H5ANX Mk4 Delta Loop Design
By Sajid Rahim – E-Mail
H5ANX (Bophuthatswana), ZS6EW and A22EW

Antenna Background

This antenna design was brought about by a need to have a simple effective and efficient antenna using simple materials. Its inspirations were derived from HCJB and W6SAI in his book *All About Cubical Quads*.

My experimentation started in late 1995 into quad loops as a means of achieving a 40m DX antenna that could be made at home and be put on a 11-m high mast. It had to be cheap and made from materials available in rural African areas. A dipole worked but did not have a low angle of radiation. Hence resulting research and experimentation created this antenna.

Discussion

The antenna is based on the fundamental principle of a full wavelength loop antenna. A single wavelength loop remains an efficient and effective antenna for all bands. While exhibiting good gain (1.5 dB over a dipole), there are various properties, which can be exploited to make it better.

A loop is most efficient when its circumference covers the largest surface area (delta, circular or quad shape). Since a loop is a balanced antenna, it requires a balanced feed mechanism (more to be discussed later) and where to feed it to achieve appropriate polarisation. It is these last two aspects, when well understood, that will make this antenna shine.

i. **Polarisation**

A loop is vertically polarised when feed from the side. If fed from either the top or bottom, it is horizontally polarised.

Experiments have shown that the delta shaped configured loop works well when the antenna is vertically polarised. This means that one uses a simple support to hold the top of the antenna while using string to span out the bottom edges.

This feed point, allows a low angle of radiation to be achieved at very low heights; an important characteristic for a DX antenna. A horizontally polarised antenna at same height will produce a very high angle of radiation. For 40m or 80m, this becomes an important consideration.

ii. **Feed mechanism**

This is probably the most important question and which sets this antenna to be noted as different.

All reference materials available speak of using a 75-Ohm quarter-wave coax. This was not available in my home QTH apart from television cable types. For the antenna described here, it may not be the most effective way to achieve a match.

Theoretical calculations showed the impedance of a delta loop cut at its fundamental frequency as being 150 Ohms when fed from the side. A better option is a 4:1 balun. A choice fell on an air-core balun (**Fig 1**), as ferrite cores were not available and the cost of obtaining a ferrite core was high.

This air-core balun is wound using following components:

a. 40mm (1 ½ inch) diameter white PVC pipe with a length of 10cm (4inches).
b. Simple zip cord (multi-stranded core insulated wire for lamps – two separate cores).

c. 8 turns of bifilar (22guage).
d. Loop is connected to terminals B and C.
e. 50-Ohm coax is connected with RF (centre core) to C and ground wire (shield) to D.
f. A jumper is required from terminal D to A.

When fed using a 50-Ohm coax, the balun transforms this impedance to 200 Ohms, which is close to matching 150 Ohms. The effective SWR is 1.33:1.

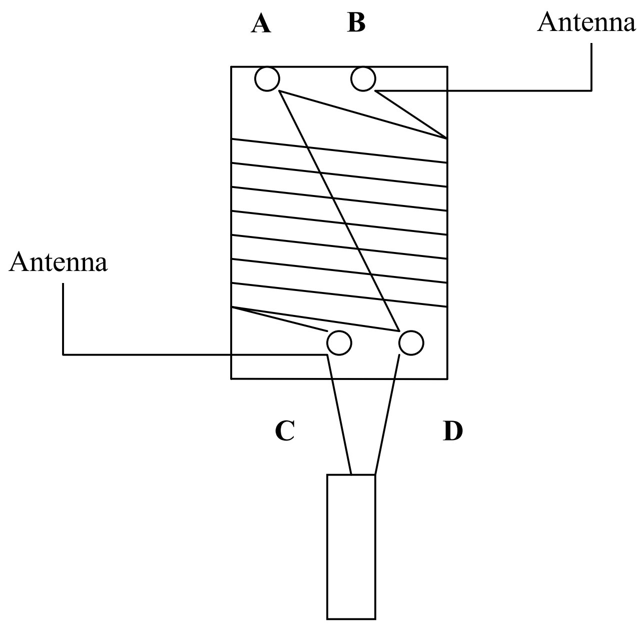

Fig. 1

Additional property of the loop becomes apparent. The loop resonates on its *second harmonic* frequency with an impedance of 200 Ohms. Thus this loop matches perfectly with 50-Ohms feedline using the 4:1 balun on that second frequency range resulting in a 1:1 VSRW match; a flatline SWR becomes very visible. An extremely wide bandwidth is available across the usable frequencies.

iii. **Length of the Loop and operating frequencies**

The delta loop can be cut using standard formula of wavelength (m) = 286/Operating base frequency.

