

## DX GROUND PLANE ANTENNA By Don HC4/W4BWS

Versions of this antenna has been used since 1958 at various locations and copied by several others. It has always provided DX as well as contacts within the USA. It is low cost compared to commercial aluminum verticals, easy to assemble and simple to erect, if a high tree or rooftop with a vent pipe is available, as it permits very flexible installations.

My last installation in Florida was self-supporting sitting in a vent pipe, which sticks out above the roof. The vent pipe was too short to permit two vent pipe mounts to hold the mast. So a cross piece was attached to the mast and the bottom of the mast inserted 3 feet down into the vent pipe. Your installation will depend on your individual situation.

After moving to South America I needed a simple antenna to get back on the air. Locally there was no supplier of aluminum for a vertical. However wood, wire, screw-in eyebolts and long bolts were available. So were 30-foot long bamboo poles to mount the vertical. So again I built this old standard vertical antenna. Several hams asked me to describe the antenna after hearing my 100-watt signal on the air. So I wrote this paper to describe how to build this DX Buster antenna.

The antenna consists of a 22 foot long 2X2 mast, or two 12 foot pieces may be bolted together, and the radiators are #12 or #14 copper house wire with plastic coating. The radials may be cut from 4 or 5-conductor rotor cable or made from individual wires.

The radiators are  $\frac{1}{4}$  lambda (wavelength) long and the radials the same plus 5 percent.

Construction:

The Mast:

Chose a straight, dry piece of 2X2 lumber (which usually measures 1.5 by 1.5 inch) and give it 3 coats of marine varnish or good quality house paint before you start assembly. Don't forget the ends of the 2X2s.

While the paint is drying, cut the radiator and ground plane wires to length allowing 2 additional inches for connections on one end. Strip the insulation off of two 8-inch pieces of the copper wire. These pieces will be used to connect the radiators together at the feed point.

If you selected two 10 or 12 foot lengths of 2X2, overlap the pieces for 24 inches. Mark a spot 6 inches from the end of one overlap section and another spot 12 inches from the first. These will for bolting the sections together. Drill a clearance hole to pass a 4-inch long  $\frac{1}{4}$ -20 bolt or the metric equivalent.

Secure the sections together with a bolt in each hole, with a large flat washer on each side against the wood. Secure the bolts with a 1/4-20 lock washer and nut. For weather protection coat the hardware with several coats of spray aluminum paint or house paint.

The radiators:

Measure out the 4 or 5 conductor rotor or other wires and cut 3 pieces at 17 feet overall. If you are using a 50-foot roll of rotor cable, one radial group will be 16 foot long. That is OK. The following applies to each of the rotor cable conductors but is similar applied to single wires.

On one end strip 2 inches of insulation from the conductor, being careful not to nick or damage the copper conductor. Twist the wire ends together and solder the twist. Measure from the insulation on the stripped end and cut the ribbon cable as shown in the drawing so that two adjacent outside wires are 16 foot 10 inches long. They should be already this long if you cut the cable correctly. The middle conductor is 12 foot 11 inches, the 4<sup>th</sup> conductor is 11 foot and the 5<sup>th</sup> conductor is 9 foot 5 inches. Next strip 2-inches of insulation from the end of the 16 ft 10 inch conductors, twist together and solder the wires.

Place an insulator over the two wires just soldered, wrap the wires back over themselves for 5 to 6 turns and secure by over wrapping with black electrical tape. Be sure to cover the soldered wires. Attach the non-conducting support line to the other end of the insulator. I used 1/2 inch plastic water pipe, which was available, for insulators.

Now repeat this for 2 or 3 more radial groups. Individual wire can be cut to proper lengths and taped together to make the radials.

Installing the radiators.

On the 18 to 0 foot mast, measure up 2 to 3 feet if installing on a vent pipe. If mounting to a mast or pipe 2 feet should be adequate. Install the cross 2X2 for vent pipe installation. Above the mounting location about 3 inches install an eyebolt. Above that 2 inches install a second eyebolt. Three inches higher install the TV line standoffs around the mast, one for each conductor. The remainder of the TV standoffs will be installed as the radiator conductors are fixed into position on the mast.

