Assembly Hints for Double Cross Antenna

General List of Materials

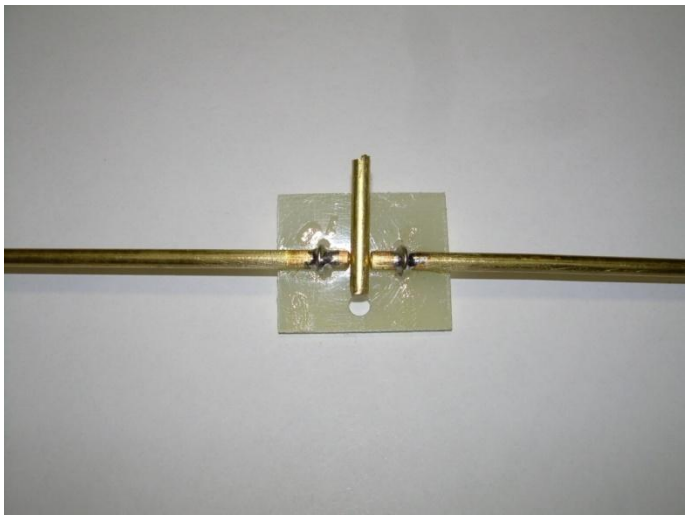
8 36 inch long 1/8 inch diameter solid brass rods, Home Depot, $3.87 each
1 10 foot long piece of 3/4 inch diameter schedule 40 Plastic Pipe, Lowes
4 3/4 inch 'T''s, Lowes
8 3/4 inch end caps, Lowes
1 5 Hole, round outdoors electrical junction box, Home Depot
1 Aluminum Top cover with gasket for junction box, Home Depot
4 1/2 inch NPT threaded nipples, 2 inch long, Lowes
4 1/2 inch NPT thread to 3/4 inch plastic pipe female adapters, Lowes
6 bags of Ferrites, 2 each per bag, Radio Shack part number 273-0067
15 Feet of RG-174 Coax Cable
30 Nylon Tie Wraps
1 Piece of insulating material, G-10 printed wiring board with no copper, phenolic or plastic (stiff)

Preparation:

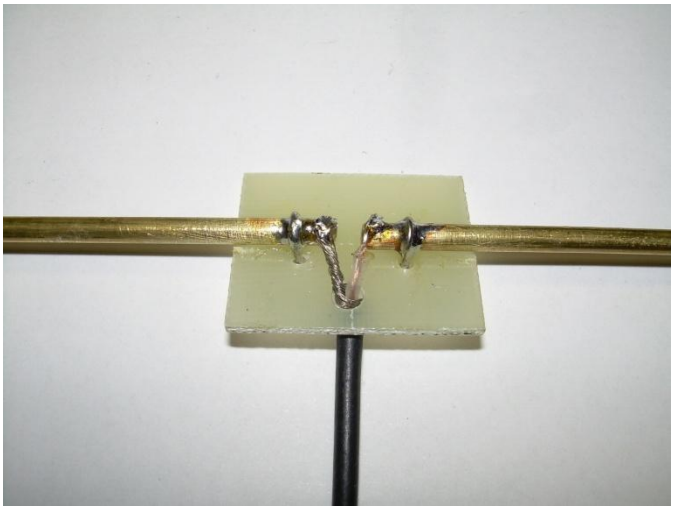
1. Start by cutting 12 pieces of the ¾ inch diameter pipe to 5.5 inches long.
2. Cut each (8) of the brass rods to 20 inches long.
3. Cut 2 pieces of RG-174 cable to 28.3 inches long. Strip and tin 3/8 to 1/2 inch at each end.
4. Cut 2 pieces of RG-174 cable to 42.5 inches long. Strip and tin 3/8 to 1/2 inch at each end.
5. Cut insulating material rectangles (4 each) to a dimension of 0.9 inches wide by 1.1 inches long.

Assembly:

Drill 4 holes in the insulator about 1/4th of the way in, a little more than 1/8th inch spacing. Also drill an 1/8th inch hole near the lower edge and centered. Make a U shaped form of the stiff wire. This will be placed around the brass element and twisted together on the back side to hold the element in place. Put each of two 20 inch elements on the insulating board. Use a piece of scrap rod left over from the cutting to space the elements 1/8th inch apart. Put the U shaped wires over the element, twist together on the back side to secure the elements and then solder the wire to the elements. Do this four times. See following picture.



