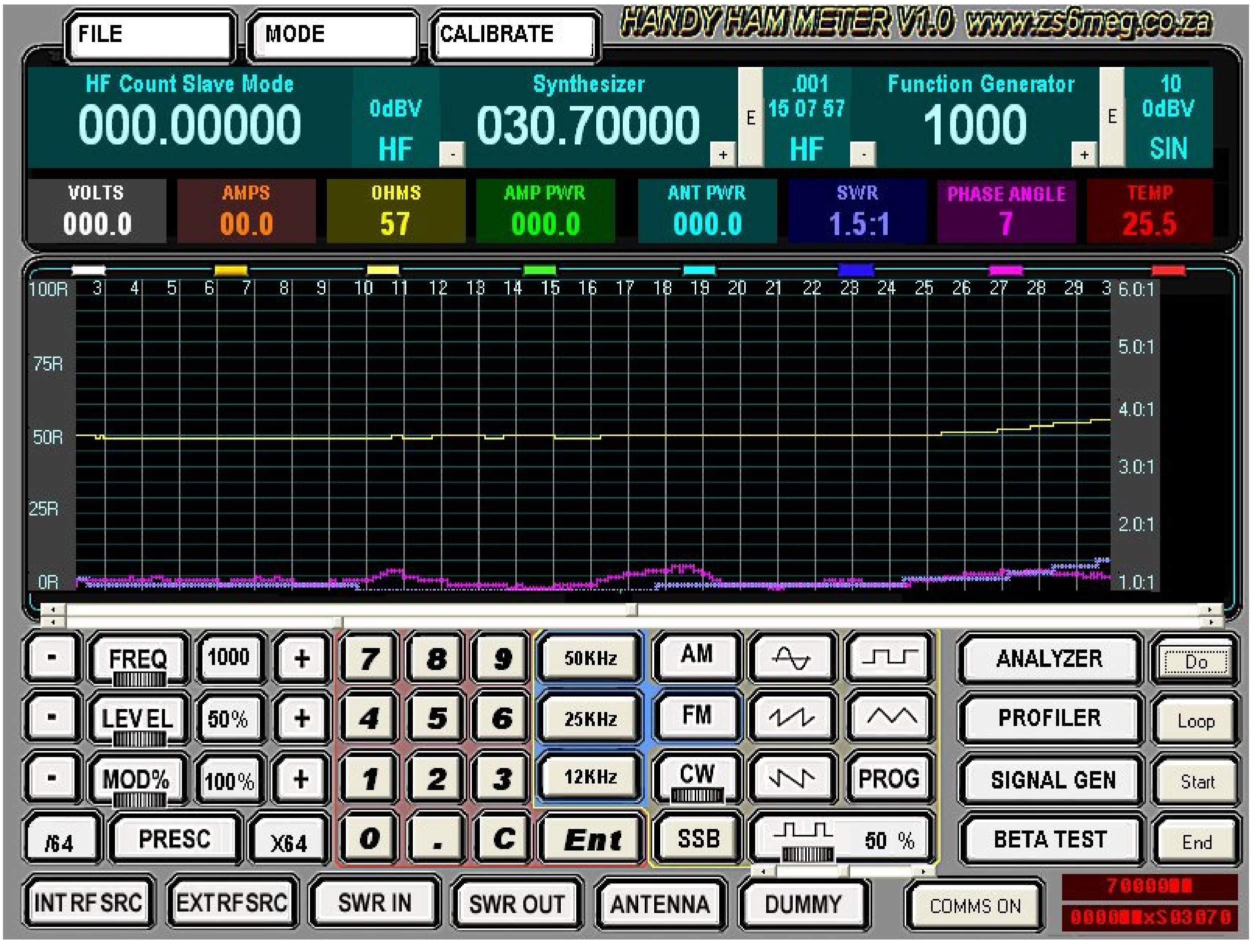
From the pen of Mike, ZS6MEG

I did this little experiment while setting up and calibrating the meters that I am working on. Sort of like a little bench mark test that others can use when setting up their ants.

