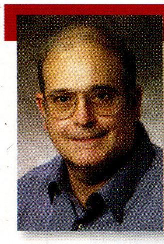


Larry D. Wolfgang, WR1B, tc@arrl.org

Changing to a Delta

Nested Full Wave Delta Loops (April 2011)

The article by Don McMinds, K7DM, "Nested Full Wave Delta Loops for 20 and 10 Meters," in the April 2011 issue of *QST*, pages 30 to 32 caught my attention. Don used separate loops for these 2 bands. This is not necessary, because you can use a single loop for this purpose.

I had experimented with delta loops in 1994 while seeking a DX antenna for 40 m that could be built using local materials in the Kalahari desert of South Africa. I opted to feed it with a 4:1 balun, resulting in an optimized version that I called the H5ANX Mk4 Delta Loop, which allows a single loop to operate on 2 bands without the aid of a tuner.

A full wave delta loop is, by nature, a highly efficient broadband antenna having 1.5 dB gain over a dipole and can be easily configured in multiple ways for polarization. Its impedance will vary between 50 Ω and 200 Ω. Gain and impedance are at the highest when the loop spans the greatest area for a given length. It is a ground independent resonant system that does not rely on the ground to complete the antenna circuit; this is highly desirable for 80 and 40 m. The length of wire for a full wave loop is given by: Length (feet) = 1005 / f (MHz).

Polarization and Feed Point Configuration

A delta loop is vertically polarized when fed from the side and horizontally polarized when fed from the bottom half or top half. Some common configurations are illustrated in Figure 1.

A delta loop works well especially for the lower frequency bands when the antenna is vertically polarized and height is a challenge. When it is fed as shown in Figure 1, Parts A and B, the delta loop will have vertical polarization, and give a low angle of radiation, approximately 28°. In horizontally polarized configurations as shown in Figure 1, Parts C and D, the antenna presents a very high angle of radiation. The configuration shown in Part E presents an exception that shows a moderately high angle of radiation, but also tends to have a low vertical component as well. The best configurations, in order of performance are B and then A, E respectively.

Matching a Delta Loop

I found the impedance of the antenna to be 150 Ω at the fundamental frequency and approximately 200 Ω at the 2nd harmonic.

The standard matching technique, which

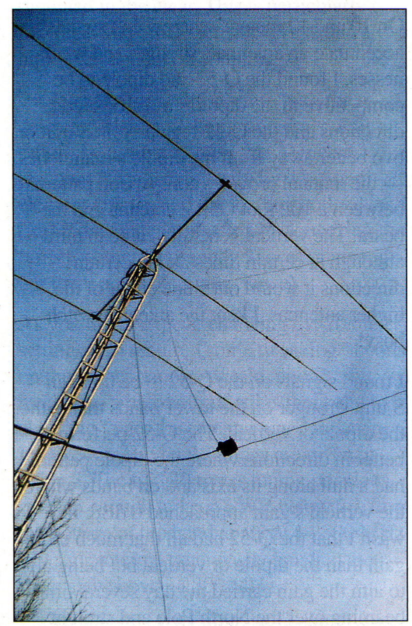


Figure 2 — Here is a view of the delta loop configuration E in practice.

Table 1
Delta Loop Dual Band Configurations Fed as in Figure 1B

Full Size Loop	Matched Dual Bands	Intermediate Bands with 3:1 SWR Requiring a Tuner
80 m	80 m, 40 m	60 m
40 m	40 m, 20 m, 10 m, 6 m	17 m, 30 m, 15 m, 12 m
20 m	20 m, 10 m, 6 m	17 m, 15 m, 12 m

