Making Your Own Linked Dipole Antenna

Introduction

Antenna Need

When I first started looking at Amateur Radio I had no idea about antennas. After much reading I decided to purchase a Hustler 5-BTV vertical and set that up in the back garden. It worked fine but cost some $500+. Pretty expensive, and the performance wasn't as good as I expected. In all fairness, I didn't have a radial field and this obviously hurt performance somewhat.

At our future home site (50km away) I built a G7FEK Multi-Band wire antenna that performs very very well.

While on holidays in the UK I bought a 4 Band Linked Dipole (80/40/20/10) from SotaBeams and saw the light with regards to cheap wire antennas for Portable work and temporary circumstances.

Wind forward 12 months and we have moved into a Granny Flat for the next 12 months or so while we build our new house and I was really wanting to get on the air but wasn't able to put up the vertical.

That's when I decided to make my own linked dipole for 80/40m. Despite my trepidations, it worked a treat. Only problem was changing bands all the time, so I changed it slightly and turned it into a Fan Dipole by adding a 40m element and leaving the 80m element permanently linked. Works a treat. Great signal reports all over. Instead of an inverted V, it's actually strung up in a U shape only 3m off the ground and it still works very well. So the G7FEK, the Sotabeams linked dipole and my temporary hack-up at the Granny Flat has me sold on wire antennas for non-mobile situations.

Now I want to go portable with my new FT-817ND so it's time to build a new linked dipole for that purpose. It is for 40/15/10m as these are the bands an F-Call in Australia is able to use. No need for 80m as this band doesn't work much during the day anyway. And most Parks/Sota activations seem to happen on the higher bands anyway, mostly 40m.

So this article is how to build this particular variation of a Linked Dipole.

Antenna Analyser

If you're going to be working the Amateur HF Bands, then I strongly suggest you get yourself an Antenna Analyser. In the last 12 months I have found this to be the most used piece of test equipment I have. I use it at least once every couple of weeks even if it's only for confirming the VSWR on my existing antennas are still within limits. It is the best money you will ever spend in the hobby.

You will need to get one for this build to tune the antenna for lowest VSWR. You can either borrow one from your local Club or Amateur Radio friend, or buy or build one from a kit.

You can buy one of the many commercially available ones (MFJ, Sark, RigExpert and others).

Or you can build one from a kit. The one I use is the VK5JST Analyser Kit I got from my club, the Adelaide Hills Amateur Radio Society (AHARS). It's a very good kit, has everything included, and is not too difficult to assemble (requires a reasonable level of soldering skills). And it's only AUD$135 (for locals) including postage. http://www.ahars.com.au/about/kits/ Other information here http://users.on.net/~endsodds/aamk7.htm

Making It

Tools Needed

The usual including Soldering Iron, Solder, pliers, drill, saw, files etc

Parts Needed

8 Clips/Connectors

I used Anderson PowerPole Connectors (Singles) (http://andersonconnect.com.au/store/index.php?main_page=index&cPath=36_41&zenid=cc009e45c4a6343aa391236c5e850852 - Various prices but cheaper than anywhere else and you know they are the real thing). Alternatively pairs of Alligator Clips. Pairs of automotive spade connectors might work but these are difficult to separate.

Plastic for Top Plate

(and 4 Link Plates if you like)
(150mm PVC End Cap from Bunnings - $7.90
http://www.bunnings.com.au/holman-150mm-pvc-dwv-push-on-cap_p4770361) uPVC and plenty to make the top plate and 4 link plates and have heaps left over..

Plastic Chain

instead of Link Plates (Bunnings $5.35/m
http://www.bunnings.com.au/zenith-8mm-white-plastic-chain_p4225313) Light and uPVC. You lose every second one freeing up single links, but the stuff is cheap enough. Cheaper to use leftover 150mm PVC End Cap though, which I bought later.

22 AWG Wire

(SotaBeams Yellow/Green/Brown $11.74 for 100m + Postage http://www.sotabeams.co.uk/antenna-wire-lightweight-100m) I couldn't get 22AWG anywhere is Australia so I got it from SotaBeams. 22AWG is stated as good for 100W. Approx 2 weeks for post from the UK. Heavier wire would work also but it'll be heavier to cart around if you're doing SOTA or Portable. More rigid too, hence why I stuck with the tested and proven 22AWG.

20m RG174 Coax

(Jaycar $24.95 http://www.jaycar.com.au/Wire%2C-Cable-%26-Accessories/Coaxial-Cable/Communication---50R/50-Ohm-RG174U-Coax-Cable-20m-Pk/p/WB2018) Nuff said.

BNC Plug

(Jaycar $4.95 http://www.jaycar.com.au/Interconnect/Plugs%2C-Sockets-%26-Adaptors/RF/Male-Line-Plug-BNC---Solderless/p/PP0652) Take out the screw and solder the centre into the hole left by removing the screw. Heat shrink to seal it up. Get some if you don't have any. Always handy.