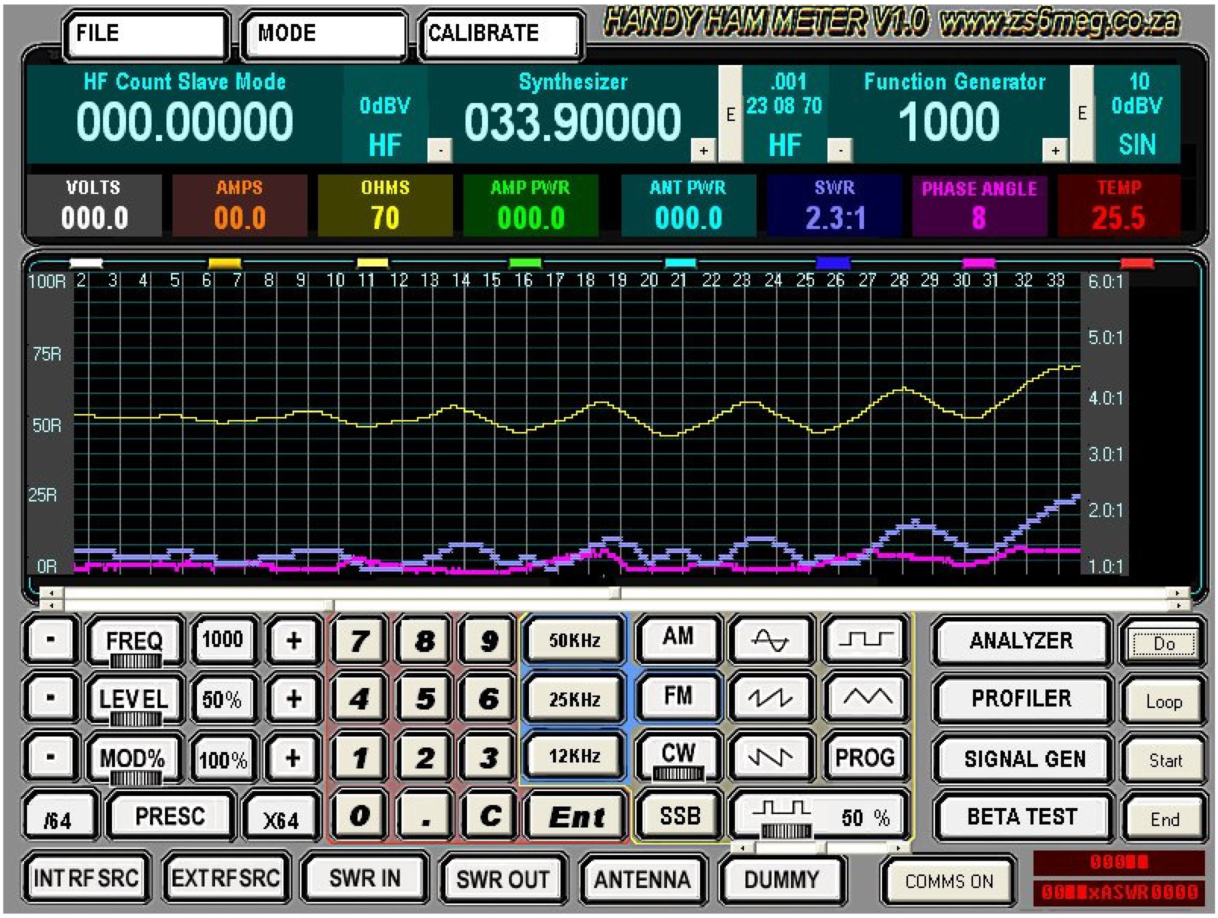
The question that arises in discussions is 'How long should the feed line be from the radio to the antenna?' and here is the answer.

I cut a length of coax exactly 20 meters long and connected the HH100 at the one end as an RF source, and a 50 ohm dummy load at the other end of the feed line as a perfect 50 ohm load.

Firstly I connected a dummy load directly on to the output and obtained a baseline plot for the dummy load from 0 - 35 MHz to use as a reference.