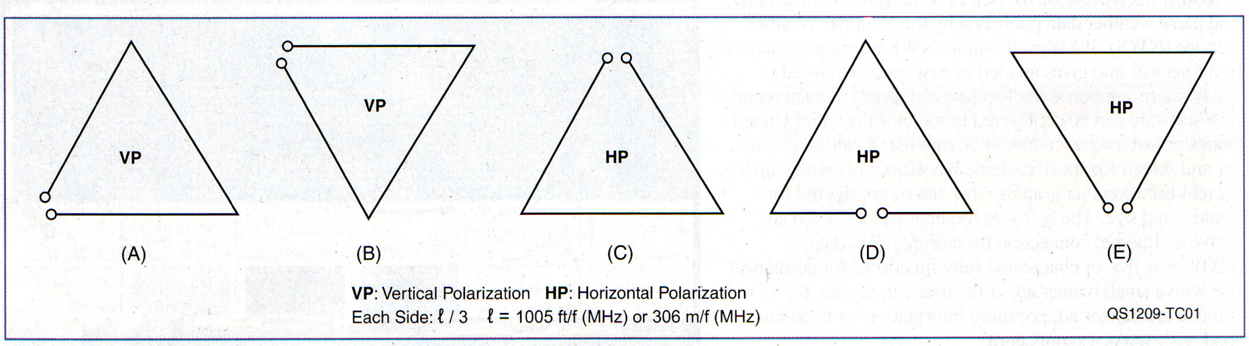


Figure 1 — There are various possible configurations and polarizations for a full size delta loop.

relies on a quarter wavelength 75 Ω transformer, gives a good match for the fundamental frequency but forfeits multi-band performance. I decided to use a 4:1 balun with a 50 Ω coaxial cable since 75 Ω coax was unavailable in the desert of South Africa. This provides an excellent match, giving two band operation on a single loop (200 Ω / 150 Ω = 1.3:1 SWR for the fundamental frequency, and 200 Ω / 200 Ω = 1:1 SWR for the second harmonic). It also opens up to tunable intermediate band operations with approximately a 3:1 SWR. Table 1 shows various band combinations. These full size versions have been successfully built and replicated numerous times by many Amateur Radio operators.

The next challenge in the Kalahari was to construct a 4:1 balun, because I did not have access to a ferrite core or a replacement commercial balun. I improvised by building an air core version based on a 1:1 air core balun by Bill Orr, W6SAI (SK). This balun costs around 3 dollars to build and it is the key to making this antenna perform. The balun can also be used for other purposes.

An Inexpensive 4:1 Air Core Balun That You Can Build

The balun is wound on a piece of white PVC pipe. The balun has two windings which are wound simultaneously.

Material:

1) 4 inch (10 cm) long white/gray PVC pipe.

- 1½ inch (38 mm) diameter for 7 MHz to 50 MHz frequency range.
- 2 inch (51 mm) diameter for 3 MHz to 20 MHz frequency range.

2) Two #16 multi-stranded insulated wires.

3) Stainless steel nuts and bolts (not shown on Figure 3) to terminate the wires and provide anchor points for the antenna wires.

Construction technique:

1) To wind the balun, first put a bifilar winding on the PVC pipe as a dry run, to identify the placement of the terminals.

2) Use a felt tip marker to indicate holes to be drilled for the terminals A, B, C and D.

3) Drill the holes and put in the stainless steel nuts and bolts.

4) Start winding with the top leads of the bifilar winding connected to terminals A and B.

5) Wind 8 to 10 tight turns with the wire from terminal A connecting at C and the wire from terminal B connecting at D.

6) A jumper cable goes from terminal A to D.

7) Cover the coils with a vinyl electrical tape for weather protection.

