# A 17M delta loop for 20-10M

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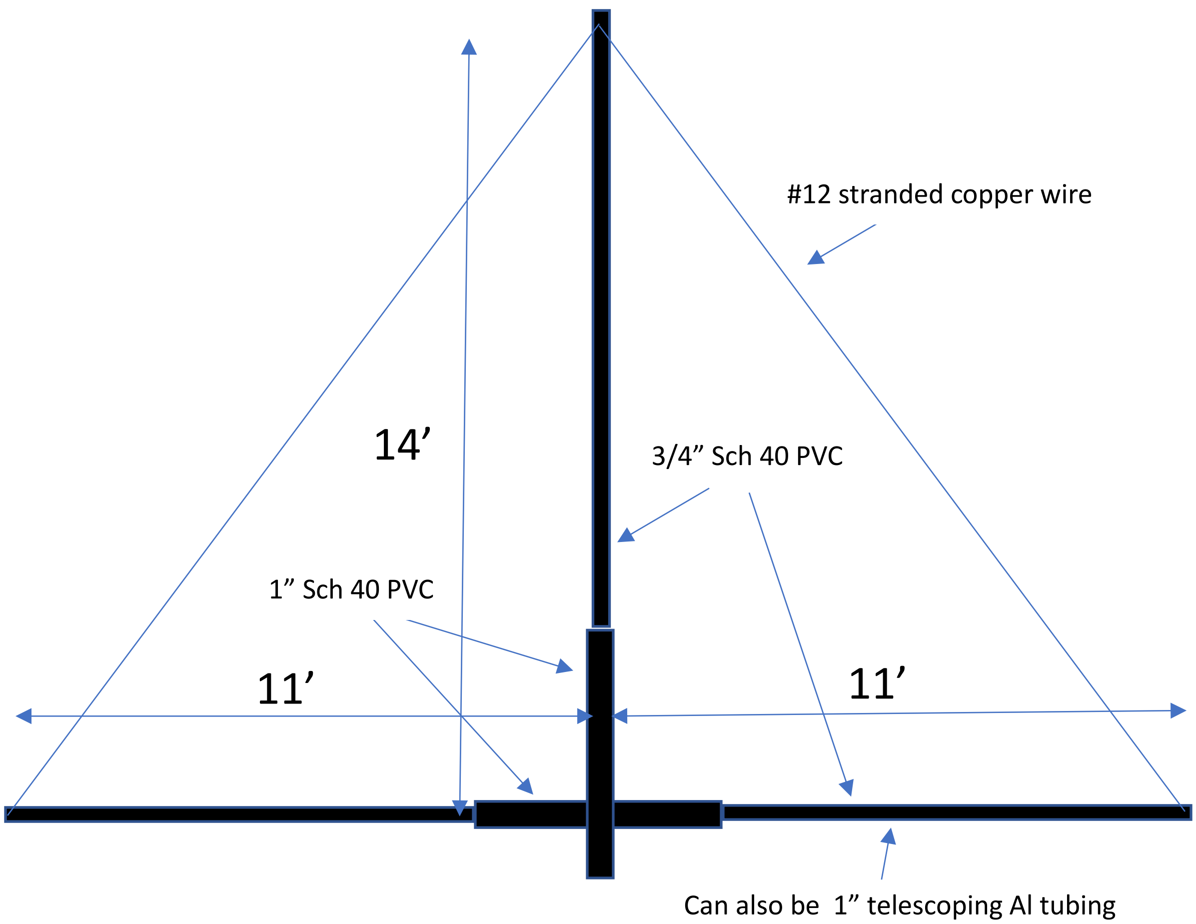
Nearly two decades ago I described a modified W8JK 2 element phased array beam I had built (A Compact and Efficient Multiband Beam Based on a Modified W8JK Array). The beam article was put in the BVARC website technical section and subsequent was spread all over internet (Thanks to Microsoft, Google, and others). The article eluded to a delta-loop antenna I had previously built and used for number of years in the 1990s. I received a number of inquiries from hams outside the BVARC club about the beam and recently I had an inquiry about my previous experience with the delta loop from a ham in Ireland! In the nearly 2 decades since the original article was publish, the BVARC club has experience considerable growth with many new hams joining through the club's VE licensing efforts. With the solar flux index on the rise, there is considerable interest in exploring propagation on the higher HF bands (20-10) by these new hams. The delta loop is a simple antenna with a small footprint and excellent performance for such a simple configuration and can be built easily by most hams at low cost.