FT114-43 TOROID

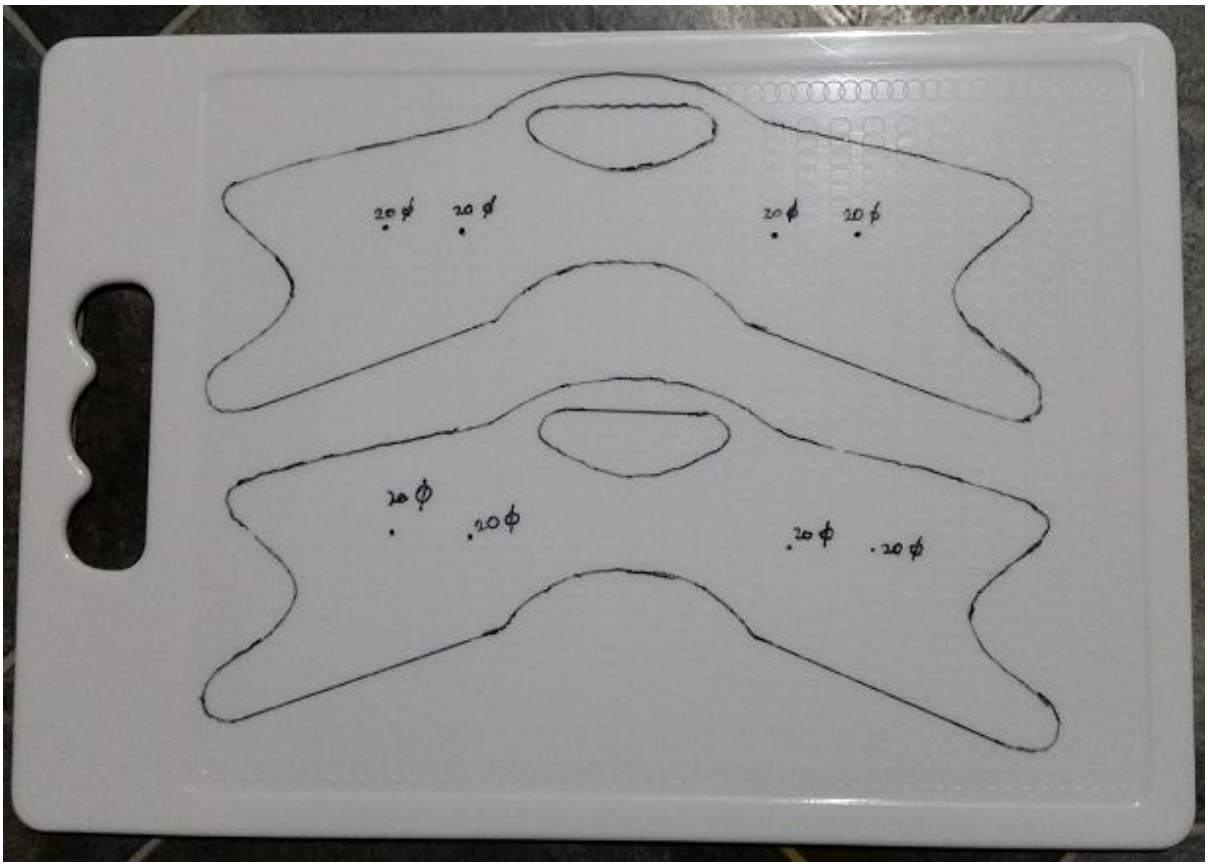
(Mini-Kits $2.65 http://www.minikits.com.au/FT114-43?search=FT114-43%20TOROID) Might be a cheaper source elsewhere, but they were local and delivered next day on normal post.

20m x 4m Poly Rope

(maybe 3mm if you can find it) (Bunnings $3.97 Probably should be UV-Resistant. Builders line will also probably do the job and is smaller when winding onto the wire winders. http://www.bunnings.com.au/syneco-4mm-x-20m-polypropylene-rope_p4313938)

Wire Winders

(SotaBeams $4.30 each plus postage http://www.sotabeams.co.uk/antenna-wire-winders/ Approx 2 weeks for post from the UK. Or home made from nylon chopping board; fairly rigid ones I would think 3-4mm thick; pattern here http://www.bushcraftuk.com/forum/showthread.php?t=120472) Got a Chopping Board from Coles for $3.00 which will make 2. 3.5mm thick. Cut with a Jig Saw on low speed slowly and carefully.



The end product

7m HD Squid Pole
(Haverfords $43 + Courier Delivery http://www.haverford.com.au/telescopic-poles.html)

Parts Manufacture

Winding the Balun

These articles will help, otherwise see below.

http://www.arnsw.org.au/html/ARNSW%20Balun%20Day.pdf and
http://www.vk3bq.com/2014/09/24/11-current-balun/ and
http://www.vk3bq.com/wp-content/uploads/Current_balun_1to1.pdf

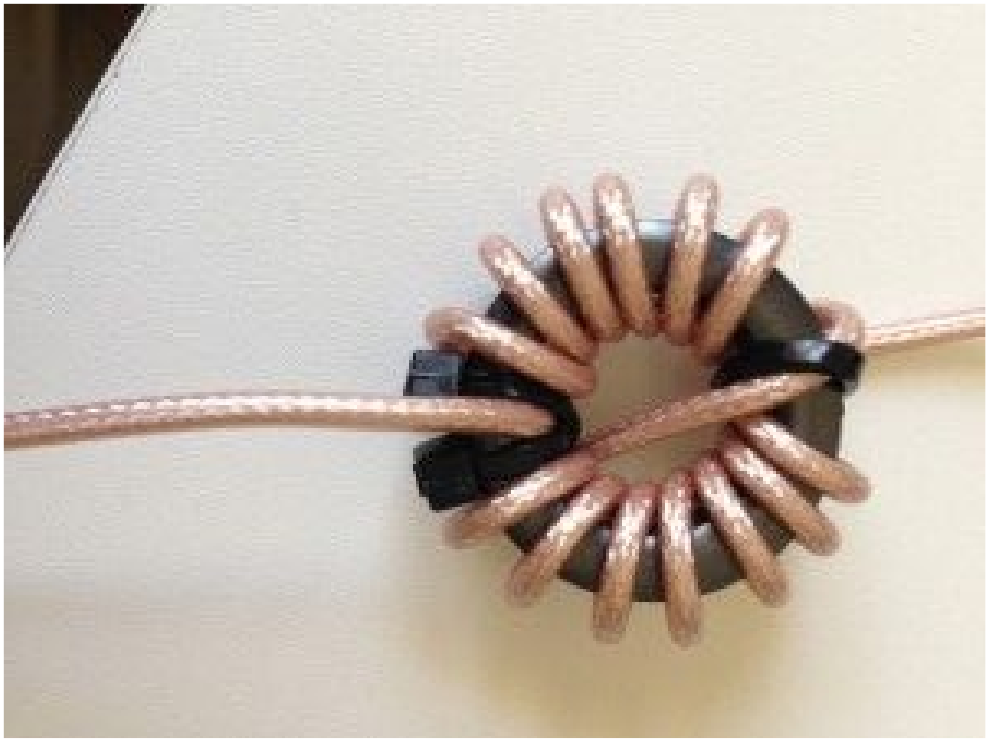
Simple job. Requires the FT114-43 Toroid, the RG174 and a couple of cable ties.

