"Self-Contained Vertically Polarized Wire Antennas

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Proponents of deltas, half-squares, and DMS (double magenetic slot) antennas for 160-40 meters find them both simple and useful for DX. All exhibit low angles of radiation without higher angle lobes. Hence, while gain cannot compete with some other antennas, the signal-to-noise ratio for DX is superior. The antennas act like a natural filter against higher angle QRM and QRN.

Some folks do not realize that all of these antennas share properties that make them members of the same family. Besides the elevation pattern shown in Figure 1 (which is broadside to any of the antenna structures), they share these properties:

1. All use about 1 wavelength of wire (except for the "doubles"). As with all 1? systems, properties can be altered by selecting the feedpoint on the system.

2. All are closed systems, independent of the ground as the completion of the antenna. Like all antennas, they depend on ground quality in the long measure for effective reflection. However, unlike vertical monopoles, the local ground beneath the antenna does not figure into their basic efficiency or operation to any significant degree. In other words, they model correctly in free space and work very well at VHF many wavelengths above the ground.

3. For vertically-polarized operation, all are fed 1/4 wl from a high-voltage node. For delta loops, this is 1/4 wl down the sloping side of the antenna from the top apex. For rectangles, diamonds, and squares, the feedpoint is mid-side, which places it 1/4 wl from the high voltage point at the antenna mid-top. For the half square, which is usually operated pointing down at lower HF, the feedpoint is at the corner junction of the vertical and horizontal elements.

4. Low horizontal members act largely as phasing lines rather than as radiators. The high voltage junctions effect a phase reversal so that anywhere along the line relative to center, the currents are of equal magnitude but opposite phase. This has the effect of largely, but not perfectly, canceling horizontally polarized radiation. (For the half square, operated pointing down, the horizontal line is at the top. See Figure 2.)

Figure 3 shows some of the basic configurations of the self-contained wire verticals. The "open double magenetic slot" and the "bobtail curtain" are double versions of the "rectangle or DMS" and the "half-square," respectively.

As a check on these antennas, I modeled each in free space at 7.15 MHz. Here are the dimensions (rounded) of the antennas modeled.

Antenna name	Abbreviation	Dimensions
Equilateral Delta	Eq Dlt	48.8'/side, base down, apex up
Right-Angle Delta	RA Dlt	60.8' base, 43' sides, base down, apex up
Square Quad	Square	36.3'/side
Diamond Quad	Diamond	36.3'/side
Rectangle (DMS)	Rect	58' horizontal, 12.8' vertical
Open Double DMS*	Open DMS	110.8' horizontal, 11.1' vertical; center vertical wire; fed on end wire
Half Square	HS	62.4' horizontal; 39' verticals
Bobtail Curtain*	Bobtail	125' horizontal; 38' verticals; fed on center wire

*Indicates a double (2?) version of the basic 1? antenna. Some antennas use a common center vertical wire, which can be treated as two wires in parallel and carries twice the current of the end vertical wires.

Here are free space performance figures, that is, azimuth gain figures and feedpoint impedances:

Antenna	Gain (dBi)	Feedpoint Impedance (ohms)
Eq Dlt	2.9	120
RA Dlt	3.3	51
Square	3.2	130
Diamond	3.1	130
Rect	4.4	15
Open DMS	5.7	30 (2 wl system)
HS	4.6	65
Bobtail	6.3	40-70* (2 wl system)

*The Bobtail can be fed almost anywhere along the center vertical. At the junction with the horizontal wire, the feedpoint impedance is near 40 ohms; at the midpoint, the impedance is closer to 70 ohms; about 60% up the vertical, the feedpoint impedance is about 55 ohms.

In practical terms, the Open DMS or the Rectangle may be much preferable for 80 meters; while the half square and bobtail come into their own at 40 meters. See especially ON4UN's Low Band DXing for further variations on these antennas, although he does not recognize them as a single group and has not sorted out ground condition from monopole completion factors in the matter of ground radials. Other antenna books and manuals seem to treat each of these antennas as a singular type.

Since we do not get to place our 40-meter wires in free space, some sense of real-world performance seems necessary to get a feel for these antennas. In the real world, there are too many possibilities to catalog, but perhaps a single example may be helpful in getting started. Thus, I created a 40-meter antenna builder's comparison, setting certain common limits to antenna height and taking into consideration minimum heights above ground. In general, for this exercise, 50' was the maximum height arbitrarily selected. Closed antennas had a minimum height requirement of 20' for safety from a low horizontal wire. Some antennas had to violate these limits or be omitted. The Half Square and Bobtail verticals had a minimum height of 10', since there was no horizontal wire at this level to create hazards to humans. Within these limits, here are the performance results.

