SHAK NOWTZ BY "MAD" FRANK - G3ZMF

SHAK NOWTZ No 5 – Wire Aerials and Earths

Introduction

'ere we go again! Now it's time to get that RF into the air, or using the analogy that I taught to the Scouts and Guides with little or no knowledge of radio, "time to get the motor car to move!" To explain the need for an efficient earth, imagine trying to push a car on a sheet of ice … no grip for your feet! In the same way, a wire antenna needs an earth system to push the RF into the air.

In my SWL days I was taught by Ted, G3GKF (SK), and Bob, G3DPW, that a good earth system was 80% of the efficiency of the radiating system. It's all well and good to have a 132 foot long wire up at 30 feet or more, but without a reasonably good earth to work against, it will perform very poorly.

Most of us install some form of earth rod, connect a piece of wire to it, and hook it up to the shack earth and go for it. Wrong - although on the good side, you have kept the RF earth separate from the house earth. The biggest mistake made by many is to get that word "earth" stuck in your mind and think that the mains earth system would do. It won't! Think RF wavelengths and the typical transmitter powers, not forgetting that equal power goes into the aerial as goes into the earth. Simply put: mains earth +RF = TVI/ BCI/ computers going bonkers!

Editor's note: Safe earthing is a complex issue, but the RSGB has a downloadable leaflet available. See:
http://www.rsgb.org/emc/pdfs/leaflets/emc_leaflet07.pdf

Ideally, we could have a sheet of copper to cover the whole of the garden, but there are a few problems with this such as (a) the cost, (b) where to plant your veggies and (c) the XYL will kill you! The next best thing is an "earth frame." This is simply a ring of wire, ideally 2.5 sq mm, brown 6491x conduit cable going round the perimeter of the garden, with an earth stake (if possible) at the far end of the garden, plus another earth stake at the centre of the "frame ring" nearest the house. The connection to the shack earth should be as short as possible, ideally less than 1/8 wave at the highest frequency. A somewhat impractical alternative would be to use wire that is a multiple of half waves in length.

A better solution is to use a reactive cancellation system. Basically, this is just a wide spaced variable capacitor in series with the main RF earth, so that the inductive reactance of the earth lead is cancelled out capacitively. The 10 kΩ to 100 kΩ high wattage carbon resistor across this earth capacitor provides a DC path and reduces/ avoids flashover of this capacitor. (See Fig 1 below.)

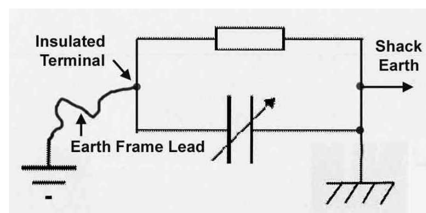

Fig 1: Tuning the earth lead

In this arrangement, the frame, tuning shaft and case of the capacitor form the shack earth; the fixed or live vanes of the capacitor go via an insulated terminal to the outside earth. To tune the system, first switch out the ATU and tune the earth capacitor for best signal on receive (or band noise). Then switch the ATU back in and using minimal RF, bring the ATU to best SWR. Next adjust the earth capacitor for best SWR before finally re-tweaking the ATU again for best SWR.

If you are unsure whether you need this earth wire capacitor, then try putting your hand near (or touch) the ATU and see if the SWR changes or if you get an RF burn! If so, then yes - you do need the series capacitor. Be safe, not sorry!

In practice you may not be able to obtain a suitably high enough value of wide spaced variable capacitor for this unit so an alternative would be to use a good quality ceramic rotary wafer switch, plus fixed capacitors of at least

1kV working voltage. Likewise, on the lower frequency bands, the capacitor may not be required, so another single pole, 2-way ceramic rotary switch could be used to short it out altogether.

Okay, now we are safely earthed, and the antenna has something to "push" the RF into the sky, time to fill the air with copper.

Wot ! No garden! Then go vertical! An excellent and quite cheap way is to get the old CB favourite the 7 foot "firestik" plus a mounting boss that allows three or four extra firestiks to be used as a groundplane, usually angled down at 30 to 60 degrees from the horizontal. These could be of the 4 foot variety if space is a problem. In essence a 27.5 MHz firestik is a ¾ wavelength of wire, helically wound, with the turns getting closer together as they reach the top. In theory and practice, this assembly can be tuned up from 10MHz to 54 MHz. Good start!

http://www.firestik.com/

But if you have a garden, by all means put some wire up, over the lovely "frame earth" you should already have installed. At this point, I should mention a typical downfall, made by many, including me in the old days, of feeding a dipole direct with coaxial cable (coax.) Think about it! Look at a piece of coax – the braid is much bigger than the centre conductor. It is unbalanced and the dipole is balanced – that's why we use a balun (BALanced to UNbalance transformer.) Baluns can take many forms, but many a slip has occurred when the antenna is not at resonance and therefore exhibits a different RESISTIVE component plus a reactive component which the balun translates to the coax feed, resulting in RF on the outer of the coax and possible TVI/BCI. Personally, I like to use balanced feed systems, to a truly balanced ATU (see Shak Nowtz no 4.)

