CONSTRUCTION OF A NEW J-POLE ANTENNA FOR 2m

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1. OVERVIEW

If you like building good antennas, this one is for you. The J-pole is a slim, omnidirectional, half-wave antenna fed at the end through a quarter-wave shorted transmission line. Its predecessor is the famous "Zepp" antenna developed for the Zeppelin airship. Both antennas have served many hams around the globe well. While the Zepp is easy to calculate, the J-pole is not; in fact, a one-percent error can throw you out of the band. However, when calculated properly, the J is an excellent candidate for a base station on the popular 144 to 148 MHz band, with a 1:1 VSWR and good efficiency. I have also used it during a Field Day on top of our "Winnipeg radio mountain".

The construction plans presented in this newsletter are based on my new design, and describe such an optimal antenna. It can be constructed from inexpensive materials at approximately $10 total cost. The first two drawings at the end of this article show the dimensions of the antenna in inches, while the third figure provides a step-by-step procedure for putting the antenna together. However, in order to achieve proper results, the following comments should also be considered.

2. CONSTRUCTION TIPS

2.1 The Copper Pipe

- The copper pipe may be of any thickness, as long as the outer diameter is rated at 1/2 inch. (Remember that the real dimension is always larger than the rated dimension by 1/8 inch. For example, the real outer dimension of a 1/2-inch copper pipe is 5/8 inch.)
- Do not bend or dent the pipe when transporting it from a supplier.
- Cut the copper pipe to the exact dimensions with a good pipe cutter (a metal saw may deform the thin pipe).
- Although a 12-foot copper pipe is sufficient for a single antenna, four antennas can be cut from only three 12-foot pipes.

2.2 The L and T Joints

- Pay attention to the dimensions of the 90-degree copper elbow (the L joint). I found that the dimensions may vary from supplier to supplier by as much as 1/8 of an inch! This will reduce the efficiency of the antenna considerably. If you cannot get the exact L joint, adjust the dimension of the Q section appropriately. (Beaver Lumber used to have the one shown in the drawings.)
- The dimensions of the T joint and the cups do not vary very much when switching suppliers.

2.3 Soldering

- For those who have never done soldering of large copper pieces (or forgot it!), here are a few useful tips.
- After cleaning all the joints with sand paper (or steel wool), apply a very thin layer of soldering paste to both surfaces to be soldered. The soldering paste should not be acid based.
- Assemble all the parts. Make sure the quarter wave matching section is not twisted or skewed (keep it flat with a clamp).
- Take the antenna outside your house or shack, as the fumes will trigger your smoke alarm (if you have one), or will be very irritating indoors.
- Use a solid-core solder (without any acid or resin core). The preferred composition of led/tin is 50/50. Other compositions can also be used, but the 50/50 has a reasonably low melting point, and is the strongest for this application.
- Solder all the joints (in any sequence you like, but I prefer starting from the T and L joints).
- Use a propane torch to solder the joints. (I have tried a 1500-W heat gun without any success because the copper pipe conducted the heat away from the joint too quickly.)
- After about 30 seconds of heating a joint, touch the solder wire to it. The best moment to apply the solder is when the copper pipe changes into a slightly brighter colour. The solder will then melt easily and flow into the joints. Do not apply too much solder, or else it will drip to the ground (or on your hands). Protect your hands just in case!
- The solder remains molten for approximately half a minute, so let it solidify before moving the antenna.
- The antenna should be quite solid and look great by now.

2.4 The Feedline

- For short runs, I use the RG-58A or the RG-8M (foam) coax. For long runs, the RG-8 or better cable is required.
- Since the coax is unprotected at the antenna end, water may get inside it and eventually damage it. To protect the connection against the weather, use either the new liquid plastic or a non-corrosive (no acetic acid) sealant. Do not use any sealant that has a vinegar smell.
- The feedline can be attached to the antenna either with two garden-hose clamps or by soldering it to the pipe directly at the locations specified. Do not use self-tapping screws to fasten the feedline as they weaken the antenna mechanically.
- A small change in the feed position will increase the VSWR and reduce efficiency of the antenna. Make sure it is done right.