The radiators are mounted by first taking the 8-inch length of bare copper wire, passing it through the top eye bolt, wrapping it around the mast, and twisting the ends together. You can shorten the wire as needed to make a neat installation, allowing adequate room to install each radiator wire to the bare wire loop and solder them.

Each radiator has a stripped end, which is wrapped around the wire loop after the wire end has been run through the lower TV standoff This can be soldered now or later solder all the radiators at one time.

The radiator is then run straight along the mast as far as it is long. Install a second TV standoff insulator and secure the radiator to it by passing the wire through the eye and wrapping it back on it self for 5 or 6 turns. Over wrap with black electrical tape.

There is no particular sequence to add the radiators, however the 10-meter radiator should be opposite the 20-meter radiator in case the 20-meter wire has to fold over at the top to the opposite side of the mast, due to its length. This may require a TV standard at the top end of the mast and another at the end of the 20-meter radiator. This fold over will not affect the operation of the antenna.

After all radiators are installed, solder the connections to the bare copper wire loop. These connections should be covered well with tape, coax-seal or RTV after the feed line is soldered to the rings.

The radials are connected next. Take another 8-inch length of bare copper wire and run it through the lower eyebolt similar to the radiator installation. Take the stripped end of the radials, where all 5 wires are soldered together, and attach it to the bare copper ring. Solder these connections being careful not to melt the wire insulation. A minimum of 2 radial sets should be used, but more that 4 are not required on elevated radials.

Select the coax feed line to be used. RG 58 type is adequate up to 500 watts if 50 feet or less is used. Over 50 feet or 500 watts, use RG8 or better cable. Determine the length needed and carefully strip the outer insulation on one end for 6 inches, taking care not to cut or nick the shield wires. Using a nail or awl end, carefully open the braid and pull the center conductor and insulation through a hole in the braid at the end of the outside insulation. Twist the braid together and cover with plastic tubing or tape to weatherize it.

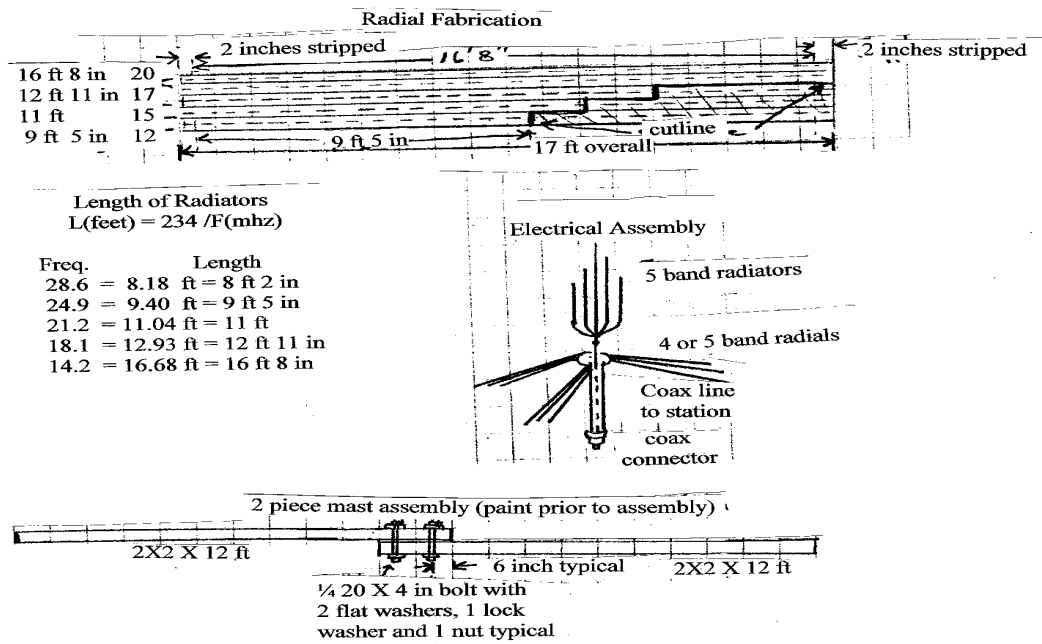
Trim the center conductor insulation to allow one inches of bare center conductor. Seal the end of the coax outer insulation and the center conductor insulation to prevent moisture from entering the coax. Solder the center conductor to the ring with the radiators. Solder the shield to the lower ring with the radials.

