Zepp antennas for VHF

by Aaron VK4VOX

Arguably the most talked about topic on air at any one time will be the subject of antennas.

For most new Hams these days, having recently acquired their license, the dream of communicating with the local brethren, yet alone to far away places, is soon shattered by the under performing stick they were promised by the sales person was a magic wand able to radiate better than an atom bomb, cover more channels than Foxtel and enable them to talk to more stations than OTC. Disillusioned, they turn their mind toward the reference books and are soon overwhelmed by the myriad of designs.

Then late one night in hushed tones they hear an on air discussion about an antenna that some body built way-back-when in the distant past that is longer, or shorter, has more gain, has wider band-width, and can copy more stations than a three handed DX'er.

Recent events in my region has seen Hams looking for ways to improve their VHF and UHF performance by heading back to the reference books and the back yard shed in an effort to boost the performance of their stations by experimenting with different antenna designs. After all, as the "Guru" once said "the amateur license is granted as a license to experiment not rag chew on morning nets". Sadly a statement we choose to forget.

My own personal experimenting over the years produced some interesting results from poor to remarkable. In one case an antenna that is in my humble opinion truly remarkable and stands out as a joke no one gets. I believe it is worth a mention as it ticks all the boxes – it delivers the goods which does it for most of us and is cheap which does it for all of us.

History tells us this antenna originates from the days of the great air ships called Zeppelins. The radio shack on board a Zeppelin air ship would, at altitude, trail a half wave antenna with a quarter wave tuning stub behind the air ship. The antenna went on to be known as a "Zepp" antenna which was short for, you guessed it, Zeppelin. Nowadays we sometimes refer to them as a "J" poles because the physical construction resembles the letter "J" or "slim Jim" in the variant form, where a second half wave element is folded back on itself for a gain of 3dB. For VHF work this style of antenna has great attraction.

The Zepp antenna is a ground independent antenna consisting of a half wave radiator and a quarter wave tuning stub section that can be made from old plumbing supplies or a parallel feed line which makes a great, cheap, travelling antenna as it can be rolled up and packed away. It has zero dB gain over a dipole but can be stacked by end feeding or folding one or more half waves to get gain. It can be extended to five eights or three quarters and stacked for even higher gain. It is a truly remarkable and versatile design.

According to the ARRL Antenna handbook, the ordinary Zepp or J-pole has a gain of around 3dB over a quarter wave ground plane antenna and when a second element/section is added has around 3dB over a dipole.

According the ARRL Antenna Handbook, by stretching the half wave dipole extension to five eights or three quarters of a wave length and by adding another element it will increase the gain to around 7 dB over a dipole that produces an omni-directional pattern which means no need for a beam antenna or a rotator making for ease of installation on any suitable shy hook. 7 dB over a dipole from an omni IS a remarkable feat that some beams struggle to achieve !!!

At my home QTH I am surrounded by a ring of low hills blocking line of sight to my favourite repeater. I have run a 2 metre extended Zepp for some time with excellent results, and while only using 5 watts at the set I make the distance with ease and get a reception never less than 40dB over from the repeater tail.

When care is taken to measure cut and tune the antenna to the bandwidth dimensions it produces a great V.swr result with the V.swr in the middle of the band at 1:1 and the band edges at around 1:1.3 or 1:1.4. I would strongly suggest anyone wanting a cheap alternative to expensive store bought antennas to give this a try.

In my area I have access to an aluminium welder who has an abundance of lengths of marine grade aluminium tube which is strong, resilient, light, easy to work with and the best of all, very cheap. I have made, given away and sold many to hams over the years that have needed a reliable stick or a little extra gain and never had a bad report.

In the single half wave form I use two pieces of marine grade aluminium. The larger is a tube of about 25-32 mm in diameter. The larger diameter positively affects the frequency to radiator-diameter ratio that helps to make the band width wide and to keep the V.swr low across the band. The large diameter 25-32 mm section also allows for ease in stacking in case you decide like me, to stack another half wave later for more gain. The other section is a piece of 8 mm aluminium rod that is measured cut and bent to form the tuning stub.

Each section is carefully measured using the equation - Wave length λ = 300 ÷ frequency.

For the centre of the Australian two meter band this is - Wave length λ = 300 ÷ 146
= 2054 mm

2054 mm is the full wave length and 1027 mm the half wave length in "FREE SPACE".

