butternut

Instructions

Model HF5V-II

Butternut Electronics Co's Instruction Manual for:
Model HF5V-II – 1977

NOTE:

The HF5V Vertical antenna previously manufactured by Butternut Electronics Co. was discontinued in 1979. Parts are no longer available for these antennas. This instruction is made available as a reference.

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BUTTERNUT ELECTRONICS CO.
ROUTE 1, LAKE CRYSTAL, MN 56055

ASSEMBLY AND INSTALLATION: MODEL HF5V-II

(August, 1978)

During assembly and installation take care to avoid contacting power lines with the antenna. Do not mount the antenna in any location where it might blow into or fall upon power lines.

Tools recommended for assembly: standard blade screwdriver, 5/16 in. nutdriver, pliers, pocket knife.

Study the pictorial diagrams and proceed as follows:

1. Check to see that all parts are present. See the parts pictorial page.

2. Plant the mounting post (A) in a hole approximately 21 in. deep so that the upper end of the fiberglass insulator clears the ground by 5 or 6 in. Pack earth tightly around the tubing post to make sure that it remains vertical. Concrete is recommended for more strength. The post may be twisted slightly while the concrete is setting so that it may be removed easily at a later date, if desired. The post should not wobble in the hole. NOTE: Hammering the post into the ground may cause splintering of the fiberglass insulator. If the post must be hammered, protect the top with a block of wood.

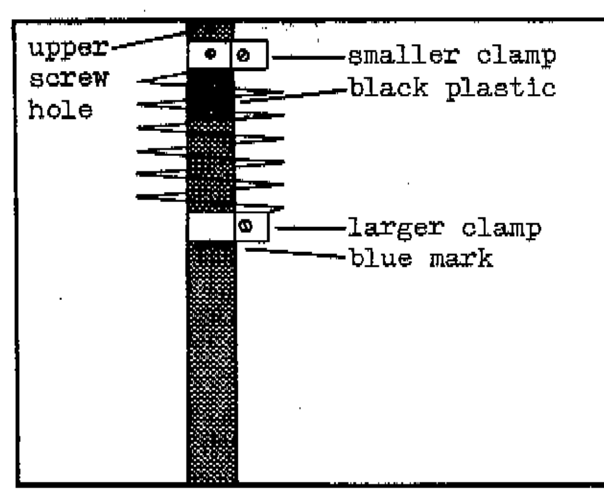
3. Prepare the impedance matching/ grounding coil (M) as shown on the pictorial page.

4. Pass a #8 x 1-3/4 in. screw through the braid lug of the impedance matching line (L), through a flat washer, through loop 2 of coil (M), through another flat washer, and through hole 2 of the mounting post (A). Secure with a flat washer, a lock washer, and a #8 nut.

5. Note that the 80m resonator coil (C) has two clamps, one large and one small. Remove the round head screw from the large clamp and spread the clamp slightly.

6. Pass the top of (B) first through the larger clamp of (C), then through the smaller clamp. The larger clamp should be below the black plastic on (B).

7. Line up the screw hole in the smaller clamp of (C) with the lower screw hole in the top of (B). Tighten the clamp, then secure with a #10-24 self-tapping screw through the clamp into (B).



8. Replace the 1/4 in. x 1 in. bolt in the larger clamp of (C). Remove the packing tape from (C) and slide the larger clamp down section (B) until the bottom of the clamp touches the blue mark on (B). Tighten the clamp. This gives the preliminary 80m setting. Set assembly (B-C) aside.

9. Install the 40m resonator coil (E) in the same manner. Slide the larger clamp down section (D) until the bottom of the clamp touches the blue mark

and tighten the clamp. This gives the preliminary 40m setting.

10. Telescope the lower end of (F) onto the top of (D). Line up the screw holes in (D) and (F) and secure with a #10-24 self-tapping screw.

11. Place a large stainless steel clamp over the slotted end of (G) and telescope (F) into (G). Adjust the distance between the black plastic part of (G) and the top of (E) to 5 ft. 8 in. and tighten the clamp.

12. Telescope the bottom of (H) into the top of (G). Line up the screw holes and secure with a #10-24 self-tapping screw.

13. Telescope (J) into (I), line up the screw holes, and secure with a #10-24 self-tapping screw.

14. Telescope (K) into (J), line up the screw holes, and secure with a #6-32 self-tapping screw.

15. Place a small stainless steel clamp over the top of (H). Telescope the bottom of (I) into (H), adjust the distance from the top of the black plastic trap (G) to the top of (K) to 13 ft. 4 in. and tighten the clamp.

16. Place the bottom of (B) over the top of (A) and line up the screw holes. Pass a #8 x 1-3/4 in. screw through the center lug of (L), through a flat washer, through loop 1 of coil (M), and through (B-A). Secure with a flat washer, a lockwasher, and a #8 nut.