Wires in the sky:

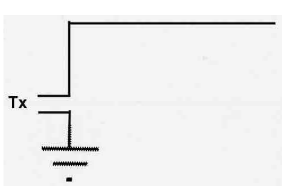

Fig 2: "Up and along" inverted L

Fig 3: Grounded loop top fed vertical

In the antenna shown in Fig 3, the RF is forced to start radiating from the far end, making it a top fed vertical. The vertical, if ¼ wave or more high, will have a fairly low angle of radiation, whereas the top section will exhibit a fairly high angle of radiation. The feed point impedance will of course, vary dramatically depending on the frequency/ wavelength in use.

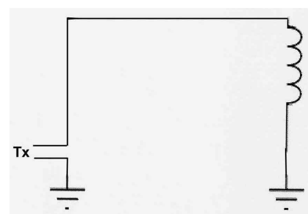

Fig 4: The famous UFY antenna, designed and used by Steve, G3UFY, in a restricted garden.

The antenna in Fig 4 was primarily designed for 160 m. The "L" is lots of turns of insulated wire wound onto a discarded washing-up liquid bottle, with the halyard/ cord running through the bottle (a) to support it and (b) to support the top wire. The Tx feed goes into a parallel tuned ATU (see Shak Nowtz No 4.) This antenna has improved low angle radiation for the LF bands compared with Fig 3.

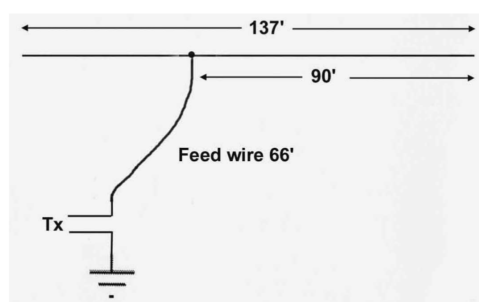

Fig 5: VS1AA. This is a modified Marconi Tee with an offset feed point, ideally tuned using a parallel mode ATU.

The Apex antenna

I developed this antenna back in the 1970s, to begin with in the loft and then a larger version in the garden. It is made of 300 Ω ribbon and fed with the same 300 Ω ribbon to a balanced ATU. Saying that, I have also grounded one leg and fed the other into a parallel tuned ATU with success.

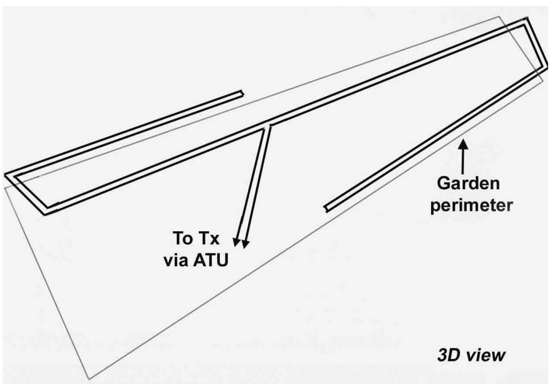

Fig 6: The Apex antenna – 3D view

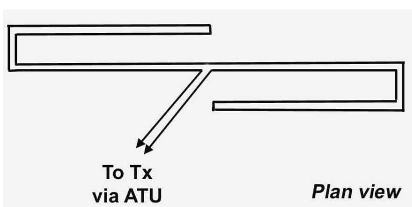

Fig 7: The Apex antenna – plan view

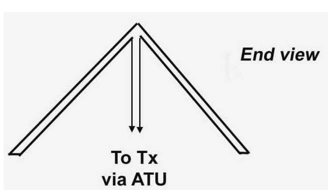

Fig 8: The Apex antenna – end view

The top section is as high as possible and the ends come down the supports 8 feet or more above the edge of the garden and out of harm's way. One leg goes left (as you look down the garden) and the other at the far end goes to the right and then folds back up the garden. Both ends of the ribbon are shorted out to complete the loop. The overall length depends on how much garden and height you have.

The Multiband Horizontal Quad Square

In recent publications, this has been described as the Cobweb because of how it is made up. They work well for those who have no garden but may have roofspace or an area on the roof of a block of flats. In any case, they work much better than the "magnetic loop" efficiency-wise and do not produce such high voltages as found in the mag-loop tuning system.

Basically, each band has a one wavelength wire around a 4-sided (ie ¼ wavelength per side) square, within a square. For simplicity, try feeding with 300Ω ribbon to a balanced ATU.

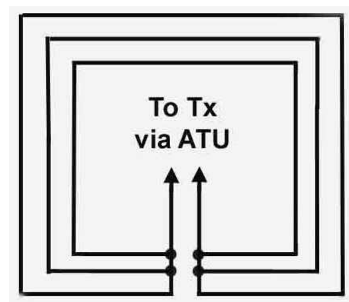

Fig 9: The Multiband Horizontal Quad Square

Bamboo canes make ideal supports across the corner points with, say, a 9 inch by 9 inch piece of ¾ inch ply at the centre and a suitable mounting system onto your mast/ support system.

You could for instance have 70 MHz, 50 MHz, 28 MHz, 24 MHz, 21 MHz, 18 MHz, 14 MHz, making each side no more than a maximum of 8½ feet per side. Using Pythagoras that means the canes have to be 12 feet long – each ! If this is a problem, try using thick-walled PVC tube, then extend the mast through the centre plate by 3 or 4 feet, and fit support guys to each boom ½ to 2/3 out from the centre.

Have fun, see you at the club or on GB3NS (70 cm) or next time in Shak Nowtz No 6 – "Beams and Yagis Made Easy."

See Yer !
Mad Frank G3ZMF