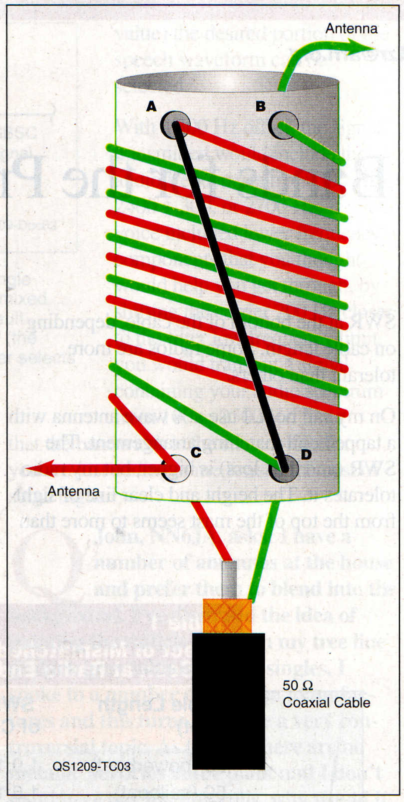


Figure 3 — This diagram shows the balun coil winding details. Stainless steel nuts and bolts are used at points A-D.

External Connections

1) The antenna connects to Terminals B and C.

2) A length of 50 Ω coaxial cable connects with the center lead going to terminal C and the cable shield to terminal D.

To summarize, an air core 4:1 balun, used with either configuration A or B from Figure 1 presents a very effective DX multiband antenna. The balun used with configuration E would be the second best choice. This antenna has given me flexibility and multiband performance from a number of station locations over the years. The 20 m delta loop, in particular, goes with me everywhere for portable operations across 5 bands. — *73, Sajid Rahim, VA3QY/ A22EW/H5ANX, 3474 Hannibal Rd, Burlington, ON L7M 1Z6, Canada;* **sajsanr@gmail.com**

Using a Noise Bridge (Mar 2011)

Walter Mellish, KC2ZKJ, wrote an excellent article, "Using a Noise Bridge and Spectrum Scope to Adjust Your Antenna Tuner," in the March 2011 issue of *QST*. He demonstrated how to use a noise bridge (RX bridge) to adjust your antenna tuner without stressing your transmitter or generating QRM. I'd like to expand on his information by passing along a technique I use to make it easier to hear an RX bridge null point when adjusting an antenna tuner.

My rig, like many, doesn't have a spectrum scope. The method I've been using makes it much easier to hear the null, especially for those with not so pristine hearing (because of age, hearing damage, and other hearing problems). When the null is easy to hear, consistently adjusting the tuner to an SWR of 1:1 or very close is easier.

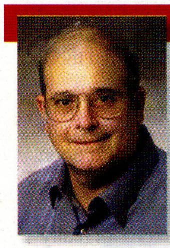
- Tune to a signal at or close to the frequency you want to tune to. You will not cause QRM with an RX bridge. If you can't find another Amateur signal near your frequency, a steady source of RFI is often available. Now it is time to put the noise bridge to work for you.
- The S9+ noise level from your RX bridge should completely cover up the signal you tuned to. As the tuner adjustments get close to the null point, the signal begins coming out of the noise. Slowly adjust the tuner controls now. Small changes in tuner settings make a big difference in the noise level because impedance changes very quickly near resonance.
- When you can clearly hear the signal, the tuner is properly adjusted. Depending on band conditions and signal strength, the RX bridge noise level will range from barely audible to a noticeably lower level. The SWR should be very close to 1:1.

Why it works: Experienced operators can hear SSB signals close to the noise level, and CW signals below the noise level. The gray matter signal processor recognizes a signal in the noise much easier than a very small change in the noise level.

I do not claim that I discovered this method, but I have not seen it discussed in any articles about using an RX bridge.
— *Lew Wallach, N9WL, PO Box 52071, Albuquerque, NM 87181*: **n9wl@arrl.net**

Technical Correspondence items have not been tested by *QST* or the ARRL unless otherwise stated. Although we can't guarantee that a given idea will work for your situation, we make every effort to screen out harmful information.

Materials for this column may be sent to ARRL, 225 Main St, Newington, CT 06111; or via e-mail to **tc@arrl.org**. Please include your name, call sign, complete mailing address, daytime telephone number and e-mail address on all correspondence. Whether praising or criticizing a work, please send the author(s) a copy of your comments. The publishers of *QST* assume no responsibility for statements made herein by correspondents.