Seal all the solder connections. Tape the coax to the mast or secure with plastic cable ties. If desired, a coax balun can be installed below the feed line connection or the feed line can be coiled with 12 turns of coax on a 4 to 6 inch form. This will help to reduce feed line radiation. If desired to hang the vertical from a high tree, an eyebolt can be screwed into the top of the mast to attach a rope. The antenna is completed.

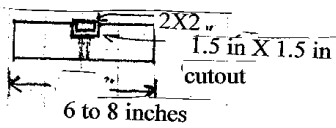
The antenna can be attached to a chimney or vent pipe using mounts designed for this purpose. Or it can be installed on a pipe mast using 2 or 3 adjustable hose clamps. If possible mount it so the radials can be run at a slope of about 45 degrees down from horizontal to assist matching to the antenna.

If the antenna is to be installed in a vent pipe and the cross 2X2 has been installed, then the antenna can be raised and dropped into the vent pipe opening. The 2X2 crosspiece will sit on the top of the vent pipe and support the mast.

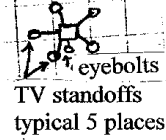
Operation on 30, 40 or 80 meters is possible by making a shorted coax connector to mate to the connector at the radio end of the coax. The center pin of the connector can be fed as an end fed wire with an antenna tuner. This utilizes the coax shield and center wire plus the antenna wires as a random end fed wire. A good ground connection or 1/4 wave counterpoise wires will be necessary for each of these bands.



Top view of 2X4 used for Dropping in vent pipe

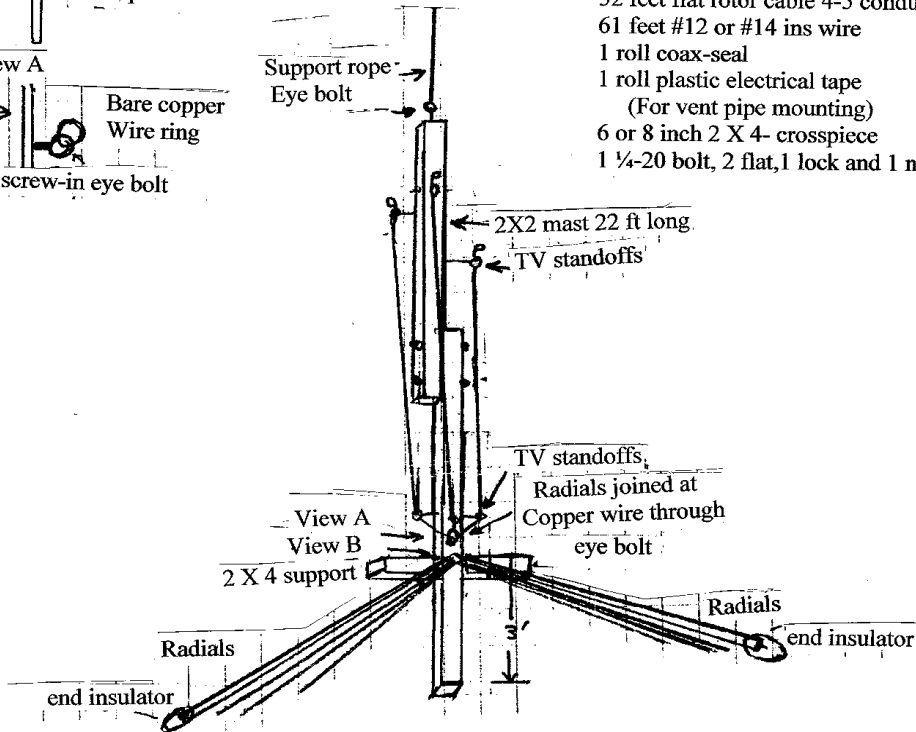
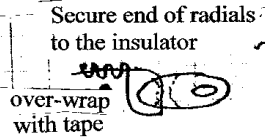
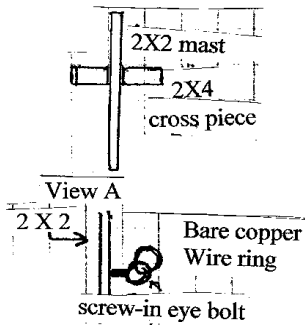


