Rebuilding an Old Classic

When Bill took possession of a gift of an old Wilson 5 element 20 metre mono-band Yagi, I was given the assignment of getting it back on the air. I was delighted when the antenna came with its original manual, a bonus for sure. It also came with a lot of handwritten notes, mods and upgrades—which turned out not to help in the end.

This antenna, appeared to have had at least 2 owners before Bill took possession, each adding their own concept of how the antenna should be put together. So the challenge was to decide what version to use for assembly.

To digress for a moment, the Wilson M520 Yagi was designed by W7GVA for Wilson Electronics in Henderson, Nevada in or around 1970. The Yagi Bill has, appears to have been initially purchased January 29th, 1972 by WA7BAY.

At some point, the antenna was bought by Heinz VA7AQ and was in operation of over a decade, then disassembled and sat neglected for years...as old antennas often do. When it came time to unwrap the bundles of tubing and do an inventory, there were pieces that needed replacing – some because the tubing had cracked over time, and some because they were simply missing. About $50 worth of new tubing and hardware and we were on the road to putting some signals through the old Yagi once again.

Spec time; It was amazing to see the original 1972 price tag was only $159.95 US! Today, you would have to spend around $750 for the very same antenna—a real-life example of inflation at work.

Gain was stated at 12db. That means if you pumped 1000 watts into it, you might expect 15,849 watts effective radiated power—assuming no other losses. However, the antenna will end up about 150 feet away from the station up a 50 foot pole, so add 200 feet of LMR600 cable plus a flexible section, a few connectors and round things up—about 1.1 dB loss for a calculated ERP of 12,173 watts out—still an impressive figure.

Back to front ratio, 20db or 100 times difference between signals received from the front and the back of the antenna. Boom 40 feet, width 36 feet. 6 square feet of surface area, 145 pounds of wind load up to 100 mph before the self-destruct sequence. Weight 85 pounds—although ours felt heavier! All-in-all, a very impressive looking antenna when it's all put together.

The first attempt to assemble the antenna per the modified instructions was—unsuccessful.

As a valuable learning experience however, I did note these points;

