
# Tiny Portable EFHW antenna

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# MOTIVATION

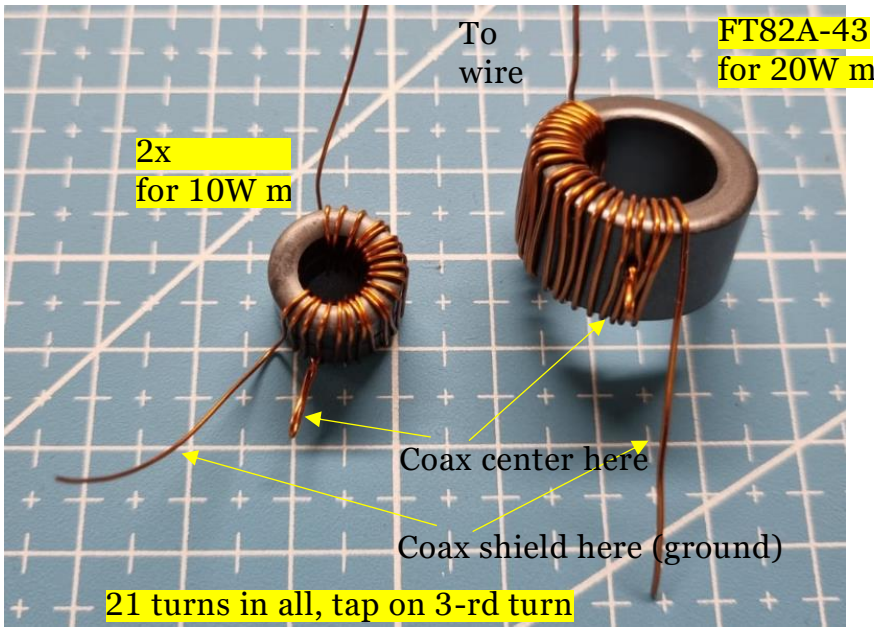
End Fed Half Wave antennas are great for portable shortwave operation due to easy built-up in any terrain conditions. In order to minimize space needed to carry such antenna I came with an idea to design EFHW which integrates coax with BNC connector, unun and antenna wire in a very compact solution. The final result is outcome of many discussions and build iterations with members of OM3KII radioclub. We have nice tradition of preparing XMAS surprises for our members, this construction was surprise for 2022.

Thanks to my experience in 3D modelling in OpenScad the basic design was ready rather quicky, nevertheless there were many iterations needed till the final version. Special thanks go to Rado OM2ZZ with work around UNUN and tuning and to Brano OM2FY with work around coaxial cables and connectors.

# EFHW AND MECHANICAL SETUP

I will not focus on EFHW theory and principles here, there are many good articles on this topic, see References.

The key component of EFHW antenna is UNUN (unbalanced-unbalanced transformer). It transforms high impedance seen at the end od half-wave wire to usually 50 Ohm. Typical UNUN transformation ratios for EFHW antennas are in range from 1:36 to 1:81, we use ratio 1:49. This is achieved by 21 turns in all, while the tap is on 3-rd winding.



Construction details of UNUNs for 10/20W rated power are on the figure above.

For bands above 20m a shunt capacitor between tap (primary winding = coax center) and ground is usually added, this helps achieving better SWR. Typical value is around 100pF and must be in theory rated for 100V when considering 20W maximum operating power, however I strongly advise to use even 3kV rated, high quality RF capacitor. Please do not underestimate selection of the magnetic material and capacitor since it can completely degrade overall quality of the antenna.

The proposed solution is winder which integrates UNUN in the center and contains two compartments, in first one thin coax cable such as RG174/U of length 2.5m and ended with BNC connector is wound, while in the second one the thin wire of length 20.2m (some adjustment may be needed) is wound.


The 3D printed construction is very light, thus after unwinding in the field it can freely hang above the ground. I use rubber band attached to center end of the winder and fixed close to location where I have my transceiver. The other side is pulled upwards by a tension of half-wave wire fixed via pole on the other side.

I use the rubber band to keep the winded construction together during transportation.