Antenna	Height Range	Gain/TO Angle	Feedpoint Impedance
	(feet)	(dBi) (degrees)	(ohms)
Eq Dlt	10 - 52.3	1.1 / 21	160
RA Dlt	20 - 50.4	1.9 / 19	60
Square	20 - 56.3	1.6 / 18	145
Diamond	20 - 71.4	1.5 / 16	135
Rect	37.2 - 50	3.0 / 17	15
Open DMS	38.9 - 50	4.5 / 16	30
HS	11 - 50	3.4 / 19	45
Bobtail	11 - 50	5.0 / 18	40 (corner-fed), 56 (60% up), 70 (center-fed)

To meet the ad hoc building constraints, the Equilateral Delta and the Diamond must be eliminated, and the Square is close to elimination. The Equilateral and Right-Angle Deltas can be operated with the horizontal wire at the top for some improvement in performance. Likewise, one can operate the Half-Square and the Bobtail with the horizontal wire at the bottom, although this places the high current nodes close to ground and presents additional mechanical problems to the builder. From the perspective of performance, the Half-Square and the single-loop DMS Rectangle are the best low angle antennas, while their double-size counterparts improve performance further. One constrant on the Half-Square and Bobtail is that one cannot raise their height too far (higher than about 30' at the bottom on 40 meters) without the appearance of a secondary lobe at a higher angle. The rectangular and other closed loop antennas can be raised much higher without the formation of the secondary lobe.

In the end, each builder must create his own comparison chart to account for local restrictions and opportunities. However, these numbers might be useful as a start in better understanding the members of this interesting family of antennas--the SCVs (self-contained verticals). LB

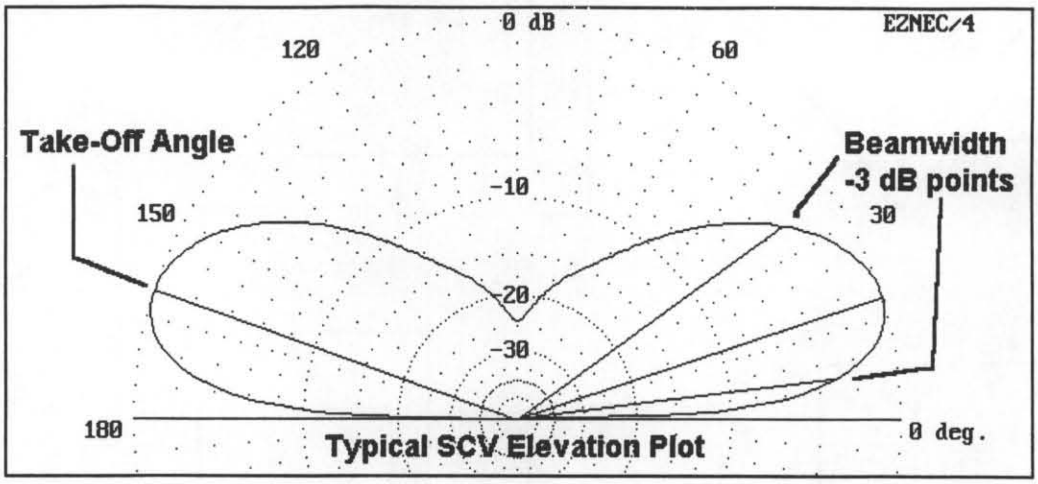

Fig.1 A typical elevation plot of a self-contained vertically polarized wire antenna.