THE ANTENNA WILL BE RAISED IN THE NEXT STEP. WATCH OUT FOR POWER LINES!

17. Raise assembly (D) through (K) and place it atop (B) by telescoping the bottom of (D) over the top of (B), lining up the screw holes, and securing with a #10-24 self-tapping screw.

18. To avoid a possible shock hazard, be sure that your rig is well grounded and/or disconnected from the AC mains. Connect the rig to the antenna with any convenient length of 50-53 ohm coax. A double female connector (N) is provided to mate with a standard PL-259.

19. Connect point 3 on the impedance coil (M) to a ground rod. Radials may be connected to the screw holding the coax braid, soldered to point 3 on coil (M), or connected to the ground rod. See the radial information attached.

Note: Coil (M) is not strictly required for operation of the antenna. If a better match on 80m is possible without the coil, it may be left out of the circuit. If this is done, a static-discharge type of lightning arrestor should be used.

20. Follow the Checkout and Adjustment Procedure. Do not exceed the ratings of the antenna. (Data sheet provided.)

CHECKOUT AND ADJUSTMENT PROCEDURE

The dimensions given in the pictorial should produce very low SWR readings over the 20, 15, and 10 meter bands, and the 80/75 and 40 meter resonator circuits are set for resonances of approximately 3700 and 7100 Khz. when unpacked and adjusted as on p. 1. Inasmuch as some variation is to be expected, the following procedure should be used to adjust the antenna for minimum SWR at any desired point in each of the five bands. SWR readings may be taken at the transmitter end of the feedline or at the junction of the feedline and the 75 ohm line for greater accuracy. SWR should always be monitored during operation. Erratic or high readings indicate a problem which must be corrected before operation resumes.

1. Determine the frequency of minimum SWR on 15 meters. To raise frequency, telescope the sliding sections F-G closer together. To lower frequency, slide them farther apart.

2. Determine the frequency of minimum SWR on 20 meters. To raise or lower frequency, adjust the total length of sections H through K by varying the amount of overlap between sections H and I a few inches at a time.

3. Determine the frequency of minimum SWR on 10 meters. The 20 meter adjustment also determines the 10 meter resonant frequency, but resonance on both bands is so broad that slight adjustments for the sake of improved SWR on one band will not appreciably affect SWR on the other.

4. Determine the frequency of minimum SWR on 40 meters. Adjustment may be made by loosening the lower clamp of the 40 meter resonator coil (section E)

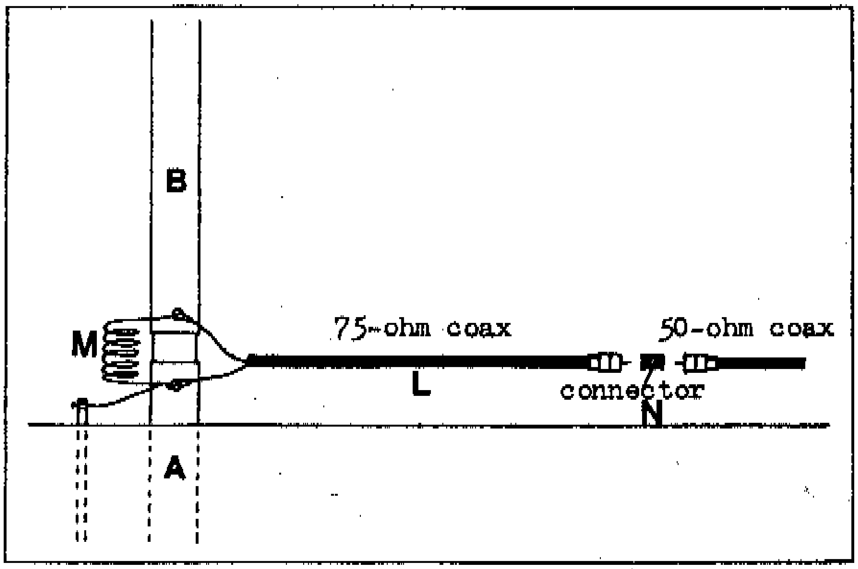
   and compressing or expanding the spacing between coil turns to lower or raise frequency, respectively. One half-inch of travel will move the frequency of minimum SWR by approximately 70 Khz. When the proper setting has been found, tighten the lower clamp in place.

