Half-Length Dipoles (for 40 Meters)
Part 2: Shortening and Reshaping the Dipole

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In the first part of this series, we reviewed in practical depth the properties of a full-length 40-meter dipole. The data in those notes provides both background information on dipole properties in general and specific entries with which we can compare the performance of some shortened antennas. Now the time has come to begin the shortening process.

In this part—with others yet to come—we shall tackle two significant questions. First, what happens when we simply cut an initially resonant full-length dipole to shorter lengths? Second, can we obtain a shorter length while still having at least some of the properties of a full-length dipole? The first question is almost self-explanatory. The second one involves various forms of folding, spindling, and mutilating the linear dipole form to squeeze a full dipole into half-dipole space. We shall evaluate a number of possibilities, even though amateurs are adept at finding news ways to accomplish the task.

As we did in Part 1, we shall adopt AWG #12 (0.0808" diameter) wire as our standard antenna material. As well, when we set a half-length value for our shortened dipole, we shall use a length of 33.33' (400.0") due to its numerical convenience. A free-space resonant ½ λ dipole using AWG #12 copper wire actually requires 66.87' (802.4"), so our rounding is very slight.

Shortening the Copper Wire Dipole

The process of discovering the properties of shortened dipoles is very straightforward. As shown in **Fig. 1**, we simply trim the dipole ends while retaining the center feedpoint position. To create a finite task, let's trim the initially resonant ½ λ dipole in 10% increments down to a final length that is 10% of the original. We can use a free-space environment for convenience, since the properties would transfer easily to any height over any ground that we might use in practice. The information will take both tabular and graphical forms.

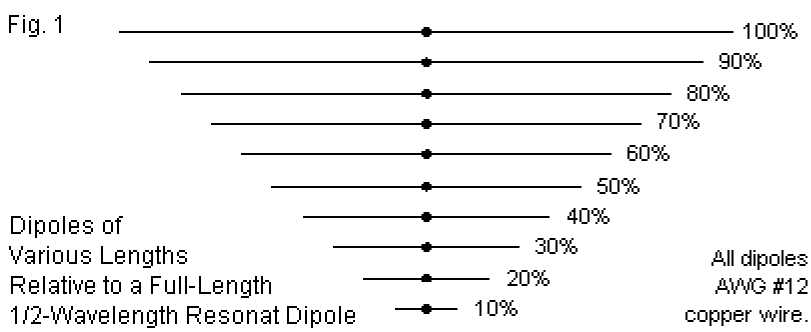


Table 1 provides the numerical overview of the progressions of values for the essential performance characteristics, including maximum bi-directional gain, beamwidth between the half-power points, and the feedpoint impedance, given in the usual series terms of R +/- jX Ω. The general progression contains no major surprises, since the gain shows a continuous downward trend, while the beamwidth shows a small but steady progression upward. The feedpoint resistance moves downward from the resonant 73-Ω value, while the short versions of the dipole show ever-increasing values of capacitive reactance.

Dipole Performance vs. Length as Percentage of 1/2 Wavelength					
AWG #12 Copper Wire			Free Space		7.15 MHz
Length %	Length in	Gain dBi	BW deg	Resist	React
100	802.4	2.07	78.2	73.18	-0
90	722.2	1.99	80.4	53.82	-159
80	641.9	1.91	82.4	39.21	-322
70	561.7	1.84	84.2	28.05	-497
60	481.4	1.78	85.6	19.50	-694
50	401.2	1.71	87.0	12.95	-932
40	321.0	1.65	88.0	8.03	-1244
30	240.7	1.57	88.8	4.43	-1703
20	160.5	1.44	89.4	2.00	-2512
10	80.2	1.12	89.8	0.52	-4595
Notes	Gain dBi: maximum gain in dBi				
	BW deg: E-plane beamwidth in degrees				
	Resist: feedpoint resistance in Ohms				
	React: feedpoint reactance in Ohms				Table 1

To view more clearly how the progressions proceed, we may graph the results. **Fig. 2** shows the track of the maximum free-space gain and the beamwidth in degrees. Be certain to attend to the values along the proper Y-axis. For example, the beamwidth curve appears very steep, but the axis informs us that the range of values is quite limited: 78° to 90°