Route a piece of the RG-174 cable through the hole and solder the cable to the ends of the brass rods. To be consistent, I always solder the center conductor to the right side element and the shield to the left side elements. Do this four times, with each of the cable lengths. Mark the short coax lengths as element 1 and element 2. Mark the other two with the long lengths of coax elements 3 and 4.

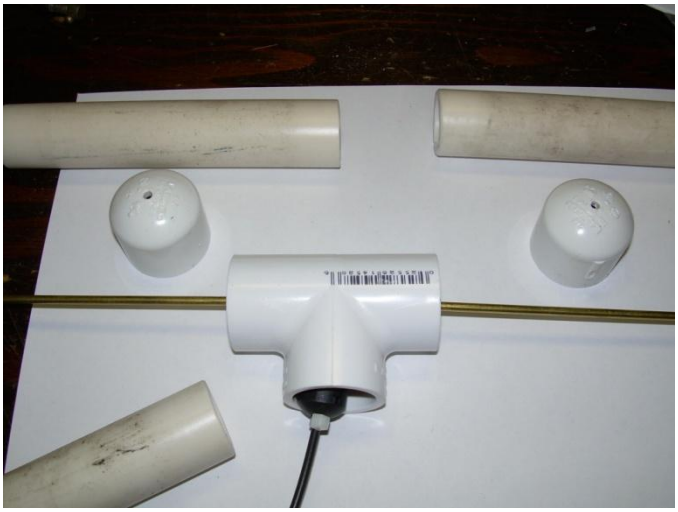


Then, slip the brass rod and insulator with cable through a “T” as shown in the following picture.

Then place the board and elements into the center of the “T”. The length of the insulator will allow for the unit to be centered when the side pieces of pipe are glued in place. The width of the insulator will center the board in the vertical plane.

Next, Install ferrite chokes on each of the four element pieces as shown in the following picture.

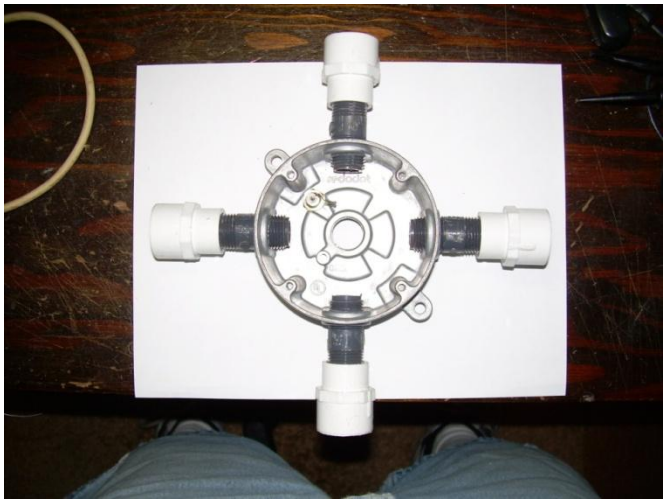
Push the ferrite choke up against the board and hold in place with a nylon tie wrap.



Next we will assemble the element support pipes and end caps and the center spacer pipe.

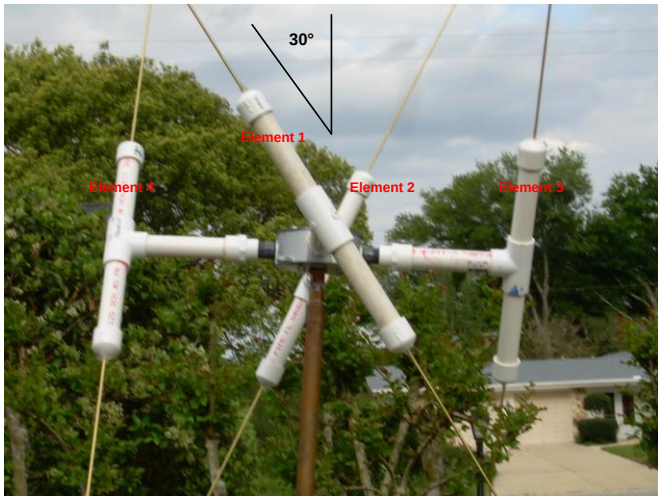
Glue assembly together. Mark the center conductor element as + and mark each of the elements 1, 2, 3, and 4, with 1 and 2 with the shorter piece of coax and the longer piece of coax as elements 3 and 4.