Larry D. Wolfgang, WR1B, tc@arrl.org

Another Delta Loop Idea

A Homebrew, Light Duty Metal Brake Revisited (August 2012)

When using a metal brake like the one described in the August 2012 issue of *QST*, or the previous article from the October 1996 issue, there are several references that can be helpful. George Averill, K4EOR, described the need for a bend allowance when calculating the overall length of sheet metal required for a project. He describes making bends in a piece of the sheet metal you plan to use, and measuring the difference in flat length versus the length and height of the bent piece.

A good approximation for the Bend Allowance (BA) is given in *Blueprint Reading for the Machine Trades*, by Russ Schultz.[1] Schultz gives an equation for BA that assumes the neutral axis to be 44% of the metal thickness.

$$BA = (0.017453R + 0.0078T)N \qquad \text{[Eq 1]}$$

where:

R = Inside radius of the bend
T = Metal thickness
N = Number of degrees of the bend.

In *Marks' Handbook for Mechanical Engineers*, they give the neutral axis as between 35% and 45% of the metal thickness.[2] — *73, William Abbott, KB1KOY, 48 School St, Hudson, NH 03051;* **wabbitt@comcast.net**

Changing to a Delta (Sep 2012) Slant Delta Loop

After reading the article on delta loops in the September 2012 issue of *QST* (Sajid Rahim, VA3QY/A22EW/H5ANX, "Changing to a Delta," Technical Correspondence), I was inspired to do a little experimenting of my own. I needed an antenna for 15 meters and had hopes of scheduling some contacts with friends in New England from my location in Texas. A delta loop looked like it might serve. It turned out to be one of the easiest antennas I have ever built.

I decided to focus on the corner-fed full wave delta loop as described in Sajid's article. I liked the idea of a ground-independent system, as he mentioned. A little *EZNEC* modeling predicted that this configuration would, indeed, work very well close to the ground — even, in fact, with the bottom (horizontal) leg *on* the ground! Also, by tilting the plane of the delta off vertical it seemed that I could realize some forward gain over a strictly vertical orientation, while the elevation pattern still showed a maximum at a fairly low angle. This seemed too good not to try. Figure 1 shows the configuration. The best part of this antenna is that it's very easy to put up.

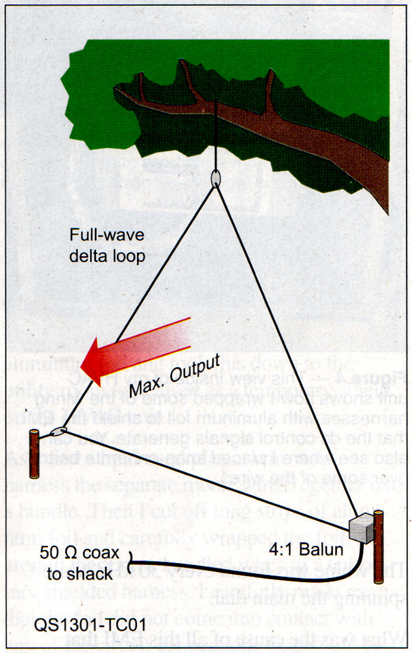


Figure 1 — This drawing shows the final configuration. The antenna is tilted out of the vertical plane by about 30°. Maximum signal strength is in the direction opposite to the tilt.

Figure 2 — If the antenna wire were black or gray, it would be even harder to see. Good for an inconspicuous installation. I needed to add the white ribbon so I wouldn't blunder into it while walking around. Note the "high tech" rocks holding the antenna down.

Step 1: Measure one full wavelength of wire at the target frequency, plus some extra to allow for final trimming. I used #18 AWG insulated doorbell wire. Because of the insulation on the wire and the closeness to the ground, the total wire is shorter (by about 5%) than the length predicted by the formula given in Sajid's article. (For a 21 MHz loop, I needed 46 feet of wire.) Mark a spot one third of the distance from one end.