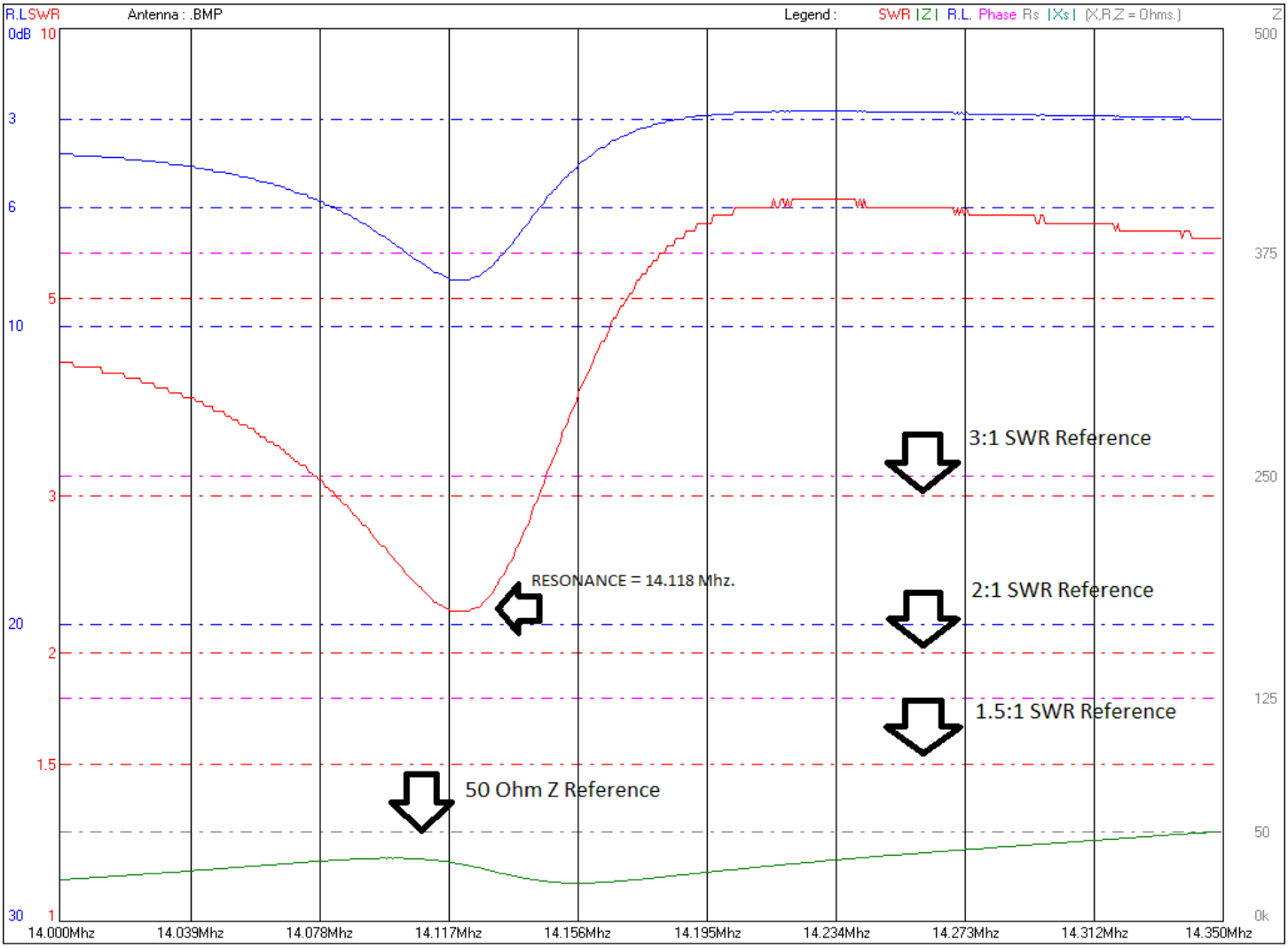
1. Use a tape measure with only ONE scale on ONE side.

2. Use friends who know how to read a tape measure; can see the numbers [make sure they wear their glasses] and can divide that number by two [in their heads] to find centre.

3. Don't rely on several people taking turns “helping” you assemble the elements, because it is a well-documented fact that men can't multi-task well.

4. Don' rely on those same friends to actually tighten all the clamps on all the elements for the same reason mentioned in item #3!

