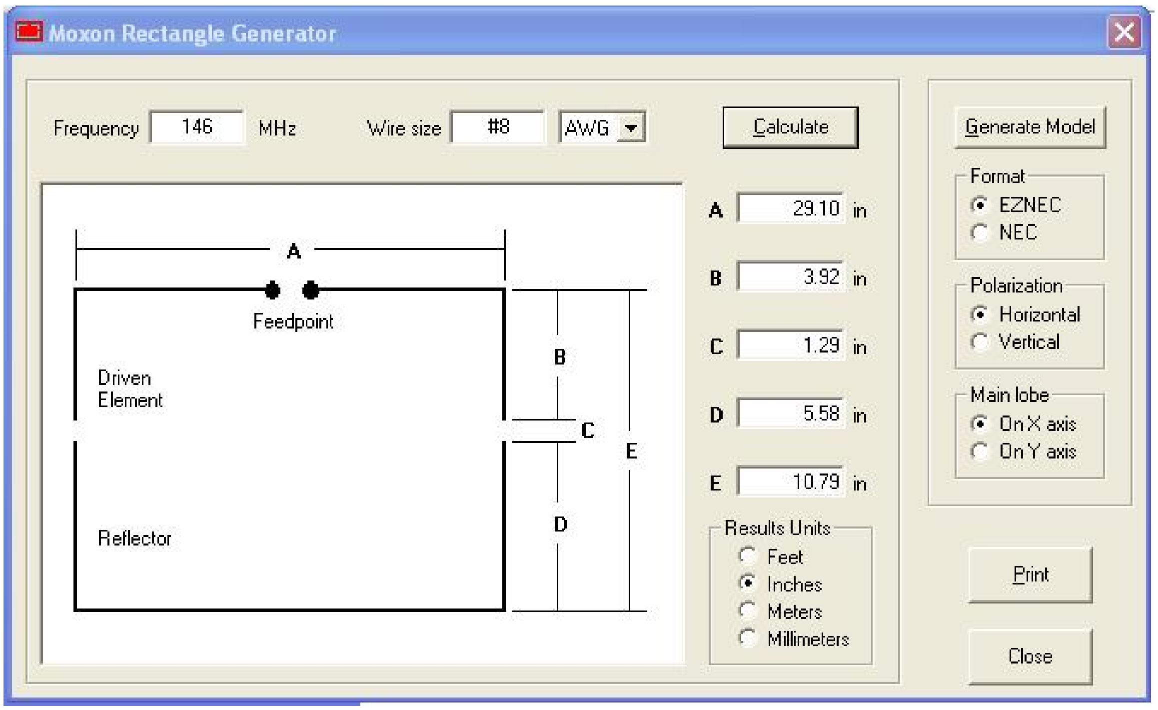
2M Moxon Antenna Project – Montgomery County ARES

2008

Use the Moxon Program to design the antenna.