2.5 The Choke

- Since the coax is an unbalanced feedline, it will radiate from the outer shield and destroy the good radiation characteristics of the antenna. It is then critical to reduce the radiation by a choke positioned below the shorted end of the Q section, as shown in the first drawing.
- A good choke has four (4) turns coiled with a diameter of five (5) inches. This amounts to approximately six extra feet of coax for the choke.
- Fasten the choke to the quarter-wave support pipe below the shorted end of the quarter-wave feed section of the antenna. Use either an electrician vinyl tape or a plastic tie, rather than a metal tie.
- Remember, without the choke, the measured VSWR will be greater than 1:1 due to the unwanted radiation from the coax!

2.6 Fastening of the Antenna

- The antenna may be fastened to any support, including grounded metal.
- For best results make sure that the shorted part of the quarter-wave feed section is above the support. Remember, however, that the support should be grounded because the antenna acts as a lightning rod.
- If the antenna cannot be mounted above metal structures, separate it from the metal by at least a quarter-wave distance. The usual omnidirectional radiation pattern will now change to a cardioid because the other supporting metal acts as a reflector. To prevent the half-wave radiator from swinging in a wind (thus producing a fading effect), it should also be fastened by a noncoductive material to the supporting structure.

2.7 Protection Against Corrosion

- The antenna can be left unprotected and will work well for years.
- If you want to prolong its life, either paint it with a good metal paint resisting ultraviolet light, or apply a chemical treatment to the copper surface.
- The chemical treatment of copper surface is quite simple. First, if the copper surface is brown, wire brush it until bright. Then wash the copper with a solution of “cloudy ammonia” (available in most supermarkets in the household cleaner section). The metal should turn into a bright green colour (except for the soldered joints). When the surface has dried, wash it again with petroleum distillate paint thinner. This turns the metal into a dark bronze colour. The metal should now be more resistant to corrosive environmental factors.

2.8 Can the Antenna Size be Scaled Down or Up for Other Bands?

- Although any piece of wire can radiate, it may not be very efficient.
- The antenna published here has been carefully designed by me for the 2m band, and when scaled may not produce good results. It may still be better than many other published J-poles, but it may not produce the desired 1:1 VSWR and be optimally efficient.
- For smaller dimensions, there are better antennas (such as collinear) that can produce more gain.

- So, the short answer is NO, do not scale it. Instead, wait for my full description of the antenna, with all the calculations included for any band.