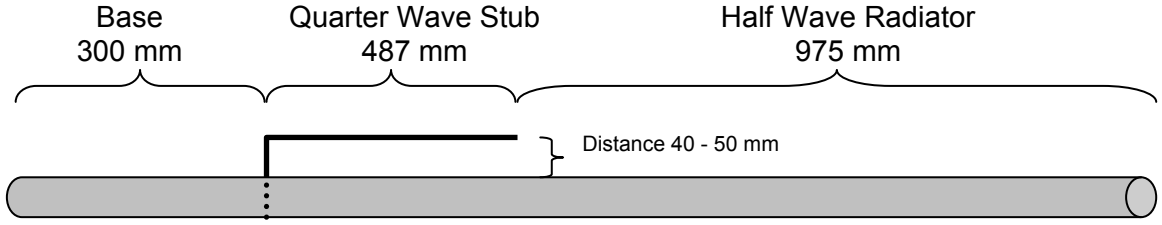
Since we don't operate our feed lines and antennas in a vacuum or outer space we must allow aluminium slowing down the speed of the signal. The Guru puts it this way "*to do this it is necessary to reduce the antenna by about 5% because of antenna "end-effect" as the wave cannot propagate as fast "c" along any metal wire so an adjustment of approximately 5% (shorter) - (5% longer for loops)"* Don't worry if this does not make sense, just be sure to remember to always shorten the calculation by 5% and you pretty much can't go wrong.

To shorten the wave length by 5% - Aluminium wave length = 2054 x 0.95
= 1951.3 mm

The half wave length for aluminium is then 1951.3 ÷ 2 = 975.65 mm

Since I don't know a tradesman who can work with 0.65 of a milli-meter I round it down to 975 mm. The quarter wave for aluminium is then 975 ÷ 2 = 487 mm (rounded down).

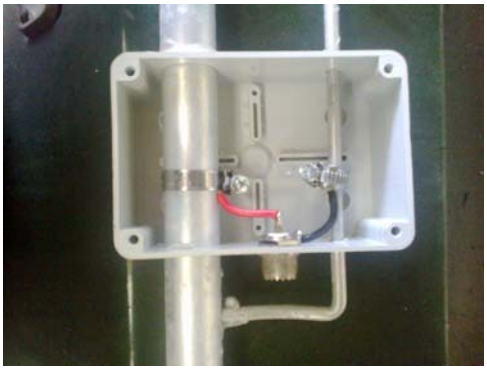
Below is a schematic showing all the measurements of a half wave Zepp. NOTE that I have left a 300 mm section as a "base" for the antenna to be mounted with a pair of u-bolts.



Leaving about 300 mm for the base allows the structural design to be extremely durable and sturdy. At my QTH my Zepp antenna has withstood every storm for the last 25 years - not many antennas can boast the same.

In this design I drill a 9 mm hole in the tube and measure and bend the 8mm aluminium rod that will become the Quarter Wave Stub to length and insert the short end into the tube as shown by the dotted line above. Then I get my aluminium welder to drop a spot of weld on the Stub to secure it in place. 5 minutes work and it's done.

Here are photos of the finished item fitted out with a waterproof box and SO239 connector.



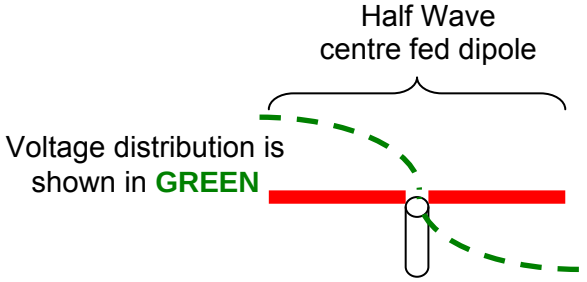
Inside the box I join the SO239 to the tube and stub - IT DOES NOT MATTER WHICH SIDE YOU CHOOSE to clamp the wires as it will work just the same either way. In the pictures above I clamp the Red to the tube and the Black to the stub. Don't let anyone tell you it matters which side it should go.

All up this should cost you about $40 for all the aluminium material, parts and welding.

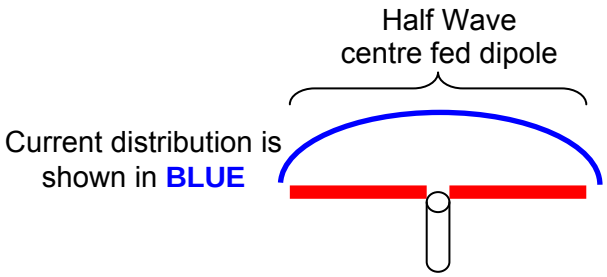
So there you have it your very own Zepp Antenna that will last you a lifetime.

Now for those who wish to see the electrical characteristics I have included a schematic of the voltage and current distributions below - IT IS NOT ROCKET SCIENCE otherwise I would not understand it myself - lol.

