Pete Millis M3KXZ – Comparison of bottom fed 7.8m vertical “no counterpoise” antenna and bottom fed 10m tall vertical single wire.
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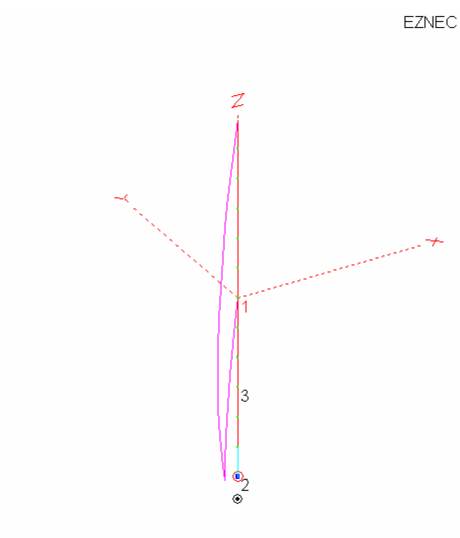
This is a brief comparison between a bottom fed 7.8m tall “no counterpoise” antenna and a bottom fed 10m tall vertical single wire, looking at how each performs across the HF range 14MHz to 30MHz.

The modelling has been carried out using EZNEC and I have discussed with Roy Lewellan, W7EL, how to deal with certain issues relating to the gain predictions. The handling of these has involved “average gain checks” to ensure that the model predictions are not over-optimistic.

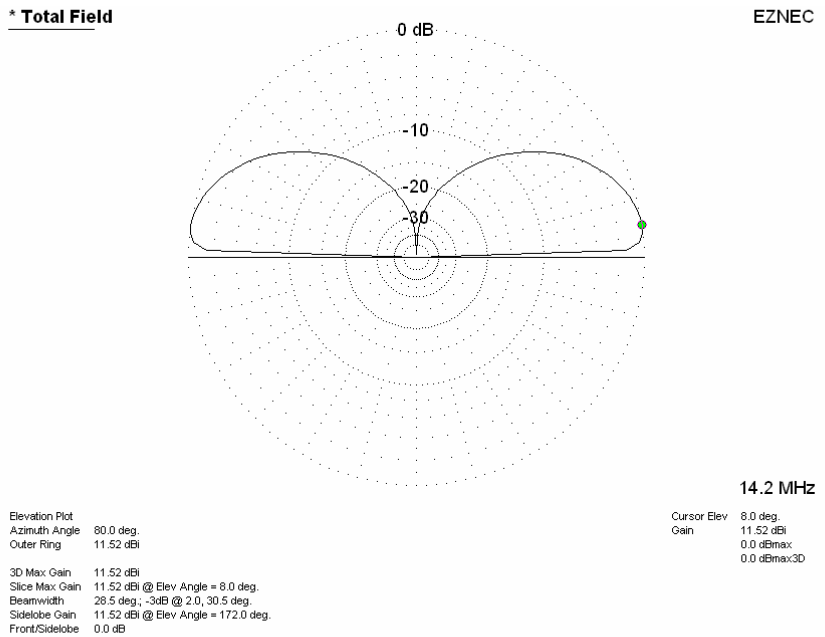
I am not sure who the design of the “no counterpoise” antenna should be attributed to, however it appears to have stemmed from the Zepp antenna. The version looked at here is the 7.8m long antenna which is for use from 14 to 30MHz, although it still works well at 50MHz. Another version can be built which is 15.6m long for use from 7 to 30MHz. And obviously one could be made for lower frequencies than this as well.

The “no counterpoise” antenna is simply constructed from a length of speaker wire/zipcord having two conductors side by side. A 7.8m length is separated down to the 3.9m point and one of the single wires cut off. The antenna is then fed at the rig end of the twin wire section, via a balun and tuner (or a balanced output tuner).

