6-Meter B-Antennas
A Dipole and a 2-Element Beam

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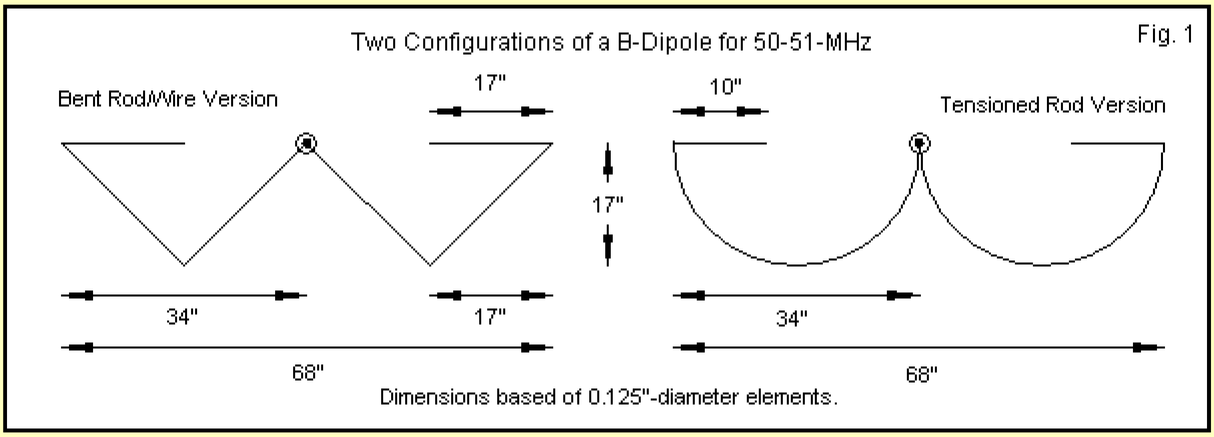
Some years ago (1998, to be precise), I described a 10-meter B-antenna. The exercise began as a dare, following some articles on the L-antenna. (Yes, there is also a C-antenna that has been used for many decades in special circumstances.) After the "initial" exercise, I did not expect to find any actual users, although the design work is itself informative. However, some weeks ago, Allison Parent, KB1GMX, reported on her success in building at least two of the antennas for 6 meters, using the rounded configuration shown in the photo. The antennas fit her special need--to have an antenna for portable work on SSB with a size that would fit the bed of her pick-up truck when she went into the field. Her tests showed that other stations could not tell the difference between her B and a normal dipole in horizontally oriented service. 6-meter hilltopping--often tied to other VHF and UHF efforts--has become very popular in the present mid-decade slump in sunspots. Antennas for 2 meters and up generally fit into pick-up beds or the rear of vans. A good performer for 6-meter work is often the limiting factor.

Therefore, I decided to explore the B-antenna once more, this time for low-end 6-meter work. In the process, I worked up both a dipole and a 2-element driver-reflector Yagi. Both give very respectable performance and lend themselves to various forms of space-saving transport. Reviewing the B-dipole version will instruct us in why the B-configuration is superior to some other forms of element shortening. The B-beam will open up some further applications.

