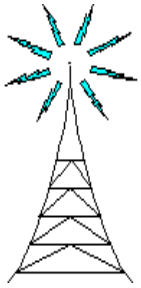


W4TWW 1/4 WAVE BROAD BANDED COAXIAL INVERTED L ANTENNA FOR 160 METERS

Article and Website By KN4LF (Now NZ4O) in 2007

I decided to publish this website in order to pass on some insights about this antenna that I've garnered through extensive experimentation. A warning though, some of the combined design aspects of the antenna may be unique and unorthodox, a think out of the box antenna design. Note! I do not have a B.S. or M.S. in EE, which makes me a true amateur radio operator not a "professional" amateur radio operator, so some of my antenna theory explanations may be incorrect.

Note, this antenna was introduced to me by Coleman Rowland W4TWW of Charleston, S.C., now a silent key. I make no claim to have invented or even improved the antenna in any way. I'm only passing along information about it because it works very well. This antenna appeared in CQ Magazine in August 1984 on page 72.

My antenna has been slightly modified from the W4TWW design which used 450 ohm window line for the non stub portion of the antenna. I found that use of the window line structurally weakened the antenna with time due to wind resistance. In my design the non stub portion of the antenna is made up of 72 ohm Belden 88241/RG-59coax.

As follows is information on construction of a 160 meter version of this antenna. This antenna can also be adapted to 80-10 meter operation.

First we have to discuss what type of coax to use. The larger the diameter of the coax used the more broad banded the antenna is. We also have to cover velocity factor because it's used in calculating the "matching stub" length.

RG-58, Belden 88241/RG-59 and RG-213/RG-8 have a velocity factor of approximately 66%.
RG-8X has a velocity factor of approximately 78%.

Start with the formula for a 1/4 wave antenna without velocity factor figured in: 246 divided by frequency in mc.

Normally you use a 95% velocity factor for a wire antenna made out of #12-14 stranded and covered wire, times 246 which equals 234.

For RG-58, Belden 88241/RG-59, and RG-213/RG-8 take the 66% velocity factor and multiply it times 246, which equals 162.36.

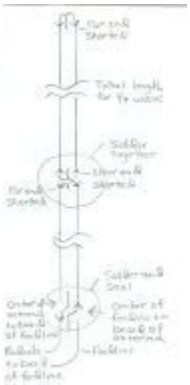
For RG-8X it's 78% times 246, which equals 191.88.

Let's design a coaxial L antenna for 160 meters using the center of the band at 1.900 kc. First you take 234 divided by 1.900 kc which equals a "total" length of 123 feet for the antenna.

If we make the antenna out of RG-8X that would be 191.88 divided by 1.900 mc. This makes the matching stub length 101 feet long. The remaining length to add to make a physical 1/4 wave is 22 feet. 101 plus 22 equals the 123 foot 1/4 wave antenna.

If we make the antenna out of RG-58, Belden 88241/RG-59 or RG-213/RG-8 that would be 162.36 divided by 1.900 mc. This makes the matching stub length 85.5 feet long. The remaining length to add to make a physical 1/4 wave is 37.5 feet. 85.5 plus 37.5 equals the 123 foot 1/4 wave antenna.

Below is a not to scale drawing of the antenna. Excuse the poor diagram it's the best I can do as a non artist type.



CLICK TO ENLARGE DIAGRAM

CLICK HERE FOR A .PDF DIAGRAM OF THE CONTRUCTION OF THE ANTENNA
NOTE IT'S NOT MY .PDF FILE AND I DON'T KNOW WHO MADE IT

To explain the construction looking at the diagram contained within the above links and RG-8X coax for the whole of the antenna.

The feed point connections are reversed from normal.

You take the "center" conductor of the coax feed line and solder it to the near end of the 101 foot long matching stub "braid".

You take the "center" conductor of the near end of the 101 foot long matching stub and solder it to the "braid" of the coax feed line. Also at this point solder a #12-14 pigtail of stranded covered wire. This is where you attach your radials.

At the far end of the 101 foot matching stub you short the center conductor and braid together.

Take the 22 foot piece of remaining coax and short the "center" conductor and "braid" together on both ends, so that the 22 foot section acts as a very large diameter single wire.

Solder the far end of the 22 foot shorted conductors together and seal it from moisture.