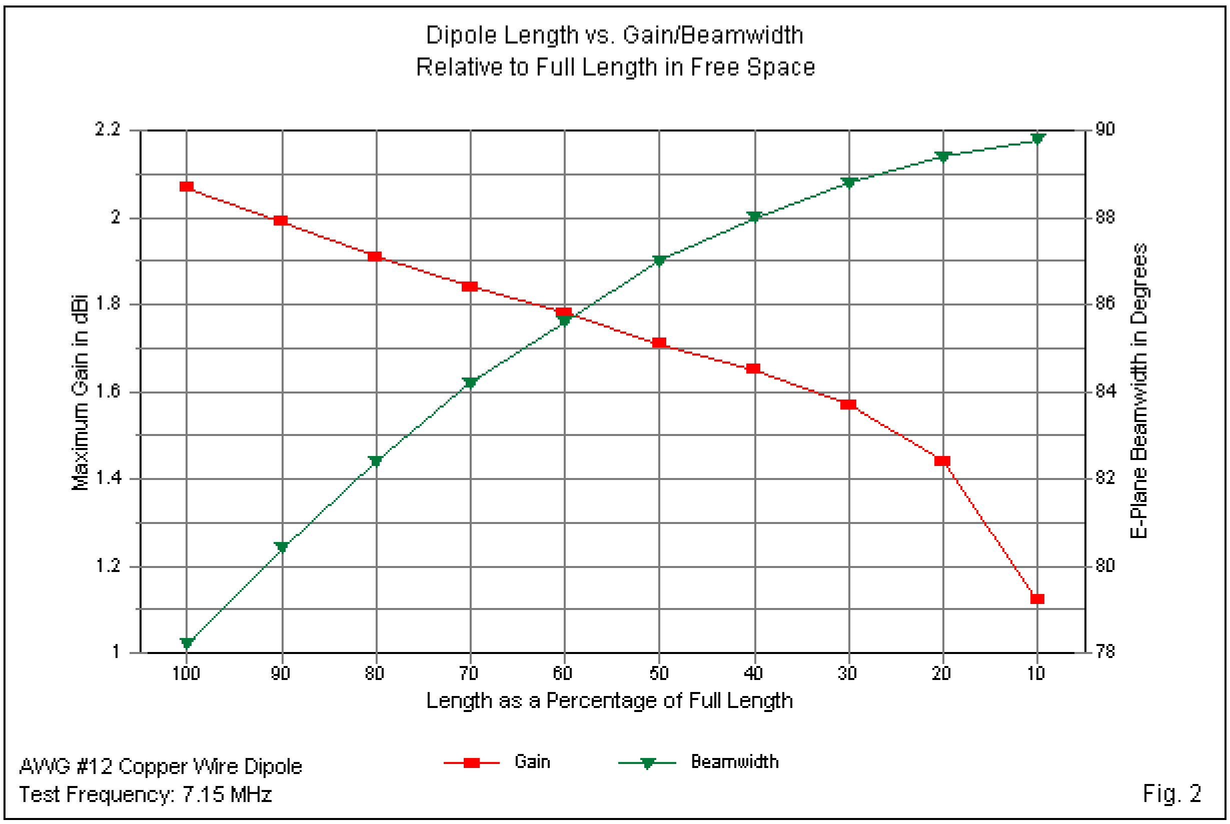
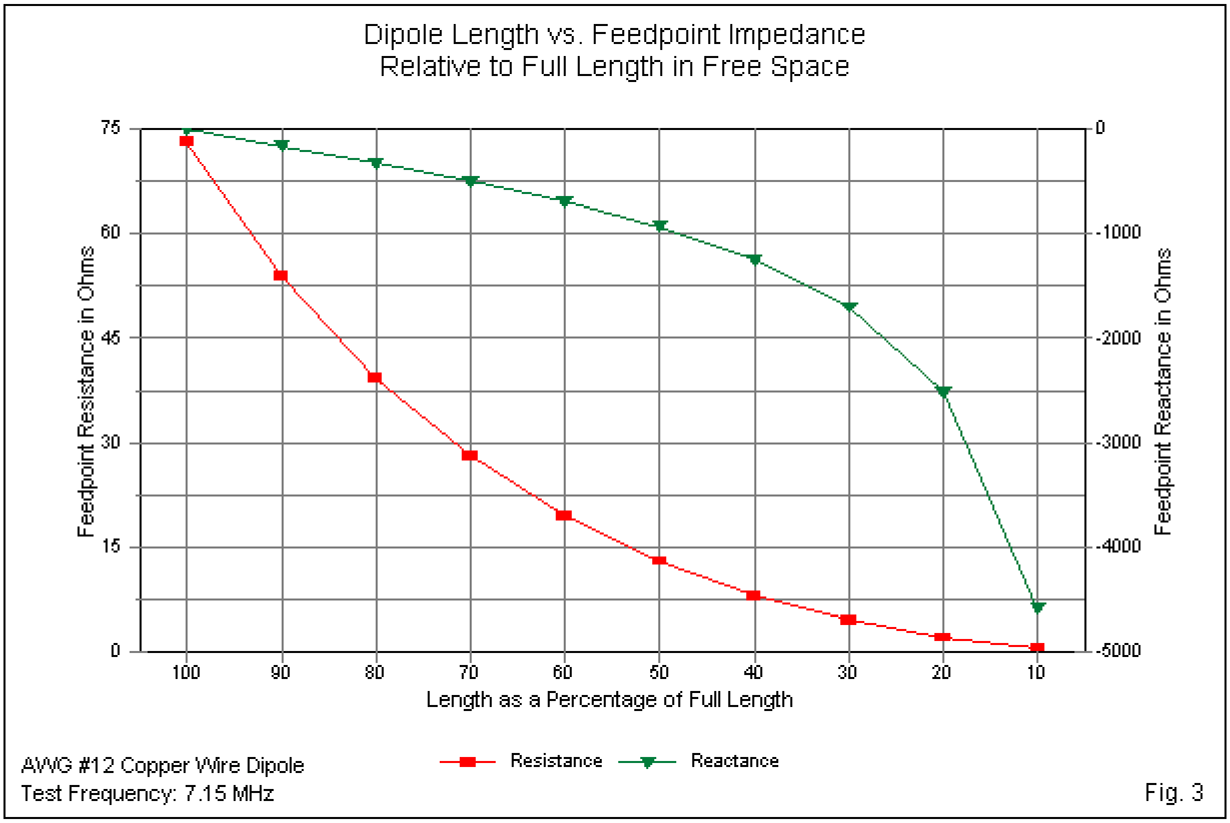


Fig. 2

The gain curve is interesting because it shows a nearly (but not quite) linear decrease in value per increment of length change until we reach the 30% mark. For shorter lengths the curve becomes steeper with each change of length. Contrary to the intuitive guesses of many new amateurs, the gain of the dipole holds up very well, even at a length that is only 10% of the resonant length (80.24” compared to 802.4”). The gain is only about 1 dB lower at the very short length than it is at full length. Over ground, the same differential would appear. At some height over some ground quality, a full-length dipole might show a maximum gain of 7.0 dBi. The 10% dipole would show a gain of about 6 dBi.

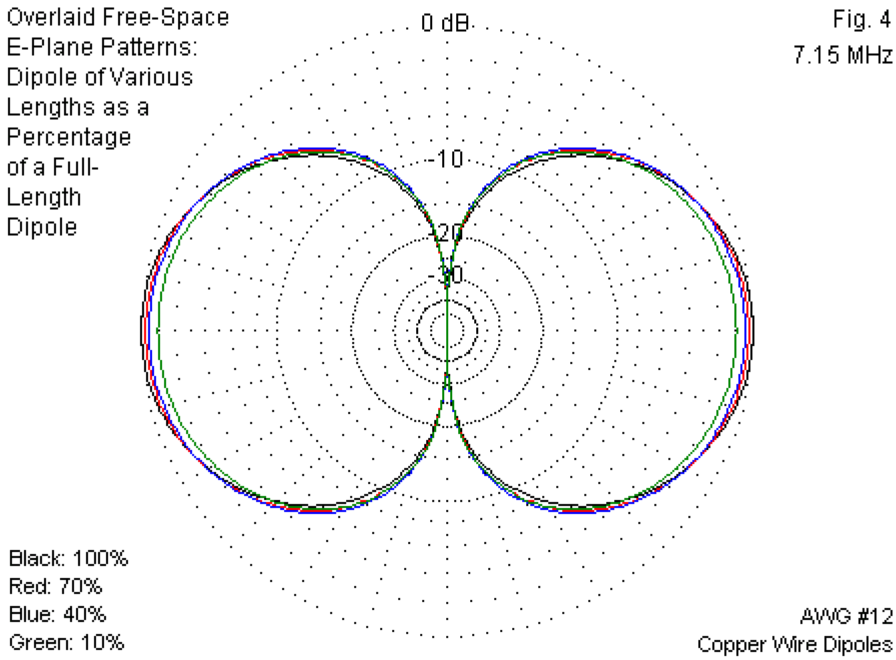
The major practical problem facing users of shortened dipoles is usually not basic performance. Rather, both the resistive and reactive components of the feedpoint impedance take turns for the worse, as revealed both by the numbers and by the curves in **Fig. 3**. The resistive component drops very rapidly so that lengths below the 70% mark begin to present very difficult matching situations regardless of the value of reactance at the feedpoint.



On its own, the feedpoint reactance shows an increasingly steep curve as the capacitive reactance grows with our dipole trimming. The curve may seem initially shallow, but the scale covers a very wide range. A dipole that is 70% of full length has a reactance of nearly –j500 Ω. Reactance conditions grow more troublesome for most types of installations as the antenna length becomes shorter.