The B-Dipole

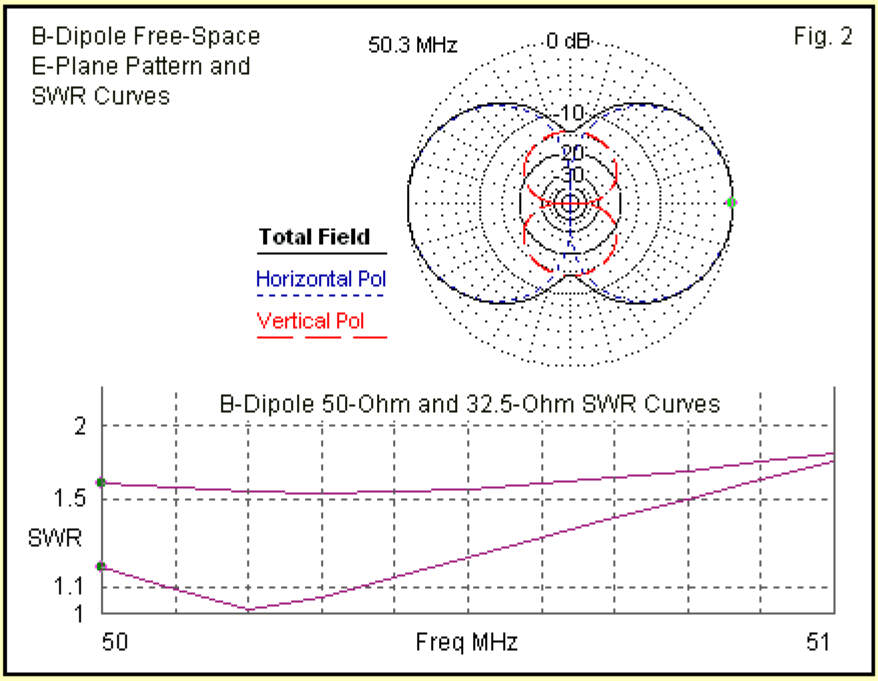
The basic B-dipole is a form of shortened 1/2-wavelength element that uses a fold back portion to reduce the required length. Generally, fold-back portions of an element that are in close proximity to the central portion of the element incur considerable loss in performance. Therefore, the B-dipole bends the central portion away from the centerline. The fold back occurs along the centerline, keeping it well spaced from the central portion of the element. The result is an improvement in performance and a more usable feedpoint impedance.

On 6-meters, a dipole is about 10' long. As shown in **Fig. 1**, the B-dipole reduces that length to just under 6'. The cost is a width of 17" in either the angular or the round versions of the antenna. The angular version requires a fold back of 17", exactly the distance from the feedpoint to the peak of the angle. (The rounded version requires a smaller fold back length because the circumference of the semi-circle is greater than the combined length of the two straight sides of the angular version.)



Of course, the rounded version of the antenna looks most like the letter B if we set the antenna vertically. As well, the angular version turned around vertically looks like a sigma. But these a small points are applicable only to someone who wishes to use the idea but change its name to sound more original. Actually, the angular version may be easier to build from the 0.125" rod used in all models shown here. Before we are finished, we shall consider a few construction ideas.

The dimensions shown provide a design frequency of 50.3 MHz, which is adequate to provide full coverage of the entire first MHz of 6 meters. Dipole performance does not change rapidly as we use the antenna off its self-resonant frequency. Therefore, the pattern in **Fig. 2** and the accompanying SWR curves give a good picture of what we can expect from 50 to 51 MHz. The free-space E-plane pattern is broadside to the element plane as defined by the triangular structure. The broadside gain is about 1.7 dBi in free space, down by only about 0.4 dB from a full-length dipole.



The self-resonance feedpoint resistance is just about 32.5 Ohms, although the diameter of the element material will have a small effect on that value. The 50-Ohm SWR curve shows that we may use the element with a direct feed, especially in portable operation, where coaxial cable lengths are generally fairly short. The 32.5-Ohm SWR line would be similar to a 50-Ohm SWR curve if we introduce one of the feedpoint matching systems, such as a Regier series-matching scheme.

It is possible to re-design the B-dipole for vertical service in the FM region of 6 meters. However, element shortening does take its toll on the operating bandwidth available. It is likely that, even with a matching system, the B-dipole would cover only about 1.5 MHz of the band.

The B-Beam

The B-antenna is susceptible to use in a 2-element driver-reflector Yagi-Uda beam with only slight modifications to the two required B-dipoles. Because the dipole impedance is already only about half the value of a full size dipole, I selected a boom length of 36", close to 0.15-wavelength at the design frequency. This spacing provides a feedpoint impedance of about 25 Ohms with the 1/8" diameter element material. Fatter materials may require additional spacing to achieve the same impedance, since the greater mutual coupling between elements will not only change the lengths of the individual elements, but also reduce the feedpoint impedance without modification to the spacing.