Take the near end of the 22 foot piece of shorted coax, attach it to the far end of the shorted 101 foot matching stub, solder and seal from moisture.

That's it it's done. It's important to seal all soldered joints from moisture. I have always used good quality electrical tape and then covered it with "liquid" electrical tape.

I first used this antenna between 1989-1991. I used RG-8U because it gave me full coverage of the 160 meter band within the 1.5:1 VSWR points, though it was heavy to pull up and support. Use smaller RG-8X and you will probably see full band coverage between the 2:1 VSWR points. I built my coaxial inverted L for 160 meters and laid down eight 1/8 wave radials (64 feet). Using only 100 watts I worked my first 100 DXCC countries in one DX season. The vertical section was only 35 feet high but the antenna worked very well.

As it's been a long time since I thought about it I don't remember all of the theory involved in how the antenna works. I use the description of "matching stub" for the longest piece of coax and that might be an inaccurate description of it's function. From memory though basically the matching stub acts to raise radiation resistance of the feed point from the theoretical 36 ohms and actual real world of approximately 18 ohms, to 50 ohms which is more efficient. Also the large diameter of the coax acts to counteract reactance as you QSY around the band, giving you broadband transmit coverage.

On February 6, 2009 I built and installed another coaxial inverted L for 160 meters. This time I used high quality and very strong Belden 88241/RG-59. It is a 72 ohm coaxial cable with a velocity factor of 66%. The stub is 87' 6" feet long and the rest of the antenna 38' 6" feet long for a total of 126 feet, which is a 1/4 wave on 1857.142 kc However the resonant frequency is 1910 kc due to interaction with other nearby antennas. It is fed with 75 feet of RG-213 coax and 25 feet of 50 ohm Cushcraft Ultralink TL-93605 RG-213 type coax, which comprises a choke BALUN to reduce local QRN (noise) on receive.

The ground system consists of twenty 1/8 wave radials (64 feet) using #14 stranded bare wire. I also have nine eight foot ground rods connected together with 300 feet of #6 solid bare copper wire buried 3" deep that encircles my house, my house copper water pipe system and city water system. The ground rods do little for collection of RF and are tied in per NEC standards for lightning protection.

The vertical section is 41 feet high then goes out 85 feet in the flat top.

As follows is the VSWR curve with one 1/8 radial:

2.0:1 1701 kc
1.5:1 1800 kc
1.1:1 1850-1950 kc
1.5:1 2002 kc
2.0:1 2505 kc

As follows is the VSWR curve with twenty 1/8 wave radials:

2.0:1 1732 kc
1.5:1 1783 kc
1.1:1 1830-1852 kc
1.5:1 1900 kc
2.0:1 1950 kc

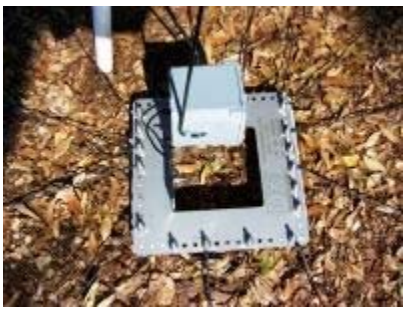
As you can see by the following information about the VSWR curve of the antenna, the more radials that you add the more narrow the band width becomes. I stopped at twenty radials because the antenna works like gang busters with that number. If I want to operate above 1950 kc I use an old but well maintained MFJ-989 tee network tuner to fool the amplifier.

One thing that I observed that was expected was a drop in received strength of the local QRN. On the coaxial inverted L the local QRN level is S 4-5. As a comparison my 160 meter 1/2 wave dipole has a QRN level of S9 to S9+5 db.

As follows are four views of the feed point of the coaxial inverted L. The gray watertight PVC electrical box contains the reversed feed point connections that makes the antenna magic work. The radial plate was purchased from DX engineering and is of high quality stainless steel.

http://www.dxengineering.com/Sections.asp?ID=109&DeptID=32#Top .


Pictures Of The Coaxial Inverted L
Click To Enlarge




Pictures Of The Coaxial Inverted L
Click To Enlarge


Pictures Of The Coaxial Inverted L
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By the way the antenna also works on 60, 30 and 6 meters as they are all odd harmonics. It will not work on even harmonics, even with an antenna tuner.

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