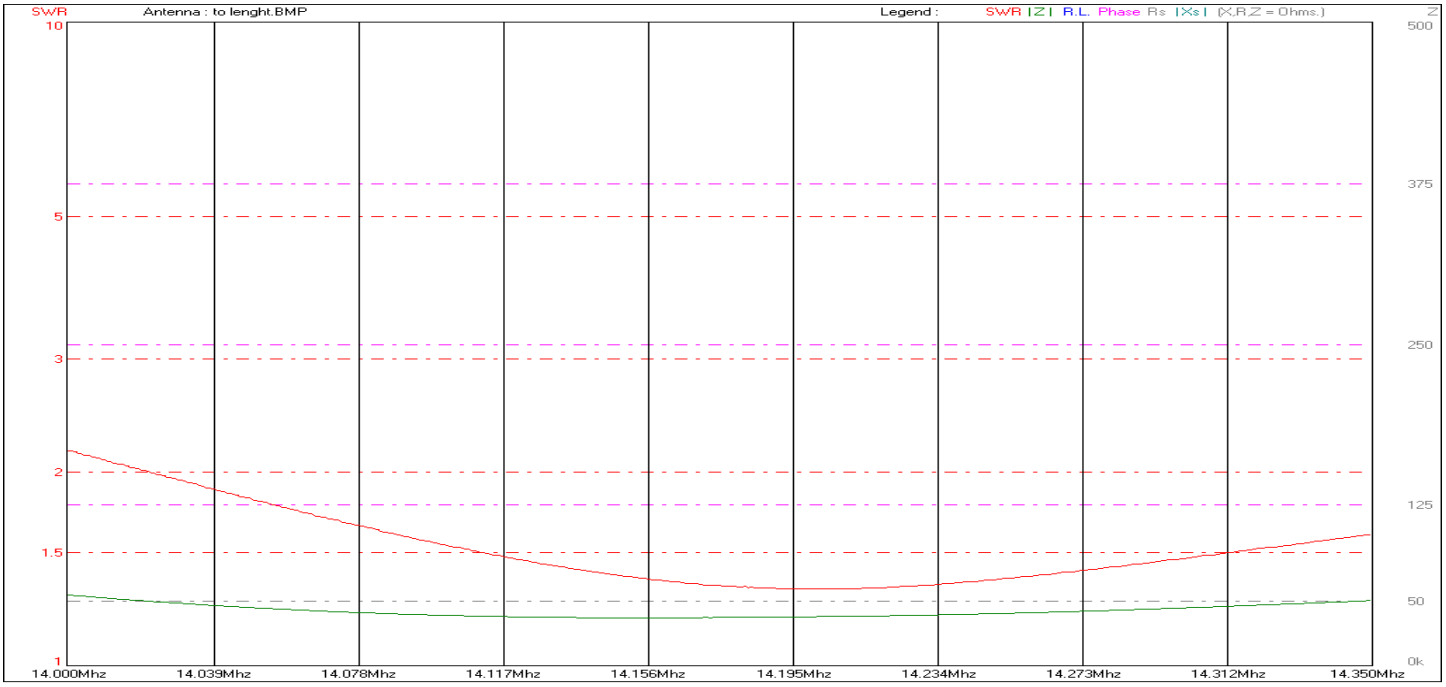
The initial MiniVNA results were disappointing.



Above is a 14.0 to 14.350Mhz. VNA scan. The blue line represents the Return Loss, which should be greater than -30db down, it's only -8db—dismal. The red line is the SWR and it's only below 3:1 between 14.080 to 14.140—not good. The Impedance line [green] shows that it's below 50 ohms—not what I was expecting. So something was wrong—I am reminded of items 1 to 4 on the previous page for the reason.