Start at the ”bottom” and fix the RG174 to the toroid with a cable tie.

Now wind the coax around the toroid on the left hand side 5 full turns (each time the cable passes through the centre of the toroid is counted as a turn). When you get to the “top” (half way), cross the rg174 back over to the “bottom” and wind the second half of the total winding on the right hand side. 5 Turns again.

Fix the RG174 to the toroid with another cable tie, and the job is done.

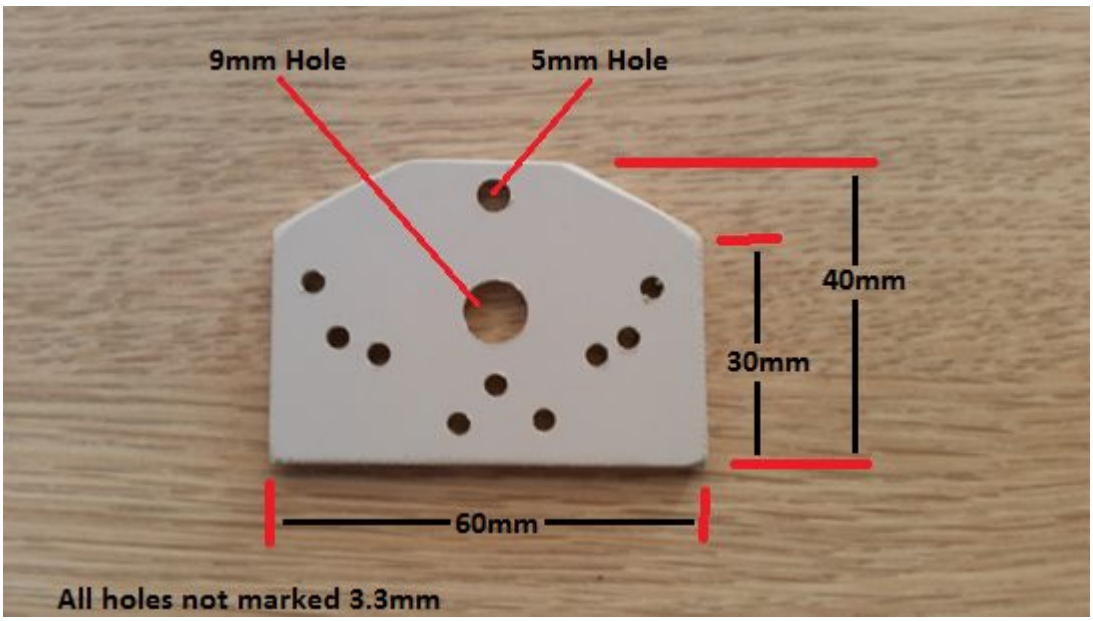
This method ensures the start and finish are at opposite ends. Note also that the RG174 enters on top and exits on the bottom of the toroid. See the pictures below. It’s not difficult at all.




ELECTUS

Making the Top Plate

Drill the holes in the positions as shown. 3.3mm holes are the old ⅛” (rivet drill bit) size.



Making the Link Plates (if you go this way)

Cut 4 plastic plates 50mm x 10mm and drill a 3.3mm hole at each end.