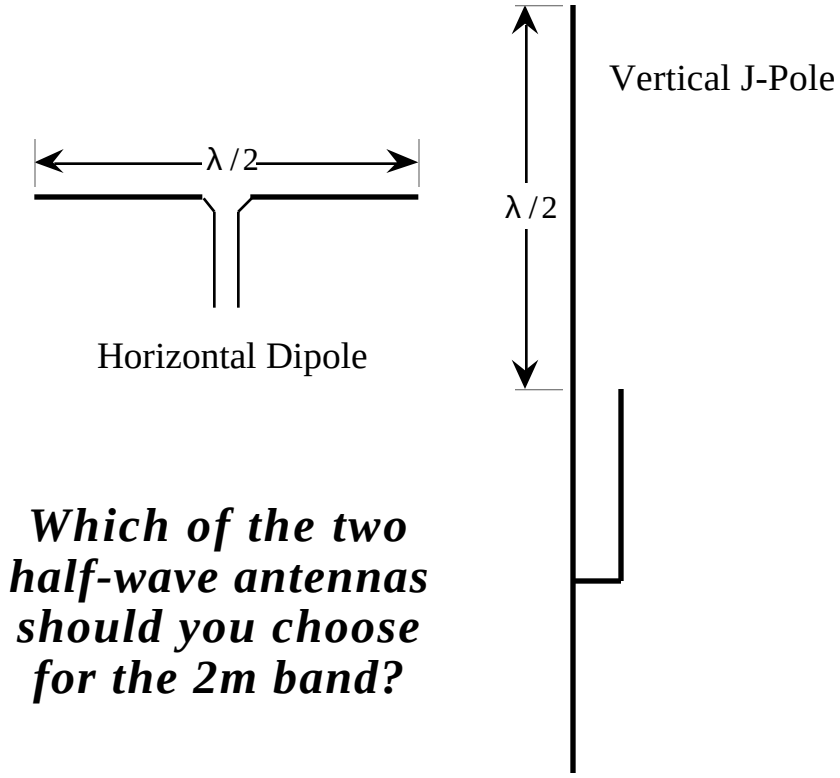
2.9 Suggestions or Questions

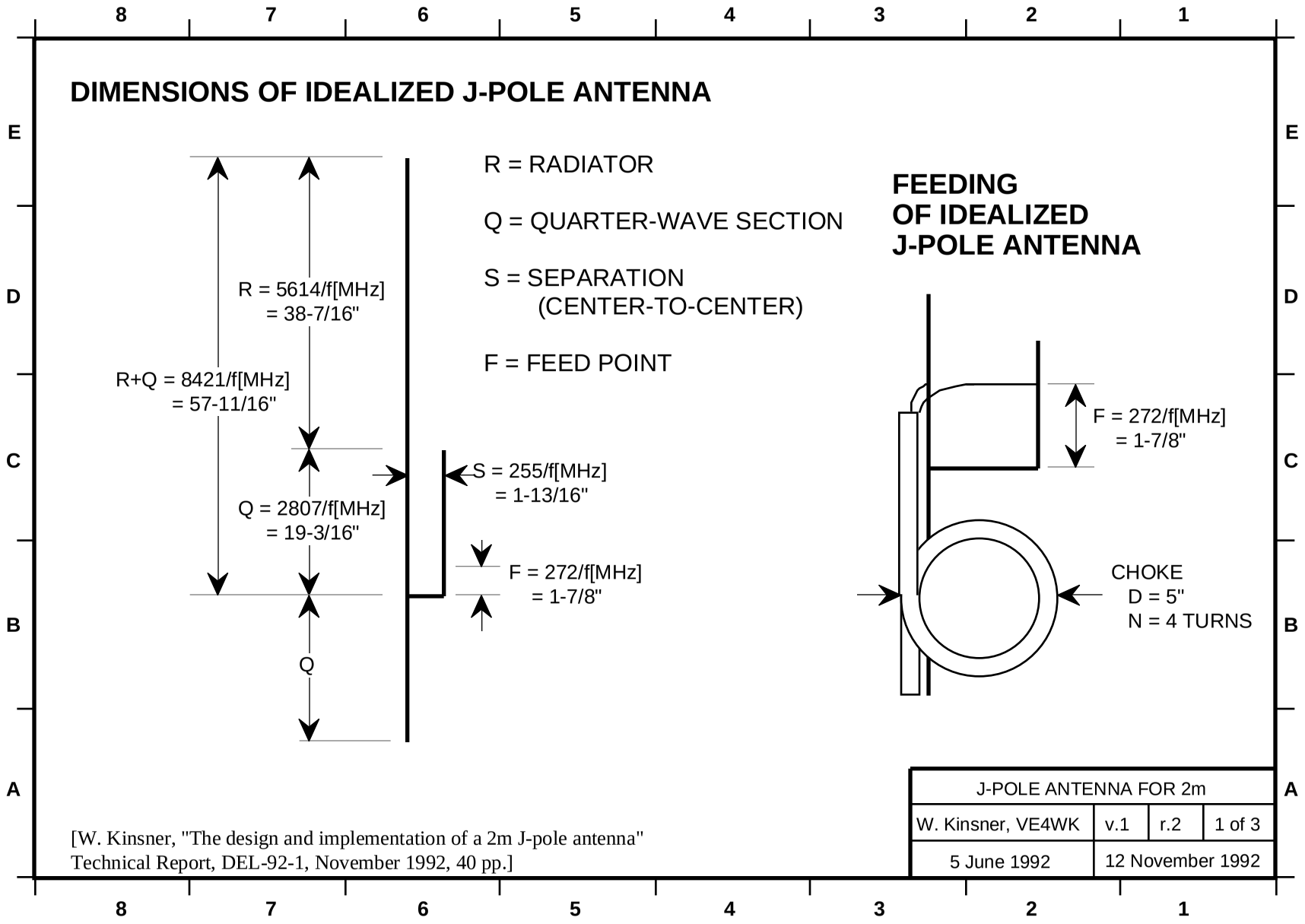
If you have any suggestions or questions concerning this antenna, contact me either by packet at VE4WK@VE4KV.#WPG.MB.CAN.NOAM, or FAX: (204) 275-0261, or eMail: kinsner@ee.umanitoba.ca.