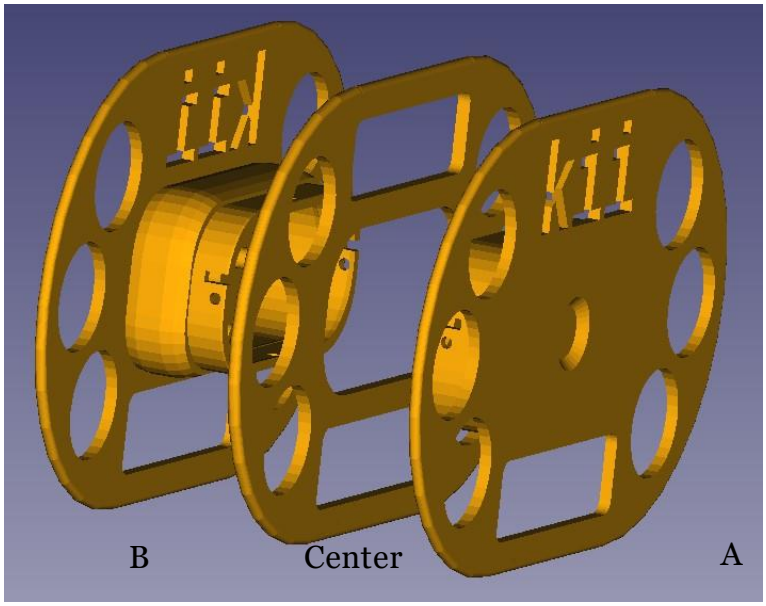
**Material list, summary:**

- 2.5m of RG-174/U or similar thin coaxial cable
- BNC or SMA connector
- UNUN:
  21 turns of 0.5mm diameter Cu wire, tap on 3-rd turn
  - 2x FT50-43 core for 10W max power, or
  - 1x FT82A-43 core for 20W max power
- Insulated stranded wire, diameter 1.0-1.1mm (incl. insulation)
  - 20.2m length
  - if 30m band is needed then cut the wire in ~~10.12~~ 13.9m for insertion of link separator
  - Note: exact wire lengths depend on velocity factor of given insulated wire. It can vary around 0.95, for thin insulated wires it can go down to 0.9. One can calculate the wire length for any frequency:
    wire_length = ( 150 / Freq_in_MHz ) * 0.94
- Thin thermoshrink tube
- 3D printed parts, see further
- Strong rubber band
- Optional: Shunt capacitor 100pF / 3kV. We have good experience with JYC3F101KCB065000B (100pF; 3kVDC; Y5P; ±10%; 7,5mm)

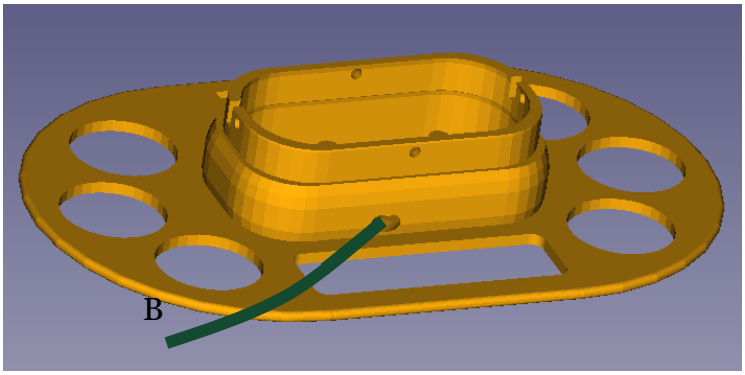
## BUILDING INSTRUCTIONS

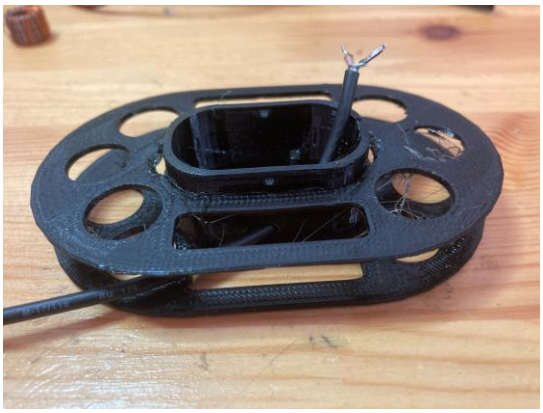
- Print the provided models on 3D printer, I have used PETG material.
  `EFHW_Tiny_Winder_v5_all.stl` - all 3 parts in one run
  or each one separately:
  `EFHW_Tiny_Winder_v5_center.stl` - center part
  `EFHW_Tiny_Winder_v5_A.stl` - side A
  `EFHW_Tiny_Winder_v5_B.stl` - side B


- I also provide source code in OpenScad so that experienced “makers” can easily modify the original design
- The parts will be assembled as follows

