

A Simple 50-Ω Feed for W8JK Beams

Shifting the antenna's feedpoint makes a classic antenna easier to feed.

W8JK beams have been popular since John D. Kraus, W8JK, first published its concept in 1937.^{1,2,3} The antenna consists of two closely coupled half-wave dipoles fed out of phase. For a two-element antenna, the gain is quite high: 6.0 dBi. However, with the antenna's 0.1 l element spacing, the feedpoint impedance of each dipole element is quite low, approximately 5 Ω. Attempting to match a 50-Ω feed line to the combined low feedpoint impedance has likely kept many amateurs from building an '8JK. Here, I'll describe a design modification that yields a real 50-Ω feedpoint impedance. Hopefully, this will make the antenna more appealing to other hams.

Analysis

Figure 1 shows the basic antenna. I used Roy Lewallen's *ELNEC*⁴ to analyze the antenna's feed. With out-of-phase current sources located at the center of each dipole, as shown, the (dual) input impedance is raised to 17.9 Ω by increasing the element spacing to 0.188 l. Doing so decreases the gain by only 0.2 dB.

The element lengths in Figure 1 are shown for two conditions: First for the case where the elements are composed of RG-8/X (0.4688 λ) and second for elements composed of RG-8/X with an exterior vinyl jacket (0.4612 λ). The exterior vinyl jacket adds dielectric loading to the element, so the necessary length is shortened slightly.

If we shift the feedpoint away from the center of each dipole, the input impedance increases smoothly, because the element current is lower farther from the center. This is a convenient means of increasing an antenna's impedance without affecting the standing current lobe on the element. Figure 2 shows the dimensions for dual 25 Ω feedpoints offset from the center of each dipole element.

Of course, it would be even better if we had a single 50 Ω feedpoint. This can be



Caitlin Ferguson, a neighbor, stands next to a 2-meter version of the antenna.

Table 1
Dimensions for 2- and 6-Meter W8JK Beams Using RG-8/X Dipoles Supported by PVC Pipe

	2 Meters (144.2 MHz)	6 Meters (50.1 MHz)
Dipole Length	34 inches (86.5 cm)	104 inches (264 cm)
Dipole Spacing	20 inches (51 cm)	48.43 inches (123 cm)
Stub Length	11.02 inches (28 cm)	33.66 inches (85.5 cm)

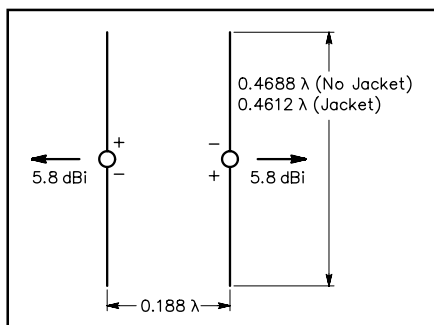


Figure 1—The usual arrangement of the W8JK beam, with sources at the center of each element, yields driving point impedances of 17.9 Ω at the two feedpoints. The directional gain is 5.8 dBi in the two major lobes in the plane of the figure. The dimensions shown are for coax elements with and without its jacket.

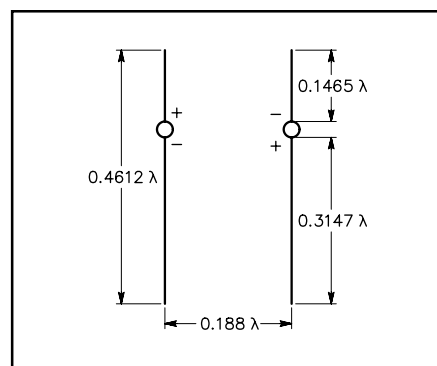


Figure 2—Moving the feedpoints away from the center of each dipole yields a higher feedpoint impedance. This may be easily seen since the element current decreases away from the center. For the dimensions shown, the driving-point impedance is 25 Ω (both elements).

¹Notes appear on page 47.