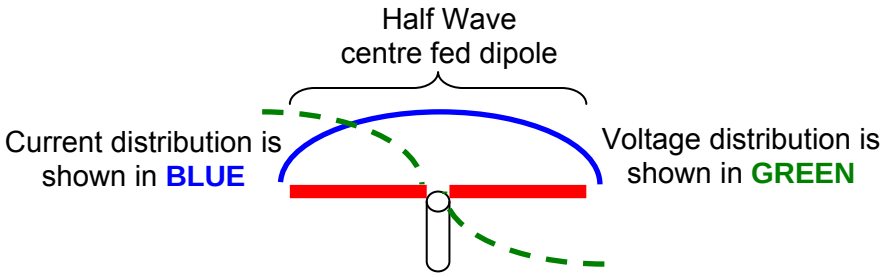
Below let's start with a dipole shown in red with the Voltage distribution that looks a bit like this Green dotted line with the minimum voltage near the feed point and the maximum voltage near the tips of the dipole. It is that simple.



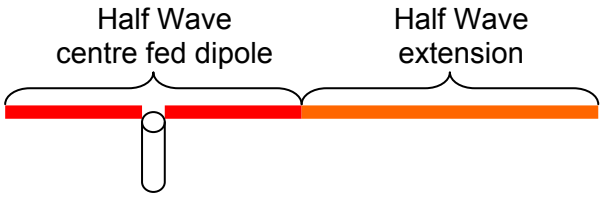
Now let's look at the current distribution on a dipole below that looks a bit like this Blue line with the maximum current near the centre feed point of the dipole and the minimum current near the tips of the dipole. Again not rocket science.



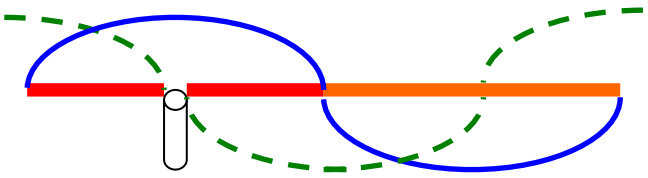
When the two are over laid they look a bit like this below.



Now to explain the workings of a half wave Zepp or J-Pole I like to use a half wave dipole like the one below with one end of the dipole stretched and extended another half wave length until is looks like this.



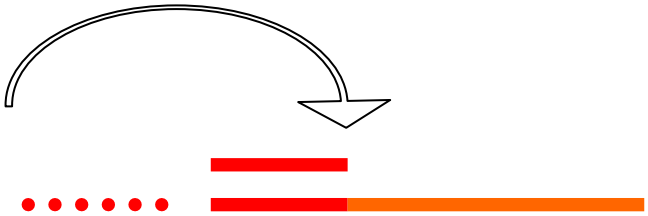
If we add the voltage and current distribution over the dipole AND the half wave extension it looks a little like this below.



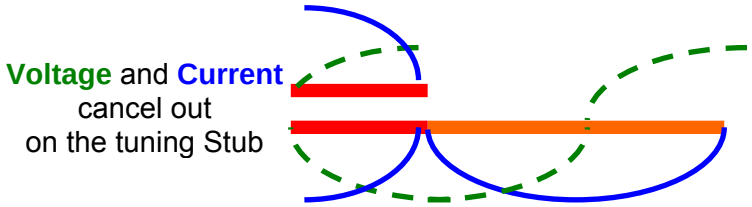
Can you see that the voltage and current distribution of the half wave extension is opposite that of the dipole ???

If you can't don't worry as it took me a while to “get the joke” as they say.

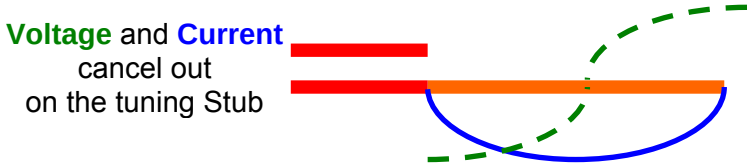
If we fold the dipole back on itself until it looks a bit like this schematic below we have the makings of a Zepp or "J" pole antenna. Does that make sense ???



Then if we look at the voltage and current distribution over laid the schematic below we can see how the Zepp antenna works.



Again keeping it simple with voltage in Green and current in Blue, can you see how the voltage and current on the Stub cancel each other out ??? - leaving only the voltage and current of the half wave extension to do all the work and radiate a signal as seen below.



Engineers call an antenna that is feed this way a "voltage fed" antenna because the voltage is highest where the half wave extension meets the stub feed point. When it is stood up as a vertical it will radiate an omni directional pattern. When more "phased" extensions are added it will produce gain over a dipole with very pleasing reports.

I hope this makes sense.

Please let me know if you would like to know more about how Zepp antennas work or how to get another 3 dB gain from your Zepp by adding another "phased" half wave or how to get 7 dB from two three quarter waves phased together.

Thank you to my mentor and friend the Guru for his expert advice and a life time of encouragement in Amateur Radio.

Regards and 7-3 to all from Aaron VK4VOX on the beautiful Gold Coast.