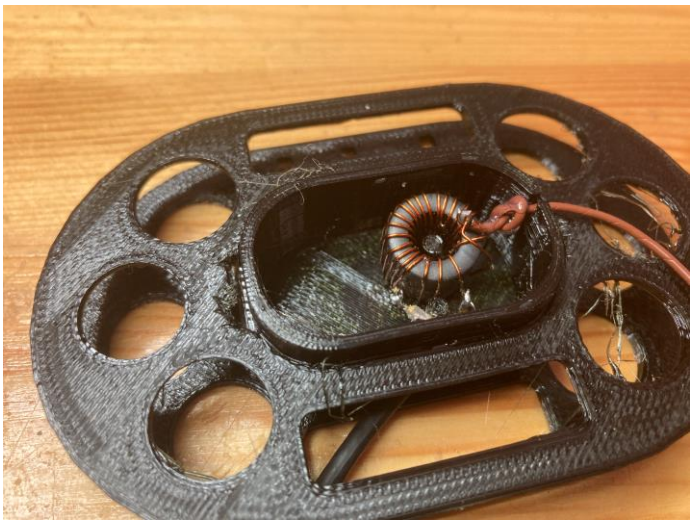



- Cut 2.5m of RG174/U or similar thin coaxial cable, insert it from side into part-B, then prepare the coax cable for soldering. Prepare the UNUN and solder it to coax cable as depicted below. Finally, push the center part on top of the part-B.

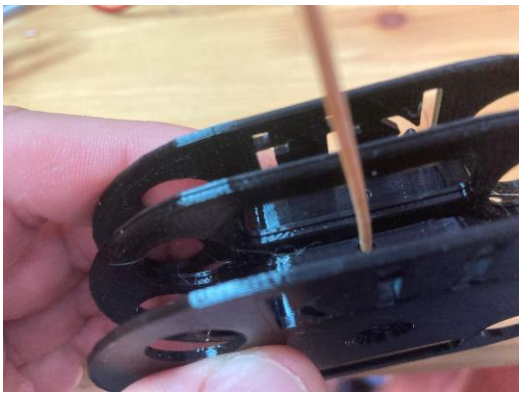


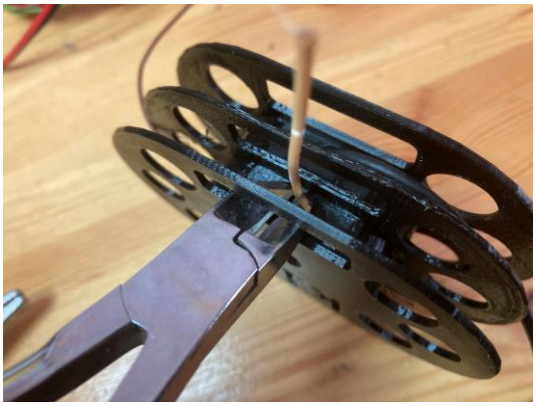



- Pull the coax cable outwards until the UNUN is inside of the center part (there is small stick which goes through center). Prepare 20.2m of wire. Insert thin thermoshrink tube close to the end of wire, then create knot at end of the wire, fix the wire in the side slot. Solder the end of the wire with end of secondary winding of UNUN as depicted below (there is no thermoshrink tube shown on left picture). The thermoshrink tube helps protecting the insulated stranded wire from breaking in the most critical point where it is bent when the wire is winded. It helps if you start winding carefully and do not bend the wire immediately in right angle.
  Fix everything - the coax, the UNUN and wire with got glue. Optionally you can add shunt capacitor.




- The final step is putting the part-A on top of the remaining ones and fixing everything together. When you stack the parts correctly you will see holes of 1.7mm diameter from each side. Please use 1.75mm filament or wooden sticks of similar diameter and insert them into the holes from each side, this will fix the parts together. Finally, cut or break the filament. For insertion, use only short length so that when construction needs to be disassembled the filaments can be pushed inwards.





- The 20.2m wire EFHW will work on the following bands
  - 40m half wave
  - 20m 2x half wave
  - 15m 3x half wave – shunt capacitor may be needed

- If 30m band is needed, cut the wire at ~~15.12m~~ 13.9m from UNUN side and insert tiny insulator. For removable wire connection use e.g. standard size pin header pin and receptacle.

## FIELD OPERATION

When unwinding in field, go to the point where you expect end of the EFHW and start with unwinding the thin wire. Just take the winder between your fingers, there is center slot from both sides, and pull the end of the wire while the winder rotates. During this process the coax wire should remain fixed, e.g. with rubber band.

Finally unwind also the 2.5m coax cable and fix the winder close to the point where you expect to operate.

Ideally, the wire should be supported in the middle by 5-6m post, while end of the wire can be fixed in any height

Important is that there is no high tension on the wire as the wire is thin and could break. Using the rubber band to fix the winder can help, flexible fishing pole is helping too.

If the weather is nice and without wind, just putting the winder on elevated point and moderate fixing is possible.

Wishing you happy field activities with your new friend.

Hear you soon on the bands, 73/44 de Jan, OM2JU

## REFERENCES

Great EFHW article is from HB9EAJ, there are many references to other onl of the document

https://hb9sota.ch/wp-content/uploads/2021/08/Portable-7-Band-EFHW_H