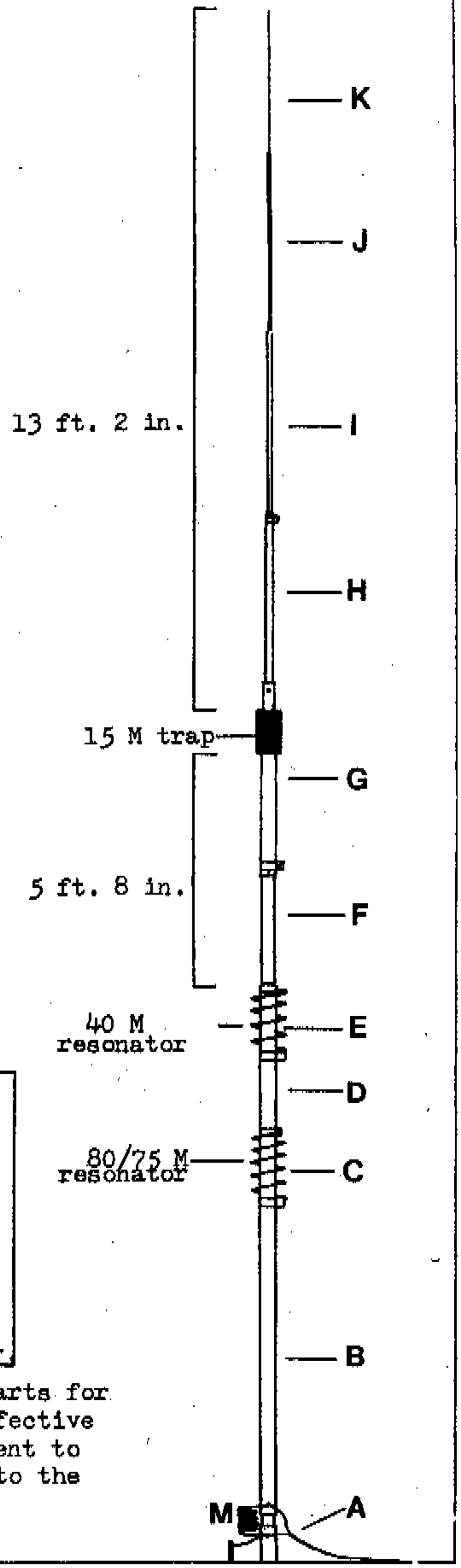
5. Determine the frequency of minimum SWR on 80 or 75 meters. Adjustment is made as in the preceding step by repositioning the lower clamp on the 80/75 meter resonator coil (section C). When the proper setting has been found and the lower clamp tightened, adjust the impedance matching coil at the base of the antenna by spreading the turns farther apart or squeezing them closer together until the SWR drops to a new minimum value. One adjustment of the impedance matching coil should suffice for operation over the entire 3500-4000 Khz range, provided that the necessary readjustments are made to the 80/75 M resonator coil. In general, the 40 and 80/75 meter adjustments will not appreciably affect adjustments previously made for 20, 15, and 10 meters. However, if the 80/75 meter tuning is readjusted for operation at a much higher or lower frequency, it may be necessary to readjust the 40 meter tuning as in step 4 in order to maintain SWR of less than 2:1 at both band edges.

Finally, it should be remembered that SWR will depend to some extent on losses in the ground connection and that low SWR readings do not necessarily mean that an antenna is operating efficiently. In any case, there is no point in expending great effort to attain SWR readings significantly below 2:1 over the operating range on any of the five bands, as the difference between 2:1 SWR and a perfect match would be negligible in the average case.

BUTTERNUT ELECTRONICS CO.
ROUTE 1, LK. CRYSTAL, MN. 56055

MODEL HF5V--II VERTICAL ANTENNA
PICTORIAL DIAGRAM



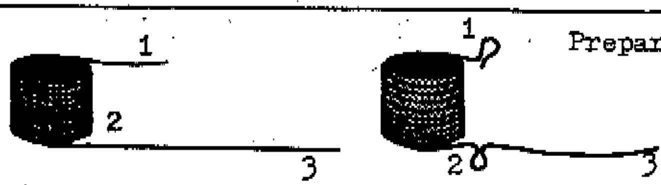


Safety first! Do not install the antenna where it can contact power lines during or after installation!

High R.F. voltages can appear on the exposed resonator coils--a protective fence around the antenna is recommended if there is a chance of people touching them during operation.

Remember that the transmitter chassis will be connected to the braid of the coaxial feedline. A good earth ground to the transmitter chassis will reduce the danger of shock when making adjustments at the antenna.