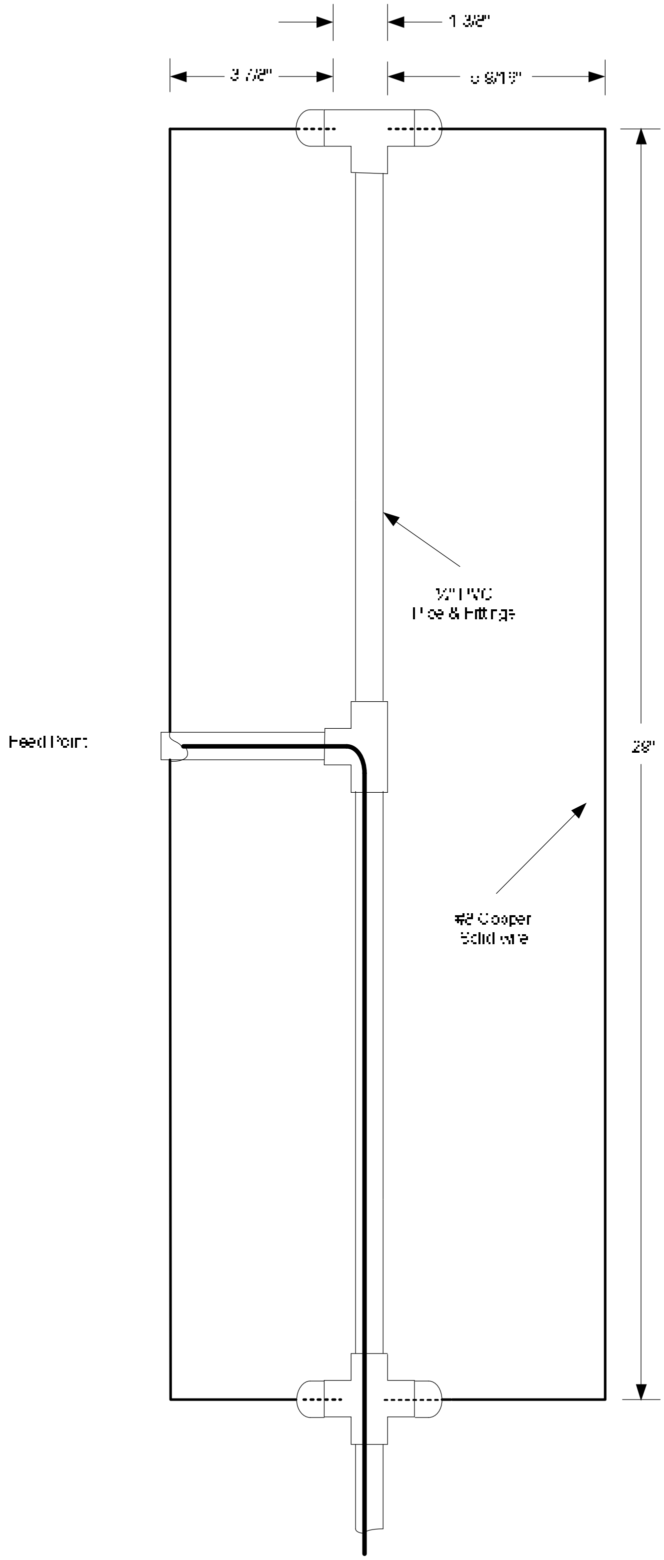


We will use the above dimensions for our antenna. We will use ½" PVC sch. 40 piping and fittings. The PVC items are readily available from the local hardware store and are very inexpensive.

http://www.moxonantennaproject.com/design.htm (download program from here)

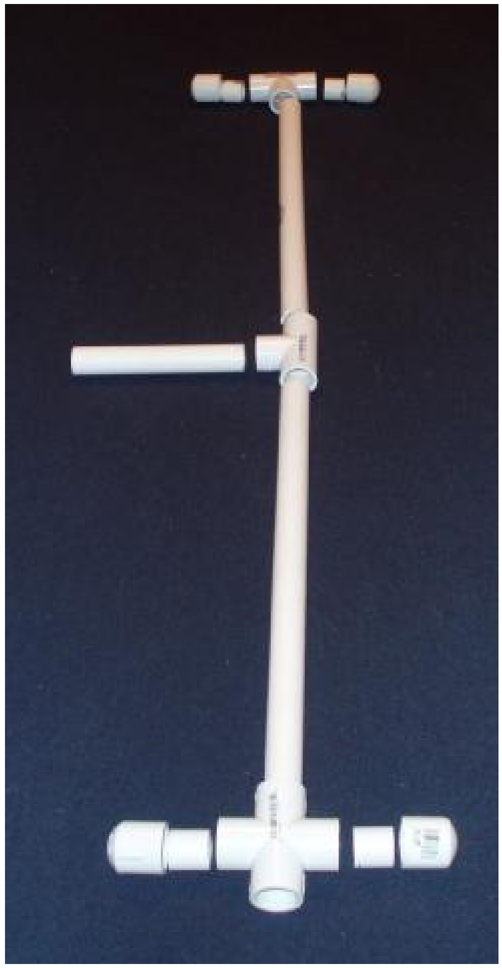
You will need the following parts:

2	½" PVC TEEs
1	½" PVC Cross
4	½" PVC Caps
5'	½" Sch. 40 PVC Pipe (white)
7'	#8 solid copper wire
1	PL-259 & UG-175



2 M
Moxon Beam

We will cut the PVC pipe into pieces:



Making the end assemblies. They consist of 2 - ½" PVC Caps and 2 – PVC pipe sections ~ ¾" long.