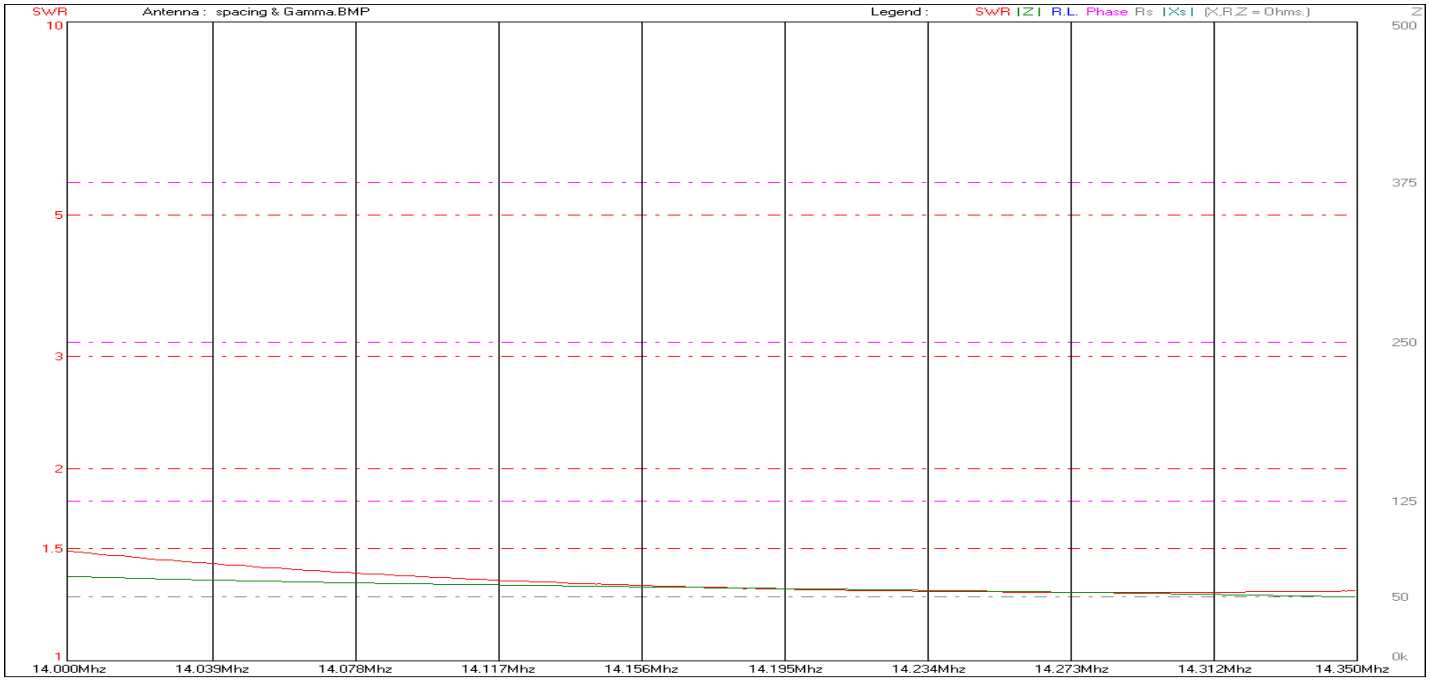
So, two weekends later, I took it all apart and started from scratch. Used the original measurements, a better tape measure and worked alone. I added new tip elements, re-measured everything and decided to assemble the Yagi one element at a time while adjusting the gamma match as I went. I started by taking the gamma measurements back to the manual's original lengths.

No success getting it to work with just the driven element on the boom. Discovering that a gamma matched "dipole" doesn't work well on its own—unlike a trapped dipole. So I added the reflector and made another measurement.



As you can see in the graph above, the 2:1 bandwidth expanded to 14.050 to 14.350, or basically 90% of the 20m band. Resonance was around 14.190 Mhz. and the Z [impedance] very close to 50 ohms, but more importantly almost flat across the band. So with just adding the reflector to the driven, we have a 3db gain 2el Yagi... Useable as is! Why? Because the gamma match needs the interaction of the parasitic element to work it's phasing magic.

Now time to add the first director. After re-adjusting the spacing, the graph displayed a much