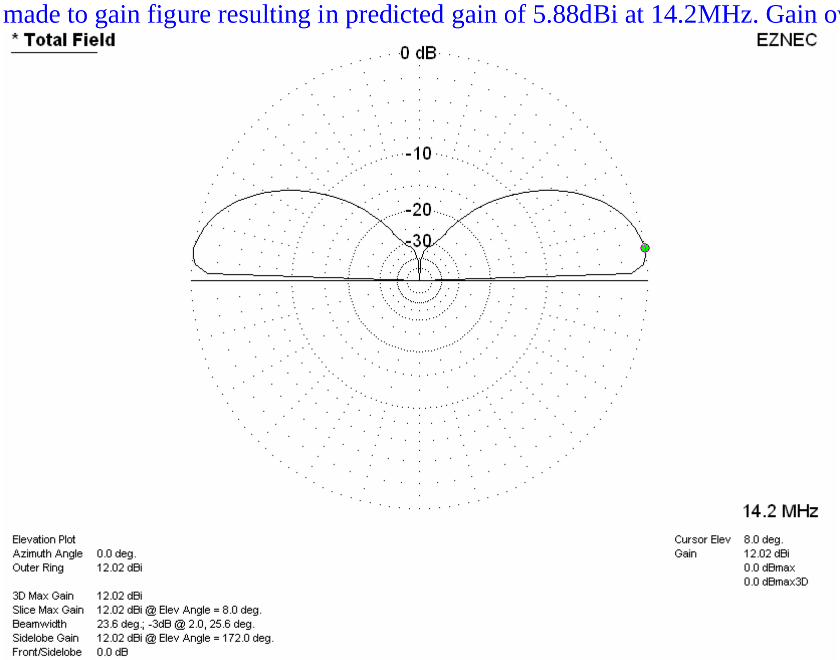
Below is a diagram that shows how each part of the antenna radiates at 14.2MHz. The feeder section (bottom half) effectively works as the bottom half of a vertical half wave dipole. The current summing on the feeder section results in no current at the base and maximum current at the antenna centre. The current maximum is also at the centre of a half wave end fed at its design frequency. With the “no counterpoise” antenna, the current maximum is at the centre regardless of frequency. When the antenna is mounted horizontally the radiation patterns are typical of horizontal dipoles with very little distortion.



Bottom fed “no counterpoise” antenna 7.8 metres long for 40 thru 10m with base 0.5m above salt water ground. EZNEC average gain check shows adjustment -6.61dB needs to be made resulting in predicted gain of 4.91dBi at 14.2MHz. Gain over average ground is -0.48dBi (6.13dBi – 6.61dB)



Bottom fed 10 meter tall wire, base 0.5m above salt water. EZNEC average gain check shows adjustment of -6.14dB need to be made to gain figure resulting in predicted gain of 5.88dBi at 14.2MHz. Gain over average ground is 0.46dBi (6.6dBi – 6.14dB).



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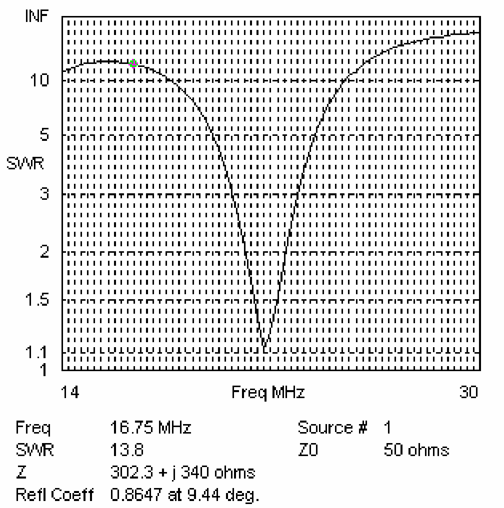
OK, so the comparison of the 7.8m tall bottom fed "no counterpoise" antenna against the bottom fed 10m tall half wave, at 14.2MHz, over salt water, shows that the 10m tall half wave leads by 0.97dB. Over average ground the 10m tall half wave leads by 0.95dB. This is to be expected as we are comparing a 7.8m tall antenna with a 10m tall antenna. Notice that the elevation plots are almost identical, both with good low angle radiation.