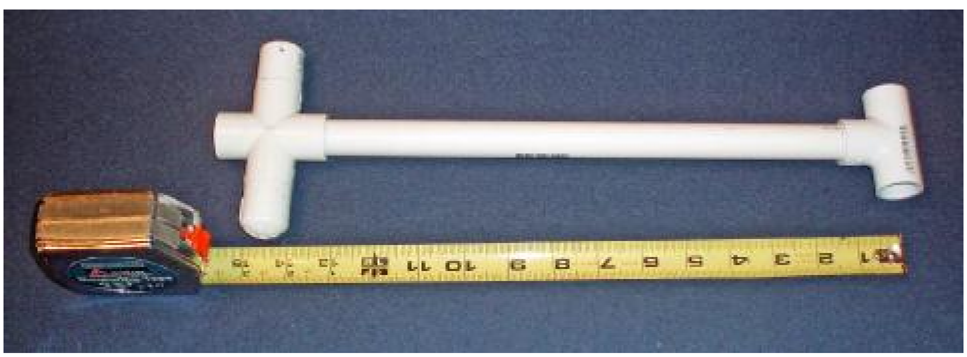
Coat the pieces with the PVC cleaner (purple solvent). Coat the inside of the Cap with the PVC glue and insert the short piece into the Cap approximately half way.

Drill a hole in the middle of the Cap with a size # 17 drill.

Glue the Caps into the TEE and the Cross.

Mark the ends for the center spacing. These marking will be used later to mark the wire so we know how far inside the fitting the wire extends. This is a pretty precise measurement if you want to get the best out of the design.

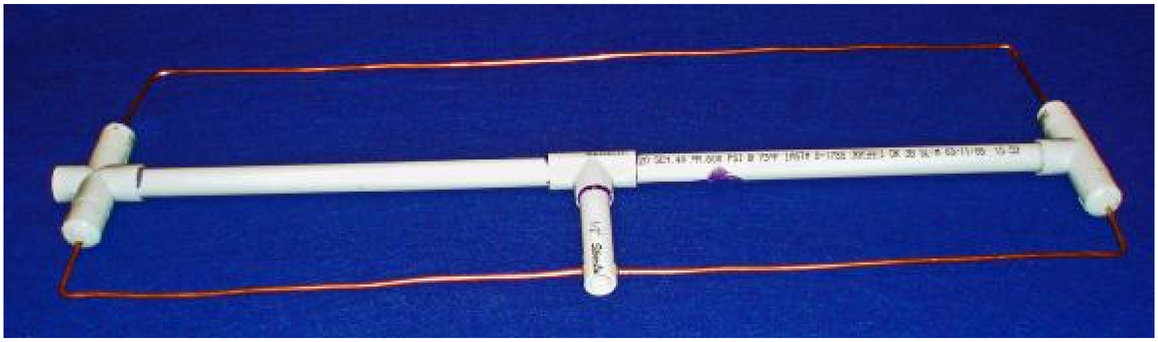
When both end have been marked assembly one half of the antenna. Measure the length between the middle and the center of the cap. This will provide a good performing antenna. The antenna is 29" long so you should have 14 ½" from the center to the hole in the end cap. I turned the Tee so I could get a good measurement and marked the pipe. I turned the Tee around correctly and glued the Tee onto the pipe.



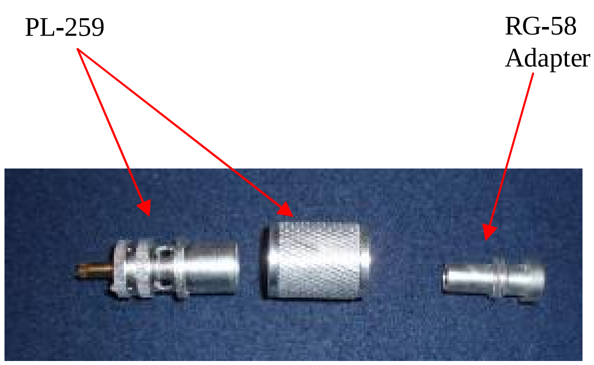
Glue the piece of PVC pipe into the Tee. Layout both pieces and mark the new pipe and glue it. From the hole in the top cap to the hole in the bottom cap should be 29"

When the PVC frame is completed the wires will be attached. Bend the wires according to the design figures. You will have to mark the wires to indicate how far they will be inserted into the PVC caps.

