SHAK NOWTZ BY "MAD" FRANK - G3ZMF

SHAK NOWTZ No 7 – Little Whips & Big Whips *(but only kinky in strong winds ...)*

Introduction

The story of the vertical is long and complicated. There was, in olden days, a debate as to whether the polarisation of an antenna mattered at HF. Who knows, even now?

I've tried to find information on formal comparisons between vertical and horizontal radiating antennas on HF. There must be lots – but I've not found any! However, this is what I have found:

1. Verticals give a lower angle of radiation towards the horizon, leading to much better DX compared with a dipole or long wire at less than a wavelength above ground.
2. Verticals only work well with a good counterpoise or earthing system. (See Shak Nowtz no. 5.)
3. The nearer to a full size ¼ wave for the radiating element the better. Even longer is even better and most cases can be fed via an ATU to cover more than one band. (See Shak Nowtz no. 4.)
4. A compromise vertical is the good old Firestik, plus mounting boss, on top of a pole or mast with ground plane radials into an "end-fed" style ATU. This should give you a good start from 10 MHz up to 52 MHz not forgetting that a Firestik has actually got ¾ wavelength of wire (at 27 MHz). That's a ¼ wave at 9 MHz, so already longer than a quarter wave at 10 MHz.

Types Of Vertical Antenna

As already mentioned the Firestik is a good starting point. Its construction is a single helically wound wire that starts at the base/ feed point with a "stretched" coil, gradually tightening up the coiled wire until, at the top of the antenna, the windings are tightly wound side by side. This gives the effect of "top loading", producing a much more efficient radiation pattern compared with base or centre loaded antennas. See Fig 7.1 (d).

As a proof of this antenna (by those who have compared the firestik to other compromise verticals over the past few years) several people have checked into the Saturday night ten metre net (on 28.5 MHz ± 5 kHz, SSB, at 21:00 clock time) using only an FT817 running 2½ or 5 watts and been heard all over the Home Counties. In fact during the summer of 2008, one of the group exchanged reports with a station in TF-land (Iceland). Long live QRP!

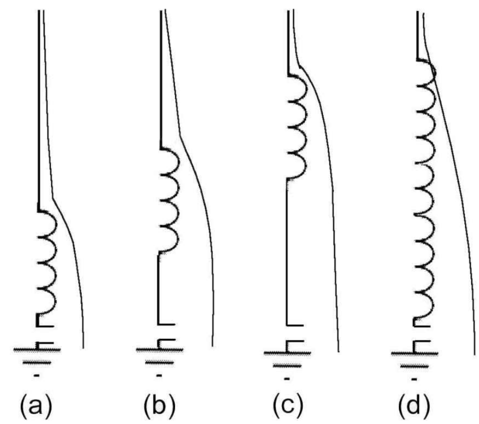

Fig 7.1 (a), (b), (c), and (d): Approximate Radiation Patterns (RF Current) Note that in (d), the winding pitch is tighter at the top and further apart at the bottom.

<u>(a) Base loaded</u>. Convenient to build, okay for mobile, but low radiation efficiency. (This is similar to CB whip type KB40.)

<u>(b) Centre loaded</u>. Also quite easy to build, but consideration must be given to the material on which the coil is wound, the mechanical strength of this material and, most importantly, its RF properties. (See later in this Shak Nowtz for testing RF properties.) Radiation is now more efficient than (a) but not as good as (c) or (d).

<u>(c) Top loaded.</u> Much higher radiation efficiency, but wind loading can be a problem either in the garden or, even worse, mobile.

<u>(d) Helical wound.</u> Highest efficiency shortened vertical antenna.

In the cases of (a) (b) and (c), the top whip section acts as a form of capacitor, as well as a radiator, when tuning for resonance. In the case of the top-loaded (c) it is often augmented with a "capacity hat". This can be in the form of 1 to 8 copper wires attached to the top of the antenna and splayed out, ideally at 90 degrees to the antenna. The wires can be bent up (or down) to reduce (or increase) capacitance - thereby adjusting the resonant frequency of the antenna.

Bandwidth and efficiency

The smaller the antenna is compared with a full size quarter wave, the smaller the bandwidth between useable frequencies and the lower the radiating efficiency of the antenna. On 160 m and 80 m the bandwidth for useable VSWR (1.5:1 max) may be only 5 or 10 kHz, whereas on 28 MHz bandwidths of 50 to 100 kHz are easily achieved for the same length of antenna.

The efficiency of a loaded vertical is also dependent on the coil construction. Often more than 50% of the power from the transmitter is dissipated in the loading coil as heat. With this in mind, careful consideration must be given to the choice of coil former material and winding wire. [4]

At this point I would like to mention that Adam, G7CRQ, who lives in a top floor flat, has had great success using a range of mobile whips mounted on a hook arrangement that fits over the parapet of the flat roof of his building. He uses an "artificial ground" unit plus 20 to 30 feet of wire in the shack with great success.

