butternut

Instructions

Model HF2V

PLEASE READ THE INSTRUCTIONS THOROUGHLY BEFORE PROCEEDING TO ASSEMBLY. DURING ASSEMBLY AND INSTALLATION TAKE EXTREME CARE TO AVOID CONTACTING POWER LINES WITH ANY PART OF THE ANTENNA OR WITH OTHER CONDUCTORS.

DO NOT INSTALL THE ANTENNA IN ANY PLACE WHERE ANY PART OF IT CAN COME INTO CONTACT WITH POWER LINES IN THE EVENT OF STRUCTURAL FAILURE OR ANY PART OF THE INSTALLATION OR IN THE COURSE OF NORMAL FLEXING AFTER INSTALLATION, FOR SUCH CONTACT CAN RESULT IN DAMAGE TO PROPERTY, BODILY INJURY, OR EVEN DEATH!

IN NO CASE SHOULD THE ANTENNA BE INSTALLED IN ANY PLACE WHERE STRUCTURAL FAILURE OR ANY PART OF THE ANTENNA OR ITS SUPPORTING SYSTEM CAN ENDANGER PERSONS OR PROPERTY.

Tools required for assembly: standard blade screwdriver, pliers, knife; a set of nut drivers will be useful but not necessary.

NOTE: A small packet of anti-seize/anti-oxide compound (Butter-It's-Not™) will be found inside mounting post (A). This compound should be applied lightly to each tubing joint and to the inside of all clamps that must make good electrical contact with the tubing sections.

A small roll of weatherproof sealing tape (Konnector-Kote™) is also included. Use it to seal your coax connection.

ASSEMBLY

1. Check to be sure that no parts are missing (see part pictorial page)

2. If the antenna is to be installed at ground level, plant mounting post (A) in a hole approximately 21 inches (.55 meters) deep so that the upper end of the fiber rod insulator is approximately 5 inches (12 cm.) above ground level. Pack earth tightly around mounting post (A) so that it will remain vertical. Concrete may be used in areas of high wind for greater rigidity, in which case the mounting post should be rotated while the concrete is setting so that it may be easily removed later.

NOTE: If the antenna is to be mounted in concrete or in damp, acidic or alkaline soil, the mounting post should be given a protective coating of asphalt roofing compound, polyurethane varnish, or another suitable covering to protect the metal against corrosion.

WARNING: DO NOT HAMMER THE MOUNTING POST INTO THE GROUND AS THIS CAN SPLINTER THE FIBER ROD INSULATOR AND COMPLICATE INSTALLATION.

ASSEMBLY

3. Slide the insulator on 40 meter tube (B1) into the top of base section (B) and secure with a #8 x 1 1/2" bolt, #8 lock washer and #8 hex nut.

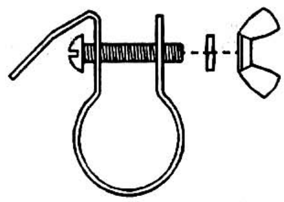
NOTE: The top of base section (B) has the mounting hole located 1/4" from the end and the danger label is located near the bottom.

In all subsequent steps involving base section (B), assembly should be done indoors or in an area where dropped hardware may easily be recovered.

WARNING: IF A FLAT BLADE SCREWDRIVER IS USED DO NOT HOLD THE WORK OPPOSITE THE BLADE IN ORDER TO AVOID POSSIBLE INJURY INCASE THE BLADE SLIPS.

4. Locate the 80/40 meter coil assembly (C) and slide the clamp at the <u>outer</u> end of the larger coil over the 40 meter tube (B1) and onto base section (B), until the middle clamp can be positioned around the fiber glass insulating rod. The middle clamp will have to be pulled open slightly to pass over the 40 meter tube (B1) and bolt that goes through the insulator rod. Position the center coil clamp around the insulator rod so that the distance from the clamp to the end of either piece of tubing is approximately equal, and pass a #10 x 1" bolt through the holes of the center coil clamp as shown in the drawing immediately below. The outer tab of this clamp may be bent back slightly to provide clearance for the bolt, and bent back into place after final assembly. Fasten the center coil clamp firmly in place using a #10 lock washer and #10 wing nut. Using #10 lock washers and #10 wing nuts secure the two remaining coil clamps, tightening the wing nuts only enough to hold the hardware in place. Coil adjustments will be made later.

5. Install the capacitor bracket (E) on the capacitor assembly (D) using the hardware already on the capacitor. Refer to the pictorial.



6. Position capacitor assembly (D) over the threaded end of the bolt protruding from the center coil clamp on the 80/40 meter coil assembly (C). Make sure that the capacitor bracket (E) runs along side the lower (80 meter) coil of the 80/40 meter coil assembly (C). Fasten the capacitor assembly (D) to the 80/40 meter coil assembly (C) using a #10 flat washer, #10 lock washer and a #10 hex nut. Using the large non-adjustable clamp, fasten the end of capacitor bracket (E) firmly against base section (B) and secure it with a #8 x 1" bolt, #8 lock washer and a #8 hex nut.

NOTE: IN THE FOLLOWING STEPS TUBING SECTIONS <u>G</u> THROUGH <u>M</u> WILL BE ASSEMBLED AS A UNIT FOR LATER PLACEMENT ATOP BASE SECTION (B)/40 METER TUBE (B1). AN 11/32 INCH NUTDRIVER WILL BE A USEFUL (BUT NOT NECESSARY) TOOL.

7. Insert the <u>unslotted</u> end of tube (H) into the <u>slotted</u> end of tube (G), align the four holes, and pass a #8 x 1 1/2" bolt through both tubes. Secure it with a #8 lock washer and #8 hex nut and tighten snugly.

8. Insert the <u>unslotted</u> end of tube (I) into the <u>slotted</u> end of tube (H) and proceed as in step 9, using a #8 x 1 1/4" bolt, #8 lock washer and #8 hex nut.

9. Insert the <u>unslotted</u> end of tube (J) into the <u>slotted</u> end of tube (I) and proceed as before, using a #8 x 1 1/4" bolt, #8 lock washer and #8 hex nut.