Insert the wires into the frame and we will glue them in using a hot glue gun.



Terminating the Coax



We will use a PL-259 and an adapter. If you are using RG-8 then no adapter is needed. There are several different adapters that you can use. You have to purchase the correct adapter for the cable. RG-58 uses a different adapter than RG-8X (mini – RG-8) or RG-59.

The first thing to do is to un-screw the outside of the PL-259 and place it on the coax. Be sure to orient it correctly. The next thing to do is to slide on the UG-175 adapter onto the coax.

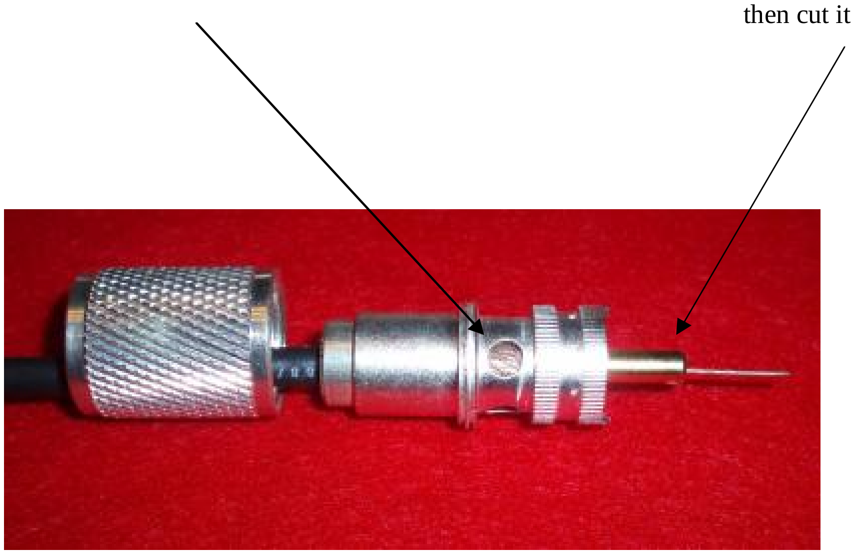
Strip the outside of the cable off. The stripped portion should be longer than center of the PL-259. This don't need to be exact as you will cut it off after it is soldered.

Now cut the braid so it just fits the small section of the UG-175 adapter.

Slide the adapter down to the end of the black outer conductor. Then fold back the braid over the adapter.

Leave approximately 1/8" on the center conductor and remove the insulation of the center conductor.

Screw the adapter into the PL-259. Now we are ready to solder. You will need a large high wattage soldering iron for this. The small pencil types are not large enough and the PL-259 acts as a heat sink. By the time you get the solder to flow you might have melted the center conductor. I use an old Weller 550 watt soldering gun.



Notice how the solder is flowing. ***<u>If the solder doesn't flow you don't have a good soldering connection.</u>*** You only have to solder a couple of the holes and the braid.