Step 2: Find a tree limb or a pole about ¼ λ above ground. At 21 MHz, this was about 11 feet. This distance is not critical; it's just low enough to tilt the delta loop out of the vertical plane. Pass the wire over the support so that the spot you marked is at the peak.

Step 3: Form the rest of the wire into an equilateral triangle as shown in Figure 1. Since the bottom corners are on the ground, you can use a couple of rocks to hold them in place, as shown in Figure 2.

Step 4: Connect a 4:1 balun to the two loose ends and run 50 Ω coax to the transmitter. Trim the antenna wire for minimum SWR, using an antenna analyzer or low power from the transmitter.

Step 5: Get on the air!

Maximum radiation is perpendicular to the plane of the loop. According to *EZNEC*, slanting the antenna at about 30° from vertical gives an increase in gain of about 2 db

[1]Russ Schultz, *Blueprint Reading for the Machine Trades*, 3rd Ed, 1996, p 288, ISBN: 0-13-287541-1. The current update is the 7th Ed, Oct 2011, ISBN: 978-0132172202.

[2]Eugene Avallone, Theodore Baumeister and Ali Sadegh, Editors, *Marks' Standard Handbook for Mechanical Engineers*, 11th Ed, Nov 2006, ISBN: 0071428674 / 9780071428675.

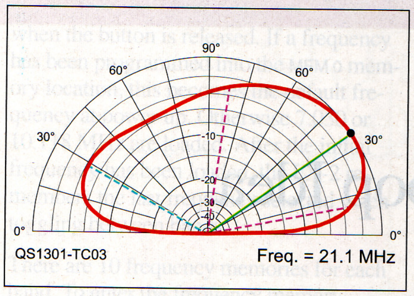


Figure 3 — The elevation pattern shows a maximum gain of 2.34 dBi at 34° elevation. This is only 0.25 dB less than if the antenna were in free space (at an infinite height above ground). It's nearly 2 dB more than if the antenna were strictly vertical (not slanted).

over a straight vertical orientation. Figure 3 is the *EZNEC* elevation plot, using the *EZNEC* "real ground model" (conductivity = 0.008 S/m, dielectric constant = 13).

It's worthwhile to keep in mind that, as mentioned in Sajid's article, this loop will also tune up nicely at twice the fundamental frequency, although with some changes in the radiation pattern. With the right length of wire, 20 meter/10 meter dual-band operation seems an attractive possibility.

I suggest this would make a nice antenna for low power operation, perhaps for Field Day or a backpacking expedition. It's quick and inexpensive, and if you have a need to rotate it, just pick up the rocks and walk it around! It is a pretty effective antenna. With the setup I've shown here, running 75 W from my location in Texas, I have worked hams in Japan, Germany and South America, besides attaining my original goal of making contacts to New England. — *73, Larry Coyle, K1QW, 167 Black Hawk Ct, Dripping Springs, TX 78620*; **k1qw@arrl.net**

Heating Ventilation Air Conditioning (HVAC) EMI Generation

In the summer of 2010 we moved to a new home with a bit more space. As I was becoming accustomed to the new place and its obstacles, one of these I was not ready for. I had chosen to establish the radio room adjacent to the utility room because it provided all the necessary items, such as space, access to the outside for the antenna coaxial runs and electrical wiring just to name a few. I was looking forward to another season of Top Band DX contesting, but that was short lived. To my surprise when I powered on my Kenwood TS-940 for the first time there was a loud hiss/whine coming from the speaker and it didn't matter where I tuned, whether it was on 1.8 MHz or right through to 30 MHz.