Practical Designs

Moving on to those lucky enough to have a little bit of space and perhaps a convenient "sky-hook" such as a tree or chimney, the next antenna may be of use. I came across it in the ARRL Antenna Book [2] and also in the old RSGB Handbook [1]. The text suggests it is useable for two band operation. Personally, I have yet to try it but I have spoken to several people who have and all speak highly of it, providing a good ground is used. See Fig 7.2.

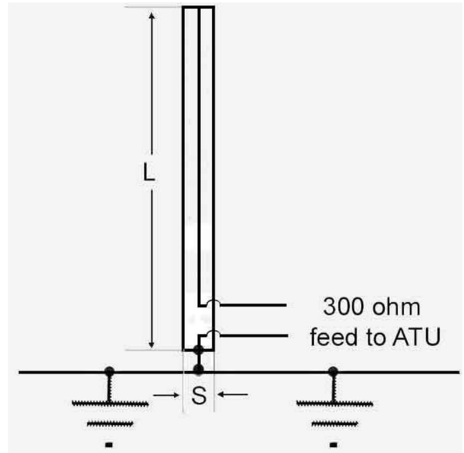

Fig 7.2: Three wire vertical antenna

L (in feet) = 234/f (in MHz) or

L (In metres) = 71.3/f (in MHz)

S = 30 to 45 cm

Eg for 7.1 MHz, L = 30 ft 4 in (9.242 m)

All the above measurements are taken from the text.

UA1AR Antenna

Way back in the 1970s, UA1AR described in Radcom a single band, switched direction antenna. I built one for ten metres, then for 20 metres adding my modifications to it. My best result on 10 metres was to work UA1AR. Both of us were using a UA1AR antenna. This was UA1AR's first contact with any station outside the USSR using the antenna he had designed!

Since the early 70s there have been published the bi-square and also the maypole antenna: both similar configurations to the UA1AR antenna. See ref [3].

My variant gives a two element beam in four directions, plus dipoles in a further two bi-directional patterns. Basically, it is a full wave dipole folded up into a quad shape, stood on one corner, with the tops of the dipole ends 4 to 6 inches apart.

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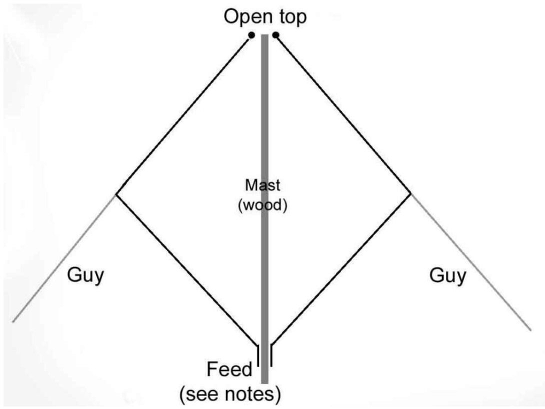

Fig 7.3a: Side view of UA1AR antenna
(all internal angles are 90 degrees)

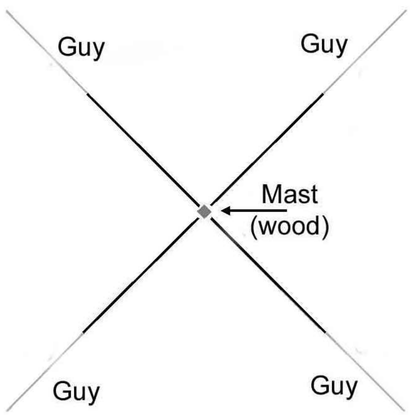

Fig 7.3b: Plan view of UA1AR antenna

The mast can be wood (mine was a piece of 2" by 2") or fibreglass. I didn't try a steel or aluminium pole so I cannot comment on this configuration. The mast was guyed using polypropylene rope with the upper half of each element tied to the guy.

The directivity of each configuration is shown in fig 7.4 (a) to (f) – all plan views.

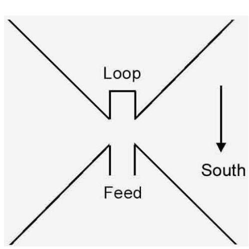

Fig 7.4 (a)

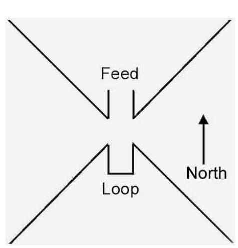

Fig 7.4 (b)

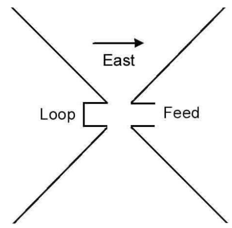

Fig 7.4 (c)