While this antenna would never be considered a stealth antenna, it is small and less noticeable than big beams. And if the support structure was painted brown or black it would be hard to see it if deployed amongst trees. A full wave loop has gain (~1dbi) over a dipole at the same height and a lateral extent less than a dipole. The azimuthal radiation pattern is a figure 8 similar to that of a dipole. A full wave loop has a feed point impedance of ~100 ohms resistive at its fundamental operating frequency so would require a 1:2 step-up balun at the feed point if fed with coax. If fed with ladderline it can be used on other bands at the cost of requiring an antenna tuner at the transceiver (a current balun at the tuner would should be used for best performance).

So why a 17M loop for 20-10M rather than a 20M loop? While 20M loop works well on 20-12M with a nice figure 8 azimuthal pattern, it has a very messy azimuthal radiation pattern on 10M - many lobs. A 17M loop, however, has a good figure 8 pattern on 10M for only a very slight reduction in gain at 20M – less than a db (still more than a dipole). It is also possible to use this loop on 30M although the feedpoint SWR is quite high (not such a big problem when using ladderline). The ARRL Antenna book has much more on full and half wave loops.

I built the supporting structure using PVC pipe and set it up to be rotatable using the "Armstrong" method! This is an area for individual creativity.

**A 17M delta loop antenna**




The 11’ horizontal spreaders can be 3/4” PVC pipe slid into and glued to the central T section made with 1” PVC components. Then the #12 wire can be laid along the spreader to one end, up to the top of the vertical 3/4” PVC piece, back down to the tip of the other 11’ spreader and then into the center. Some metal screws set about 1-2” apart at the center will serves as the attachment point for the #12 wire and the feedline.

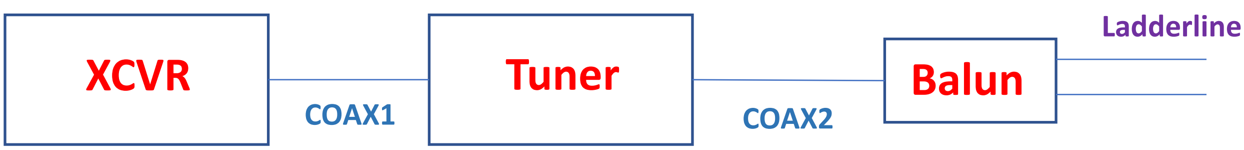
Another option is to make the horizontal spreaders using telescoping 1” Al tubing. Then the #12 wire is attached at the tips. The metal screws for attachment of the feedline near the center must now penetrate the PVC to the AL tubing and will serve to provide mechanical constraint as well as an electrical connection between the Al tubing and the feedline. The two Al tubes must not touch at the center and should be about 1” apart.

This antenna may then be installed on a vertical pole. Several lengths of 2&3” SCH 40 10’ long pipes can be joined together for a 30’ pole. PVC makes a nice antenna pole and only requires a little ingenuity to construct it. A light duty rotator could be used to rotate the loop, if desired and affordable. Or a slip ring used for constraining the vertical shaft at a roof eve and cement pad with a depression in the middle at ground level (or maybe some kind of ceramic bowl – to keep the pole base from moving around) so the whole affair can be rotated by the "Armstrong" method as I did in my 1990's version of this antenna – depends on how much you want to invest in the effort. If you can't locate the antenna next to the house or some other structure, using guys attached just under the D-loop can be employed. This served me in the mid 90's until a small tornado came along and demolished the whole affair (along with our patio cover). After that I went out and bought a 50' Al tower!

## Feed line considerations

If used only on 17M, this loop could be fed with coax and 1:2 step-up balun at the feed point. A full wave loop has a feed-point impedance of ~100 ohm resistive hence the need for a step-up transformer. Also in this case, the loop circumference would need to be accurately determined since this is a resonant antenna in this situation.

However, the loop can be used with considerable success on 20-10M if fed with ladderline. This will require a tuner at the XCVR end and a current balun between the tuner and the ladderline. The current balun helps maintain equal current flow in each of the ladderline conductors reducing feedline radiation and preserving the directional pattern of the loop. Using ladderline cable results in impedance values all over the ball park at the end of the line so a tuner is required to match this impedance to the 50 ohm resistive required by the XCVR. This is a schematic representation of the setup:




If the tuner is a manual type, it usually would be located near the XCVR and COAX1 would be quite short. In this scenario the balun would be at the output of the tuner – COAX2 would also be quite short. Some tuners possess internal baluns but they may not be current type baluns (voltage type baluns are common in tuners – you would need to check). The internal types can often be switched out.