Putting It Together

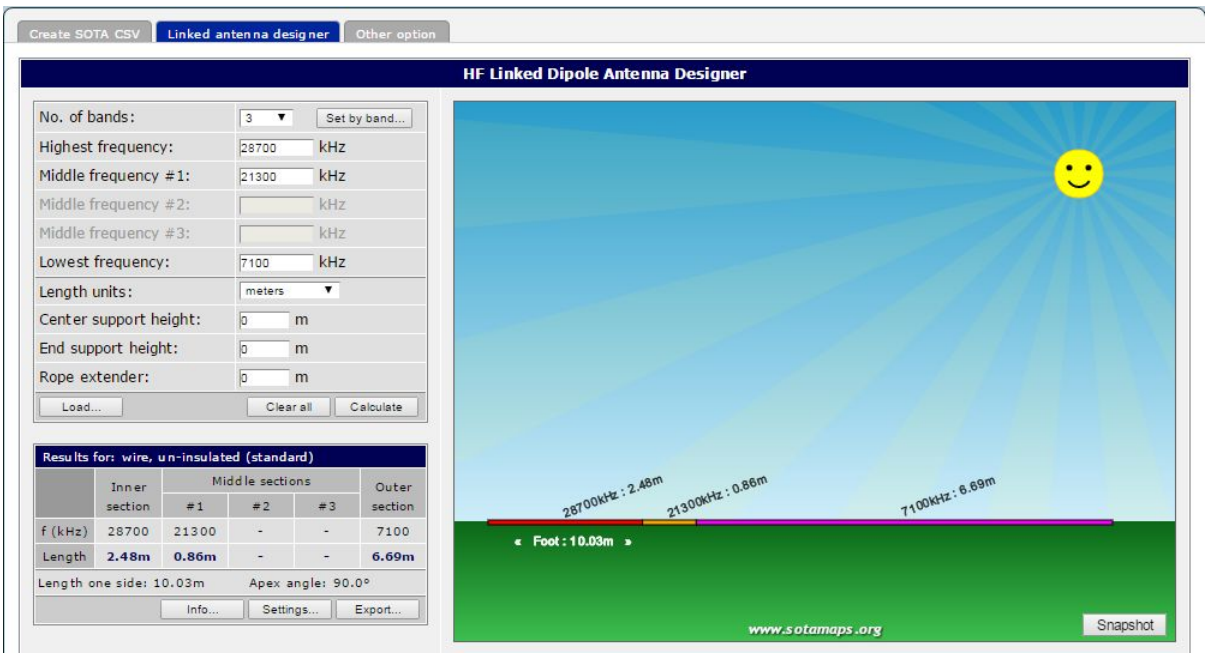
Cut the wire sections to length

Depends on the bands you are wanting to use

I did 40m, 15m and 10m as 80m is no real use during the day when Park Activations usually happen.

I used the SotaMaps Linked Dipole Calculator here http://www.sotamaps.org/extras.php My frequencies are middle of the SSB allocation in Australia (28700, 21300 and 7100kHz). Your requirements may be different to mine, so do as you require.

I ended up with wire lengths of 2.48m (10m Band), 0.86m (15m Band) and 6.69m (40m Band). 2 of each length.



Cut the RG174 to length and attach a BNC Male to one end

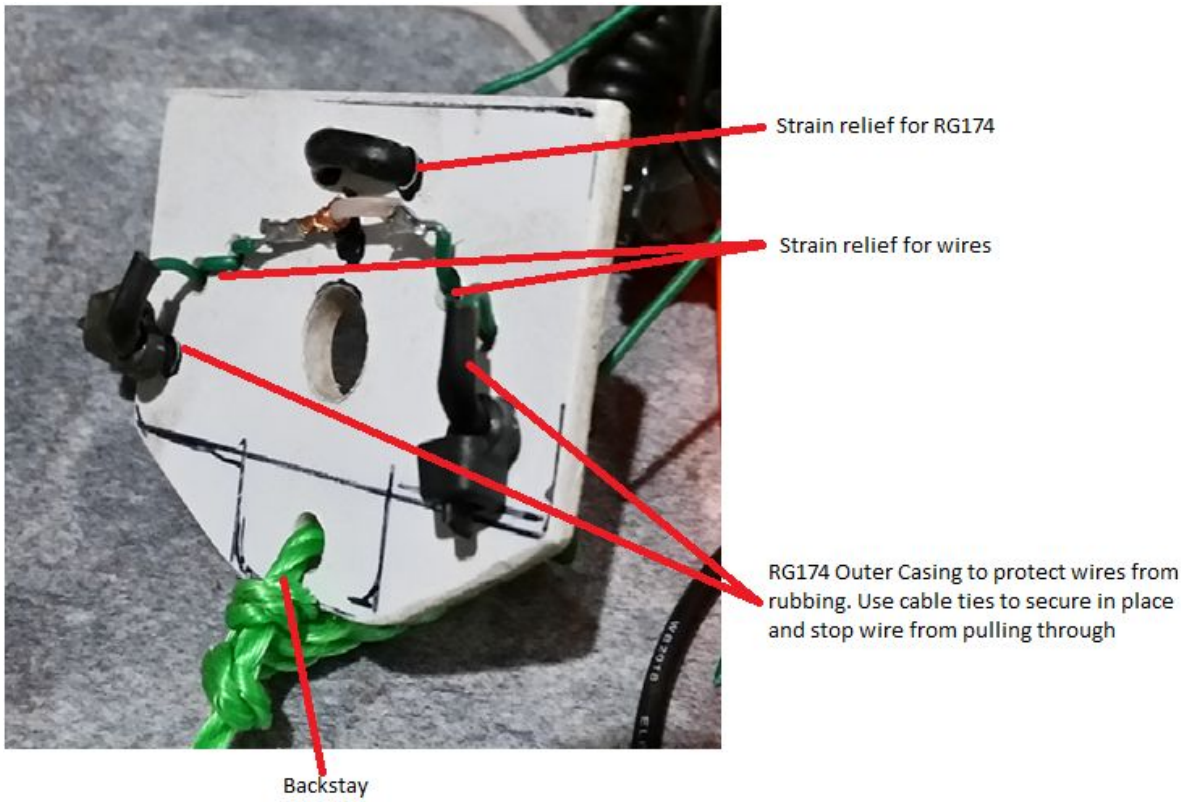
Cut a length of RG174 10-12m long (10m is plenty but I cut mine to 12m - too long really). Strip the outer case and centre insulator to the appropriate lengths and solder and/or crimp the BNC Connector as required. The connector you have chosen will determine this exact process. I have only loosely explained what I did with the connector I bought. Seal with 1 or more layers of heat shrink to waterproof and to help with mechanical strain relief if appropriate.