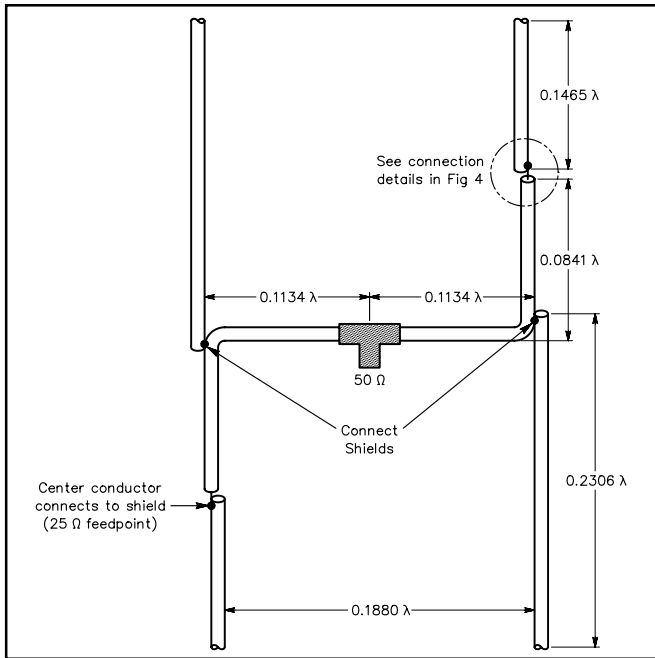


Figure 3—This figure presents a convenient coaxial network for feeding a W8JK beam. The 25-Ω feed points are located on opposite ends of the dipoles. RG-8/X foam-dielectric coax (with a velocity factor of 79%) transforms each 25-Ω feedpoint impedance to 100 Ω at the central T connector. Connected in parallel at the T, the two 100-Ω impedances yield a 50-Ω input impedance, a perfect match for 50-Ω coaxial-cable feed line. This figure shows the shields are soldered together; there is no overlap between the 0.0841 λ and 0.2306 λ sections.

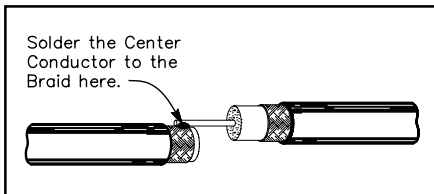


Figure 4—Drawing showing the details of the 25-Ω feed points of Figure 3.

achieved rather easily with the dual coaxial feed shown in Figure 3. The out-of-phase feeding is implemented by feeding the dipoles *on opposite ends*. Using 50 Ω RG-8/X foam dielectric cable with a velocity factor of 79%, it is possible to place two $\frac{1}{4} \lambda$ transforming cables in the beam structure. Each element's 25 Ω impedance is thereby increased to 100 Ω at the center T connector. With the two 100 Ω impedances in parallel, the impedance presented to the coaxial feed line is now 50 Ω! A detailed drawing of how to make the 25 Ω feedpoint connection is shown in Figure 4.

Construction

W8JK beams can be used on HF and VHF. On HF, you can hang the antenna between any conveniently available supports. The dimensions in Figure 3 slightly overestimate the actual free-space dimensions so that minor pruning of the dipoles (on the dummy legs) will bring the elements right on frequency.

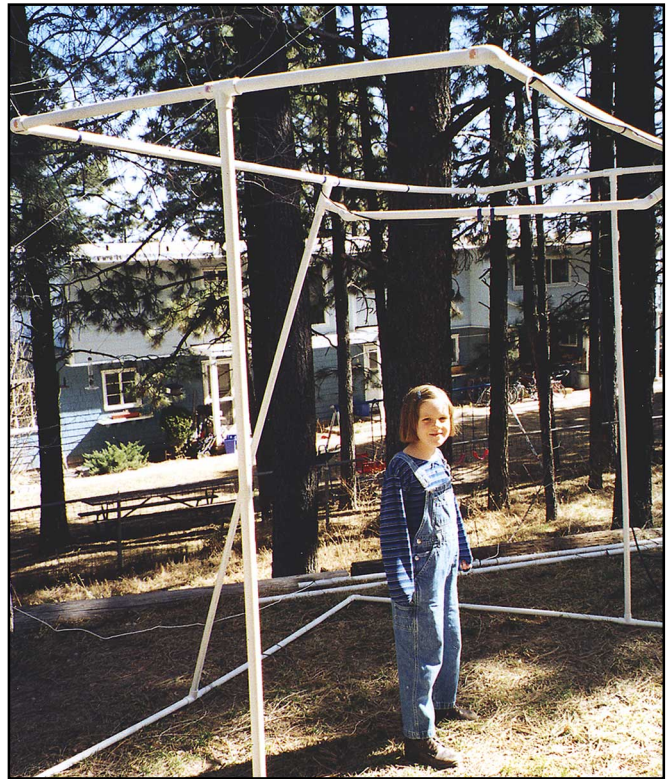


Figure 5—My 6-meter beam in a PVC frame work.

