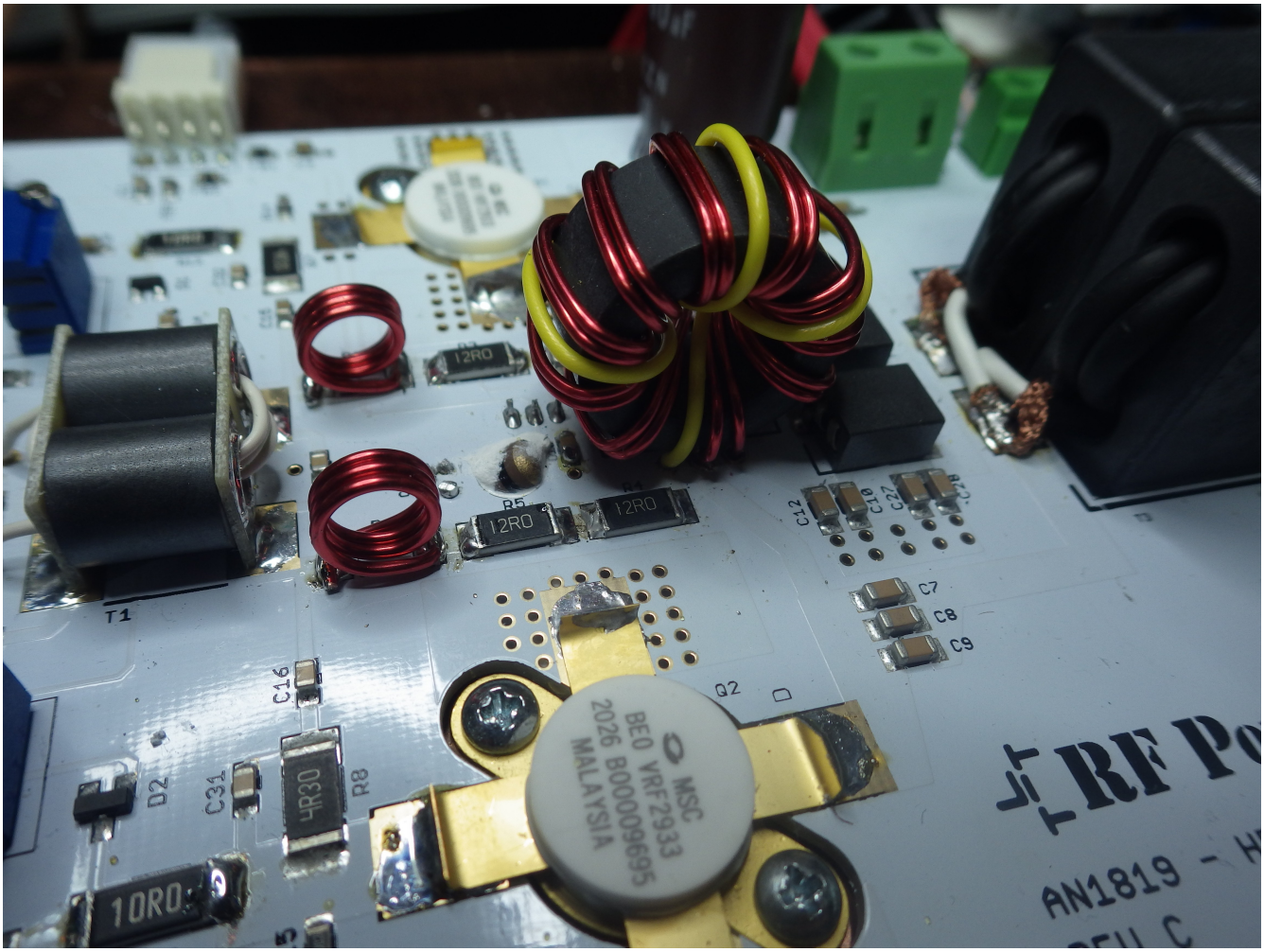
The transformer core in the middle which is T2 was re designed using a FT82A-61 and more turns to reduce core flux at low frequency. The original was a core with smaller area and turns count of 8:3 which is a turns ratio of 2.6. The new transformer used 10:4 turns which is 2.5 so broadband negative feedback is slightly reduced but not much. The core flux in the original T2 was so high at 1.8MHz that the transformer would be too hot to touch in seconds. More turns and larger cross-sectional area on the new core brought the core flux down to the recommended limits according to Amidon's tech reference material. The new transformer is a tight fit but was able to use the original PCB holes. The photo also gives a clearer view of the chip resistor feedback network. The application note had a very different layout with a long meandering PCB trace forming a large loop which adds inductance at high frequency reducing negative feedback to help offset the loss in gain of the transistors as frequency rises. Clearly the layout of the HR-500 pallet uses a much more direct route placing the six chip resistors in a direct line between T2 and the input transformer which is just off the right edge of the photo.



In the final photo below the modified feedback network is visible with the coils and 2 x 12 ohm chip resistors which are increased to 3 watt from the original 3 x 8.2 ohm 2 watt ones. The total dissipation is still 6 watts but now concentrated in a smaller area but this seems to work ok. Also visible on the far right is the new output transformer. It uses two BN61-002 cores turned on their side which happily fits in the same size PCB cutout. The app note used the same cores but had 3 full turns on each side which ends up with the wires coming out both on the same side of the core and there is no way this will fit or work. Since the original design worked to some degree at least on higher frequencies with only 3 half turns I decided that 2.5 full turns on two cores would at least be much better than the original transformer if not quite as much inductance as the app note's 3 turns but it was my only option other than cutting a hole in the top of the chassis and letting the transformer poke through which I was certainly not going to do. The original white teflon transmission lines for the output transformer are 25 ohm characteristic impedance which is very important. I found a european source of teflon 25 ohm coax but it is very expensive, the shipping option to North America is only an expensive option as well so I decided to make my own coax. This may seem like a wild idea but actually it is not that difficult and I am not the first to do so. After calculating the needed dimensions for the conductor, shield and internal dielectric I found that I could buy teflon insulated wire from Digikey and the instructions for constructing this cable are as follows:

Digikey 55PC0716-18-9CS2502-DS-ND 18Ga ETFE insulated wire with jacket OD 0.079" for center conductor.
0.1" wide Solderwick hollow braid opened to form shield.
Heatshrink on outside.

Make coax length 23.5cm
Make heat shrink 21.5cm
Assemble shield and heatshrink with 1cm braid spearated on each end.
Wind 2.5 turns on BN61-002 core.



Now the amp works as it should and I am fairly pleased with it. The user interface is adequate but lacks some niceties like auto-ranging bar graphs which would be nice when running lower output power. Since it is open source I may get around to that some day and will probably change the display colour scheme to something that is more suitable for sitting in a darkened room.

Best regards...Joe ve3vxo