Cut the ropes to length

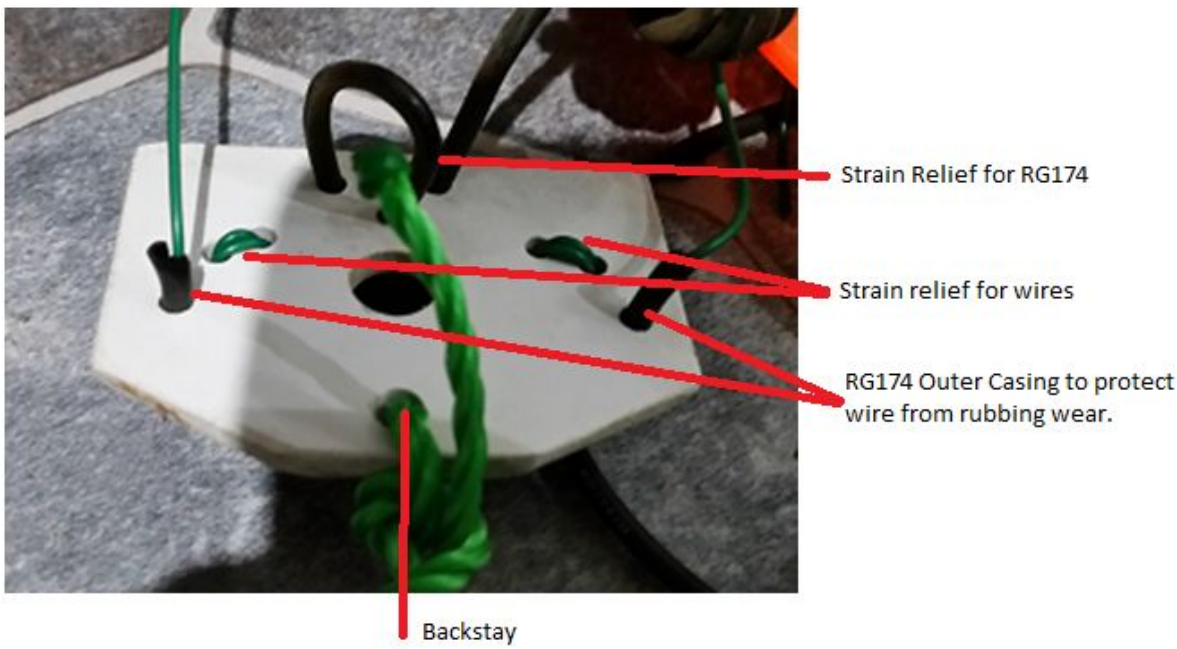
1 x 10m (Backstay)
2 x 3.5m (between the end of the wire and the Wire Winder)

Assemble the Top Plate

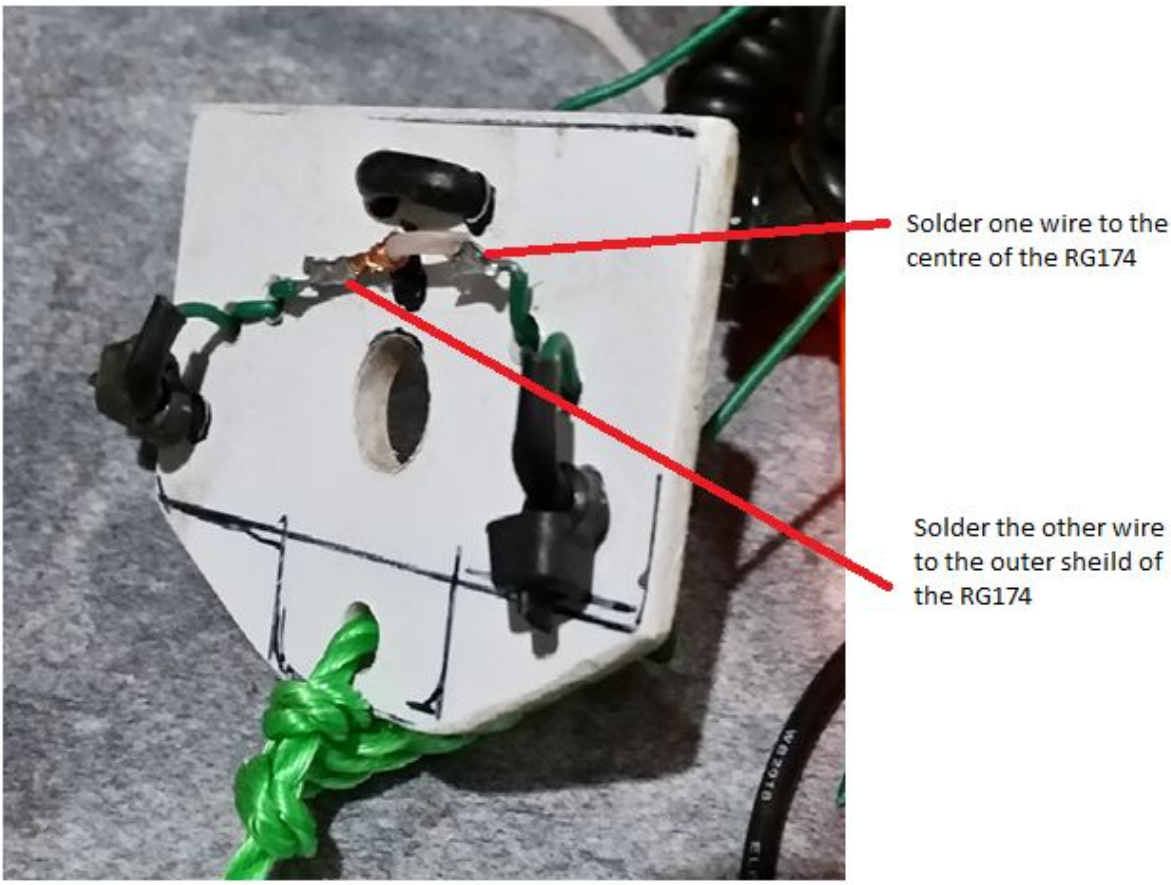
Thread the remainder of the RG174 through the top plate, then down the next hole then up the next hole. This acts to hold the RG174 firmly and will stop any pressure on where you join the 2 wires to the RG174.