Frequency (MHz)	**Length (m)**
7.00	40.8
14.200	20.15
21.200	13.5
28.500	10.04

The H5ANX Mk4 loop will work on two fundamental frequencies of the loop. These are the base frequency and the second harmonic frequency. A 20-m loop works for 20m and 10m, an 80m loop works on 80m and 40m, and a 40m loop works on 40m and 20m without any tuner. However, the intermediate frequencies can be worked on without any problems using a tuner, as the VSWR is below 3:1. The intermediate frequency for a 40-m loop is 30m, and for a 20-m loop, they are 17m, 15m, and 12m.

A question posed to oneself is for the case of a 40-m loop; will it work on 15 and 10m for transmitting purposes? The answer is NO. In theory, it does match well; however, the feed point for these frequencies is now a high voltage point rather than a high current point. Consequently attempts to operate 40-m loop on 15m and 10m will be met with the transmitter shutting down.

The length of the loop antenna should be preferably constructed with simple light insulated copper wire.

iv. **Orientation of antenna.**

This antenna DOES NOT require height to give a DX performance. A figure-8 pattern is produced, similar to a dipole.

a. Inverted Delta Loop: **Fig. 2**.

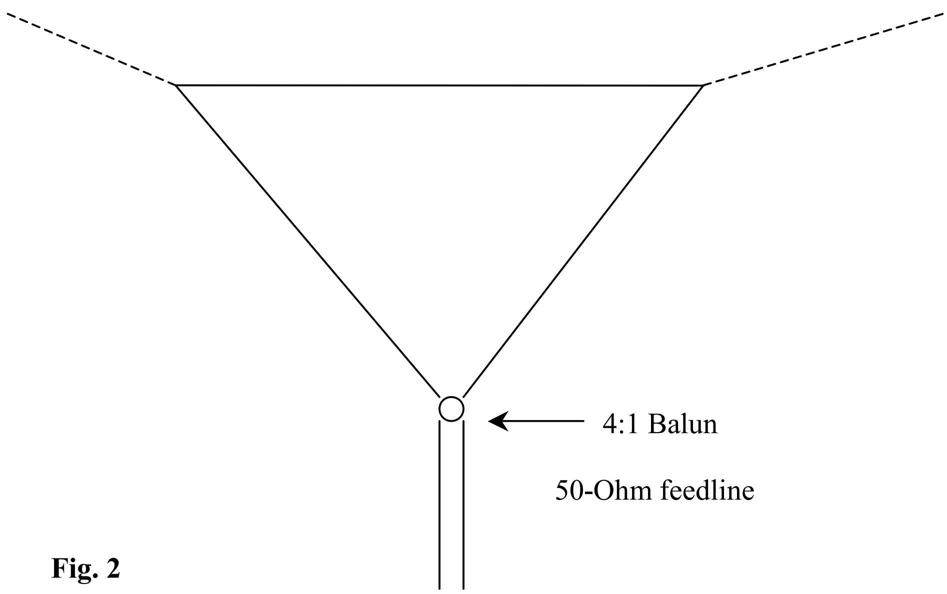

Fig. 2

b. Delta Loop: **Fig. 3**. This remains the most common way using the mast/support to hang the loop and expand out using thin nylon string.