10. Insert tube (K) into tube (J) as in the previous steps, using a #8 x 1" bolt, #8 lock washer and #8 hex nut.

11. Insert tube (L) into tube (K) as in the previous steps, using a #8 x 1" bolt, #8 lock washer and #8 hex nut. Note that the upper end of tube (L) has only slots. Place the small gear-driven hose clamp around the slotted end of (L) and tighten only enough to hold the clamp in place.

12. Place a black cap over the end of tube (M) and slide the uncapped end into the slotted end of tube (L) to a depth of 3 inches (76 mm.). Tighten the hose clamp around the upper end of tube (L) snugly in order to hold tube (M) in place.

NOTE: If a rooftop or other above-ground installation is intended, please read the section entitled "Above Ground Installations" immediately following the check-out and adjustment instructions before proceeding.

13. Take the assembled base section (B), slide its lower end over mounting post w/insulator (A) and align the holes in the tube with the hole through the insulator. Pass a #8 x 2" bolt through the tube and insulator securing it with a #8 lock washer and #8 hex nut.

WARNING: AVOID POWER LINES!!

14. Raise tube assembly G through M vertically and slide the lower end of tube (G) into the upper end of 40 meter tube (B1). Align the holes of tube (G) with those of 40 meter tube (B1), pass a #8 x 1-1/2" bolt through the holes and tighten securely with a #8 lock washer and #8 hex nut.

WARNING: DURING THE FOLLOWING STEPS PLEASE REMEMBER THAT A DIFFERENCE IN POTENTIAL MAY EXIST BETWEEN COAXIAL LINES CONNECTED TO STATION TRANSMITTING OR OTHER EQUIPMENT AND THE ANTENNA OR THE EARTH AROUND IT. IN ORDER TO AVOID A POSSIBLY FATAL SHOCK HAZARD BE SURE THAT THE FEEDLINE TO THE ANTENNA IS DISCONNECTED FROM STATION EQUIPMENT BEFORE ATTACHING IT TO THE ANTENNA OR OTHERWISE COMING INTO CONTACT WITH IT.

15. Any length of cable having a characteristic impedance of 50 to 53 ohms may be used to feed the HF2V. Refer to figure 3 for the procedure to be followed in preparing the cable for attachment to the antenna. Note that the center conductor of the coax goes to the bottom of base section (B) and the outer (braid) conductor goes to mounting post w/insulator (A). Place a #8 washer over the threaded end of each feedline terminal before attaching the feedline. When the feedline is attached, place another #8 washer over each feedline terminal. Do not attach lock washers and hex nuts at this time.

16. Place base matching coil (Q) across the feedline terminals as shown in figure 3. Place #8 washers over each feedline terminal. Use #8 lock washers and #8 hex nuts to secure the feedline and base matching coil (Q) to the feedline terminals. The "tail" at the lower end of the base matching coil (Q) may be connected to a ground rod or stake a short distance away.

NOTE: The function of a ground rod is to place the antenna at D.C. ground potential. It cannot take the place of an effective r.f. ground system, such as a number of radial wires, regardless of its depth in the earth. It does, however, serve as a convenient tie-point for such radials, as does the bolt through mounting post w/insulator (A) to which radials can be connected by means of the remaining #8 hardware. The exact number of radials required for low SWR and reasonably efficient operation on 80 and 40 meters will depend in large measure on local earth conductivity, and this may vary considerably from one place to the next and from one frequency band to the next. The best procedure is to assume that most earth is a poor conductor over the HF range and that some radial wires will be needed. Radials may be placed on the surface of the earth or buried slightly below the surface to get them out of the way, and their length is largely a matter of convenience, although it is a good idea to make each radial at least as long as the antenna is tall. In general, a large number of short radials is preferable to a small number of longer radials for a given amount of wire, especially if fewer than a dozen radials are to be used. Unlike resonant radials that must be cut to the proper lengths for use with elevated verticals, ground-level radials need not to be cut to any particular length; their sole purpose is to provide less lossy return paths for currents flowing along the earth than the earth itself can provide. And, since "return" currents will be flowing back to the antenna from all points of the compass, the radial wires should be spaced uniformly over 360 degrees, although physical circumstances will often make this "ideal" distribution impossible. For a discussion of ground system for elevated verticals, see the section entitled "Above Ground Installations" following Checkout and Adjustment instructions.

CHECKOUT AND ADJUSTMENT

NOTE: The two coil shorting straps (F) are provided as a means of decreasing the inductance of the 80 and 40 meter coils more than is possible simply by stretching the coils. Lower than normal inductance may be necessary if the HF2V is top loaded as described later for the sake of greater SWR bandwidth on 80/75 meters and on 160 meters with the optional TBR-160-S unit.

For operation of the HF2V without top loading or any optional accessories for other bands attach the lug end of one shorting strap to the upper clamp of the 40 meter coil. This is done by removing the wing nut and other hardware from the upper clamp and placing the lug end of the coil shorting strap (F) over the #10 bolt ahead of the locking washer and the wing nut. The other end (clamp end) of the coil shorting strap (F) should be tapped down along the 40 meter coil so that four full turns are shorted out. Secure it with #8 x 3/4 bolt, #8 lock washer and #8 hex nut.

The other shorting strap, if needed, may be attached to the lower clamp of the 80 meter coil and tapped upward along the coil for decreased inductance. Secure it with #8 x 3/4 bolt, #8 lock washer and #8 hex nut. With no top loading, however, it is unlikely that any turns will need to be shorted to achieve satisfactory operation over any 60 kHz segment of the 3500-4000 kHz range. For MARS or other operation above 4000Khz the shorting strap will probably be required.

With the 40 meter coil shorted as noted above and with the following coil settings resonance and lowest SWR should occur at approximately 7150 and 3750 kHz.

1. Refer to figure 1 and set the 80 meter coil so that the distance between the upper edge of the lower coil clamp to the lower edge of the center clamp around the insulator is 14 inches or approximately 35.6 centimeters. The 40 meter coil should be adjusted so that the distance between the lower edge of the upper clamp and the upper edge of the center clamp is 10 inches or approximately 25.4 centimeters.