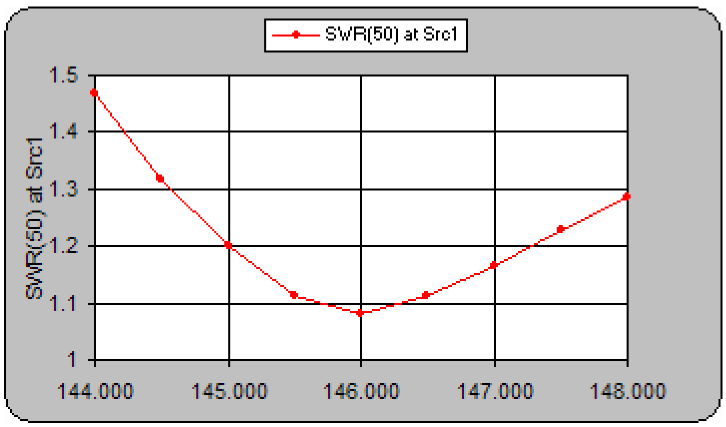
Unexpected Antenna Operations

The antenna performed according to the antenna modeling. At 10 watts the antenna had less than 2:1 SWR across the entire band (145 – 147.6). I was On the Air and working direct so I turned up the power and the SWR increased to above 2.5 SWR whenever I got above about 35 watts. Did the antenna characteristics Change??? - no it is still the same antenna with the same impedences. What was happening is that RF is getting on the coax and feeding back to the radio and shack causing problems. This can be a common problem in running higher power depending on the type of antenna. The coax in this case runs in the RF field and picks up the RF and it is routed down the outside of the coax. To correct this phenomenon, we will make a coaxial choke and put it under the antenna out of the RF field. This will reduce the amount of RF coming down the transmission line. At this frequency all we will need is a small coil made up of the coax with about 4 turns on a small piece of PVC (to make it look nice).

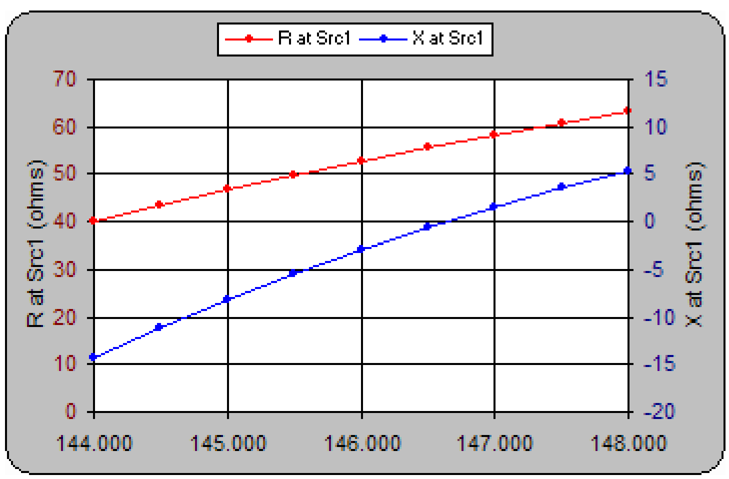
Technical Description of the 2M Moxon Antenna

Using Antenna Modeling Software Program

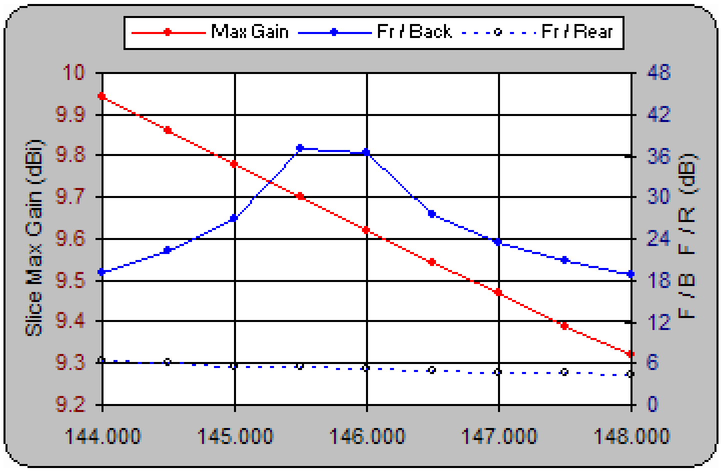
Antenna was modeled using MultiNec software. This is Antenna Modeling software that uses Excel for an Interface and standard NEC 2 equations. The model is for Average Ground conditions and with an elevation 20 feet. The Moxon Generator (Design Program) configures a file for direct import into Antenna Modeling software.



This is the calculated SWR curves for our antenna. Notice it covers the entire 2M band with an SWR of less than 2.



If the antenna was a 50 ohm resistive circuit then the SWR would be 1:1 but because we have SWR the Impedance and the Resistance changes across the band. Notice at the design (146 Mhz) the resistance is close to 50 ohm. Most antennas never are perfect 50 ohm resistive. As they move off resonance then you start to get some Impedance.



The chart shows the Max. Gain vs Freq. Notice at 144 Mhz. the Gain 9.95 and at 148 Mhz the gain is 9.3 dB.