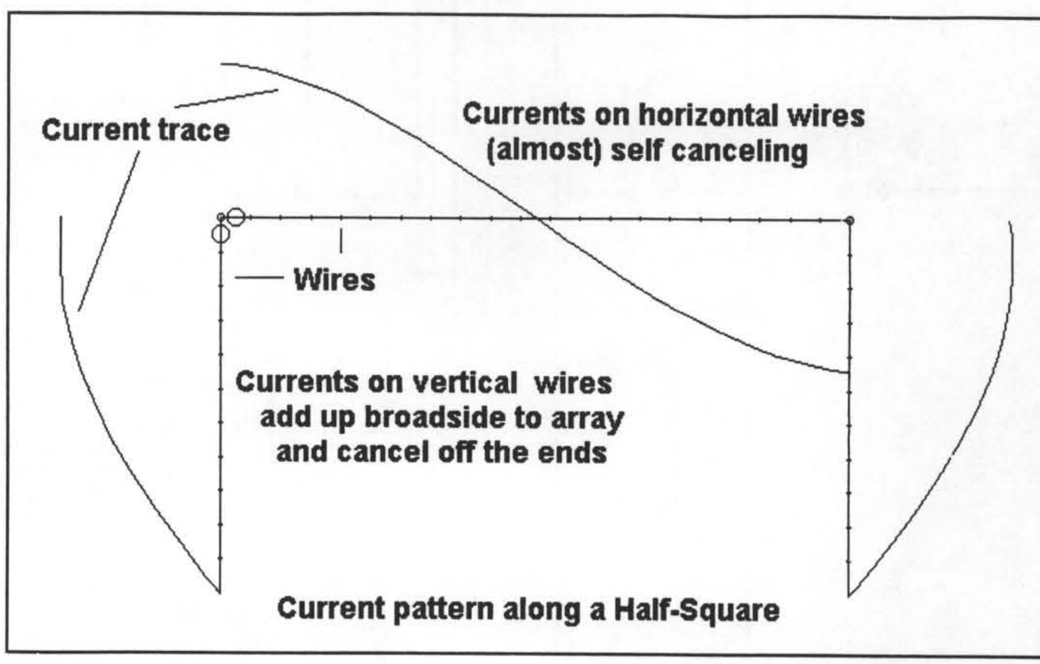

Fig. 2 The current patterns that produce vertically polarized radiation from SCVs (as illustrated with the Half-Square).

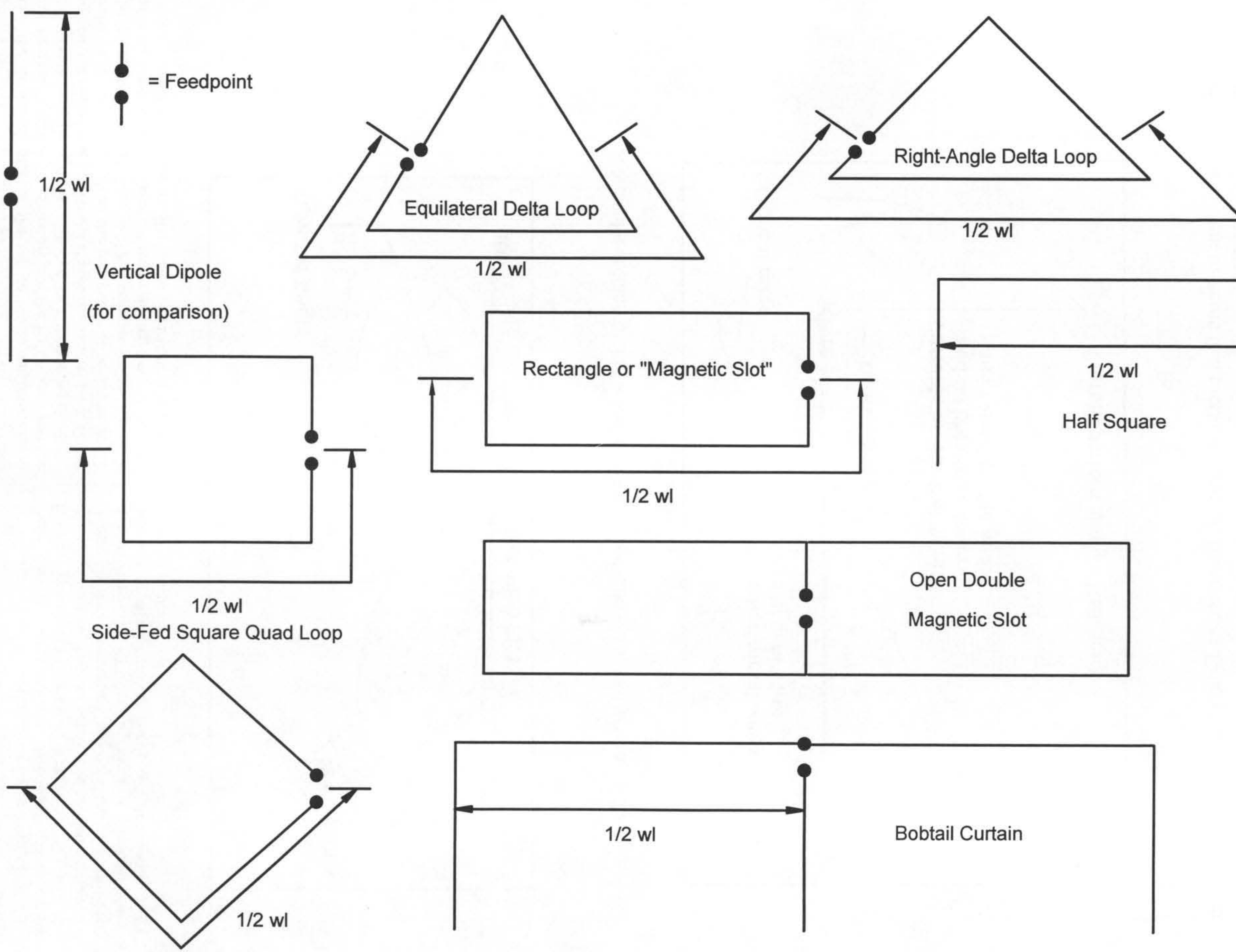

Fig. 3 Outlines of some self-contained vertically polarized (SCV) antennas