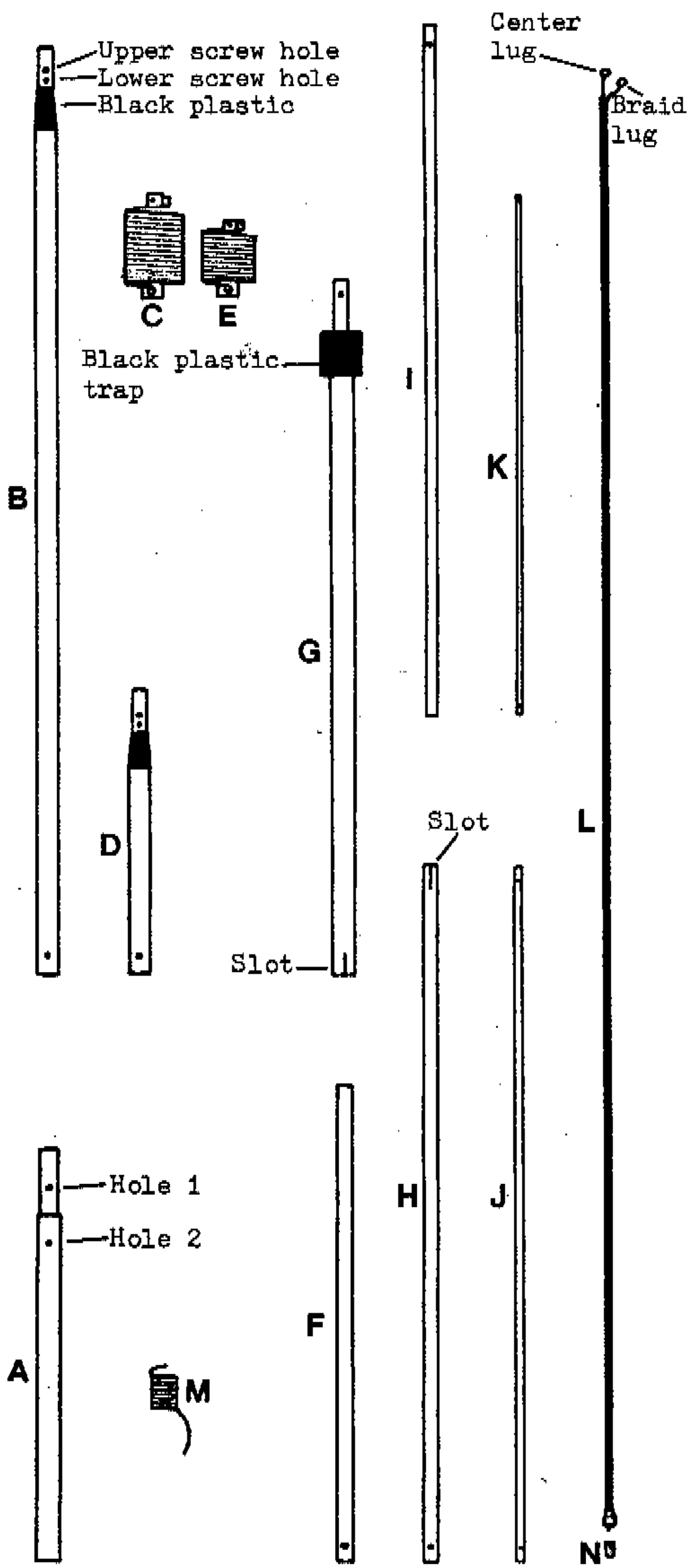
Preparing coil (M).



1. Using a knife, scrape 1½ in. of enamel insulation from points 1, 2, and 3. Be sure the copper is bright and clean.

2. Bend two of the clean areas (1 and 2) into loops for connection later. The clean areas may be tinned with solder.

Warranty: Butternut will repair or replace defective parts for a period of 90 days following the date of purchase. Defective parts, if returned for repair or replacement, must be sent to the factory. The purchaser bears the cost of shipping to the factory; we pay the return shipping.



Parts List

(A) Mounting post with fiberglass insert

(B) 80m resonator capacitor section (5-½ ft.)

(C) 80m resonator coil

(D) 40m resonator capacitor section (20 in.)

(E) 40m resonator coil

(F) 1 in. x 33 in. tube, screw at bottom

(G) 15m trap section, bottom slotted

(H) 3/4 in. x 4 ft. tube, top slotted

(I) 5/8 in. x 4 ft. tube, screw hole in top

(J) 1/2 in. x 4 ft. tube, large screw hole in bottom, small screw hole in top

(K) 3/8 in. x 3 ft. tube, screw hole in bottom, top closed.

(L) Coaxial matching section

(M) Impedance matching/dc grounding coil, enameled copper wire

(N) Double female coax connector

Hardware Packets:

1. #8 hardware

2. clamps, self-tapping screws

THEORY OF OPERATION

The HF5V-II operates as a full quarter-wavelength radiator on 15 meters, using a parallel-tuned decoupling trap to isolate sections K through H from the lower antenna sections on this band. On 20 meters the entire antenna length is active, and the antenna operates with a physical length of approximately 3/8 wavelength. This length is resonated by the capacitive reactances of the 80/75 and 40 meters resonator circuits and by the inductive reactance of the 15 meter trap. 20 meter radiation resistance is much higher than that of conventional trapped or monoband quarter-wave verticals, and overall efficiency is considerably better. 10 meter operation is similar to that on 20 meters, and the antenna functions as a 3/4 wavelength radiator with improved low-angle radiation characteristics and much greater efficiency than quarter-wave types. On 40 and 80/75 meters, the appropriate resonator circuits provide the inductive reactances required for resonance, and the 15 meter trap provides a slight amount of additional inductive reactance. Because of the higher than normal radiation resistance on 20 meters, the impedance at the base of the antenna is in the neighborhood of 100 ohms on that band. An electrical quarter wavelength section of 75-ohm coaxial cable is used as a matching transformer for the 50 ohms impedance of the main transmission line. This matching section does not appreciably affect impedance matching on the other bands.