Thread the 2 inner wires, one on each side 2.48m long, into the top plate and loop through the strainer holes to bring them out next to the RG174.

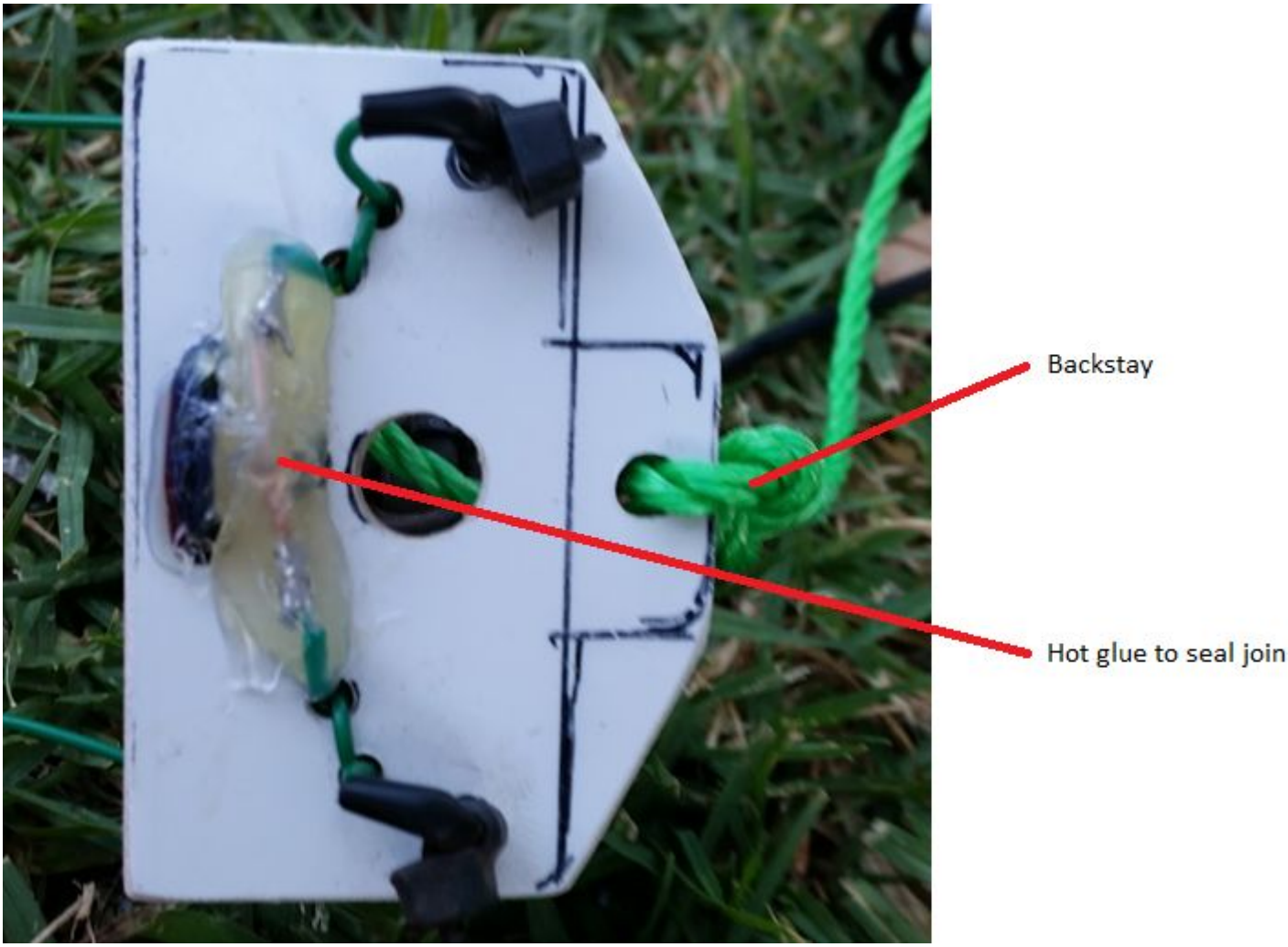


Strip the ends of the wires and enough RG174 to enable you to solder one wire to the RG174 centre and the other to the twisted up outer shield.