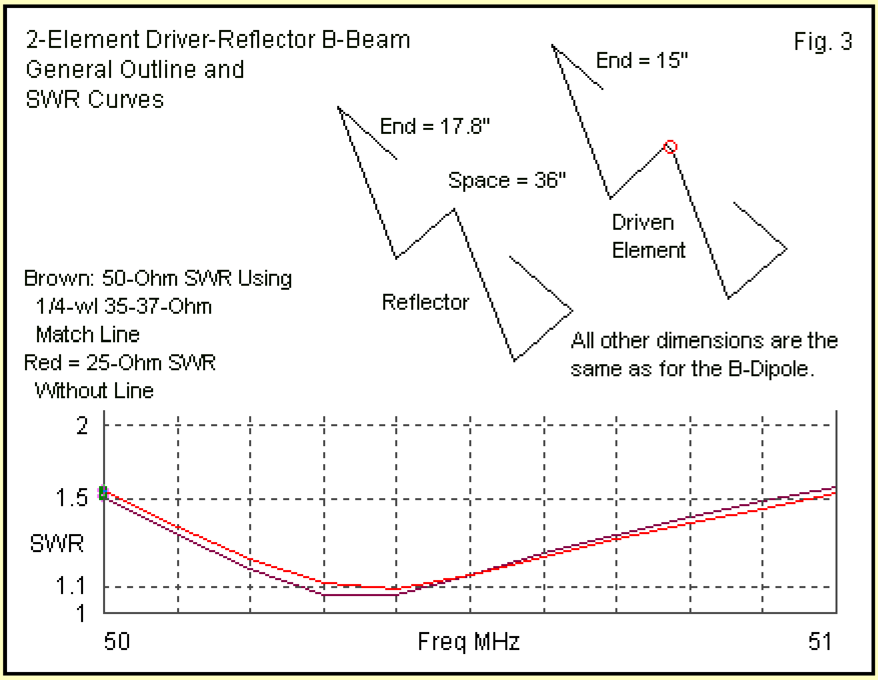
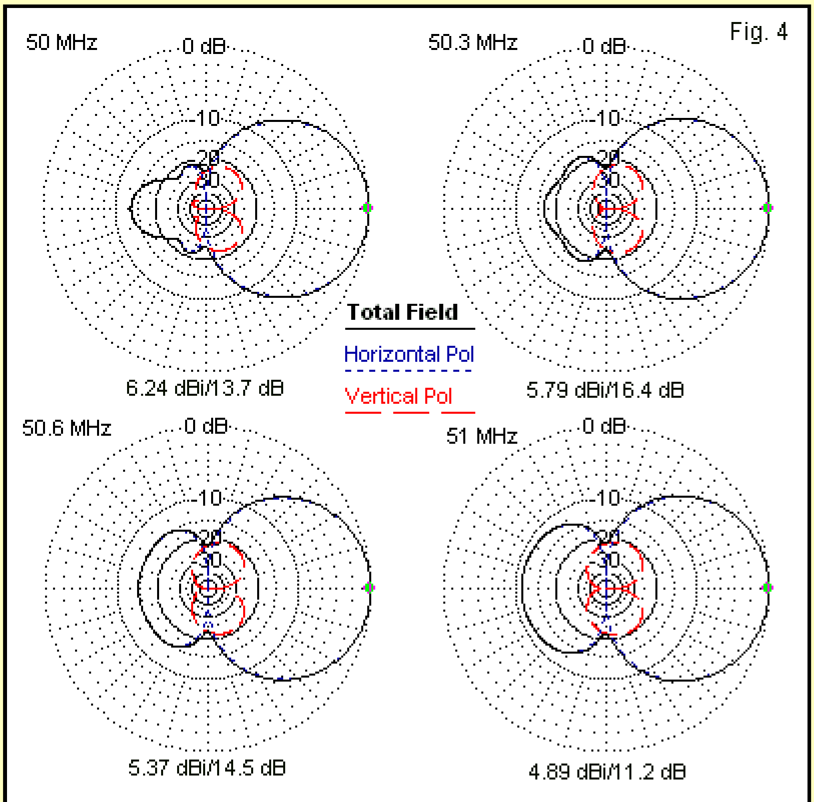