SERVICE

In case of difficulty during installation or operation, please feel free to write or call for assistance.

BUTTERNUT ELECTRONICS CO.
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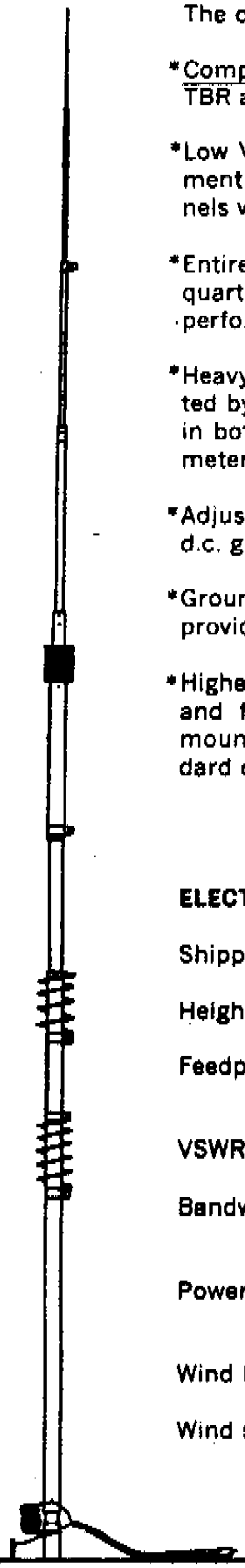
Data Sheet: Model HF5V-II



The only really NEW 80-10 meter vertical design in 20 years!

*Completely automatic bandswitching 80-10 meters (160-10 meters with optional TBR add-on unit).

*Low VSWR over entire 40, 20, 15 and 10 meter bands plus any 60-100 Khz segment of 75/80 meters. May also be used on adjacent M.A.R.S. and C.A.P. channels with little or no adjustment. NO ANTENNA TUNER REQUIRED!

*Entire radiator length is active on 80/75, 40, 20 and 10 meters (full physical quarter-wave resonance on 15 meters) for greater bandwidth and superior DX performance.

*Heavy duty air-wound resonator inductors for 75/80 and 40 meters are unaffected by moisture and may be slide-adjusted for minimum VSWR at any frequency in both bands -- no need to take the antenna down to QSY between 75 and 80 meter band segments!

*Adjustable shunt inductor at antenna base for lowest 80/75 meter VSWR and d.c. grounding on all bands.

*Ground or roof/tower mounting -- no guys required! Complete instructions provided.

*Highest quality construction and workmanship: high-strength aluminum alloy and fiber glass used throughout. Comes complete with 1-1/8" O.D. tubular mounting post, RG-11/U matching line and double-female connector for standard coax plug and any length of 50-53 ohm cable.

ELECTRICAL AND MECHANICAL SPECIFICATIONS:

Shipping weight: 12 lbs./5.4 Kg.

Height: 26 ft./7.8 meters

Feedpoint impedance: nominal 50 ohm on all bands with included matching section.

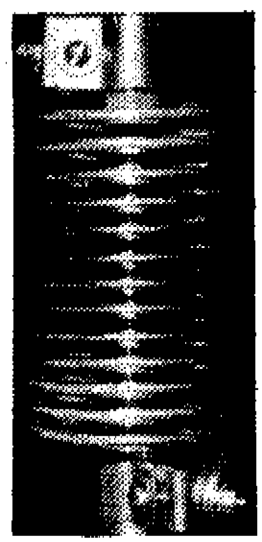
VSWR at resonance: 1.5:1 or less on all bands.

Bandwidth (for 2:1 or less VSWR): entire 40, 20, 15 and 10 meter bands; 60-100 Khz on 75/80 M.

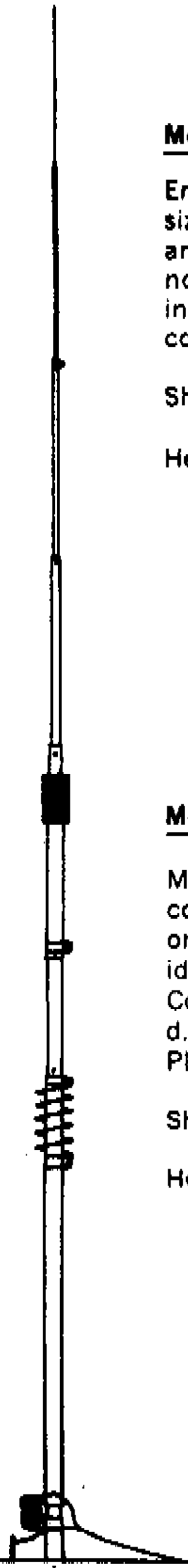
Power rating: legal limit SSB/C.W. 40-10 meters; 1200 W P.E.P./ 500 W C.W. 75/80 meters.