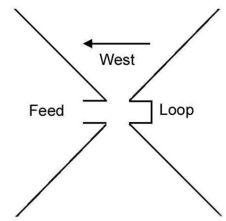

Fig 7.4 (d)

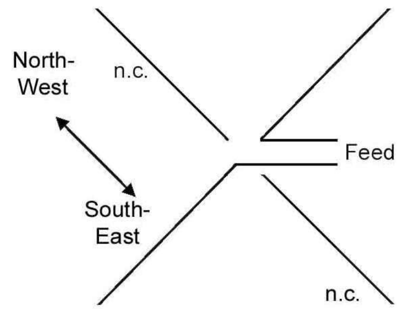

Fig 7.4 (e)

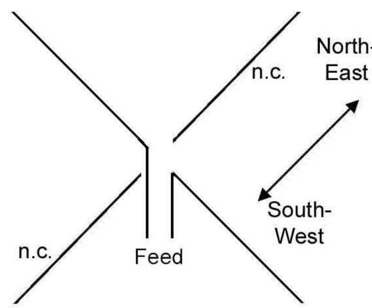

Fig 7.4 (f)

(a), (b) (c) and (d) act as 2 element beams ie driven element plus reflector.

(e) and (f) act as bidirectional dipoles

The loop is to increase the length of the reflector to 5% longer than the driven element.

Driven element length in metres is given by:

(300 x 0.95)/ f (MHz)

On 28 MHz this equates to approximately 8 ft 6 inches per side. The reflector "stub" is approximately 3" of wire or 1.5" of shorted 300Ω ribbon, making a total of 3 inches altogether. Start at 2.5 inches of ribbon and prune for best forward gain.

The feed points, which were only 4 to 5 feet from the ground, were made from "squared 300Ω ribbon": see Fig 7.5 below.

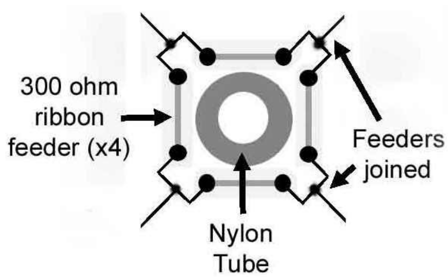

Fig 7.5: "Squared" 300 ohm ribbon (by G3ZMF from a suggestion by Norman G2AIH)

The drawing above shows approximately how I used a piece of 6 mm outside diameter nylon tube of unknown origin and glued the four lengths of 300Ω ribbon in a square formation, with adjacent wires in the ribbons soldered together at each end to give, as near a possible, a 4-way 300Ω feed. Yes, I know that the opposite corners are probably nearer to 450Ω, but it worked!

The switching arrangement from the shack was done with a 36-way screened cable, earthed at both ends. The reason being (a) I had a long length of it and (b) I used the second set of contacts on each relay to power some lamps in the control box in the shack to show that the relays had operated. The relays used were ex-equipment with 12 volt DC coils and reasonably wide gaps between the contacts.

The control box at the antenna end was a large diecast one with two terminals for the 300Ω feed to the shack plus 4 terminals for the antenna. The control cable was terminated using a multi-pin free socket and fixed plug. The shack control had a 16 to 17 volt DC PSU to drive the relay and lamp system allowing for voltage drop and a 6-way selector switch with internal diode matrix for relay synchronising.

A full circuit diagram is available on the CATS website www.catsradio.org.

Follow the links to the newsletter page and click on the link adjacent to the newsletter for January 2010.

In the shack, the 300Ω feed was connected to a balanced ATU (see Shak Nowtz no 4).

If you want more details of any of this, give me a call on the GB3NS (Echolink node 383403) and have a chat.

Testing Coil Formers For RF Use

(1) Put a piece of kitchen paper in the bottom of a microwave oven.
(2) Put ¾ cup of cold water on the oven's turntable. This is to provide an RF load for the oven. No load = BANG. Believe me, I've done it!
(3) Put a small piece of the proposed coil former next to the cup
(4) Cook on full power for one minute
(5) If the former sample is warm, hot or melted, find another former made of different material. Black coloured piping is not recommended as the black colour is often obtained by using carbon particles – an excellent absorber of RF!
(6) If the sample is till cool and firm, you win!

Have fun and let me know how you get on. Shak Nowtz no 8 will be antenna rigging and erection. Beyond that, I plan to write a Nowt about "Homebrew Test Kit & Things" and another that will be a collection of handy circuits. However, if there's anything else that you would like to see covered in a future issue of "Shak Nowtz", please let me know and I'll see what I can do.

73 de Mad Frank G3ZMF

References:

[1] RSGB Communications Handbook, 1971, page16.33, Fig 16.42.
[2] ARRL Antenna Book, 964, pages 205, 206
[3] RSGB Communications Handbook, 1994 edition, pages 12.76 and 12.92
[4] RSGB Communications Handbook 1971