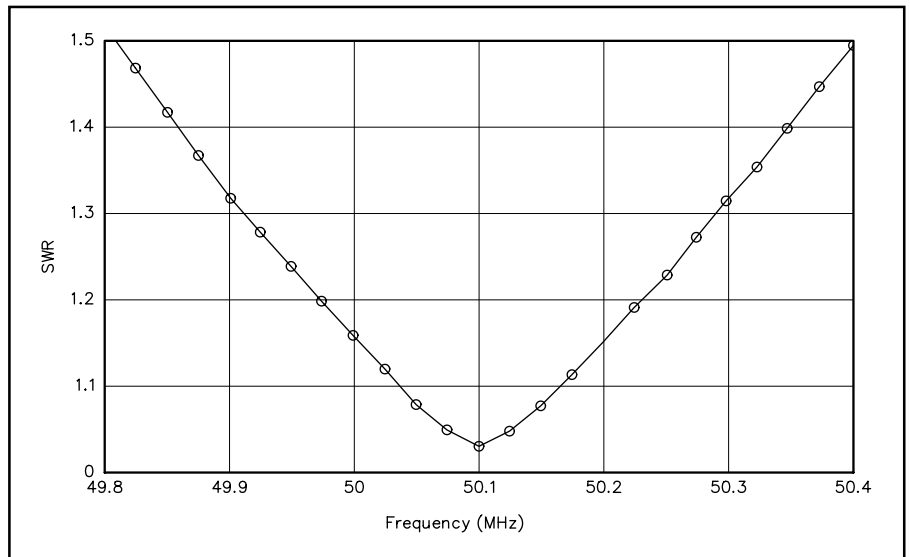


Figure 6—SWR plot of the 6-meter beam.

On VHF, you must pay more attention to dimensional accuracy because of the shorter wavelengths involved. At these frequencies, it is also easy to build a support framework of PVC pipe and tape the dipole elements to the pipe. However, because the PVC pipe acts as a dielectric, the physical lengths of the dipole elements must be shortened by about 3% from the dimensions given in Figure 3. Figure 5 shows my 6-meter beam supported on a PVC framework. A simple 2-meter beam can be seen

in the title photo. The length-adjusted dimensions (to account for the dielectric action of the PVC) for both of these beams are given in Table 1.

An SWR plot of the 6-meter beam is shown in Figure 6. In Figure 7 is a frequency-scaled SWR plot showing the performance one might expect of a 20-meter W8JK beam cut for resonance at 14.1.

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acts to insert a space if you haven't pressed a paddle in a while. I suggest recording messages at a speed a bit slower than that at which you'd normally send them. You can always increase the transmission speed. By the way, the memory used for the message is nonvolatile. If you don't record over it, Microchip says it will still be there 40 years from now.

The QUICK has three modes: **SETUP** and **TUNE, RECORD/PLAYBACK** and **OPERATE**. I use a simple CW menu system like many of the previously published designs. Basic operation is described in [Table 1](#).

Summary

During testing, the advantages of using a PIC instead of dedicated hardware were reinforced. I had recorded a CQ and tuned around 40 meters. There was a lot of dead air (it was 4:30 AM local time—don't ask). I sent out a CQ and suddenly there was a QSO on frequency. The only thing I could do was to reach up and turn off the radio because I hadn't thought about an abort switch. Ten minutes and four lines of code later, I had added the ability to abort in the middle of sending a prerecorded message by pushing the **PLAY/RECORD** button.

I accomplished what I set out to do:

Learn a little about PIC microcontrollers. If you would like to learn a bit about PICs and have a good controller and keyer, you can download the software and modify it to do just what you desire. I originally had it send my call sign on power-up, but bypassed the code for this article. The code is still in the listing and it's simple to substitute your call sign for mine. I won't apologize for the software, even though I should, since I'm just a hardware bum.

If you want more than a simple keyer and you've been wanting to try out a PIC-controlled project, here's one for you. Have fun—and look for me on 40!

Notes

¹David Benson, *Easy PIC'n: A Beginner's Guide to using PIC 16/17 Microcontrollers* (Kelseyville, California: Square 1 Electronics, 1996) is a popular book for those learning about these devices. Microchip Technology Inc, 2355 W Chandler Blvd, Chandler, AZ 85224-6199; tel 602-786-7200, fax 602-899-9210; <http://www.microchip.com> offers a wealth of good information and free software.—Ed.