Wind loading area: 1.5 sq. ft./.14 sq. meters

Wind survival (unguyed) rating: 80 m.p.h./128 Km.p.h.



Resonator



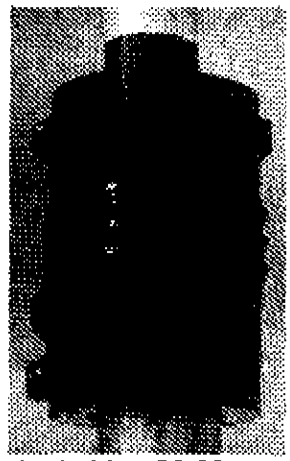
Model HF4V-II - - Automatic bandswitching 40-10 meters.

Entire radiator length is active on 40, 20 and 10 meters (full size quarter-wave resonance on 15 meters). Same construction and 40-10 meter specifications as model HF5V-II except as noted below. Comes complete with mounting post, base shunt inductor for d.c. grounding, RG-11/U matching section, and connectors for PL-259 and any length of 50-53 ohm cable.

Shipping weight: 9 lbs./4 kg.

Height: 25 ft./7.5 meters.

Trap



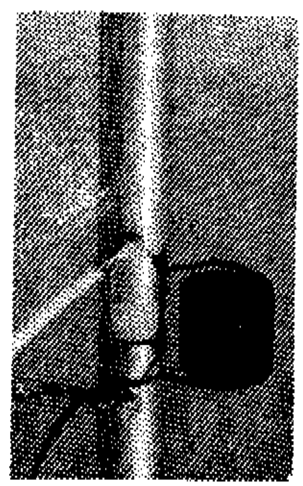
Model HF3V - - Automatic bandswitching 80-20 meters.

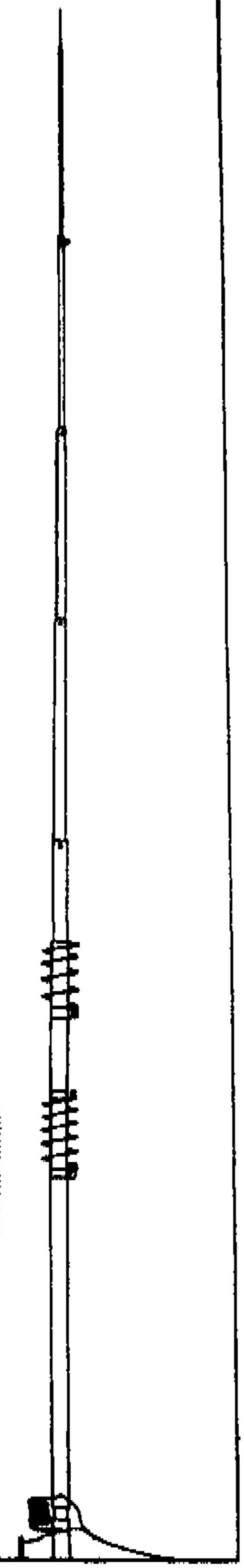
May also be used on 10 meters with low VSWR. Same rugged construction as models HF5V-II and HF4V-II. Will not operate on 15 meters without a tuner, but specifications are otherwise identical to those of model HF5V-II except as noted below. Comes complete with mounting post, base shunt inductor for d.c. grounding, RG-11/U matching section, and connectors for PL-259 and any length of 50-53 ohm cable.

Shipping weight: 10 lbs./4.5 kg.

Height: 25 ft./7.5 meters

Base





HF4V-II

HF3V

NOTES ON GROUND / RADIAL SYSTEMS FOR VERTICAL ANTENNAS

Ground Mounting:

A vertical antenna in its simplest form, is electrically equivalent to one-half of a dipole antenna stood on end. When the antenna is mounted close to the ground, the earth below takes the place of the "missing" half of the dipole. If ground conductivity is fair to good, a short metal stake or rod may provide a sufficiently good ground connection for resonant and low SWR operation on the bands for which the antenna is designed. This basic arrangement is shown in figure 1. In almost every case, however, the efficiency of a vertical antenna will be greater if radial wires are used to improve ground conductivity as in figure 2. Wire size is unimportant, and the radials may be of any convenient length. They need not all be the same length, nor do they have to be laid in a straight line . It is generally more convenient to slit the sod and to push the radials into the slits to a depth of several inches, but they may be left on the surface of the ground if they do not constitute a hazard. A large number of long radials will naturally be more effective in reducing ground losses than a small number of shorter ones, but one should remember that the greatest loss will occur in the earth near the base of the antenna where current flow is greatest. For this reason it is generally better to use a larger number of radials of shorter length than a smaller number of longer ones for a given amount of wire.