2. For purposes of adjustment a simple SWR indicator at the transmitter will be adequate. More accurate SWR measurements can be obtained at the antenna, but the tuning conditions that exist at the end of the line will normally be of more practical interest to the operator.

3. Determine the frequency at which the SWR reading is lowest on 80/75 meters. In order to minimize interference to other stations adjust the SWR indicator for maximum sensitivity and use only enough power for full scale deflection in the "forward" position. Resonance on this band is fairly sharp, so it may be necessary to take readings at every 25 kHz or so across the band to find the frequency at which the SWR drops to a minimum value. If lowest SWR (not necessarily less than 2:1 at this point) occurs at a higher frequency than desired, simply loosen the wing nut on the lower 80 meter coil clamp and readjust its position upward for greater

CHECKOUT AND ADJUSTMENT

compression of the coil and increased inductance. If, on the other hand, the initial reading of lowest SWR occurs at a lower frequency than desired, position the 80 meter coil for less compression and decreased inductance. Adjustments in either directions should be made in steps of one inch or less to avoid "overshooting the desired setting." A one-inch change in the position of the lower coil clamp will produce a 75-100 kHz change in resonance.

Once the 80/75 meter coil adjustment has been made for lowest SWR at a particular frequency it may be found that the SWR cannot be lowered further without the adjustment of the base matching coil (Q), especially if an effective ground system is used with the antenna. One should remember that the radiation resistance of a vertical antenna that is physically shorter than a quarter wavelength will be less than 35 ohms and that the total feedpoint impedance at resonance will be the sum of this radiation resistance, plus conductor and loading losses, plus earth loss resistance. With a loss-free ground system the resistive part of the feedpoint impedance of the HF2V on 80/75 meters will be less than 20 ohms and the resulting mismatch with 50-ohm cable would produce SWR of greater than 2:1. Base matching coil (Q) may be viewed as a step-up transformer that will match the lower impedance at the feedpoint, to the characteristic impedance of the feedline, and proper adjustment will produce SWR of close to unity in those cases where the earth loss resistance is sufficiently low to keep the feedpoint impedance below the characteristic impedance of the cable used. If earth losses are unusually great, as in desert areas, and if no efforts are made to reduce these losses, base matching coil (Q)'s transformational properties will be the opposite of what is needed. In such a case base matching coil (Q) should be left fully compressed or disconnected entirely, depending on which condition produces lower SWR.

4. Stretch base matching coil (Q) a slight amount from its fully compressed condition and observe the effect on SWR. In general, the more efficient the ground system is in reducing earth losses, the greater the amount of stretch required for low SWR, and if one is fortunate enough to have a zero-load ground system base matching coil (Q) may have to be stretched to several times its compressed length for a proper match, in this case it may be more convenient to reduce its inductance by sniping off several turns rather than continued stretching. If base matching coil (Q) has to be stretched a good deal for the sake of a good match the frequency of minimum SWR may drop slightly, in which case the adjustment of the 80/75 meter coil setting may be touched up as in the preceding step.

5. Determine the frequency at which SWR is lowest on 40 meters and adjust the upper or 40 meter coil in exactly the same manner as the 80/75 meter coil was adjusted. Since the antenna is a full quarter wavelength tall on this band, tuning will be fairly broad and the radiation resistance will be close to 35 ohms with negligible conductor loss. Depending on the adjustment that has been made to base matching coil (Q) in connection with the 80/75 meter tuning, 40 meter SWR should be no worse than 1.5 at resonance, and even lower SWR is likely.

ABOVE GROUND INSTALLATION

If the HF2V is to be mounted some distance above the earth a resonant-radial ground system will most likely be necessary for low SWR and efficient operation. The length in feet of radial wires for any band can be found from the formula:

$$\text{Length} = \frac{240}{\text{Frequency(MHz)}}$$

At least two radials per band should be used if at all possible for the sake of efficiency, although operation with a reasonably low SWR may be possible with only a single radial per band. If only two radials are used per band these should run at 180 degrees to each other. Resonant radials should be connected to the braid side of the coax at the feedline terminals and insulated at the far end. Resonant radials need not remain parallel to the earth, and a fair amount of slope will not significantly affect SWR or performance. If, however, resonant radials are not sufficiently elevated, the earth below them can cause them to resonate at a much lower frequency than expected, and their length may have to be trimmed considerably to restore the overall system (vertical radiator and radials) to resonance for low SWR operation without having to resort to a transmatch at the input end of the feedline.

If the antenna is to be mounted above ground it is recommended that one set of short guys be attached to the antenna at a point that is approximately 1/3 of the way up from the feedpoint. These will help to steady the lower sections and to prevent the wind loading on the upper sections of tubing from transmitting an overturning moment to the base. Four guys will offer more support than three, and unusually long guys should be avoided. Under no circumstances should guys be placed on the upper section of an antenna. The light tubing used in the upper half of the antenna is capable of supporting itself in very high winds, but it cannot support itself and guy lines that will themselves will be subject to wind and perhaps ice loading. Guys should be made of non-stretch non-conductive material such as monofilament fishing line in the larger sizes. Light nylon twine should be avoided regardless of its strength rating because it can stretch as much as 15%. Polypropylene rope or even nylon rope may also be used, although the former should be checked periodically for signs of weather deterioration.

OPTIONAL ACCESSORIES FOR THE HF2V AND NOTES ON TOP LOADING

In its basic configuration the HF2V stands 32 feet tall and thus operates as a quarter-wave vertical on 40 meters with reasonably good efficiency over fair to good ground system. On 80 meters, however, this height represents something of a compromise compared to a full quarter-wave vertical antenna fir this band. One simple way to approach the performance of a full size vertical on this band is to attach top-loading wires near or at the top of the antenna in order to simulate a much taller physical structure as in figure 4. Maximum loading will occur when the wires are extended parallel to the earth, but that arrangement would call for additional supports that are nearly as tall as the antenna itself. The "umbrella" system shown will conserve space and resources in that the support lines to the top loading wires may be placed at ground level. The angle of slope for each wire is not especially critical, but 45 degrees represents a good compromise between loading and space conservation. Fewer than four wires may be used, although in such a case it may be expected that three wires of given length will provide less loading than four wires of the same length. It is obvious that the addition of top-loading wires to the HF2V will call for less inductance in the 80 and 40 meter tuning circuits, in which case the shorting strap for the 80 meter circuit will be needed. Unfortunately, there is a limit to the amount of top loading that may be used with the HF2V before 40 meter operation is adversely affected. Four "umbrella" wires each attached to the antenna at the junction of tubes (K) and (L) and each approximately 12 feet (3.65 meters) long and sloping downwards at 45 degrees, is probably the greatest amount of loading that can be used for coverage of the entire 40 meter band with acceptable SWR, even if all the turns of the 40 meter coil are shorted out. With this particular top-loading arrangement the 80/75 meter bandwidth between the 2:1 SWR points should be nearly 100 kHz, and if the optional TBR-160-S unit is used for 160 meter operation the SWR bandwidth on that band will increase to approximately 25 kHz from the 13 kHz or so that could be expected in the absence of top loading. If one is willing to sacrifice 40 meter operation for the sake of even greater operating bandwidth and greater efficiency on the lower bands the "umbrella" wires can be lengthened considerably. Four 25-foot "umbrella" wires, for example, would provide some 125 kHz of operating bandwidth on 80/75 meters and up to 35 kHz on 160 meters. Top-loading wires should not be attached to the very tip of the antenna because the tubing in the two uppermost sections is no stronger than it needs to be to support itself. Operation of the HF2V may be extended to the other bands through the addition of the following

OPTIONAL ACCESSORIES FOR THE HF2V AND NOTES ON TOP LOADING

accessories without sacrificing 80 and 40 meter performance:

Model TBR-160-S

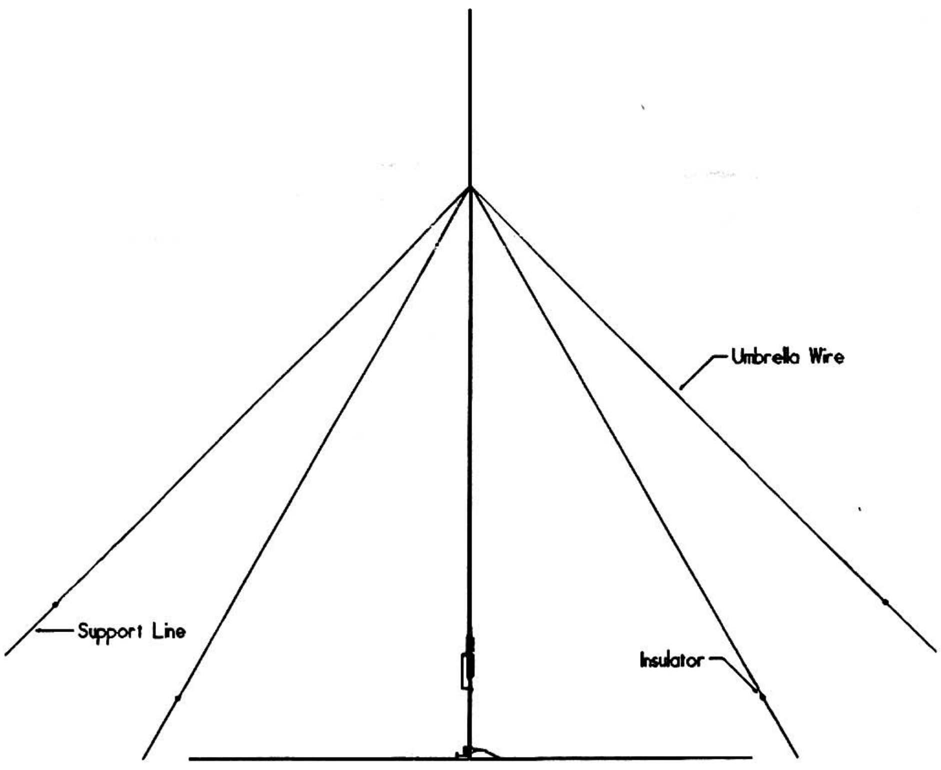
160 meter base resonator; may be used with or without top loading; rated at 500 watts C.W./1000 watts to antenna

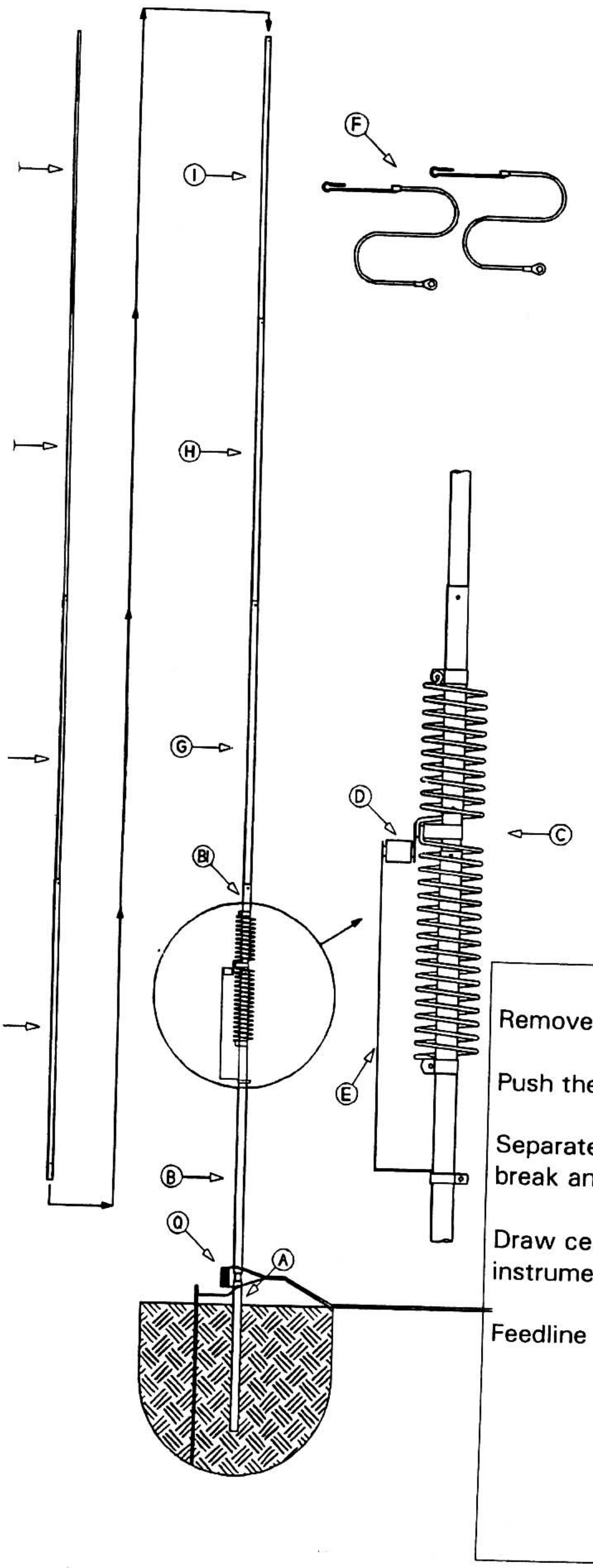
Model 30 MRK

30 meter resonator kit (not recommended if top loading is used)

Model TLK

Top loading kit of four 25-ft. stranded "umbrella" wires and insulators (see above notes concerning 40 meter operation).





NOTE: All dimensions are in inches(millimeters) unless otherwise noted

Code	Part No	Description	Qty
A	00110SZV	TUBE A W/INSULATOR 1-1/4(32) X 24(606)	1
B	00117SZV	TUBE B SECTION 1-1/4(32) X 48(1216)	1
B1	00121SZV	TUBE B1 W/INSULATOR 1-1/4(32) X 14(356)	1
C	00152SZV	COIL ASSEMBLY 80/40 METER	1
D	00155SZV	CAPACITOR ASSEMBLY 80 METER	1
E	00150BAV	CAPCITOR BRACKET 80 METER	1
F	00140RZV	COIL SHORTING STRAP	1
G	00122BAV	TUBE 1-1/8(29) X 48(1216)	1
H	00123BAV	TUBE 1(25) X 48(1216)	1
I	00124BAV	TUBE 7/8(22) X 48(1216)	1
J	00125BAV	TUBE 3/4(19) X 48(1216)	1
K	00126BAV	TUBE 5/8(16) X 48(1216)	1
L	00127BAV	TUBE 1/2(13) X 48(1216)	1
M	00128BAV	TUBE 3/8(10) X 48(1216)	1
Q	00137SZV	COIL Q BASE MATCHING	1
	00109JZV	# 8-32 X 2(51) SCREW	1
	00114JZV	# 8-32 X 1-1/2(38) SCREW	2
	00079JZV	# 8-32 X 1-1/432) SCREW	2
	00078JZV	# 8-32 X 1(25) SCREW	3
	00077JZV	# 8-32 X 3/4(19) SCREW	2
	00083JZV	# 8 FLAT WASHER	6
	00080JZV	# 8 LOCK WASHER	13
	00081JZV	# 8-32 HEX NUT	13
	00131JZV	#10-24 X 1(25) SCREW	1
	00132JZV	#10 FLAT WASHER	1
	00133JZV	#10 LOCK WASHER	4
	00134JZV	#10-24 HEX NUT	1
	00135JZV	#10-24 WING NUT	3
	00144JZV	SMALL ADJUSTABLE COMPRESSION CLAMP	1
	00143BAV	CAPACITOR BRACKET CLAMP	1
	00050DZV	KONNEKTOR-KOTE 1(25) X 8(203)	.05
	290-05	CAPACITOR 200PF/10KVDC N750	

Feedline Preperation

Remove outer insulation with a sharp knife.

Push the braid according fashion against the outer jacket.

Separate strands of braid with an awl being careful not to break any.

Draw center conductor out with and awl or other dull pointed instrument.

Feedline Detail

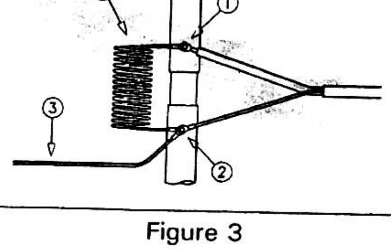


Figure 3

butternut

Instructions

Model GRK

NOTE: Please read all instructions thoroughly before proceeding to installation and assembly. During assembly and installation take extreme care to avoid contacting power lines with any part of the antenna or other conductors.

INSTALLATION CONSIDERATIONS

Ideally the antenna should be installed 30 ft (9.1 m) from any structure as shown in figure 2. In most cases this will not be practical and an alternative method such as the one shown in figure 3 may be used.

WARNING: Do not install the antenna in any place where any part of it can come into contact with power lines in the event of structural failure, in the course of normal flexing after installation or during installation.

WARNING: In no case should the antenna be installed in any place where structural failure of any part of the antenna or its supporting system can endanger persons or property.

CAUTION! A grounded antenna will be at D.C. ground potential! To avoid the danger of shock connect all station equipment to a good earth ground. It is also recommended that all station equipment be disconnected from the power mains before connecting the feed line to the antenna. Please consult the A.R.R.L. Handbook or other reference manuals for additional safety procedures when working with electrical equipment.

Tube w/insulator (A) should be protected against corrosion if it is to be placed in concrete, damp acidic or alkaline soil. Asphalt roofing compound, polyurethane varnish or other sealant that protects against moisture may be used.

Concrete may be used in areas of high winds for greater strength, in which case the post may be twisted slightly during setting for easy removal later.

831 North Central Avenue Wood Dale Illinois 60191-1219 Telephone 630.238.1183 Facsimile 630.238.1186 http://www.bencher.com

VI004047 03309

ASSEMBLY

1. Plant tube w/insulator (A) (packaged with antenna) in a hole approximately 21 in (53.3 cm) deep so that the upper end of the fiberglass insulator is approximately 7 in (17.8 cm) above ground level. Pack earth tightly around tube w/insulator (A) so that it remains vertical.

NOTE: Hammering tube w/insulator (A) into the earth may cause the insulator to splinter. If the post must be hammered into the earth, protect the end of the insulator with a block of wood.

2. Assemble and install antenna per instructions.

3. Insert a copper ground rod 6 to 12 in (15.2 to 30.5 cm) from tube w/insulator (A). The ground rod should be at least 48 in (1.2 m) in length.

4. Attach radials onto the screw protruding from tube w/insulator (A) along with coil (Q) base matching, braid side of the feed line and bonding wire from the ground rod as shown in figure 1. Secure with the supplied flat washers and hex nuts.

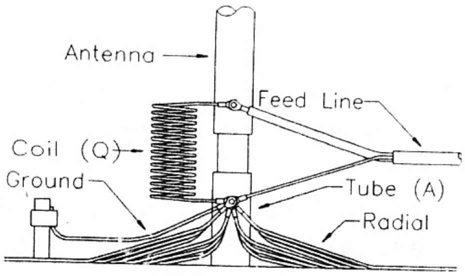


Figure 1

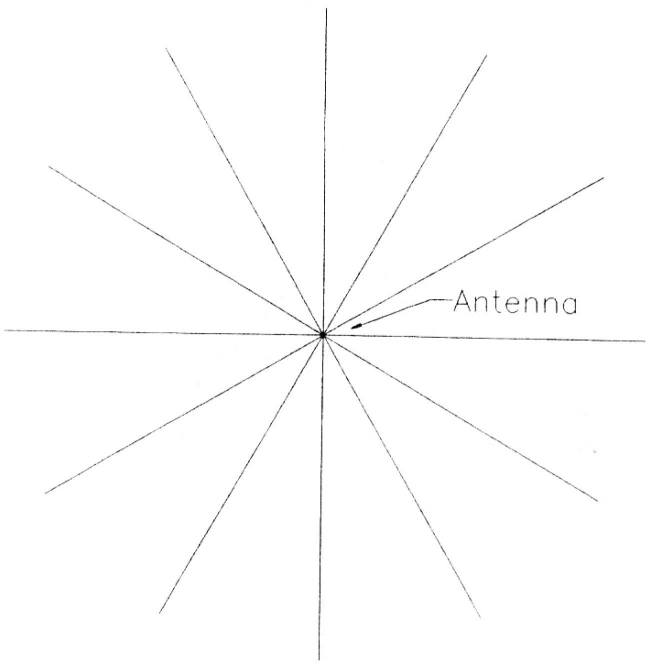


Figure 2

NOTE: Coil (Q) base matching is not used when the TBR-160-S Top Band Resonator 160 meter Kit is installed.

5. Fan out radials as shown in figures 2 or 3. Make sure that the radials are as equally spaced as possible.

Ideally, radials should be equally spaced as in figure 2 but in most cases they will need to be bent around structures and other obstacles as in figure 3. Make sure that you make your bends no sharper than 90° and as gradual as possible.

6. Slit the earth 1 to 2 in (2.5 to 5.1 cm) with a square shovel or

similar tool along the path of a radial.

7. Leaving a little slack at the base of the antenna, carefully press the radial into the slit. Make sure not to cut the radial.

Radials may left on top of the ground however they should be buried for the sake of pedestrians and lawnmowers.

8. Repeat steps 5 and 7 for the remaining eleven radials.

9. Tune antenna per instructions.

THEORY OF OPERATION

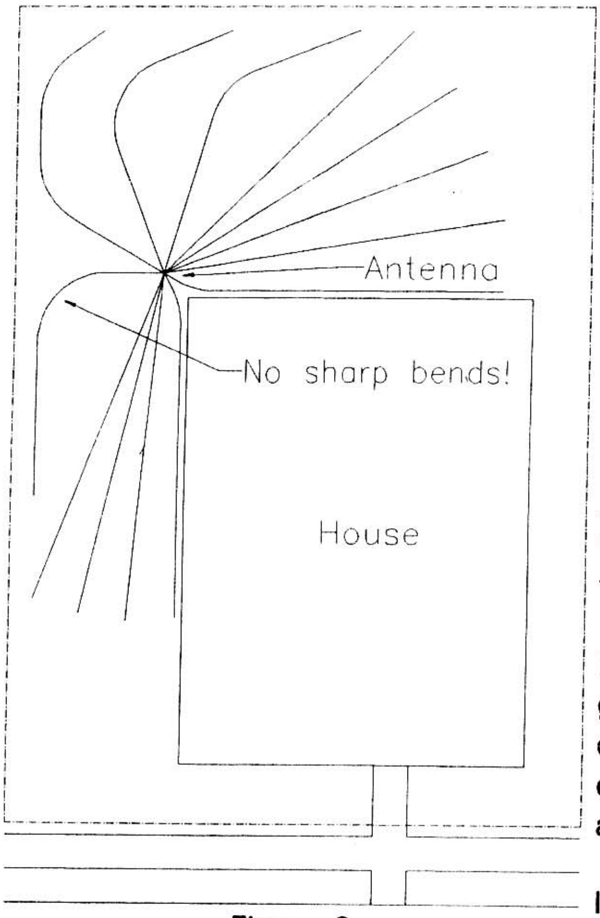


Figure 3

A vertical antenna in its simplest form, is electrically equivalent to one-half of a dipole antenna. The earth below the antenna takes the place of the *missing* half of the dipole.

Capacitance between the vertical radiator and the ground causes *return* currents to flow along the earths surface back to the transmitter. If they have to come back along the untreated lossy earth they get back to the source greatly attenuated. This *return* loss is like a resistor in series with the antenna radiation resistance and will therefore affect the feed point impedance.

If ground conductivity is excellent, a ground rod may provide a sufficiently good connection for resonant and low SWR operation on the bands for which the antenna is designed.

In almost every case the efficiency of a vertical antenna will be greater when radials are used to improve ground conductivity.

THEORY OF OPERATION

Since it's not practical to copper-plate the back yard, the best approach is run out a number of radials. Because most ground losses occurs within a 1/4λ from the antenna, the GRK Ground Radial Kit provides a good ground plane for 160 thru 6 meter operation without using much real estate. If the ground is extremely lossy, as in the desert, additional longer radials may need to be added.

Parts List

Part No	Description	Qty
VS00405Z	Ground Radial Wire	12
VJ00078Z	#8 x 1 Screw	1
VJ00083Z	#8 Washer	5
VJ00081Z	#8 Hex Nut	2

Butternut Manufacturing Co.
831 North Central Avenue
Wood Dale Illinois 60191-1219
Telephone 630.238.1183
Facsimile 630.238.1186
http://www.bencher.com

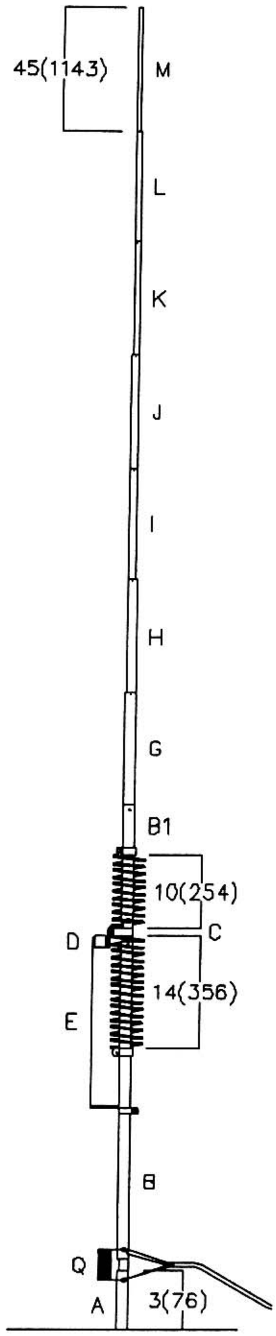
butternut

Parts List

HF2V

NOTE: All dimensions are in inches(millimeter) unless otherwise noted

Code	Part No	Description	Qty
A	00110SZV	TUBE A W/INSULATOR HF2V 1.250(32) X 24(606)	1
	00111BAV	TUBE A	
	00112BAV	TUBE A REINFORCER	
	00113FAV	TUBE A INSULATOR	
B	00117SZV	TUBE B SECTION HF2V 1.250(32) X 48(1216)	1
	00115BAV	TUBE B	
	00116BAV	TUBE B REINFORCER	
B1	00121SZV	TUBE B1 W/INSULATOR HF2V 1.250(32) X 14(356)	1
	00118BAV	TUBE B1 REDUCER HF2V	
	00119BAV	TUBE B1 HF2V	
	00120FAV	TUBE B1 INSULATOR	
C	00152SZV	COIL ASSEMBLY 80/40 METER HF2V	1
	00146BAV	COIL 40 METER	
	00147BAV	COIL 80 METER	
D	00155SZV	CAPACITOR ASSEMBLY 80 METER	1
	290-05	CAPACITOR 200PF	
E	00150BAV	CAPACITOR BRACKET 80 METER	1
	00129SZV	TUBE PACKAGE HF2V	
G	00122BAV	TUBE 1.125(20) X 48(1216)	1
H	00123BAV	TUBE 1.000(25) X 48(1216)	1
I	00124BAV	TUBE 0.875(22) X 48(1216)	1
J	00125BAV	TUBE 0.750(19) X 48(1216)	1
K	00126BAV	TUBE 0.625(16) X 48(1216)	1
L	00127BAV	TUBE 0.500(13) X 48(1216)	1
M	00128BAV	TUBE 0.375(10) X 48(1216)	1
Q	00137SZV	COIL Q BASE MATCHING	1
	00130SZV	HARDWARE PACKAGE HF2V	
	00077JZV	# 8-32 X 0.750(19) SCREW	2



831 N Central Ave Wood Dale IL 60191-1219 Tel: 630.238.1183 Fax: 630.238.1186 e-mail: bencher@bencher.com http://www.bencher.com

00768ZZV 100700

Code	Part No	Description	Qty
	00078JZV	# 8-32 X 1.000(25) SCREW	3
	00079JZV	# 8-32 X 1.250(32) SCREW	2
	00080JZV	# 8 SPLIT RING LOCK WASHER	13
	00081JZV	# 8-32 HEX NUT	13
	00083JZV	# 8 FLAT WASHER	6
	00109JZV	# 8-32 X 2.000(51) SCREW	1
	00114JZV	# 8-32 X 1.500(38) SCREW	2
	00131JZV	#10-24 X 1.000(25) SCREW	1
	00132JZV	#10 FLAT WASHER	1
	00133JZV	#10 SPLIT RING LOCK WASHER	4
	00134JZV	#10-24 HEX NUT	1
	00135JZV	#10-24 WING NUT	3
	00142SZV	CLAMP PACKAGE HF2V	
	00050DZV	KONNEKTOR-KOTE	.05
	00089FZV	PROTECTIVE CAP 0.375	1
F	00140RZV	COIL SHORTING STRAP HF2V	2
	00143BAV	CAPACITOR BRACKET CLAMP	1
	00144JZV	COMPRESSION CLAMP SMALL ADJUSTABLE	1
	00061SZV	BUTTER-IT'S-NOT	1
	00156IZV	INSTRUCTIONS HF2V	1

BUTTERNUT Manufacturing Co.

Tech Notes

Phased Arrays of Short Vertical Antennas

It is possible to devise an array of two or more vertical antennas to provide useful gain and directivity over a single vertical element, but proper design and adjustment may be a more complicated matter than one might think because gain depends on such factors as spacing between elements, phase difference, etc., and these will change from one band to the next. About the most one can hope to do is to work out a compromise design that will be truly effective on two adjacent bands.

Probably the simplest system would involve two vertical antennas spaced from 1/2 to 3/4 wavelengths apart at the highest frequency of operation and fed with equal in-phase currents. Such an array would be bi-directional and provide up to four decibels of "broadside" gain. At half the design frequency the broadside gain would be less than two decibels. Thus, an array of the two elements for 40 meters (spacing between elements approximately 35 ft.) would provide a fair amount of gain on that band and perhaps a few decibels less on 80 meters. The same array could no doubt be operated on the higher-frequency bands, but the directivity pattern (if any) would change considerably, for the great spacing (in terms of wavelength) would cause the production of "end-fire" as well as broadside radiation.

In the case of close-spaced elements (1/8 to 1/4 wave) it is possible to produce a unidirectional end fire pattern by feeding the two elements with a phase difference of 90 degrees by means of an electrical 1/4 wavelength "delay" line. This arrangement produces a rather broad single lobe (cardioid pattern) in the direction of the element with the lagging current, and very good front-to-back radiation are possible with such an array. However, both the radiation resistance and the feedpoint impedance will be much lower than for a single vertical element, making the system more critical with respect to operating bandwidth and impedance matching, especially if each element is physically shorter than 1/4 wavelength at the operating frequency and if the spacing between elements is less than 1/4 wavelength. Close-spaced out-of-phase short elements should have the best possible radial system under each element so that the earth loss resistance doesn't account for the major part of the overall feedpoint impedance. If this precaution isn't observed the earth loss may wipe out all or most of the theoretical gain of the array.

Still another problem with close-spaced arrays using physically short elements is that the power-handling capability may be less than for a single element because the mutual impedance between the elements will raise overall circuit Q while reducing the radiation resistance of the array.

As with the relatively wide-spaced in-phase arrays, the close-spaced out-of-phase types may be operated on other bands where the spacing and phase difference will not be optimum and where the directive pattern can be expected to change from band to band.

In general, the Butternut HF6V-X and HF2V will be under less of a disadvantage in phased arrays than conventional multi-trap designs that use a progressively smaller portion of the available radiator at 7 MHz and above, but the problems of devising an effective array on more than one band will remain the same. Wide-spaced in-phase arrays are generally better behaved than the close-spaced out-of-phase types and show higher values of radiation resistance. This makes the ground/radial situation somewhat less critical, but more real estate is required for effective broadside arrays, especially on 80 and 160 meters.

For further information on vertical arrays one should consult a recent edition of the ARRL Antenna Book.

HF2V 160 Mods

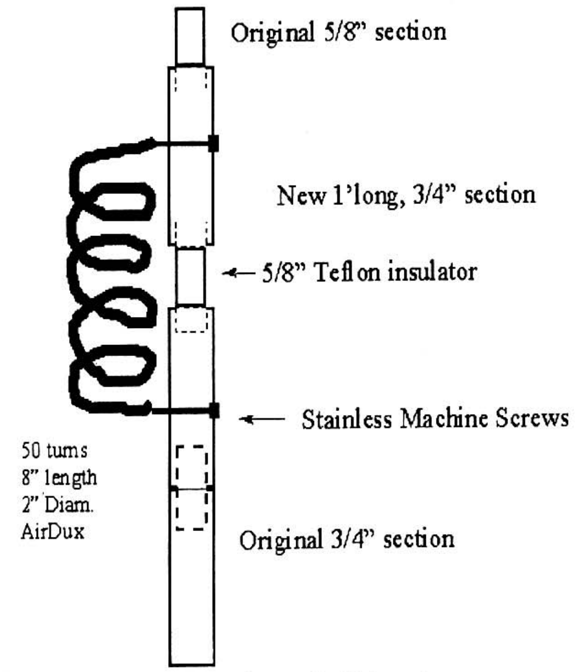
reprinted from web, Gerry, VE6LB

There isn't a lot of science behind the Mod. I read about the higher efficiency and greater bandwidth of short verticals by moving as much of the loading as high as possible as well as adding as much capacity hat as possible. I didn't try any other changes (larger coil) as mentioned in the Mods.

My experience was that the bandwidth was wider and that I was able to break pile-ups that I simple couldn't before (had to wait until there where no other callers and then I'd sometimes get through).

I've worked DXCC on 160 with this antenna (and 800 watts), the first 50 or so with the stock antenna (with the 160 kit) and the rest with the modification as shown here. The last 50 where a lot easier

This modification took me from having to wait until the pile up thinned out so I was the "last caller" to where I have been successful in breaking pileups near the front end. The HF2V does not perform well on 80/40 anymore but is useable through a tuner. This HF2V is ground mounted in the clear for 40' all around and has 15-32' buried radials and 4-4'

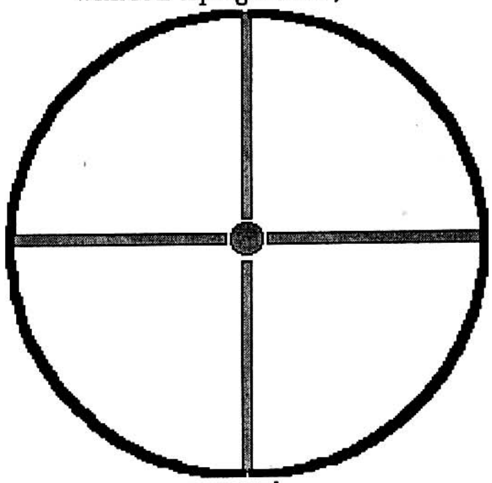


Tubing split with hacksaw and secured with hose clamps

ground rods at the base. The bandwidth is about 25 kHz at 3:1 (double the original). I also added a 50PFD remote tuned variable capacitor (very wide spaced plates as the voltage here is very high) across the 160 base coupling capacitors. This allows me to swing the resonance from 1.800 to 1.860. After this modification, the antenna was retuned to resonance on 160 by shortint out about 3 turns of the base loading capacitor. The antenna will still self support after this mod but I guy mine at 8' due to the strong winds here.

4 support rods made from 3/8"
aluminum flat rod 1/16" thick
18" long with a 1" bend. Fastened to the antenna with a hose clamp.

Heavy Aluminum wire (ground)
(I used 4 pieces and fastened to each rod with self taping screws)



Top View

I also did the previous mod plus added 7 feet of 3/4" at teh same place as the coil was added. This worked even better but it was very mechanically unstable. I guyed it at 8 and 16 feet but it still tended to buckle. If it were guyed in three places it would be OK. i found that the majority of the improvement came from the near top loading and did not go back to the longer configuration.

I also added a small top hat as shown here. A bigger one would likely add more performance but I was concerned about wind loading in the minimal guyed configuration I'm using. The Top Hat is mounted about 5' above the coil on the 5/8" section. The way this antenna is now it is not visually disturbing (to my wife or neighbors and performs reasonably well. Additional height or guys would make it more visible.

I intend to try a larger coil (more turns and larger diameter)