²Michael A. Covington, "Burn PIC Microcontrollers with a 'No Parts' PIC Programmer," *Electronics Now*, Sep 1998, pp 35-43.


³R. Dean Straw, N6BV, Ed., "TR Time Delay Generator," *The 1999 ARRL Handbook for Radio Amateurs*, (Newington: ARRL, 76th edition, 1998), pp 22.53 to 22.56.

⁴Bob Schetgen, KU7G, *QRP Classics*, (Newington: ARRL, 1990), first edition.

⁵Joel Kleinman, N1BKE, and Zack Lau, KH6CP/1 (now W1VT), *QRP Power* (Newington: ARRL, 1996), first edition.

⁶PC boards and parts kits are available from Q-Sat, PO Box 110, Boalsburg, PA 16827; rak10@psu.edu. Charge cards are not accepted and a telephone number is not available. Prices: PC board, \$8 plus \$2 shipping; programmed PIC, \$8 plus \$2 shipping; complete kit (not including switches, connectors, or enclosure), \$18 plus \$2 shipping. Pennsylvania residents must add sales tax. Please allow four to five weeks for delivery. The source code and PC board files in bit-map (.BMP) form, are in *QUICK.ZIP* and can be found on the Internet at <http://www.arrl.org/files/>.

⁷Current flow through the contacts helps to keep them clean.—Ed.

Rod Kreuter got his Technician class license at age 15 and currently holds an Extra class ticket. Rod's interest in Amateur Radio led to a career in electrical engineering. He holds a BSEET from Pennsylvania State University. Rod has worked in the fields of fiber optics, signal processing and satellite communications systems, primarily for defense contractors. He is now Director of Research Instruments for Penn State's Chemistry Department. He enjoys biking, backpacking, tinkering and "ragchewing." You can contact Rod at 319 McBath St, State College, PA 16801; rak10@psu.edu. 

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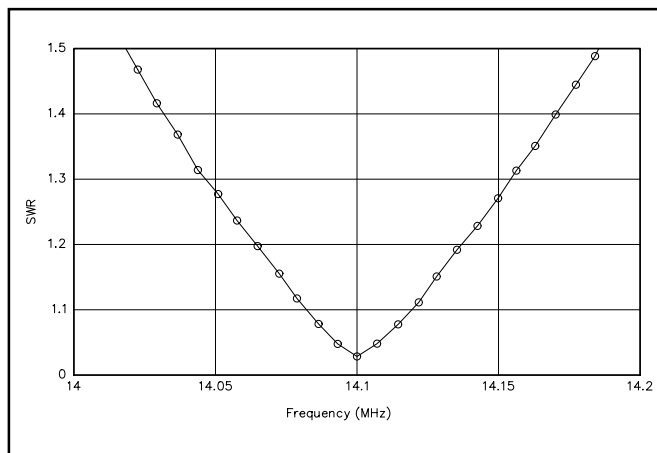


Figure 7—Frequency-scaled SWR plot showing the performance you can expect from a W8JK beam cut for 14.1 MHz.



A close-up of the antenna feedpoint. On the element to the right, you can also see the 25-Ω feedpoint arrangement that is detailed in [Figure 4](#).

Summary

This simple design yields real gain (and an excellent feed-line match) for an afternoon's effort. If you have room for a dipole, you likely have room for a W8JK beam.

My thanks to Dean Straw, N6BV, for his help in numerical antenna modeling. I dedicate this paper to John D. Kraus, W8JK, an antenna pioneer.


Notes

¹John D. Kraus, W8JK, "A Small but Effective Flat Top Beam Antenna," *Radio*, Mar 1937, pp 56-58, and Jun 1937, pp 10-16.

²John Kraus, W8JK, "Directional Antennas with Closely-Spaced Elements," *QST*, Jan 1938, pp 21-23.

³John Kraus, W8JK, "The W8JK Antenna," *QST*, Jun 1982, pp 11-14.

⁴Roy Lewallen, W7EL, PO Box 6658, Beaverton, OR 97007.

Until recently, Bob Zimmerman, NP4B, was a radar transmitter engineer at the National Astronomy and Ionosphere Center, Arecibo Observatory, Arecibo, Puerto Rico. In October 1998, he moved to New Mexico where he now works on high-energy particle accelerators at the Los Alamos National Laboratory. You can contact Bob at: PO Box 161, Los Alamos, NM 87544-0161; zimmerman@lanl.gov. 
See Feedback in July 1999 *QST*.