Front / Back Ratio is 19 dB at the edges of the band and 36 at the design (146 Mhz).

What Does This Mean?

The gain is usually compared to a ½ wave dipole. You have to put in the height above ground and also the ground characteristics to get something useful/meaningful. Measurements are calculated in dB.

DB = 10 log (P_{out}/P_{in})

Gain = 9.95 dB = number whose log is .995 = 9.89

Gain is 9.89 over ½ wave dipole. That is only in the direction of the main lobe. Other directions will be reduced (see antenna patterns).

dBs numbers you should remember:

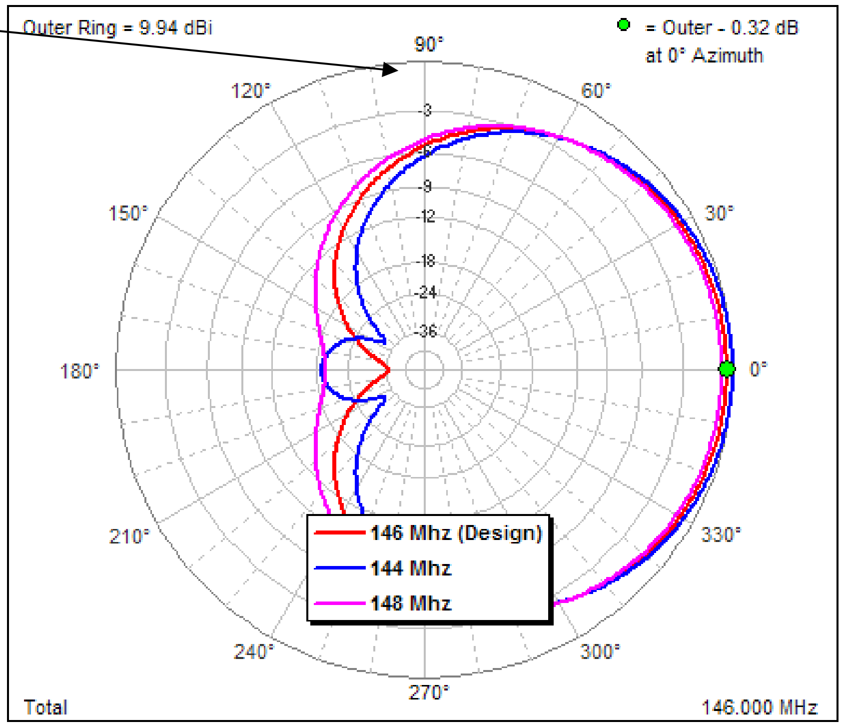
3 dB	Double or ½ Power
10 dB	10 times Power or $1/10^{th}$ Power
20 dB	100 times Power or $1/100^{th}$ Power
30 dB	1000 times Power of $1/1000^{th}$ Power

Front to Back Ratio: The difference between a signal coming in the Front compared to the Back of the antenna.

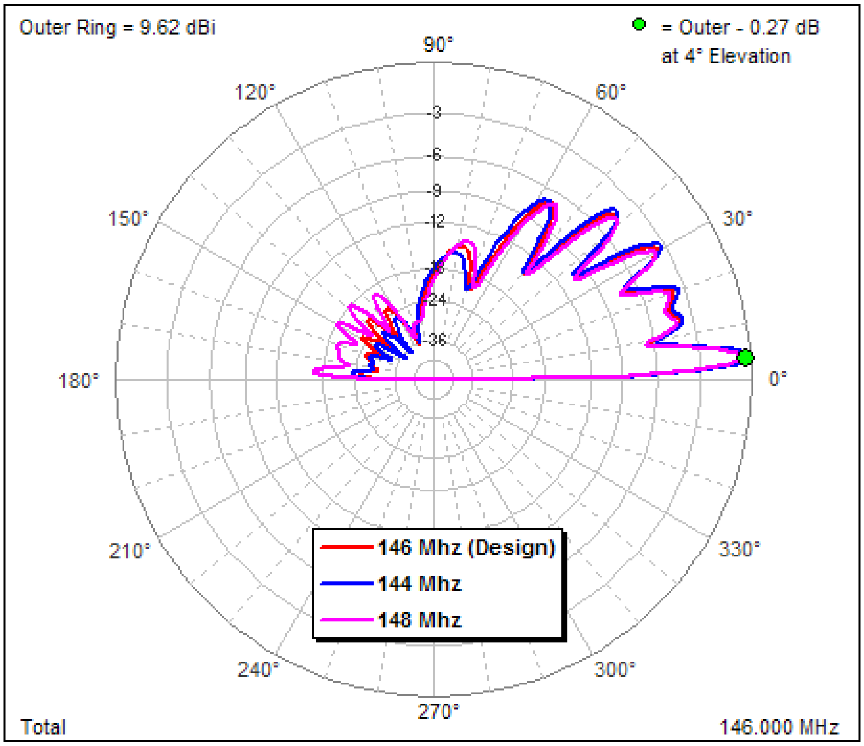
36 dB = 3981 or a signal coming from the back side will be reduce by 1/3981 @ design