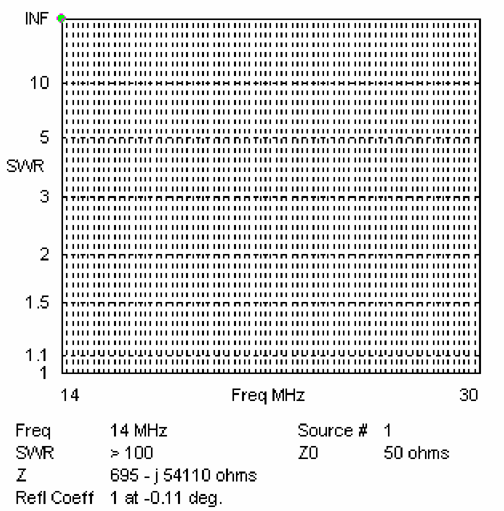
However, good gain and radiation pattern on one frequency is only a small part of what makes an antenna useful for /p operation. How about being able to use the same antenna on the HF bands from 20 thru 10 with no adjustment to the antenna itself – just a couple of twiddles of the tuner knobs would be so much more convenient and would enable faster band hopping..

First, let's see how practical it would be to match each antenna at all frequencies from 14MHz to 30MHz by looking at the SWR plots.

SWR plot of bottom fed "no counterpoise" antenna 7.8 metres long with base 0.5m above average ground, for 14 thru 30 – easy to match on all bands, with no excessive inductive or capacitative reactance. (highest reactance is several hundred Ohms).

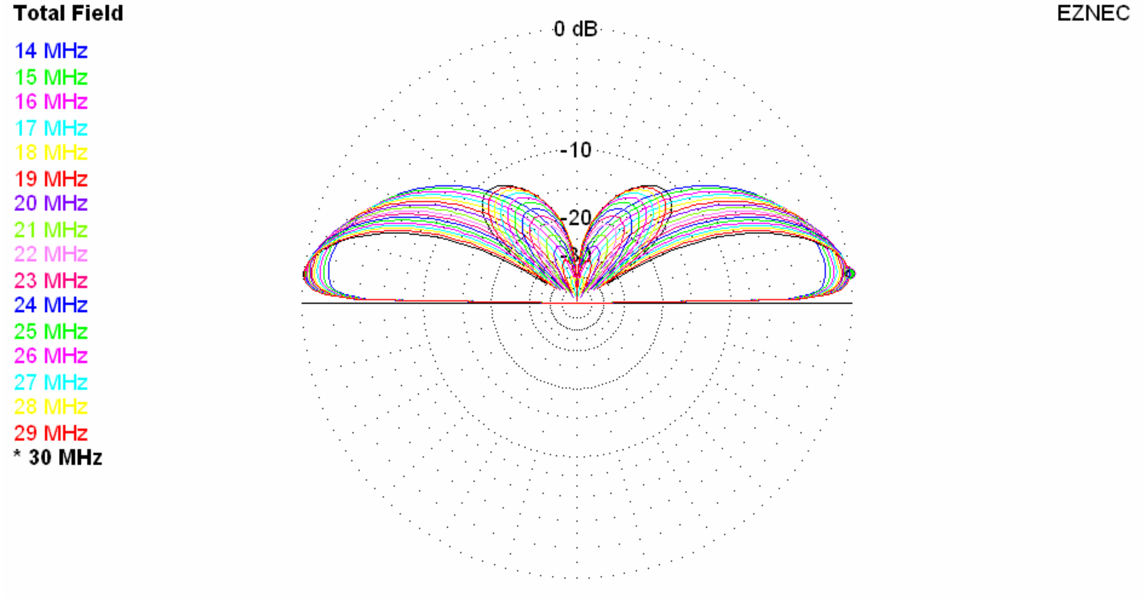


SWR plot of bottom fed single wire, 10 metres long, with base 0.5m above average ground – this is off the scale due to reactive impedance being in the tens of thousands of Ohms. Even over salt water, the SWR plot is the same. Obviously it will match but how efficiently? Will the losses in the tuning circuit be much higher due to the far greater impedance mismatch?