However, an automatic tuner might be used instead and sited at the base of the antenna pole in which case COAX1 could be relatively long. COAX2 should be kept short since it will experience the high SWR common to ladderline feed systems. EZNEC modeling of this antenna system shows SWR values at the feed point on some bands of above ~10:1. Fortunately, this SWR level does not lead to significant losses with ladderline. However short runs of COAX2 can still be used to get the feedline inside the house while leaving the balun outside at the base of the pole. With good quality RG8X, for example, incremental losses will be below 1db for 20' runs at 28MHz and a SWR of 13.

Historically ladderline has been used to obtain multiband performance from a single antenna configuration. Usually you can find some settings on the tuner that will get a match on all bands to the 50 ohm output of modern XCVRs. There are occasional exceptions for some feed-line lengths – and it is the feedline length that is the culprit here. Remember, the ladderline functions as an impedance transformer from the antenna feed point to the XCVR end of the feedline and this transformed impedance may be outside the range that common tuners can handle. This issue has bugged Hams for generations. It really has a rather simple solution. If you find that there is a band where no reasonable setting of the tuner gets a match, add a short piece of feedline to the existing feedline and try again. I have found that some incremental length value in the range 1-3' (only a small amount) will solve the problem and you will then have reasonable settings for all bands. This works just as well if the length change is accomplished by lengthing COAX2 rather than the ladderline.

## Performance

EZNec was used to evaluate this loop's performance in free-space (i.e. with no ground present). This is a common way of comparing antenna performance without the ground effect enhancement clouding the issue. Broadside gain, feed-point impedance, and SWR for 300 ohm ladderline are tabulated for each band in Table 1. Remember that the broadside gain of a .5WL dipole is 2.1 dbi. The second row is the broadside gain relative to an isotropic radiator and the third row is the gain relative to a .5WL dipole. This D-loop antenna achieves gain values even on 20M at least equal to a dipole and at 10M the gain is ~2db better than a 10m dipole. The fourth row is the source impedance of the antenna and the fifth row is the SWR that this source impedance would lead to on 300 ohm ladderline.

Table 1

| Freq. (MHz) | 14.1 | 18.1 | 21.1 | 24.9 | 28.4 |
|---|---|---|---|---|---|
| Gain (dbi) | 2.18 | 2.68 | 3.06 | 3.73 | 4.36 |
| Gain (dbd) | 0 | 0.5 | 1 | 1.6 | 2.2 |
| S Imp. | 86-502i | 130-42i | 229+263i | 871+945i | 772-1759i |
| SWR | 13.4 | 2.4 | 2.7 | 6.5 | 16.3 |

Figures 1-3 illustrate the azimuthal radiation pattern of the antenna at 20M, 15M, and 10M. The horizontal polarized pattern (green) is a figure 8 pattern on all bands but some vertical polarization energy (red) is radiated off the sides of the loop and alters the total field somewhat. The 17M and 12M patterns are similar to the 15M pattern.

Figure 1  20M

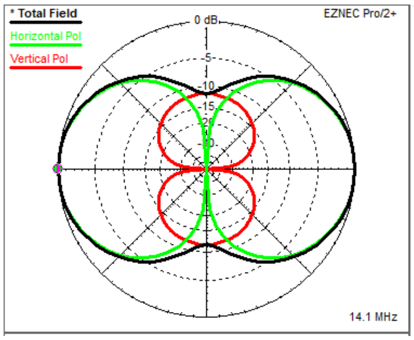



Figure 2  15M

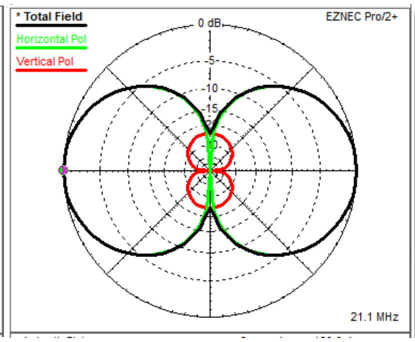



Figure 3  10M