19 dB = 79 or a signal coming from the back side will be 1/79th as strong

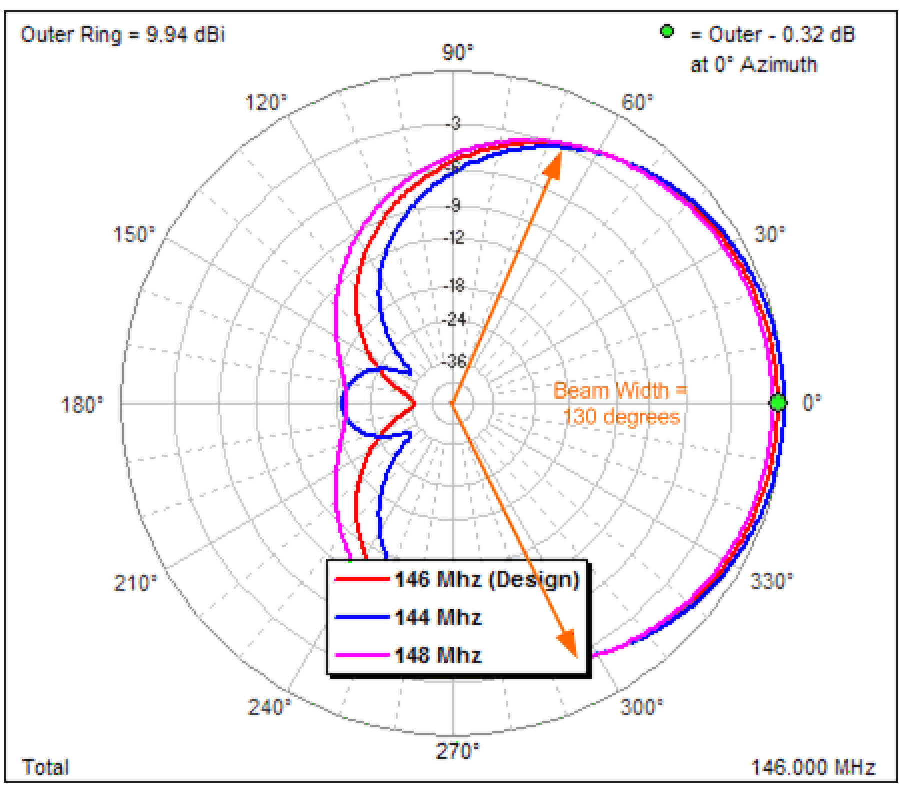
Notice outside ring is 0 dB.



Antenna Pattern parallel to the ground – notice the large beam width.



Plot of Signals perpendicular to the ground. This is also where we get the radiation angle.



Another measurement for beam antennas is the Beam Width. This is defined as the width of the radiation beam where the power is reduced by 3 dB (half power or half power points). The Moxon has a very good beam width in that if you are anywhere in the front of the antenna you have a good - fair signal, once you go to the back side the signal is very reduced. You can use this characteristic to remove strong signals from different locations.

Attributes of a Moxon Antenna:

- Reduced Size – folded elements design
- 2 elements with the approximate gain of a 3 element beam
- Large Beam Width
- Large Front to Back ratio
- Easy to construct
- Inexpensive to build