This is the baseline and you can see that the impedance plot is pretty smooth at 50 ohms over most of the spectrum, rising a little at the end.



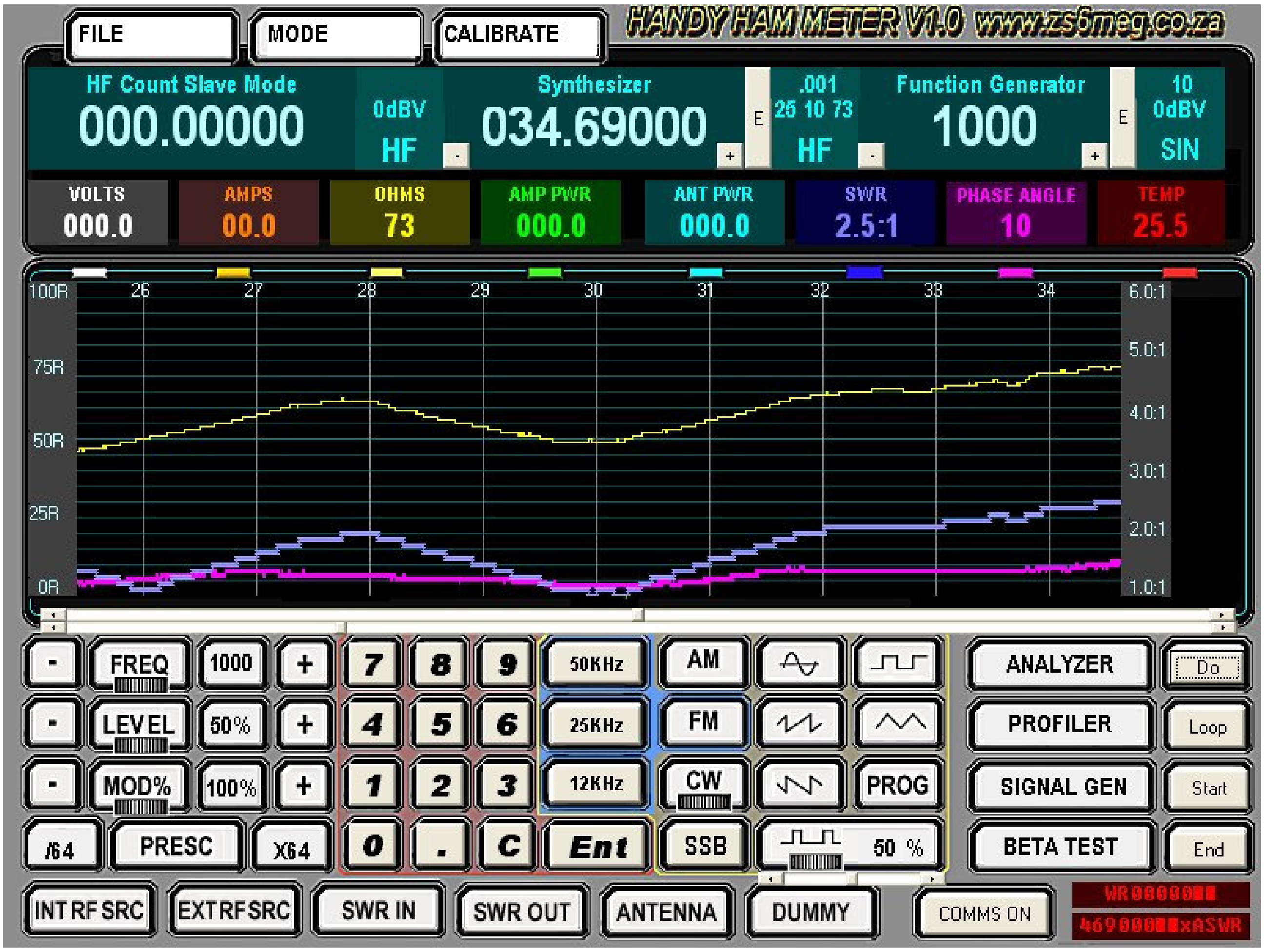
The next step was to connect the dummy load at the end of the feed line so that I could see how much of the SWR factor the feed line is responsible for and at what frequencies.