Our target length of 50% of full length presents us with a very low resistive component—less than 13 Ω—and a very high reactive component—more than –j900 Ω. Under these conditions, even the losses of parallel transmission line become very high. Working with such impedance values will become a daunting challenge for the short antenna builder.

Fig. 4 shows perhaps the major reason why antenna builders with very limited space tend to try their luck with shortened dipoles. The polar plot shows patterns for dipoles that are 100%, 70%, 40% and 10% of full size. The differences in gain and in beamwidth shown in the table turn out not to make a very large difference in performance, if we read the polar plot as a measure of potential performance. In the end, the key task will be to supply power to the antenna while holding losses to a minimum in the process. Energy that is lost in the transmission line and any matching networks that we might use reduces the gain shown in the ideal plots that contain no lines or networks.



Before we turn to any technique that might let us use a half-length dipole, we should first confirm that the antenna performs over ground in a satisfactory manner. So we should pause to repeat an exercise that we performed with the full-length dipole in Part 1. We shall set the antenna over average ground at different heights and check its performance values. We shall repeat the progression used in the earlier exercise of raising the height from 0.05 λ up to 1.0 λ in 0.05 λ increments. The new dipole is 33.33' or 0.242 λ long physically. In free space, it shows a gain of 1.71 dBi, with a beamwidth of 87.0°. The feedpoint impedance is 12.9 – j936.2 Ω.

Table 2 provides the numerical information on the half-length dipole at the listed heights above ground. We can establish that the short dipole has many of the same characteristics as the long one by graphing the feedpoint resistance and reactance values, as shown in **Fig. 5**. Like the full size dipole, the feedpoint resistance and reactance of the 50% version show cycles that vary the values as a function of the height above ground. The resistance reaches peak values at height of about 0.3 λ and 0.85 λ (close to the 3/8 λ and 7/8 λ points that are separated by ½ λ). Because the reactance is always very capacitive, we have nothing corresponding to a zero-value to coincide with those peaks, as we did with the full-length dipole. However, careful reading of both the numbers and the graph show the reactance to be close to the average value of its swings at peak resistance values.

The graph has a limitation because it cannot show clearly at least two complete cycles of resistance and reactance. As the antenna moves very close to the ground, the feedpoint impedance values show much greater changes than we found to be the case with the full-length dipole. Nevertheless, the tracks are sufficiently parallel at most heights to confirm that the general trends in impedance behavior of a dipole is independent of dipole length.

Half-Length Dipole Performance vs. Height above Ground					
AWG #12 Copper Wire			Average Ground		7.15 MHz
Height wl	Height ft	Gain dBi	TO deg	Resist	React
0.05	6.88	-1.47	88	14.3	-916.8
0.10	13.75	3.53	88	10.6	-930.2
0.15	20.61	5.32	88	11.4	-931.6
0.20	27.48	5.72	87	13.2	-932.2
0.25	34.35	5.57	61	14.8	-933.4
0.30	41.22	5.56	48	15.6	-935.0
0.35	48.09	5.76	40	15.5	-936.6
0.40	54.95	6.13	34	14.6	-937.8
0.45	61.82	6.62	31	13.3	-938.3
0.50	68.69	7.11	28	12.2	-938.0
0.55	75.56	7.45	25	11.4	-937.2
0.60	82.43	7.57	23	11.3	-936.2
0.65	89.30	7.47	21	11.7	-935.3
0.70	96.16	7.24	20	12.5	-934.9
0.75	103.03	7.00	18	13.3	-935.0
0.80	109.90	6.85	17	13.8	-935.5
0.85	116.77	6.83	16	14.0	-936.2
0.90	123.64	6.93	15	13.8	-936.8
0.95	130.50	7.13	15	13.2	-937.2
1.00	137.37	7.37	14	12.6	-937.2
Notes:	Gain dBi: maximum gain in dBi at take-off (TO) angle				
	TO deg: elevation of maximum gain in degrees				
	Resist: feedpoint resistance in Ohms				
	React: feedpoint reactance in Ohms				Table 2

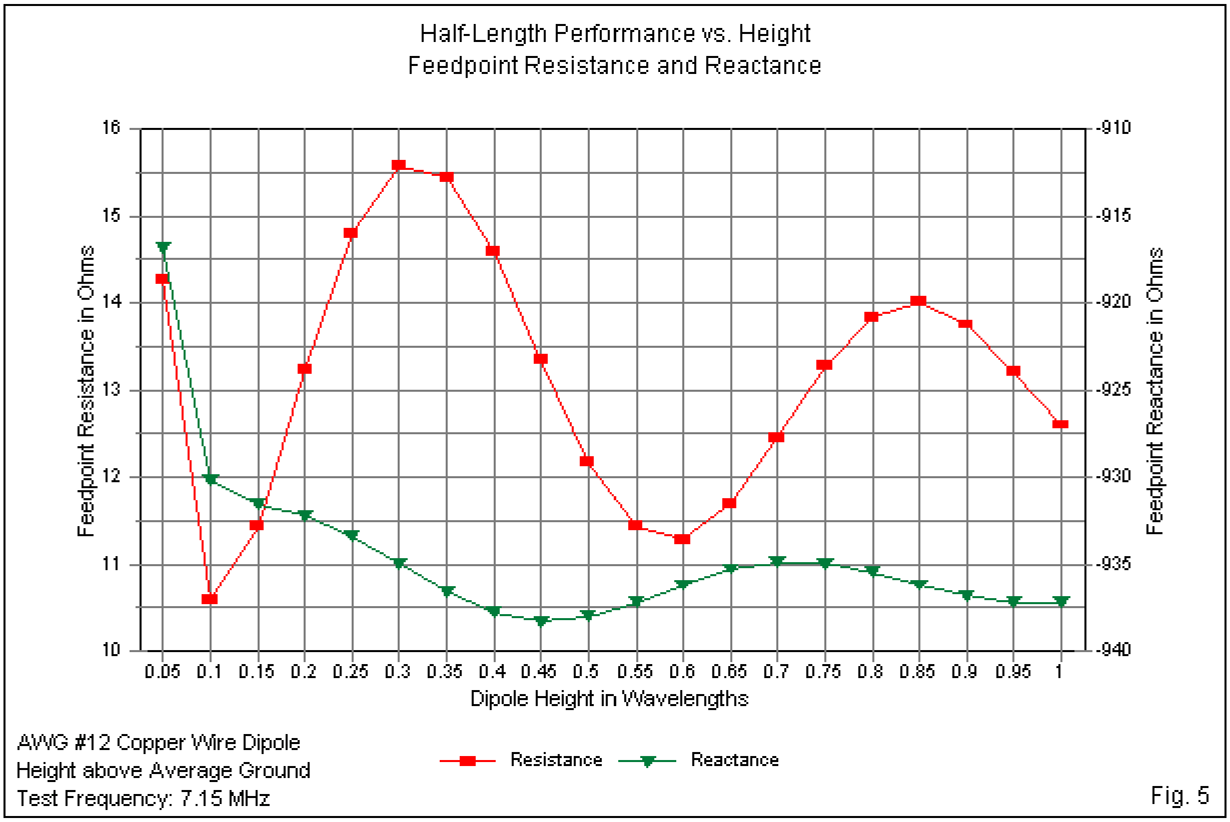


Fig. 5

The take-off (TO) angle of any horizontal single-wire antenna is a function of height. Therefore, except for the very lowest heights for our half-length dipole, the TO angles are the same for both the present and the past dipoles. More interesting is the comparison of gain curves for full- and half-length dipoles shown in **Fig. 6**. For all heights, the average gain difference between the two dipoles of 0.47 dB. The value would be slightly less had we excluded the somewhat larger differences at heights of 0.1λ and less.

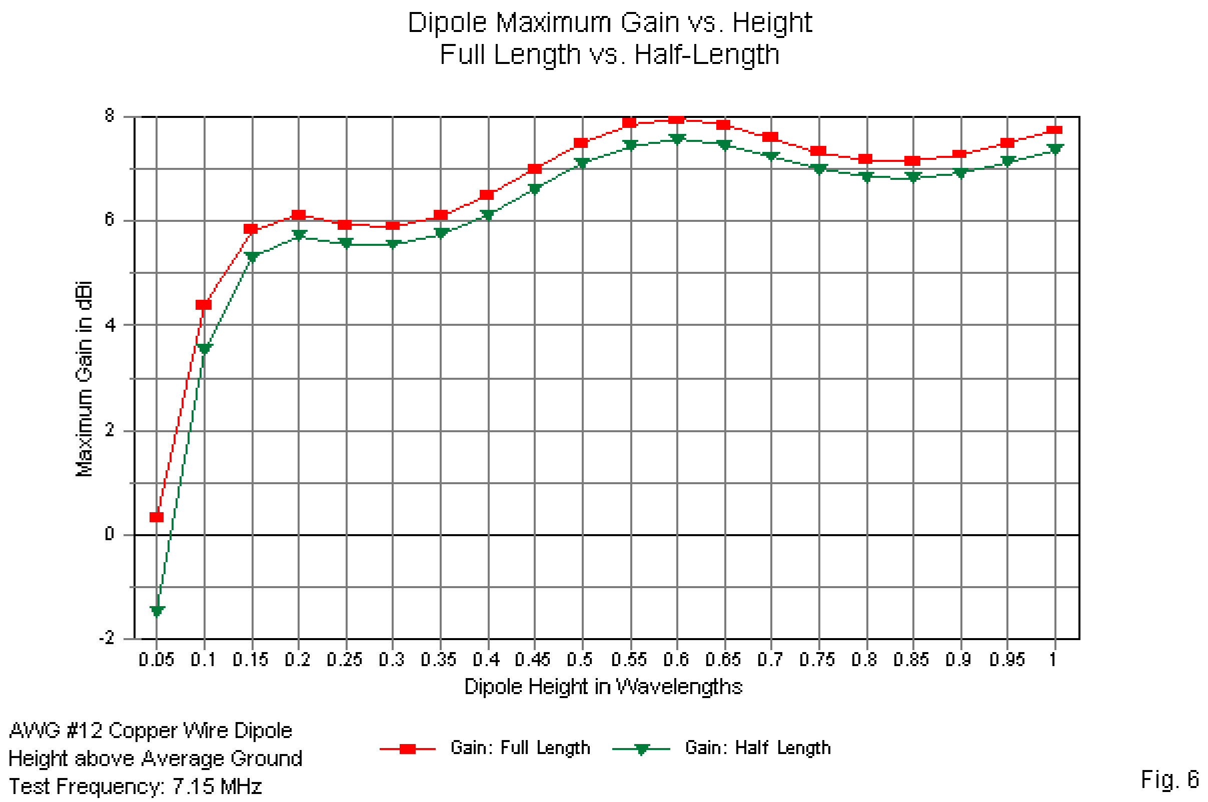


Fig. 6

The half-length dipole, then, promises adequate gain and reliable or predictable performance at all practical heights above ground. The sample elevation patterns in **Fig. 7** for various heights above ground show that we can scarcely distinguish between the short and the long dipole. All elevation lobes that apply to the full-size dipole reappear in the plots for the half-length dipole, with no significant changes in proportions. Performance is the least of the problems that we encounter when trying to work with short dipoles.

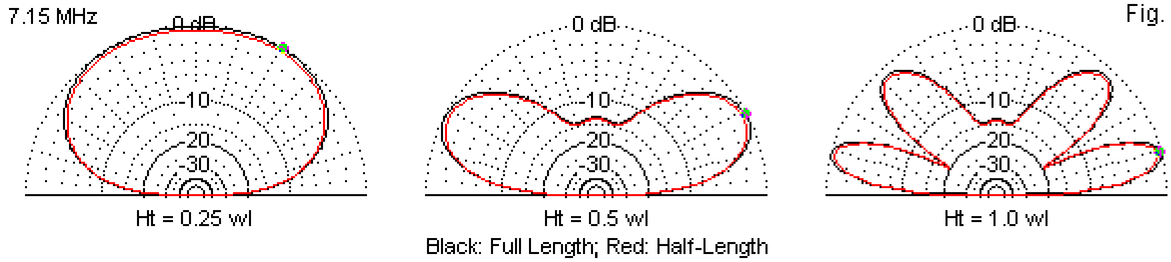


Fig. 7

Overlaid Elevation Patterns: Full-Length and Half-Length AWG #12 Copper Wire Dipoles at Three Heights above Average Ground

The most prominent challenge is to be able to supply energy to the antenna with minimal loss, a task that we often characterize as matching the antenna to a standard feedline, such as 50-Ω coaxial cable. (We shall also encounter some adjunct difficulties along the way.) In most cases, the high capacitive reactance at the feedpoint presents more problems than just converting the resistive portion of the impedance. In fact, the challenge is so great that there are a number of techniques sometimes used to avoid the problem altogether. We may call these “reshaping” strategies.

Reshaping the Full-Length Dipole

Our basic premise is that we have room in our installation area only for a 40-meter antenna that is about 33.33’ long, far short of the size of a full-length dipole. However, a dipole is a linear element with no significant lateral dimension. Suppose that we could reshape a full size dipole so that its longest dimension is 33.33’, even if it requires “some” space that gives the antenna an area. There are numerous ways to achieve this goal—some more promising than others. Therefore, let’s take another important detour to examine at least some of the major possibilities.

1. *The Zigzag Dipole*: One way to obtain a full size dipole in a smaller space is to create a zigzag shape. The sample antenna shown in **Fig. 8** uses 33.33’ of the total as the longest dimension of a rectangle. The center wire section runs from corner-to-corner of an S (or a Z) shape. The end pieces essentially fold back a bit to create a rectangle that is 27.3’ by 19.2’. Because the end pieces are not linear extensions of the center wire section, they must be longer than usual. Thus, the total amount of wire is close to 72’, compared to the 66.9’ required by the resonant free-space linear dipole.

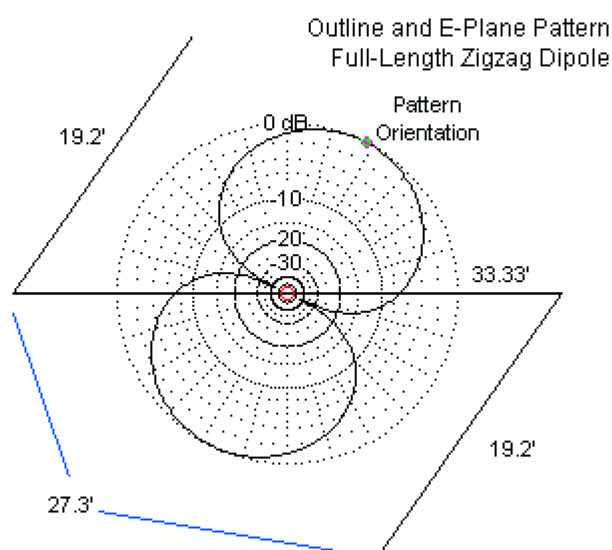


Fig. 8

The orientation of the pattern produced by the zigzag dipole is not broadside to the central wire section. Rather it is canted at an angle that is almost parallel to the end wires. Therefore, the zigzag user needs to plan carefully if he has target areas that he wishes to place along the axis of maximum gain. Because the antenna makes use of alternating fold-backs, the maximum gain is only equivalent to the gain of a 30% linear dipole, as shown by the free-space values in **Table 3**. Unlike the 30% dipole, with its low resistance and high capacitive reactance, the zigzag version has a resonant impedance of just above 25 Ω.

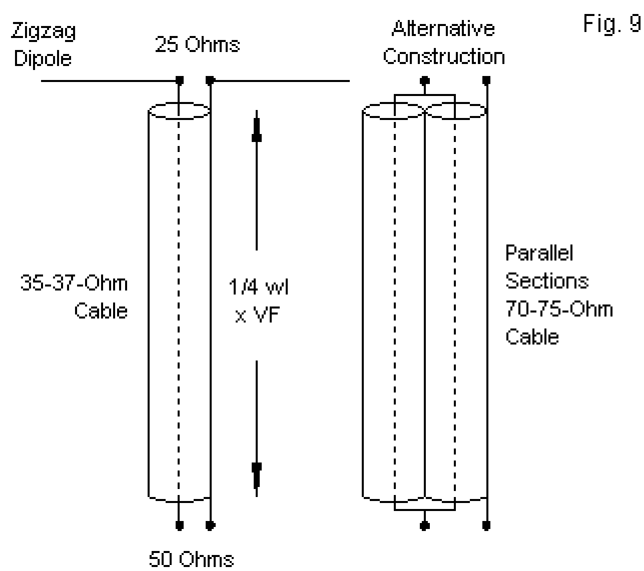
Table 3. Performance of a zigzag dipole with a 33.3' center section

Conditions	Max. Gain	Beamwidth	Feedpoint Z
Free Space	dBi	degrees	R +/- jX Ω
Pre-match	1.54	88.6	26.5 – j0.2
Post-match	1.32	88.6	50.8 – j1.2

Height	Max. Gain	TO angle	Feedpoint Z
0.5 λ	dBi	degrees	R +/- jX Ω
Pre-match	6.98	28	25.0 – j3.8
Post-match	5.82	28	52.8 + j6.0

Note: Zigzag dipole forms a rectangle 27.3' by 19.2'.
Match consists of a ¼ λ section of 35-Ω cable. Post-match data includes matching section losses.

The table shows both pre-match performance values that assume no transmission line at all and post-match values. The latter assume a ¼ λ section of 35-37-Ω transmission line to transform the 25-Ω feedpoint impedance to a value close to 50 Ω for compatibility with a 50-Ω coaxial cable. **Fig. 9** shows the basic elements of the simple series matching system. Although a 35-Ω cable does exist, most amateurs simply parallel two lengths of 70-75-Ω cable, such as RG-59, to obtain the required low impedance. As shown in the sketch, the two center conductors join at both ends, as do the two braids for the cable. Although losses are very low, the numbers in the table show that the gain with the matching system in place does incur some loss, but no more than it would with almost any transmission line of the same length.



Series Section Matching: 25 to 50 Ohms

Although the matching system produces a very low SWR at the design frequency (7.15 MHz), it cannot significantly increase the operating bandwidth of the total antenna. **Fig. 10** provides the 50-Ω SWR curve for the antenna and matching line. The 2:1 SWR span is about 180 kHz or a little under 2/3 of the band. The narrow operating bandwidth is not a function of the matching system, but of the antenna configuration. Virtually any bent, folded, or otherwise distorted version of a normally linear antenna will show a narrow bandwidth compared to the antenna when laid out in a straight line.

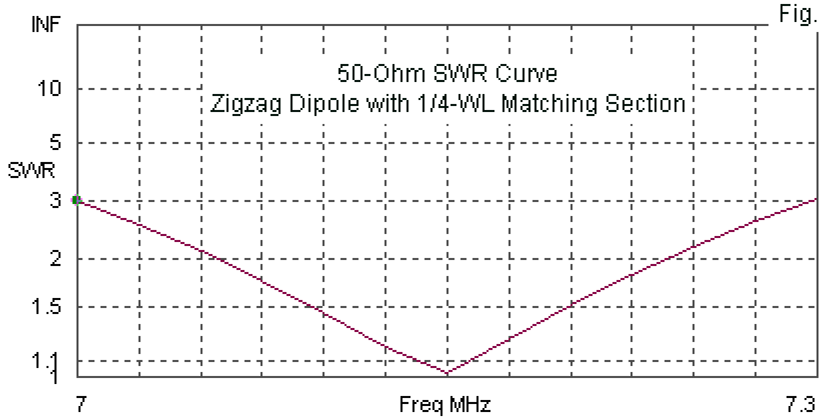
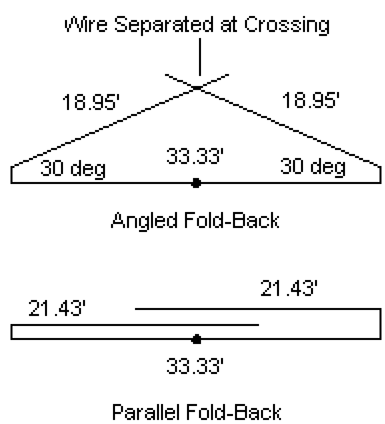


Fig. 10

As well, like the zigzag version of the dipole, bending usually results in one or another degree of reduced gain and reduced feedpoint impedance. The two reductions do not track with the succession of reductions in **Table 1**, which shows the values associated with shortened dipoles. The zigzag dipole has the gain of the 30% dipole, but the feedpoint resistance of a dipole closer to 70% of full size.

2. *Fold-back Dipoles*: Some amateurs try more radical fold-back schemes, such as the two sampled in **Fig. 11**. One version folds the elements back at a 30° angle. Any fold-back requires longer tailpieces than we would expect from a linear dipole. The two end pieces—with the standard 33.33' center section—yield a total element length of 71.2'. At the crossing point, the two wires require a few inches of separation.

Fig. 11



Two Versions of Fold-Back Dipoles for 40 Meters

If we try to run the tailpieces parallel to the center section wire, then they grow even longer. The parallel fold-back version of the antenna requires about 76.2' of wire. In both cases, the interaction between the center section and the tailpieces, with opposing current directions, yields a reduced far field as well as longer elements overall. **Table 4** shows the free-space performance numbers for the fold-back dipole samples. The numbers should discourage use of this method of bringing a short-space dipole to resonance.

Table 4. Free-space performance of two fold-back dipoles with 33.3' lengths

Type of Fold Back	Max. Gain dBi	Beamwidth degrees	Feedpoint Z R +/- jX Ω
30° angle	1.00	90.2	10.7 + j0.9
Parallel	-0.18	86.9	4.3 – j0.3

For a fixed center section length, closer spacing of the tailpieces to the center wire yields lower gain and reduced feedpoint resistance values. The combination of the two reductions suggests that there may be better ways to obtain a short dipole. Moreover, the radical folding further reduces the operating bandwidth. **Fig. 12** shows the free-space SWR curves for the two samples, each using the resonant impedance as the SWR reference value. In both cases, the region in which the SWR is less than 2:1 is so narrow as to require very careful initial adjustment. Even with such care, wind and weather may move the usable frequency span in the normal course of the seasons.

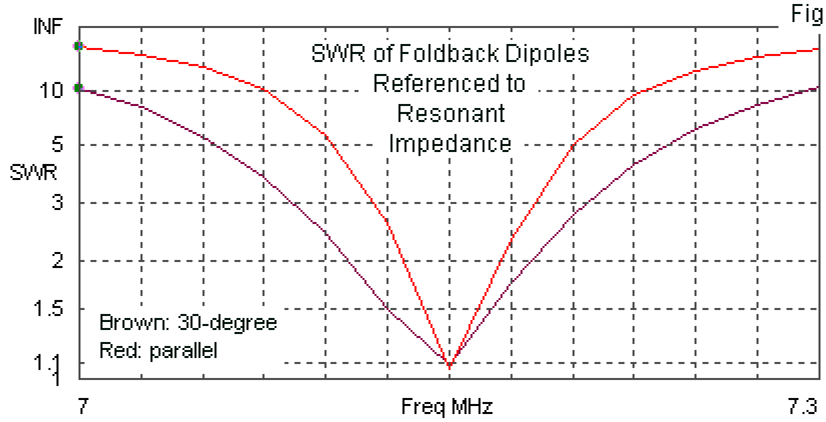


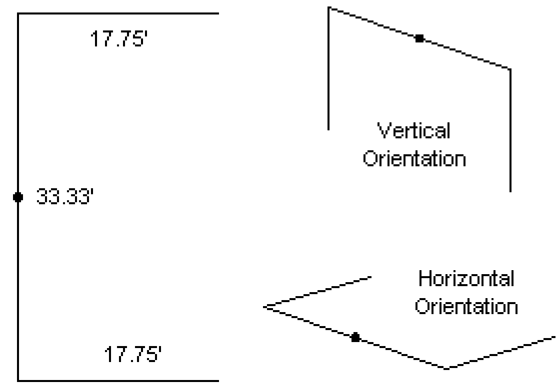
Fig. 12

The sample fold-back dipoles function mainly as references, in this case for configurations that are not recommended. However, they do provide vivid examples of the general principle that folding an initially linear structure reduces gain, feedpoint resistance, and operating bandwidth.

3. *The U-Shaped Dipole*: Both the zigzag dipole and the fold-back dipole bent their ends inward beyond the 90° point. A potentially more useful shape is a U in which the tail sections of the dipole form 90° angles with the center section. **Fig. 13** shows the general idea of the U shape, along with two common versions. In fact, the vertical form of the antenna gives the antenna its name, usually preceded by the term “inverted.” The horizontal form retains the name, although we might see it as a C or something else. We may note in passing that the sketch shows a single set of dimensions that we may use for either the vertical or the horizontal versions of the antenna.

Like all bent forms, the total length of wire required to form the U is greater than the length of a linear dipole. The U’s wire total is about 68.8’, compared to the linear dipole length of 66.9’. The reduction in length of the U compared to the previous sample bent dipoles that required over 70’ of wire promises potential improvements in gain, feedpoint impedance, and bandwidth. Which, if any, of these potentials realizes itself is part of our investigative task.

Fig. 13



Two Versions of a U-Shaped Dipole for
40 Meters Using AWG #12 Copper Wire

Table 5 provides a sampling of antenna performance in both free-space and over (average) ground. The figures are remarkably similar for both orientations of the antenna. The feedpoint impedance is close to the value for the 90% linear dipole in **Table 1**. However, the maximum bi-directional gain corresponds to a 30% length in the same table. The lower gain is a function of the bent portions of the antenna, since they contribute mainly to the beamwidth. As the tabular values show, the beamwidth is greater than any of the values for the shortened linear dipoles.

Table 5. U-shaped dipoles with a 33.3' center section

Vertical orientation, ends downward

Free Space	Max. Gain	Beamwidth	Feedpoint Z
	dBi	degrees	R +/- jX Ω
	1.51	91.8	40.7 – j0.9
Height above	Max. Gain	TO angle	Feedpoint Z
Average Ground	dBi	degrees	R +/- jX Ω
0.3 λ 41.3'	5.12	48	52.1 + j2.2
0.6 λ 82.5'	7.41	23	35.3 – j0.6
0.9 λ 123.8'	6.72	15	43.5 – j3.0

Note: wire ends 17.75' below listed height

Horizontal orientation

Free Space	Max. Gain	Beamwidth	Feedpoint Z
	dBi	degrees	R +/- jX Ω
	1.51	93.6	40.7 – j0.9
Height above	Max. Gain	TO angle	Feedpoint Z
Average Ground	dBi	degrees	R +/- jX Ω
0.3 λ 41.3'	5.42	47	48.6 + j2.7
0.6 λ 82.5'	7.34	23	35.9 – j0.8
0.9 λ 123.8'	6.74	15	43.3 – j2.8

One advantage of the U, however oriented, is the nearly perfect match of the feedpoint impedance with a standard 50Ω coaxial cable. At some heights, the impedance may by slightly low. The simplest way to increase the impedance is to lengthen the center section slightly, with corresponding decreases in the length of tailpieces.

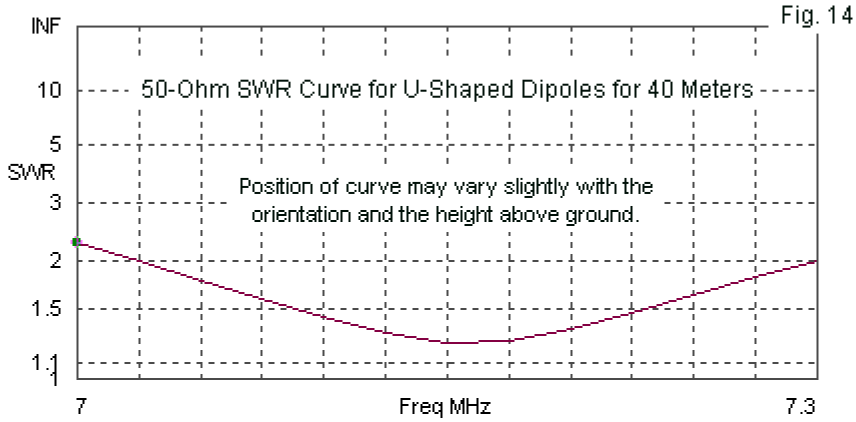
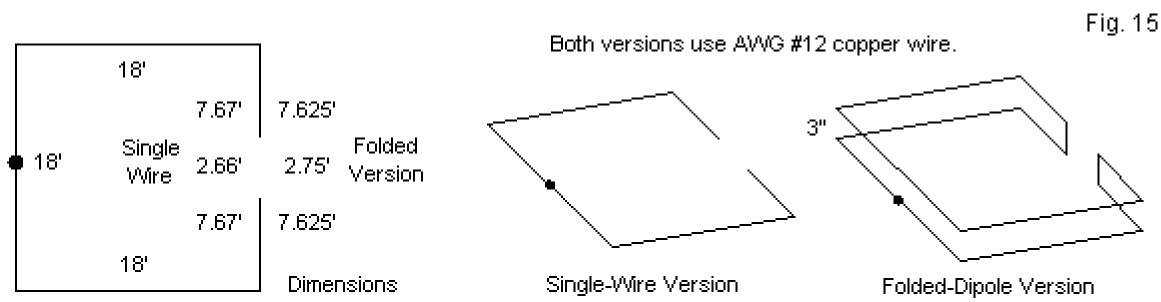


Fig. 14 shows the wisdom of lengthening the center section to more closely approximate a 50-Ω impedance at the center frequency of the SWR sweep. The SWR does not quite remain below the standard 2:1 limit if we insist upon using the 33.33' center section. Since the impedance fluctuates just like it does for a full-length dipole as we change the height above ground when measured as a fraction of a wavelength, the required amount of lengthening will vary with each specific installation.

Of the modified full-length dipoles with 33.33' center section that we have so far surveyed, the U version may be the most promising in terms of operating bandwidth and ease of matching. The beamwidth offsets the somewhat lower gain. In fact, one might set up crossed inverted-U (vertically oriented) antennas and obtain virtually full horizon coverage with a remote switch.

4. *The Square "Interrupted-Loop" Dipole*: A more extreme form of the U shape is the so-called interrupted loop configuration. As shown in **Fig. 15**, it provides perhaps the most compact form of a full size dipole at only 18' per side. The total size is comparable to a 1 λ quad element on a 20-meter beam, but laid on its side.



General Outline and Dimensions of a Square Interrupted-Loop Dipole for 40 Meters

The idea of an interrupted loop is something of a misnomer, since the gap between ends is so wide. Although there is a modicum of interaction between ends, the antenna is still a dipole and uses about 69.3' of wire for the single-element version. The sketch provides dimensions for a folded-dipole version of the antenna using a 3” separation of the upper and lower wires. Besides using twice as much wire and needing a slightly wider gap (or a shorter total tip-to-tip length), the key reason for considering the folded version appears in the data in **Table 6**.

Table 6. Square dipole (interrupted loop) 18' per side

Single AWG #12 wire version; 2.66' gap

Free Space	Max. Gain dBi	Beamwidth degrees	Feedpoint Z R +/- jX Ω
	0.81	131.4	12.7 – j0.3
Height above Average Ground	Max. Gain dBi	TO angle degrees	Feedpoint Z R +/- jX Ω
0.3 λ 41.3'	4.63	45	14.4 + j0.9
0.6 λ 82.5'	6.40	23	11.6 – j0.4
0.9 λ 123.8'	6.07	15	13.4 – j0.7

Folded dipole (AWG #12 wire, 3" separation) version; 2.75" gap

Free Space	Max. Gain dBi	Beamwidth degrees	Feedpoint Z R +/- jX Ω
	1.01	134.6	48.0 + j0.1
Height above Average Ground	Max. Gain dBi	TO angle degrees	Feedpoint Z R +/- jX Ω
0.3 λ 41.3'	4.80	45	54.4 + j4.6
0.6 λ 82.5'	6.61	23	43.7 – j0.1
0.9 λ 123.8'	6.26	15	50.4 – j1.4

The free-space impedance of the single-wire squared dipole is about 12.5 Ω. One way to obtain a better match with a 50-Ω coaxial cable is to install a 1:4 balun at the feedpoint. Transmission-line transformer baluns with a 4:1 impedance ratio are designed for antenna impedance values close to 200 Ω and may not be efficient when reversed. The folded version of the antenna provides a 4:1 step-up of the feedpoint impedance within the antenna design and requires no further impedance matching.

The gain and beamwidth numbers for the antenna extend the progression of values that we encountered for the U antennas. Gain decreases, but beamwidth increases, as shown at the top of **Fig. 16**. It is possible to use a single version of the squared dipole in a fixed mounting and to obtain reasonable result in all directions. In fact, it is possible to nest squared dipoles for several bands with a single support system. Commercial versions of this antenna do exist in both mono-band and multi-band forms.

One of the key limitations of the squared dipole is the operating bandwidth. The SWR sweeps in **Fig. 16** show the curves for each version of the antenna in free-space, with each curve referenced to the resonant impedance of the antenna. Neither version of the antenna covers a full 50% of the 40-meter band. (Any commercial version of the single-wire version of the antenna that advertises a wider bandwidth is most likely relying upon impedance transformer losses and possible transmission-line losses to broaden the bandwidth, with a consequential reduction in available gain.) The folded version of the antenna shows marginally higher gain values in the tabular data and a wider SWR bandwidth in the sweep as a result of its two-wire construction. Relative to radiating currents, the double wire simulates a single fat wire from which we expect a slightly shorter overall length and a wider operating bandwidth.

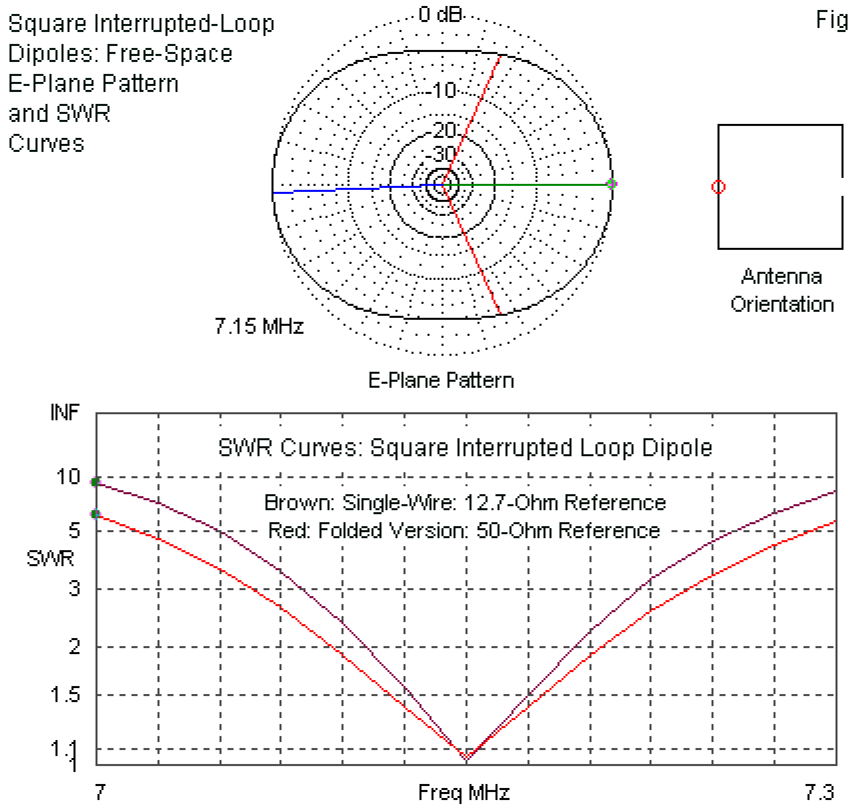


Fig. 16

For a home-built version of the squared dipole, the folded version may be preferable. Despite its operating bandwidth limitation, the squared dipole interrupted loop is perhaps the most compact 40-meter dipole design available.

5. *The Helical Dipole*: The helical dipole, sometimes called a slinky after a toy of the same name, consists of many turns of wire in an Archimedes (uniform pitch) spiral. Normally, we place the feedpoint at the center. In practice, amateurs obtain a pre-made spiral of springy wire and stretch the assembly until it arrives at resonance at a desired frequency. For our preliminary assessment, we shall construct a free-space model with about 12 segments per turn, a 6" diameter, and a 400" (33.33') total length to meet our half-length standard while remaining well within NEC limitations. The wire will be AWG #12 copper, although actual slinkys used in practice are often composed of spring steel having relatively indeterminate properties.

As shown in **Fig. 17**, the resonant helical dipole requires 65.2 turns for the specified wire, length, and diameter. The antenna acts like a closed loop rather than like a linear wire. Therefore, increasing the wire diameter has the effect of reducing the electrical length, and the dipole requires more turns within the same length to achieve resonance. Doubling the wire diameter from 0.08" to 0.16" requires 70 turns for resonance at 7.15 MHz. The greater the number of turns in a helical dipole with a fixed diameter, the more wire we need to achieve the overall length. As specified, the sample helical dipole requires about 106.5' (1278") of wire, over 1.5 times the wire needed for a full-size ½ λ dipole.

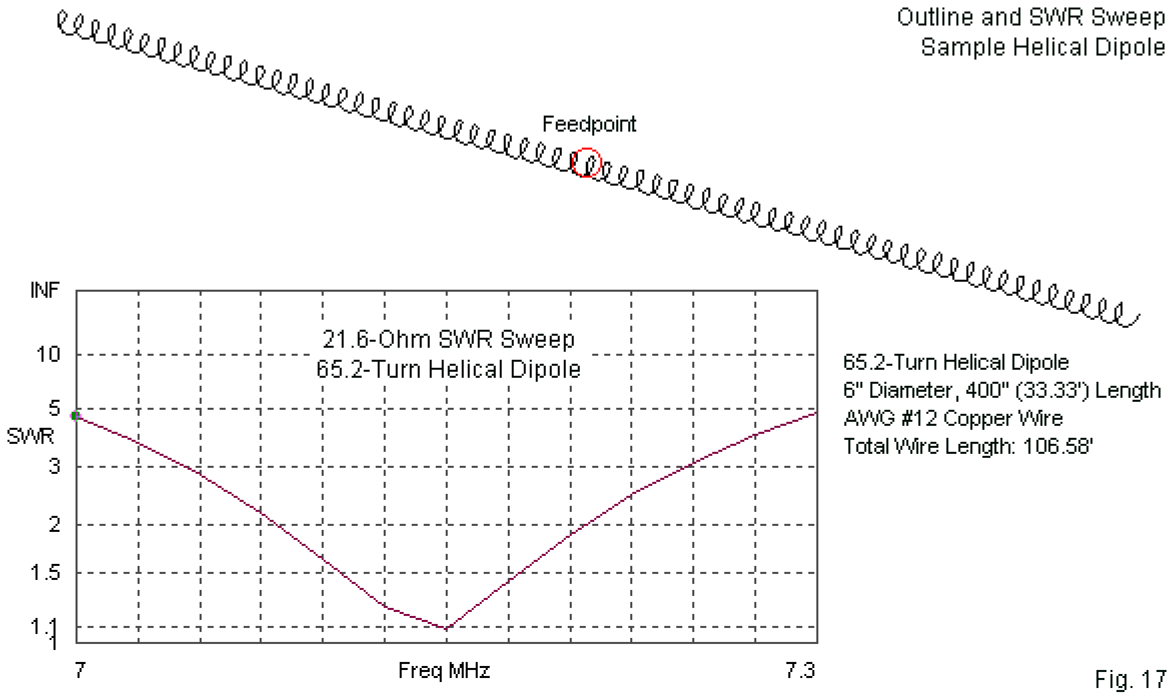


Fig. 17

Like any shortened dipole, the helix has lower gain than a full-length dipole: about 1.48 dBi or the equivalent of a 20% dipole. The resonant impedance is about 21.6 Ω, with an SWR bandwidth of 125 kHz or only 40% of the total 40-meter band. The efficiency of the sample helix is based upon the large loop diameter and the highly conductive wire. Actual toy slinkys pressed into antenna service tend to have smaller loop diameters and use less conductive material. Hence, the figures given for the sample are operationally optimistic. Users of toy slinkys often find that the feedpoint impedance is close to 50 Ω, an indication of the greater losses of using the smaller diameter spring-steel devices. Perhaps service as an emergency field antenna remains the best use of the helical dipole.

Conclusion and Preface

We have included only some of the major variations on folding up a dipole to stuff it into a small linear space. For example, we have omitted the center-fed inverted-L antenna, although it is a feasible alternative if we stretch our basic orientation to include vertical antennas. Nevertheless, the samples have shown the general trends of what is possible in the avoidance of directly tackling the impedance matching problems associated with the use of a half-length dipole. In the next episode, we shall look at several techniques of compensating for the very high capacitive reactance of a linear 33.33' wire dipole.