Top view of 2X2 mast



List of Materials

- 1 each 2X2X20 ft straight wood alternate:
- 2 each 2X2X 12 ft
- 2 each 1/4-20 X 4 in bolts
- 4 each 1/4 in large flat washers
- 2 each 1/4 inch lock washers
- 2 each 1/4-20 nuts
  
- 3 each screw-in eyebolts
- 11 each screw-in TV standoffs or small eyebolts - long screw
- 3 each antenna end insulators
- 52 feet flat rotor cable 4-5 conductor
- 61 feet #12 or #14 ins wire
- 1 roll coax-seal
- 1 roll plastic electrical tape (For vent pipe mounting)
- 6 or 8 inch 2 X 4- crosspiece
- 1 1/4-20 bolt, 2 flat, 1 lock and 1 nut



Radial Fabrication

2 inches stripped  
 16 ft 8 in 20 9 ft 5 in 2X2 mast  
 12 ft 11 in 17 cutline  
 11 ft 15 2X4 cross piece  
 9 ft 5 in 12 17 ft overall

Top view of 2X4 used for Dropping in vent pipe  
 2X2 1.5 in X 1.5 in 6 to 8 inches cutout  
 Secure end of radials to the insulator over-wrap with tape

Electrical Assembly  
 5 band radiators  
 4 or 5 band radials  
 Support rope  
 Eye bolt  
 Top view of 2X2 mast

Coax line to station coax connector  
 TV standoffs typical 5 places  
 eyebolts

2X2 mast 22 ft long

TV standoffs  
 TV standoffs  
 2 X 4 support  
 Radials Radials Radials  
 Radials joined at  
 Copper wire through eye bolt

View A View B end insulator end insulator  
 View A and B typical 2 X 2  
 Bare copper screw-in eye bolt  
 Wire ring

2 piece mast assembly (paint prior to assembly)  
 2X2 X 12 ft 2X2 X 12 ft 6 inch typical

1/4 20 X 4 in bolt with  
 2 flat washers, 1 lock washer and 1 nut typical

Length of Radiators  
 $L(\text{feet}) = 234 / F(\text{mhz})$

Freq. Length  
 28.6 = 8.18 ft = 8 ft 2 in  
 24.9 = 9.40 ft = 9 ft 5 in  
 21.2 = 11.04 ft = 11 ft  
 18.1 = 12.93 ft = 12 ft 11 in  
 14.2 = 16.68 ft = 16 ft 8 in

List of Materials  
 1 each 2X2X20 ft straight wood alternate:  
 2 each 2X2X 12 ft  
 2 each 1/4-20 X 4 in bolts  
 4 each 1/4 in large flat washers  
 2 each 1/4 inch lock washers  
 2 each 1/4-20 nuts  
 3 each screw-in eyebolts  
 11 each screw-in TV standoffs or small eyebolts - long screw  
 3 each antenna end insulators  
 52 feet flat rotor cable 4-5 conductor  
 61 feet #12 or #14 ins wire  
 1 roll coax-seal  
 1 roll plastic electrical tape (For vent pipe mounting)  
 6 or 8 inch 2 X 4- crosspiece  
 1 1/4-20 bolt, 2 flat, 1 lock and 1 nut