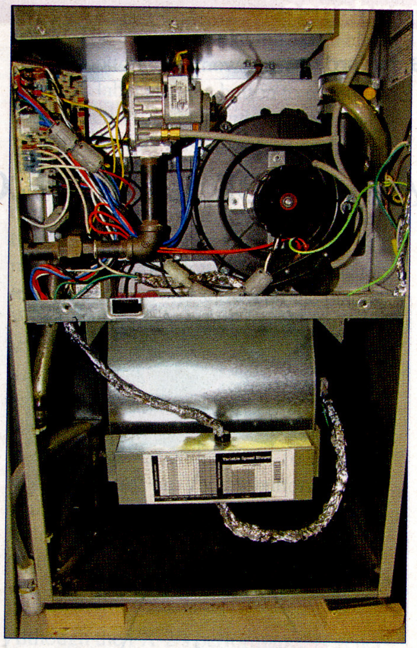


Figure 4 — This view inside of my HVAC unit shows how I wrapped some of the wiring harnesses with aluminum foil to shield the EMI that the dc control signals generate. You can also see where I placed snap-on ferrite beads over some of the wires.

The whine was found every 30 kHz while spinning the main dial.

What was the cause of all this EMI that suddenly appeared one hot afternoon just after setting up my radios in the shack for the first time? It became very apparent when I heard the HVAC system shut off, and the EMI came to an abrupt stop.

This interference was not coming from an outside source such as the house next door, but from my own home. Realizing that the EMI was coming from the HVAC unit only 3 meters away in the next room really bothered me. On further investigation, when the HVAC unit energized again the noise heard on the radio seemed to be synchronized to the sound of the variable speed blower motor as it ramped up in speed.

My new home was equipped with a more up-to-date high efficiency HVAC unit than my previous location, which had a much older mid-efficiency unit and was equipped with only a two speed blower motor that caused no EMI.

Needless to say I was not impressed with this situation. Researching solutions on the Internet only produced minimal results regarding the EMI hash that was being generated. I called the manufacturer of the unit (TAPPAN), and heard that they had never entertained this complaint before. I knew then it was up to me to resolve this problem as they would be of no help.

The variable blower speed control was created by converting the applied 120 V ac to a steppable dc voltage module mounted inside the motor itself, which when energized controlled the blower's speed from 500 to 1870 rpm.

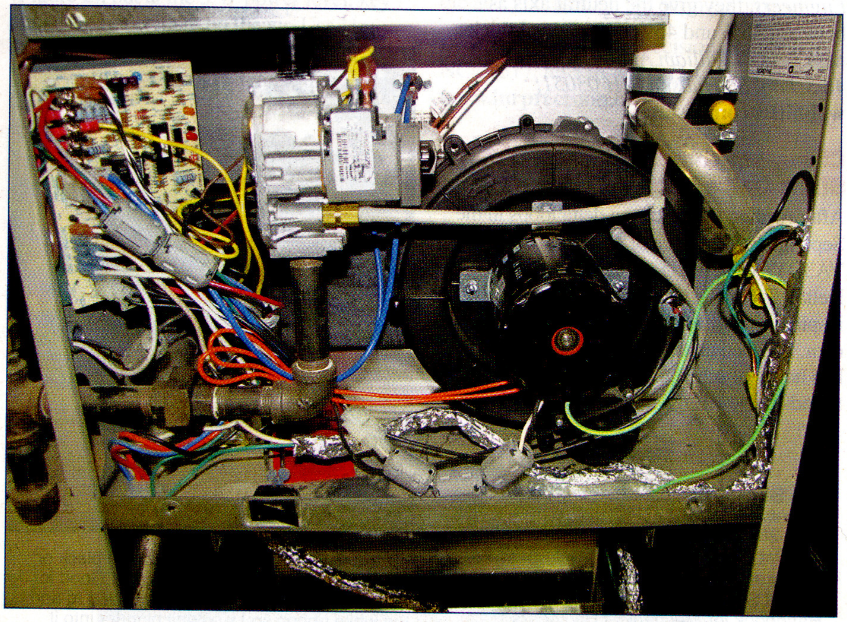


Figure 5 — This view shows more detail of the wiring in the top portion of the unit.