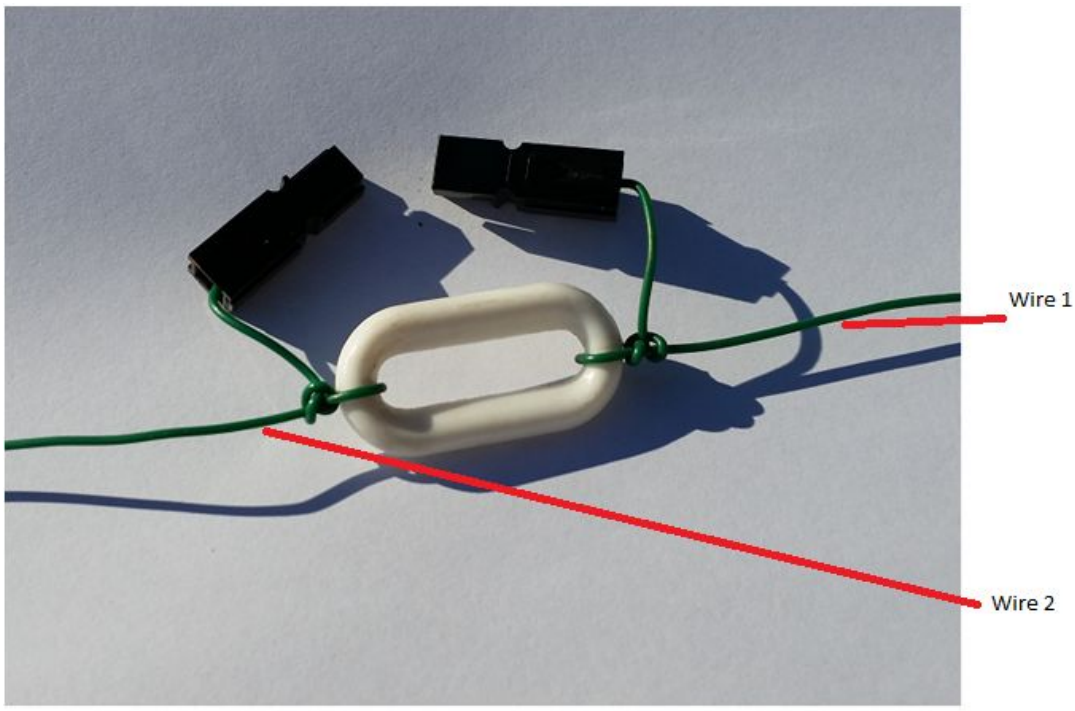
Once all your soldering is complete, check for continuity between one wire and the centre pin of the BNC connector. Then check the other wire against the outer casing of the BNC connector. If that's okay, seal the RG174 / wires to keep moisture out. Silicone, Araldite or a hot glue gun will suffice.

Tie the 10m backstay to the hole opposite the balun.

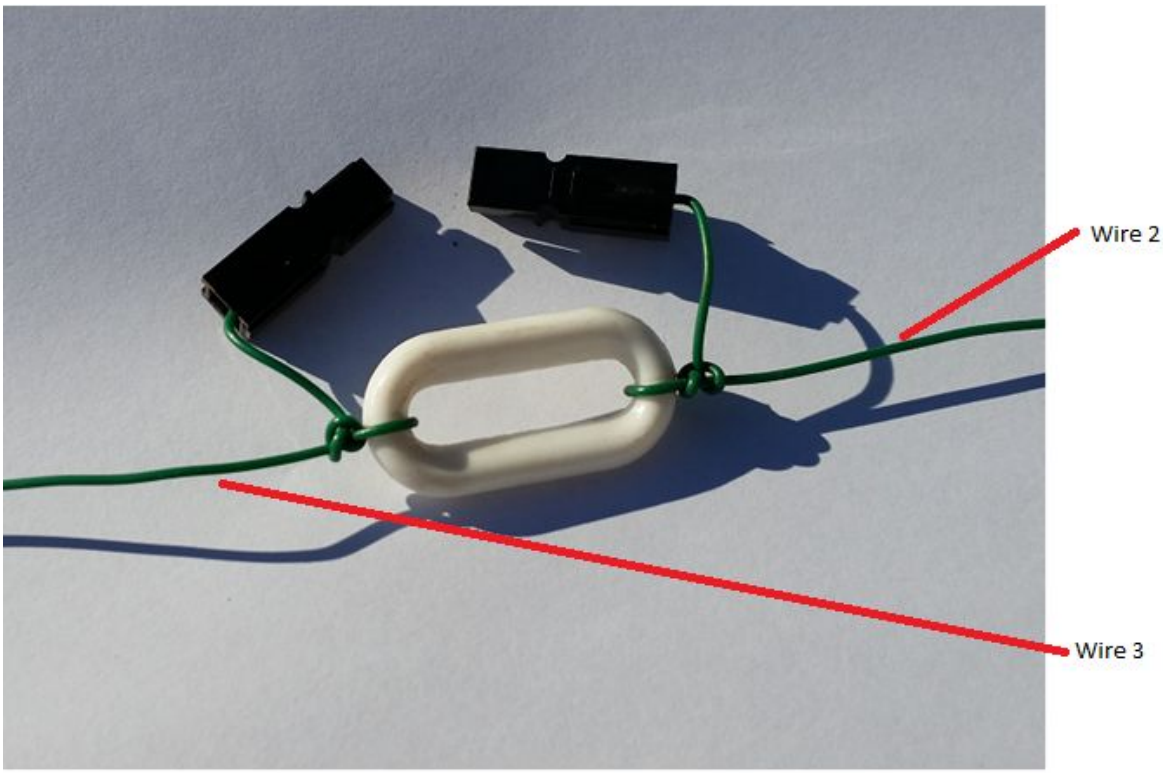


Assemble the Wires and Link Plates

Tie the loose end of one of the first wires to a link plate, leaving about 40mm free to solder on the link connector and for tune trimming. Repeat for the other side.



Tie one end of one of the second wires (0.86m) to the other end of the first link plate. Leave about 30mm free to solder on the link connector. Tie the other end to the second link plate. Leave about 40mm free to solder on the link connector and for tune trimming. Repeat for the other side.