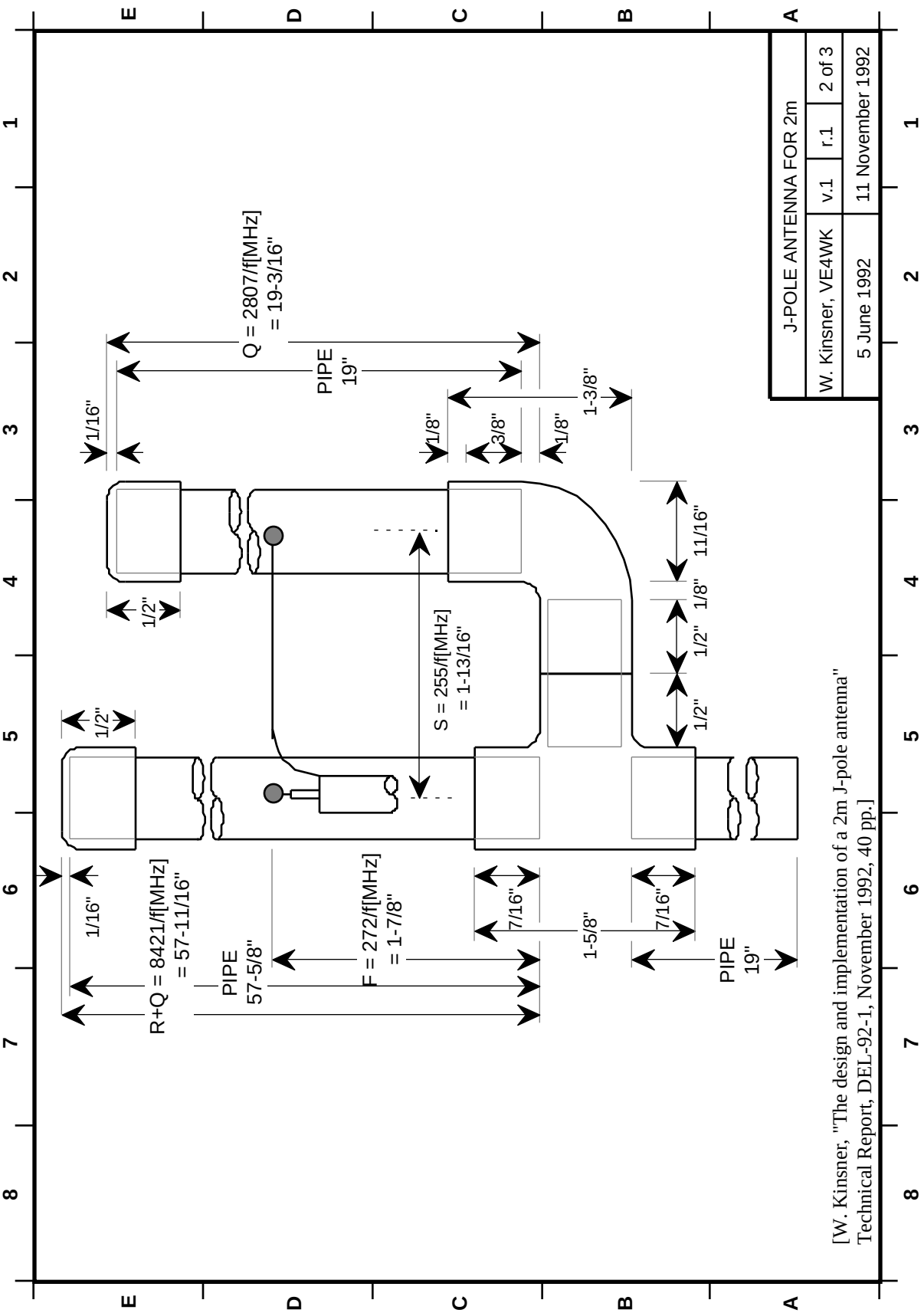
FINAL LEGAL STATEMENT

I have released the antenna into the public domain. It means that any ham (amateur radio operator) may build the antenna for his or her private use, without compensation required by the author (VE4WK). It does not mean, however, that the antenna may be built for any commercial or any other purposes by any individual or company or organization, without a written consent from the author.

HAPPY HAMMING!




8 7 6 5 4 3 2 1
E D C B A
DIMENSIONS OF IDEALIZED J-POLE ANTENNA
R = RADIATOR
Q = QUARTER-WAVE SECTION
S = SEPARATION
(CENTER-TO-CENTER)
F = FEED POINT
R = 5614/f[MHz]
= 38-7/16"
R+Q = 8421/f[MHz]
= 57-11/16"
Q = 2807/f[MHz]
= 19-3/16"
Q
S = 255/f[MHz]
= 1-13/16"
F = 272/f[MHz]
= 1-7/8"
FEEDING
OF IDEALIZED
J-POLE ANTENNA
F = 272/f[MHz]
= 1-7/8"
CHOKE
D = 5"
N = 4 TURNS
[W. Kinsner, "The design and implementation of a 2m J-pole antenna"
Technical Report, DEL-92-1, November 1992, 40 pp.]
J-POLE ANTENNA FOR 2m
W. Kinsner, VE4WK
v.1
r.2
1 of 3
5 June 1992
12 November 1992



[W. Kinsner, "The design and implementation of a 2m J-pole antenna" Technical Report, DEL-92-1, November 1992, 40 pp.]

J-POLE PARTS LIST

PART	DESCRIPTION	QUANTITY	PRICE [$]