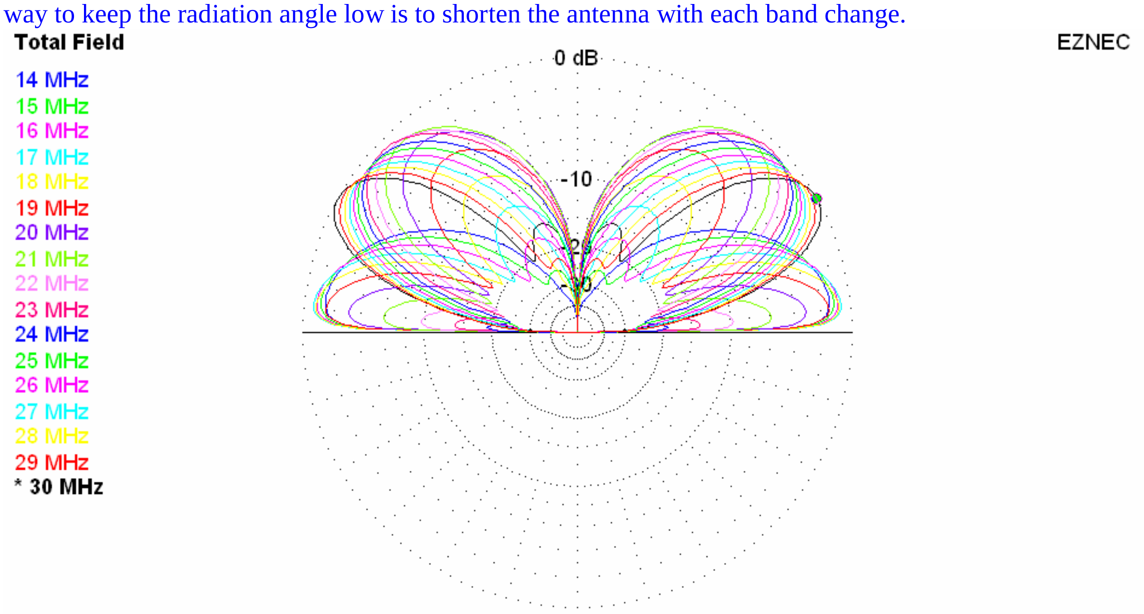


So, the "no counterpoise" antenna provides a much easier match, but how would the elevation patterns of each change across the frequency range 14 to 30 MHz?

First, the 7.8m tall "no counterpoise" antenna – this is the frequency sweep plot with no alteration to the antenna itself, other than retuning your tuner.



Now, the same sweep for a 10m tall bottom fed vertical. Note that from 17MHz upwards the angle of radiation increases rapidly. On the higher frequencies from about 22MHz there is very little low angle radiation. The only way to keep the radiation angle low is to shorten the antenna with each band change.



A point to note is that the gain figures for the 7.8m tall "no counterpoise" antenna over salt water (and corrected with the EZNEC average gain check) are 5.8dBi at 18.13MHz, and between 6.1dBi and 6.5dBi on 21.25MHz, 24.95MHz and 28.5MHz – all with no alteration to the antenna structure. It is only on 14.2MHz, where the 7.8m tall antenna is on the slightly short side, that the gain of the "no counterpoise" antenna falls just under 1dB below that of the 10m tall vertical. Is this sort of difference in gain significant when looked at in comparison with the flexibility of the "no counterpoise" antenna for HF /p operating?