In some cases wire mesh (e.g., chicken wire) may be used as a substitute for radial wires and/or a ground connection, the mesh or screen acting as one plate of a capacitor to provide coupling to the earth beneath the antenna. It should be noted that a ground rod is useful only as a d.c. ground or as a tie point for radials. It does little or nothing to reduce ground losses at r.f., regardless of how far it goes into the ground.

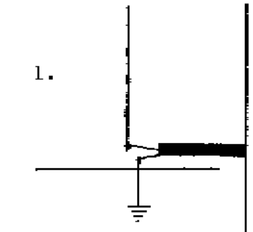
Above Ground Mounting:

It is possible to operate a vertical antenna at any height above ground provided that something be done to supply the equivalent of a ground connection. It is not enough to run a long lead to a ground stake or to a cold water pipe, for current will flow in the lead, making it part of the overall antenna length and detuning the antenna on one or more bands. The usual approach to this problem is to install 3 or 4 resonant quarter-wave verticals at the base of an elevated vertical and to connect them to the braid of the coaxial feedline as well as to the supporting mast or tower (if metal). Unlike the ground-mounted case, the length of above-ground radials is important, and the proper length(s) for any band may be found from the formula

$$\text{Length (ft.)} = \frac{240}{\text{Frequency in Mhz}}$$

Four such radials, equally spaced, would be the equivalent of a highly conductive ground plane for any band at antenna base heights of 1/2 wavelength or more. In addition to providing a ground plane, radials of the proper length act as decoupling stubs to choke off current flow on any d.c. ground lead or grounded mast or tower, thus eliminating the detuning effect noted above. The basic ground plane system is shown in figure 3. Radials may be run parallel to the earth or sloped downward any convenient amount without seriously affecting antenna feedpoint impedance or performance. Figure 4 shows a multi-band system using a separate set of radials for 40, 20, and 10 meters. Inasmuch as the 40 meter radials are also resonant on 15 meters, a separate set is not required for that band. This same system will also provide enough capacitive coupling to ground for resonant operation on 75 or 80 meters at antenna base heights below about 40 feet. At greater heights one or more radials may be required for those bands.

1.



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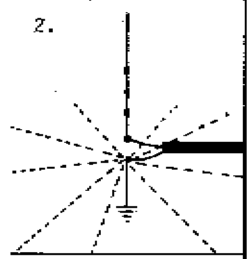

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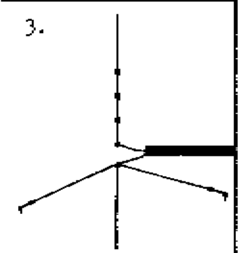
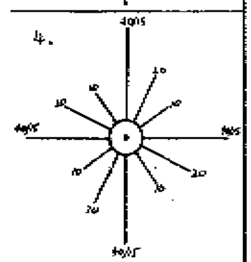


4.



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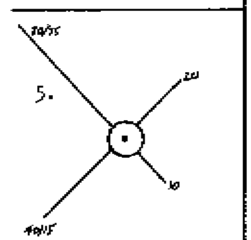


Figure 5 shows a simpler system which uses a single resonant radial for 80/75, 40/15, 20, and 10 meters. With this arrangement the antenna resembles a bent dipole on any one band, and the radiation pattern contains both horizontal and vertical components. The system in figure 4, however, produces omnidirectional vertically polarized radiation.

Figure 6 illustrates the construction of a multi-band radial which is resonant on 40, 20, 15, and 10 meters. Good quality 300-ohm ribbon should be used, and the conductors should employ at least one strand of steel wire to support the weight of the radial. Four such radials will be the practical equivalent of the system shown in figure 4 for operation on 80 through 10 meters.

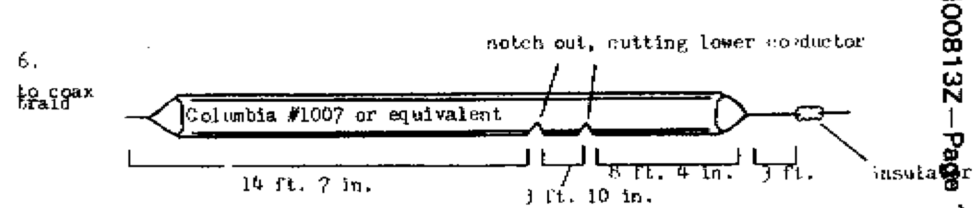
Regardless of the specific system used, radials should be well insulated at their far ends and kept well clear of large masses of metal or other conductors that could cause detuning.