As one can see from the plot, the resonant dips come in just after 10, 15, 20, 25 and 30 MHz, in multiples of 5 MHz.

The most significant would be the dip at 15 MHz (20M) and the dip at 30 MHz (10)M. From this plot it would appear that the feed line should be multiples of the wavelength at which it is going to be used.

It can be seen on the plot that an incorrect feed line length can be responsible for as much as a 2:1 reading on your SWR meter. In that case, even if you had a perfect 50 Ohm dipole, you would be getting a SWR reading of 2:1. Many would now make the mistake of trying to bring the SWR into line by trimming the antenna.

That is not where the problem lies, the answer is to first set up your feed line and then set up your antenna.



By looking at this plot, you can see that the 20 meter feed line at 30 MHz has a perfect SWR of 1:1, an impedance of 50 ohms and a phase angle shift of 0 degrees. That means that the feed line is in fact an invisible part of the connection between radio and antenna.

In a perfect world, the output stage of the TX should have an output impedance of 50 ohms and the input impedance of the ant should be 50 ohms. The wire connecting TX to antenna should be an invisible part of the equation

Look at the scenario at 34 MHz. SWR has climbed to 2.5:1, Imp to 73 ohms and phase angle to 10 degrees. Your losses would now be horrible. The feed line now represents a resistance of almost 25 ohms (which it would most probably be if you included the phase angle losses).

So, 50 Volts into a 50 ohm load is 50 watts. However, 50 volts into a 73 ohm load is 23.45 watts.

You would be losing more than 50% of your output power at the TX! In fact, it would be even worse at the antenna. Your 73 ohm load would only be able to suck 23.45 watts out of the TX, but the antenna would only be getting 16 watts at its feed point. That represents a loss of 68%, or putting it in another way, your 50 watt transmitter would only be radiating 16 watts of RF.

And pretty much the same would be happening on the RX side. You will be losing the same signal percentage if the input impedance of your RX was 50 ohm.

So, the rule of thumb here, is cut the feed line to multiples of the operating wavelength.

First connect your feed line to the TX and the dummy load at the end of the feed line. Then do a SWR check. Adjust your feed line till you have a SWR of 1:1.

Now connect your antenna and then adjust the antenna till you have a SWR of 1:1. Then you have a good antenna setup.

This is the major issue with the multi band antennae. The ideal would be to connect up the first element, and then extend the lead to the next element, tuning up the leads to the elements on a step by step basis. Just chucking an ad-hoc length of coax onto your ant and connecting it to your TX is not the ideal way to go.

Yes, you could use an antenna tuner to turn the feed line/antenna combo into something that your antenna sees as a 50 ohm load that is resonant at the desired frequency, but, if the feed line is out, you could still wasting half of your TX and RX signal into the apparent resistance of the feed line ...

... and we all know ... resistance translates directly into noise.

"For any installation or test cable thus use any multiple of 693mm.
To verify the full cable, short it at the end and check with the MFJ for zero or minimum resistance at the frequency of interest.
Generally it is wise to cut the cable slightly longer and snip little bits off until the correct frequency is reached.
Feeding an HF 10,15,20m tribander is also possible with this philosophy as the three frequencies are harmonically related:
A full wave on 20m = 2 full waves on 10m and 3 half waves on 15m.
Thus making the smallest unit of cable length a full wave on 20m, we get physical length=14,10m for f=14,25MHz
Thus in any installation use any multiple of 414,10m and coil up any excess.
Again, verify the correct overall length by shorting the end and checking for R=0 at the 3 frequencies.
Long cables or moderate lengths of thin cable will of course not show R=0 but a higher minimum reading due to losses.
For an existing installation, proof of a correctly tuned 50< antenna can only be found when adding various lengths of cable onto the feedline and verifying that readings remain at R=50 and X=0."

Please got to www.parc.org.za and checkout "Publications"
Nice article to use you MFJ 259/269.

Edited by - ZS6MEG on 20/09/2009 20:00:02