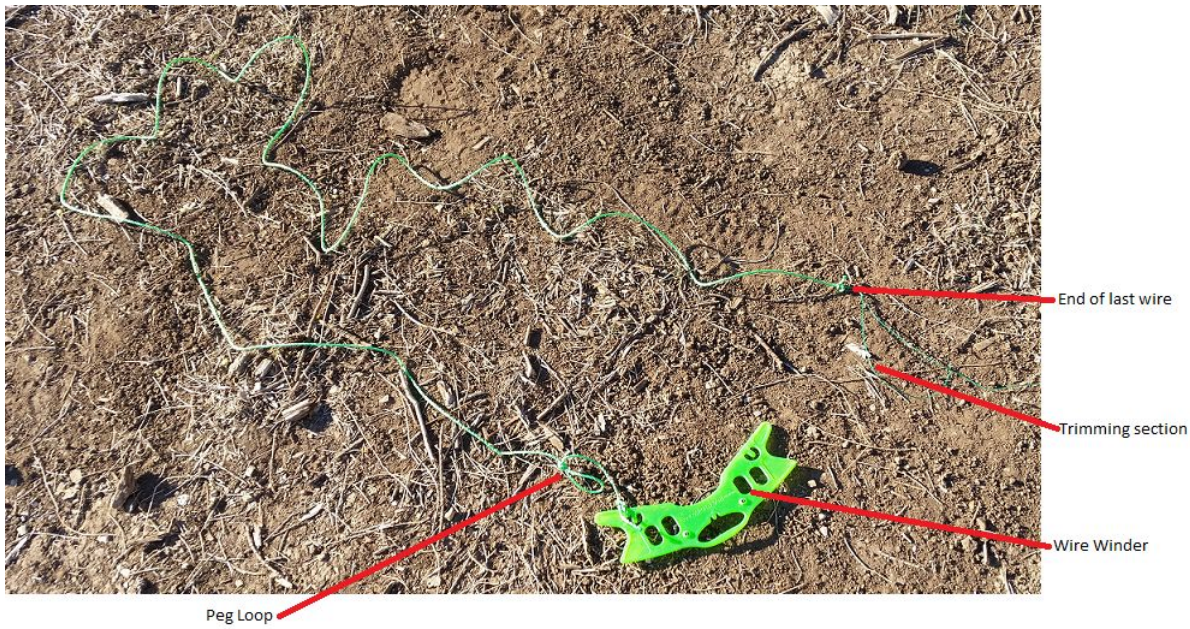


Tie one end of one of the the third wire (6.69m) to the other end of the second link plate. At the outer end of this wire, there is no link plate to attach to. Tie a loop in the end leaving about 400mm of wire loose for tune trimming.

Finish off with the Ropes and Wire Winders

Tie one of the 3.5m ropes you previously cut to the loop you just tied in the end of the third wire. Repeat for the other side. Photo

Make a loop in the rope close to the end so you can peg the rope to the ground. Tie a wire winder to the end. Repeat for the other side.



That's the assembly done. Easy.

Finished product. Green and orange winders contain the wires, the homemade white one contains the backstay and RG174 Coax feed.

Tuning

You will need that Antenna Analyser you bought, made or borrowed for this.

Start with the highest frequency (top sections closest to the centre, in this case the 10M sections).

Make sure the links between all the sections are not joined together.

Raise the antenna up to the height it will normally be used at. This can be on the squid pole you bought for this project or from a rope slung over a tree branch. Doesn't matter, just get it up to the height it would normally be deployed at and peg it out into its inverted "V" configuration. If you have trouble doing it, check out this excellent video from SotaBeams. It tells you everything you need to know for an easy put up!. https://www.youtube.com/watch?v=RI6IRgQLokk Thanks Richard.

Connect your antenna Analyser to the RG174 with the BNC connector you soldered on.

Go to the frequency you selected as your frequency band centre (in this case I selected 28.700mHz) and check the VSWR. Write it down.

Now go to the lower end of the band (28.300mHz). Check the VSWR again and write it down. Go to the top end of the chosen band (29.100mHz) and check the VSWR again. Write it down.

Now you can have a look at the numbers and get an idea if you need to lengthen or shorten the top segments to get the VSWR as low as possible. Remember, a VSWR below 1.5 is more than acceptable. You can go lower and there is nothing to stop you aiming for perfection, but the improvement in performance will be minimal. If you need to shorten the segments, you need to take the same amount off each side of the dipole. So, for example, if you want to shorten the length of the wire a bit, then take say 1 cm off each side. Always trim both sides equally, otherwise you'll end up with an unbalanced dipole, and then it is not a dipole.

Now look at the measurements.

28.300mHz VSWR 1.5
28.700mHz VSWR 1.0
29.100mHz VSWR 1.5

If they turned out like this, then that is as good as you're going to get, and you don't need to do anything. Go to the next step.

If they are like this ….
28.300mHz VSWR 1.0
28.700mHz VSWR 1.5
29.100mHz VSWR 2.1
Then the segments are too long.

Pull the antenna down and trim 1 cm off each side, put it up again, and check the VSWR again. Repeat until the VSWR is as low as you can get it. Remember, take small lengths off. It's harder to make it longer than it is to make it shorter. Then go to the next step.

If they are like this ….
28.300mHz VSWR 2.1
28.700mHz VSWR 1.5
29.100mHz VSWR 1.0
Then the segments are too short.

Pull the antenna down and add 10 cm of wire to each side (cover the solder joint with Heat Shrink to make as waterproof as possible), put it up again, and check the VSWR again. Repeat and trim or add until the VSWR is as low as you can get it. Remember, when trimming, take small lengths off. Now go the next step.

Once this first segment is is tuned, solder on your Anderson connectors to the end of the first segment and the beginning of the second segment (on both sides of course), clip them together, and go onto the next one.

Repeat the process for the second band (15M). My centre was 21.300mHz (21.150mHz bottom and 21.450mHz top).

Repeat again for the last band (in my case 40M). My centre was 7.100mHz (7.000mHz bottom and 7.200mHz top).

Finally, re-check all 3 bands again (don’t forget to unlink/link the segments as you do your measurements) just to make sure everything is as is should be.

Now, you’re done.

Go have fun with your new 40/15/10M linked dipole.