Other mounting schemes:

In cases where a resonant vertical antenna may neither be ground mounted nor used with an elevated ground plane, operation may still be possible if connection can be made to a large mass of metal that is directly connected or capacitively coupled to ground, e.g., central air conditioning systems or structural steel frames of apartment buildings. Some amateurs have reported good results with vertical antennas extended horizontally or semi-vertically from metal terraces which serve as the ground connection. Alternatively, a quarter-wave vertical may be window mounted if a short ground lead to a cold water pipe or radiator can be used. If a long lead must be used, tuned radials may be required for resonance on one or more band. Great care should be exercised in such installations to avoid power lines and to keep the antenna from falling onto persons or property.

The metal shells of camper trailers, vans and mobile homes may also be used as ground systems for vertical antennas. Whenever possible, the antenna should be mounted with its base close to the top of the roof and the shortest possible ground lead should be used. Even so, tuned radials may be required for low SWR on one or more bands.

6.



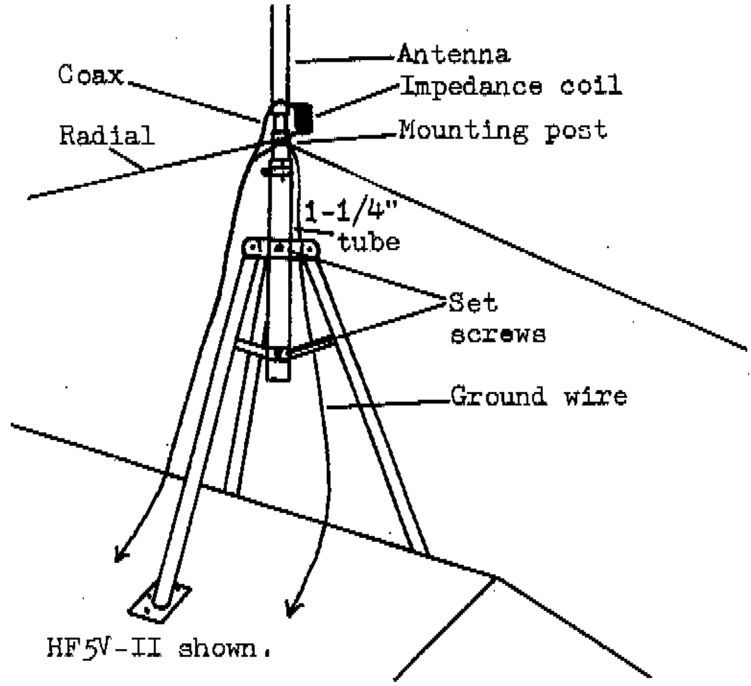
BUTTERNUT ELECTRONICS CO.

ROUTE 1, LK. CRYSTAL, MN. 56055

Roof Mounting Instructions: Butternut Vertical Antennas (8-78)

During assembly and installation take care to avoid contacting power lines with the antenna or any part of the radial/ground system. Do not run wires above or below power lines. See NOTE: Step 4 on safe installation.

1. Install the tripod tower at the peak of the roof as shown. Use lag screws to secure the tower firmly to the roof. Lag screws are best installed if a starter hole is made for each one first. Although leaks are not usually a problem, you may wish to cover the three base plates of the tripod with sealant.



HF5V-II shown.

2. Loosen the set screws at the top and middle of the tower and install the 1-1/4 in. x 2 ft. slotted tube. (Provided with roof mount kits only.) The slotted end must be up. Install a stainless steel hose clamp over the slotted end.

3. Tighten the set screws to secure the 1-1/4 in. tube. Do not overtighten, as this will prevent the mounting post from sliding in smoothly.

4. Install the assembled antenna by telescoping the mounting post into the 1-1/4 in. tube 1 ft. 10 in. (nearly as far as it will go), and tighten the clamp. NOTE: If the roof is steep, or if there is no help to stabilize the antenna as it is going up, you may wish to install it in the tripod on its side, and walk or pull the antenna up, hinging it on two of the tripod's base plates. Alternatively, the mounting post may be installed, and the antenna placed on top of it. SAFETY FIRST! Although the antenna is not heavy, it may be hard to handle alone or in a wind. A safety belt should be used if working alone!

5. Connect radials and a ground wire to the screw holding the fiberglass in the mounting post, to the clamp on the 1-1/4 in. tube, or to the extra wire coming from the ground side of the impedance coil. (Solder if connected to the wire.) <u>THE LEAD TO THE RADIAL SYSTEM MUST NOT BE OVER SIX INCHES LONG.</u>

To avoid a possible shock hazard, be sure that the rig is well grounded and/or disconnected from the AC mains before proceeding.

6. Connect a 50-53 ohm coaxial feedline and proceed with checkout and adjustment.

Alternate Method of Raising Antenna: