

Building A 2 Meter Antenna

The Quarter Wave Ground Plane

ABSTRACT

A favorite pastime of many amateur radio operators is building and testing antennas. A vast field, exotic materials, and piles of expensive gear are not required. In this document, materials are listed, steps for building are described, and testing of the final product is demonstrated. Components are inexpensive and readily available from several sources.

The 2 meter quarter wave ground plane antenna is a very simple step up from the 'rubber ducky' or mobile mag mount. Performance is impressive, building skills can be developed, and mounting and testing are easy. The antenna is easy to break down for storage or portable use.

MATERIALS

Experimenting with antennas shouldn't break the bank. Many common household items are easy to work with and some radiate just fine. The most common is the wire clothes hanger. These may be made of 12 or 13 gauge wire, with 14 gauge preferred for this first project.

A wire stripper confirms heavy, lacquered hangers are 12 gauge. A very flimsy hanger checked out to be 14 gauge. ROMEX cable wire is well marked, but it is too soft to use.



The "BNC female flange mount solder post" serves as the foundation of this design. A five-pack is available from Amazon for under \$10. Very small #4 crimp-on ring terminals are used

to connect the ground plane elements to the four corners of the BNC flange mount holes with #4 ring terminals, nuts, and 1/2 inch screws. If #6 hardware is used, the flange mount holes may need to be drilled out slightly larger.

A ten foot length of 3/4 inch, Schedule 40, PVC pipe will be used for the mast. Cut it at 6 feet to get it home. The remainder will be used in later build projects. A four-foot section of iron rebar is used to stabilize the mast at home or on the road.

These materials are all available at Home Depot or Lowe's.

DESIGN

The wavelength in meters of the frequency of our favorite repeater, 146.94 MHz, is the speed of light divided by the frequency, or about $300/146.94$, giving 2 meters. One quarter of 2 meters is 50 cm, or about 20 inches. Our design will include a 20-inch radiating element and four 20-inch ground plane radials. Start long and trim to match SWR and impedance.

A quarter wave monopole mounted against a perfect ground will have an impedance of around 36 Ohms, but by bending the radials down at an angle of around 45 degrees, we increase this to around 50 Ohms while at the same time lowering the take-off angle more towards the horizon. The rule of thumb is match SWR, then match impedance.

CONSTRUCTION

The first step is to deconstruct the hanger. Clip just below the twisted area as this is too hard to straighten. Unfold the hanger and straighten it as well as you can. This can result in a section over 40 inches long – enough for two elements. Repeat a total of three times.

The 14-gauge radiating emitter will be soldered to the center post of the BNC flange mount. The end of the wire may need to be sanded or ground slightly to clean and for a good fit.

The radials will have the small #6 ring terminal crimped at one end. They may be secured with solder for a stronger joint.

Attach the radials to the BNC flange mount using #6 screws and nuts. Bend down at the ring terminal to 45 degrees.

MOUNT THE ANTENNA

Drive the rebar about a foot into the ground (or a five-gallon bucket of sand for apartment dwellers). Fish a long BNC feed line through the 6-foot, 1/2 inch PVC pipe. Attach the antenna and take out the slack so that the BNC panel mount rests inside the end of the PVC pipe. Slide the pipe and feed line over the rebar. This will provide stability and height in an easy-to-setup and take-down solution.

TUNE THE ANTENNA

Straight off of the page, the design is stable and should work across the 2 meter band.

Readers with the NanoVNA can read SWR and impedance on the same chart. The use of other tools is left as an exercise for the reader.

The length of the radiating element affects the SWR. The angle of the radials affects the impedance.

TESTING RESULTS

In the first field test, the SWR is 1.65:1, which isn't all that bad.

The plot shows the SWR minimum to be off the chart to the left, so experience tells us the driven element is too long.

The impedance is 42 Ohms, which is not so great.

1/2 inch was cut from the radiating element as a first guess, and the radials were adjusted to a lower angle.



In the second test, the SWR is 1.4:1 and impedance is 47 Ohms. This is much better.

We see the SWR minimum is still to the left of our target frequency.

Another 1/2 inch was removed, and the radials were lowered further.



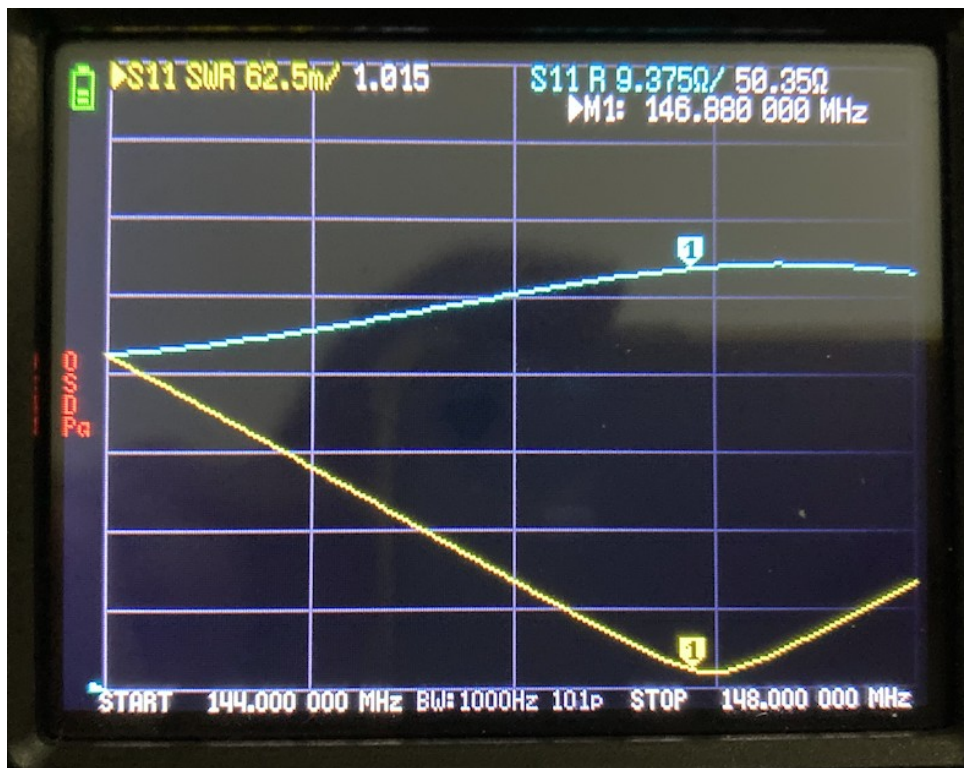
In the third test, the SWR is 1.174:1. This is pretty good. We have increased impedance to 50 Ohms.

The SWR minimum has appeared and is just to the left of the screen.

Another 1/4 inch was removed.



The final SWR is observed to be 1.015:1. Very nice. The impedance is still 50 Ohms. Very fine results! Note we have shot past the minimum, but we aren't going back.



FOOTNOTES

The quarter-wave ground plane is a very easy-to-build antenna. Commonly available parts and simple construction techniques make this a good starter project. This antenna can provide improved performance on handhelds and mobile radios over supplied antennas.

Differences in materials and feed line may influence SWR and impedance. Lengths of different antennas may be different. It is important to learn and use antenna tuning skills.

Using the remaining 2 feet of 1/2 inch PVC pipe as a 'holster', the antenna may be broken down and stowed while not in use, or for use in a 'Go Bag' for portable operation.