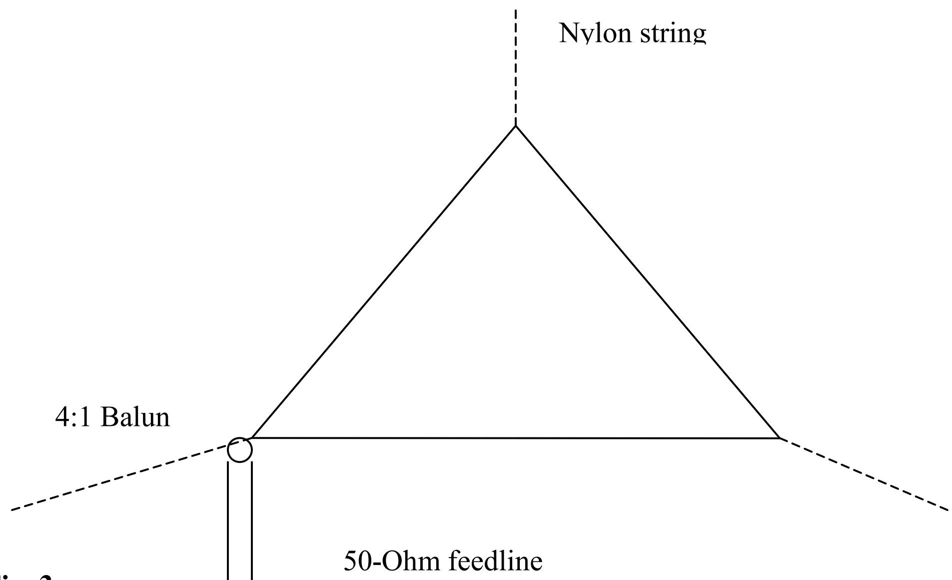

Fig. 3

c. Sloper Delta Loop **Fig. 4**. This configuration does produce small directivity to the direction in which the loop is slanting to as well as small front to back ratio.

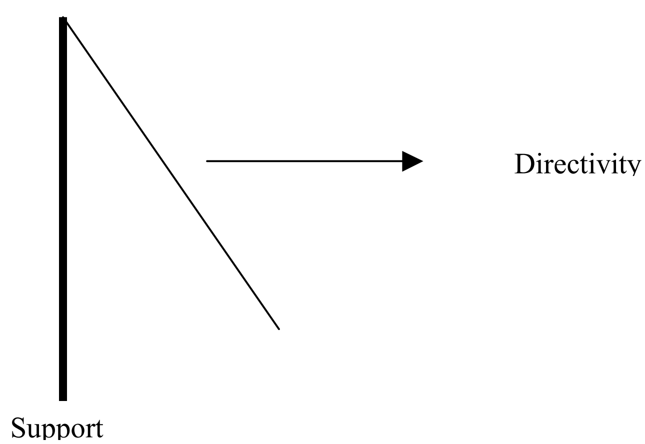

Fig. 4

Conclusion

Loop antennas have excellent potential especially within amateur radio for their simplicity and their effectiveness. This antenna lays a foundation for further improvement by other amateur radio operators.

This antenna has served me well and the design has been replicated many times by other operators who report similar results. I am confident that this design will be of help to others.

Author's background

I grew up in Africa's heartland where television did not exist. Shortwave was the sole means of getting news of the world. My interest in this grew as I started to develop an interest in antennas by which I could get better reception for my father's shortwave receiver, which was a simple 4-band shortwave radio from National.

At Rhodes University, situated in Grahamstown, Eastern Cape, South Africa, a group of us in 1991 laid the foundation for AstroSoc (Amateur Radio and Astronomy Society). The society amongst its early accomplishments put up a large astronomical observatory and amateur radio station. To date, this society continues to actively further its work and objectives amongst the students and community alike.

I obtained my advanced grade licence in 1994 with callsigns of H5ANX (Bophuthatswana), ZS6EW and A22EW.

My interests remain in Astronomy, Amateur radio, and current affairs. Academic interests are in computer sciences, specifically compiler theory, cryptography, and operating system design. Work interests are in Financial Systems related designs and implementation. I am accredited with a Bachelor of Science (Information Processing), a Bachelor of Commerce (Honours) in Information Systems, and a Master of Science in Information System.

For further information and feedback, I can be reached at zs735@yahoo.com.

References

a. *All About Cubical Quads*, by William Orr (W6SAI).
b. *ARRL Antenna HandBook*, ARRL
c. *Rhodes University,* Grahamstown, Eastern Cape, South Africa*;* www.ru.ac.za
d. *Amateur Radio and Astronomy Society*, ASTROSOC, www.astrosoc.ru.ac.za

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