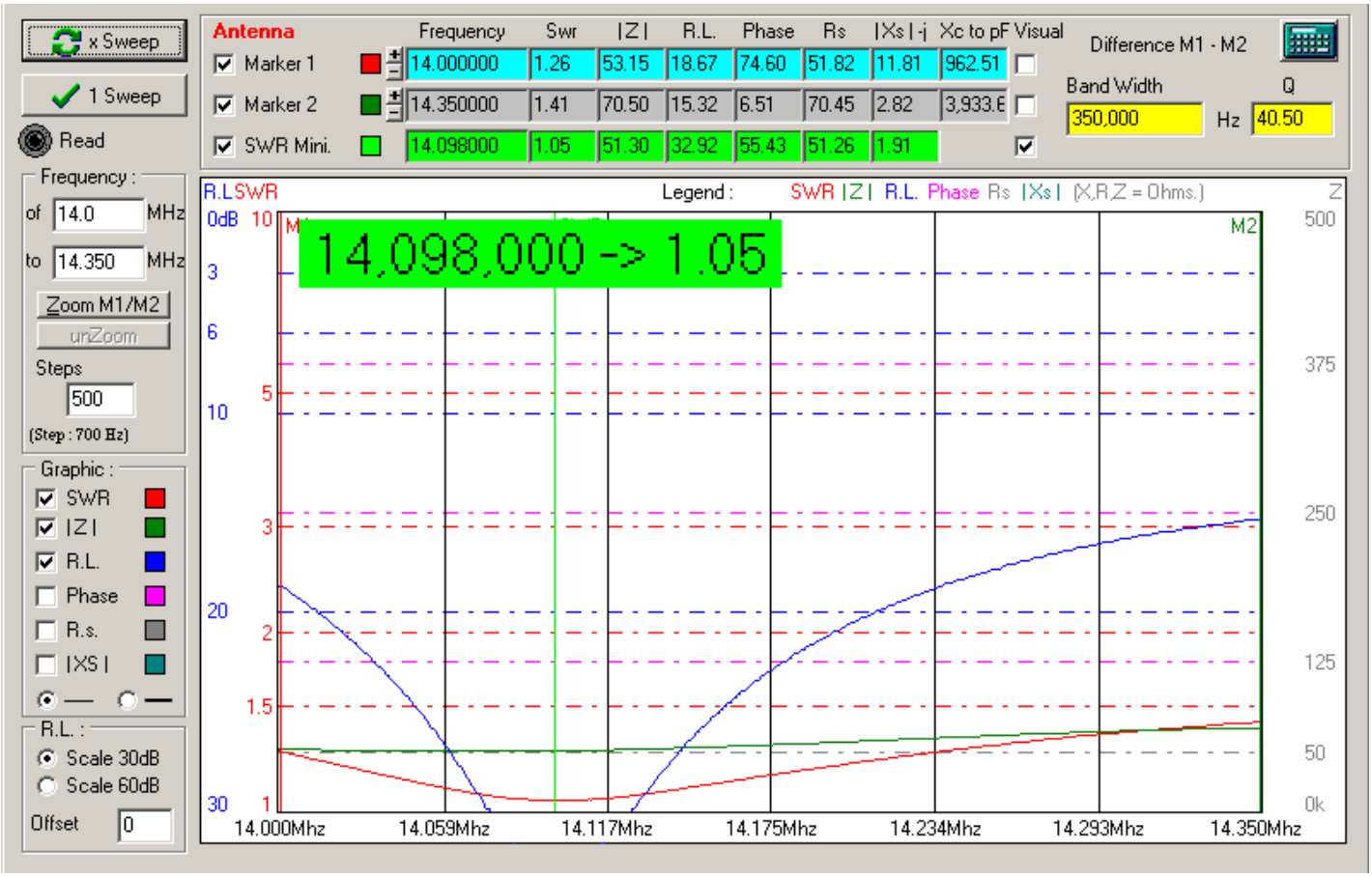


better 1.5:1 [and declining] SWR across the entire band. Impedance improvement too. Amazing how the interaction of elements affects things. We now had a 3el Yagi with about 6db gain.

Rather than adding the last two directors, one at a time and spending another hour playing with the gamma match, I added the last two directors, checked the spacing and then pointed the fully assembled Yagi north [the reflector near the C-cans]. I forgot to save a screen shot, but it was slightly higher at the top end of the band, more resonant toward 14.300 than the desired 14.200.... I should have left it, but I decided to tweak the gamma just one more time.

Note to self: If it's pretty darn close to a low SWR [below 1:5.1] and it's "almost" flat across the band...then leave it the heck alone! Oh, but no, I had to tweak it and do you think I could make it better or even get back to the above measurements?

After admitting that I could not make it perfect, and rotating it 90 degrees – the antenna now pointing SE, here is what we ended up with: [screen print shot]



You can see the resonance has dropped considerably—down to 14.098 with a SWR of a respectable 1.05:1 [red line]. The return loss [blue line] is well below -30db which is what is expected with a low SWR. The green impedance line is good too, staying close to 52 ohms.

NOTE: The antenna was only 10 feet off the ground, too close to the C-cans and the propane tank so this graph will [no doubt] all change once the antenna is on top of the 50 foot telephone pole. We'll all just have to wait for the last MiniVNA measurement.

Stay tuned!