P1	Copper water pipe, 1/2"	1	6.99
P2	Copper tee joint, 1/2"	1	0.49
P3	Copper 90° elbow joint, 1/2"	1	0.39
P4	Copper end cups, 1/2"	2	0.58
P5	Feedline clamps, #6 (5/16" to 7/8")	2	1.59
C1	Measuring tape		
C2	Marker for cutting		
C3	Pipe cutter		
C4	Reamer of file		
S1	Solid solder wire, 50/50		
S2	Solder paste		
S3	Sand paper, fine		
S4	Brush for soldering paste		
S5	Paper tower		
S6	Torch for soldering		
S7	Metal sheet for dripping solder		
S8	Plastic paint		
C1	Coax feedline, RG-58/U or M, or RG-8		
C2	UHF connector		
M1	SWR meter		
M2	Frequency meter		

PROCEDURE

– Remove all labels from pipes
– Use acetone to remove glue
– Cut the R+Q section (57-5/8")
– Cut two Q sections (19")
– Cut the joining section (1")
– Sand all joints
– Fit the pieces and adjust if needed
– Disassemble the pieces
– Apply paste with the paste brush
– Clamp the Q section
– Rest the assembly on a solid base
– Solder the joints with a torch
(be VERY CAREFUL!)
– Cool the joints
– Clean the joints
– File any excess of solder
– Make a choke (4 turns, 5" diameter)
– Attach the feedline
– Fasten the feedline and choke
– Tune the antenna for lowest SWR

ENJOY THIS INTERESTING ANTENNA

J-POLE ANTENNA FOR 2m			
W. Kinsner, VE4WK	v.1	r.2	3 of 3
5 June 1992	12 November 1992		