Next, screw in the ½” NPT nipples to the Junction box.

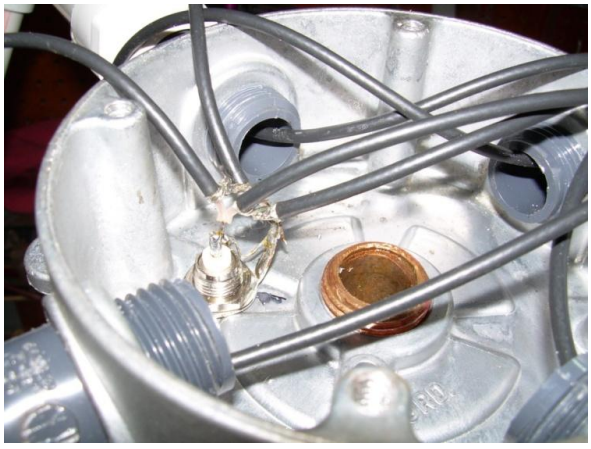


Then screw on the ½ NPT to ¾ inch pipe female. When screwing the nipples and adapters together, make them fairly tight or snug, but not to the limit where they can’t be turned a little. We will use this to adjust the final angles when everything is put together. Now it is time to glue the elements with the horizontal pieces to the adapters. When you glue the pieces together, make sure the + end of the elements, that is the center of the coax, is pointing up. When looking at the assembly, element one is the one closest to you and two is the farthest away. Element three is to your right and four to your left. You can see this in the following picture. Get the elements nearly 30 degrees from vertical

when you glue them in, but don't get too worried as final adjustment can be made by twisting which is allowed because of the threaded pipe adapters. Element three is angled toward you and element four away from you when facing element 1. As you put each element in place, feed the coax through and into the junction box, and drape the surplus over the edge for now.



So now it is time to wire it all up. This is for sure the hardest part. I will try to explain it without a schematic and we'll see how that goes. Remember, the "pointing up" element of each leg is the center of the coax. The element pointing down is the ground or shield of each coax. Element 1 center coax goes to the ground lug. Element 3 center coax goes to the ground lug. Elements 2 and 4 center coax goes to the center element of the connector (BNC or SO-239). The coax shield of element 1 and 2 are connected together and to nothing else. Likewise, the coax shield of elements 3 and 4 are connected together and to nothing else. Each of these should be covered with electrical tape or some insulating material so they do not touch anything else. See the following picture.



We then have to add more ferrites. I went through several iterations. One needs to be placed on each line as it exits the NPT nipple. It still had a serious null at 10° so I added four more, one each at each line at the BNC. It still has a small null at 10°, but not too bad. Also, the first time I coiled all the coax inside the junction box. That wasn't too good, so I unwound the coax and fed it down the mounting pipe. This seemed to be the best and that is how it is now. Once all that is done, put the cover and gasket on the top and go for it!

First try with cable all coiled inside junction box.

The cable was fed through the center hole in a long linear fashion as opposed to all coiled up. Feed lines through center hole and tape together, tightly (It's a snug fit). This seemed to be better than the coiled version, but your results may differ.

Lengths of Coax fed through hole and inside mounting pipe

The antenna, through 50 feet of RG-8X cable, was swept with a VNA to establish its electrical parameters and performance. The plot is shown in the following figure. As can be seen, the VSWR points for 1:1.5 or less are ± 10 MHz centered about 137.5 MHz. The VSWR at 137.5 MHz was 1:1.09. This indicates, from a transmission standpoint, that the antenna is resonant and a good match to the receiver input. Of course, this says nothing with regards to the actual pattern or phase of the antenna.