Fig. 3 provides the outline of the B-beam and the changes required relative to a self-resonant B-dipole. The main element dimensions do not change--only the fold back portions. Some newer amateurs tend to believe that they can make a 2-element beam simply by adding a longer reflector to an existing dipole. Unfortunately, such a procedure tends to yield very poor performance. To optimize the array for the maximum obtainable front-to-back ratio as well as forward gain, the driver element requires shortening to go with the longer reflector element.

The dimensions shown apply specifically to 1/8"-diameter element material. As guidance for versions of the beam that may use other materials, the driver--when not in the presence of the reflector--is self-resonant at about 51.3 MHz. The reflector, if fed independently of the driver, is self-resonant at about 49.45 MHz. The goal, whatever the element material, is beam resonance at just about 50.3 MHz. The lower portion of the figure shows the 25-Ohm SWR curve, as well as a 50-Ohm curve when we add some necessary matching.

The geometric mean between the natural 25-Ohm resonant feedpoint impedance and the 50-Ohm characteristic impedance of our standard coaxial feedline is about 36 Ohms. If we parallel-connect two lengths of 70- to 75-Ohm feedline, such as RG-59, we can obtain an effective impedance of 35-37 Ohms. We can create such a parallel cable by taping together two length of cable. At each end, we connect the two center conductors together and also the two braids together. The electrical length that we need is 58". However, this value assumes a velocity factor of 1.0. All coaxial cables have velocity factors of less than 1.0. To find the required physical length of paralleled cable, we multiply the line's velocity factor times the required electrical length. If we use cables with a solid dielectric, the velocity factor will be close to 0.67. Hence, this type of cable needs to be about 38.9" long. Foam cables have a velocity factor close to 0.8, resulting in a required physical length of about 46.4". In all cases, if you have a more precise value for the cable that you plan to use, substitute its velocity factor for the two samples here and multiply times the 58" electrical length. The result should be an SWR curve very similar to the 50-Ohm curve shown in the figure.

Impedance matching has no effect on the radiation pattern developed by the 2-element beam. Unlike the broadband performance characteristics of a simple dipole, the characteristics of a Yagi (of any type whatsoever) will change more rapidly as we move away from the design frequency. **Fig. 4** provides free-space E-plane patterns for the B-beam at 50, 50.3, 50.6, and 51 MHz. Since most SSB and similar activities that call for a horizontally oriented beam occur very low in the band, performance peaks in that range.



2-Element Driver-Reflector B-Beam
Free-Space E-Plane Patterns and Performance

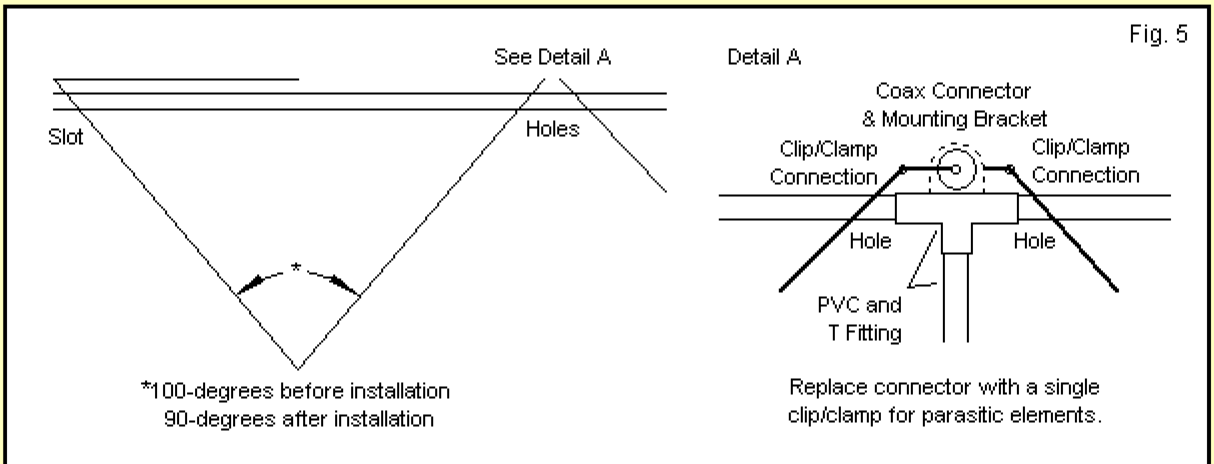
The free-space gain and 180-degree front-to-back ratio values below each polar plot provide a gauge of the performance change across the operating passband. They also show that on average, we increase the forward gain by about 3 dB relative to the B-dipole. The front-to-back values are modest by quite adequate to most hilltop operations.

In fact, the forward gain of the B-beam comes within about 0.2-0.3-dB of the gain of a similar Yagi with full size elements. (Such a Yagi might not need a matching system for a 50-Ohm feedline.) The full-size Yagi would only have a front-to-back ratio of about 10-11 dB. An interesting fact about 2-element Yagis of this general design is that shortening the elements by almost any means generally increases the front-to-back ratio, despite the falling gain. The front-to-back advantage of the B-beam is modest, since the elements are designed to sustain as much as possible of the performance of full size elements.

The performance values shown occur with each element face-to-face. Performance may differ if the elements are edgewise to each other, since that orientation will change the mutual coupling between them.

Building B-dipoles and B-Beams

The construction of a B-antenna is subject to the available materials and the ingenuity of the individual builder. This section provides some ideas, but they are by no means the only ones that will work--or even the best of what will work. For simple antennas, my favorite support material is PVC, which should be RF transparent well into the VHF range, if not higher. We can obtain the material cheaply from home centers, along with 1/8" rod of any conductive material from copper to aluminum to brass.



Some Construction Possibilities for a Portable 6-Meter B-Beam/Dipole

Fig. 5 outlines the general properties of one possible portable set-up for a B-element. Let's take two 3' sections of PVC tubing and a T connector. The neck of the T is for either the beam-boom or for a dipole-mast. The top or T portion holds the PVC that supports the element halves. In most cases, a pressure fit will hold the PVC tubing in place for the duration of most hilltop operations. Therefore, we can disassemble the elements and end up with a 3' long transport package (except for whatever mast we use). Remember that the beam boom is also 3' long.

Some materials are springy enough to form rounded B half-elements without collapsing. Angular elements can be pre-bent to half-element shape. I recommend that the bend angle be about 100 degrees so that the element will be under tension when fitted to the support. However, the fold-back section should be fixed at its 45-degree angle relative to its adjacent side.

Near the T fitting, you can drill a hole at a 45-degree angle through the PVC to accept the feedpoint end of the half element. At the far end, sawing a 45-degree slot in the PVC is best for angular elements. If the slot angles into the PVC, then the tension of the installed element will hold it in place. (For rounded element halves, a pair of holes would suffice, since you can pass the element through them. However, for rounded elements, the holes should pass straight through the PVC.)

At the feedpoint center, the element should extend beyond the support tube far enough for connections. In most cases, you can use short pigtail leads from a coax connector and fasten them to the element center ends with pressure clips or a screw-down clamp of any small and convenient sort. On a parasitic element, a single clip or clamp will complete the element.

Variations on this central construction theme are as endless as the variety of available materials and your own ingenuity. The goal of the ideas used here has been to describe a method of assembly that requires perhaps 5 assembly minutes to go from the pick-up truck bed to an operating antenna, even allowing for the time it takes to screw on the coax cable connectors. As well, the parts for the antenna--dipole or beam--would fit inside of a transport case made from two (worn?) bath towels sewed together at three of the 4 edges. (Clips or clamps, of course, go inside an additional small bag, along with extras, since Murphy will dictate that at least one gets lost in the grass or gravel on every outing.)

The tale of the B-antenna for 6 meters is not a long one. But then, neither is the antenna.

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