

Buildathon

July 11, 2020

John Meade W2XS

- Contact Info:
 - jm416@optonline.net

End-Fed, Half-Wave Antenna

- Simple to build.
- Simple to erect as an inverted vee with a pole or tree.
 - Pole doesn't support the weight of a feedline or center insulator
- Very good radiation efficiency. Most of the signal is radiated.
- Performance is much better than a small antenna with poor efficiency.
- No antenna tuner is needed.
- Bands are switched by replacing the antenna wire length.
- No adjustments needed (after initial set up).
- Easily moved around.
- Can be mounted vertically, horizontally, or as an inverted-vee.
- An extensive counterpoise or radial system is not needed

End-Fed, Half-Wave Antenna

- A half-wave dipole is a great antenna. When fed in the center, it is a good match for 50 ohm coax. When fed at the end, the impedance is very high (3k to 5k ohms) which is easily matched with a simple transformer. The EFHW has been chosen by a QRP operator's poll as the most popular low-power portable antenna. We thought it might make a relatively simple project but one that would work well out in the field. There is only one toroid to wind and a few parts to solder. Total assembly time should be an hour or two. Total cost (not including a mounting pole and ground mount) is about \$34.

End-Fed, Half-Wave Antenna

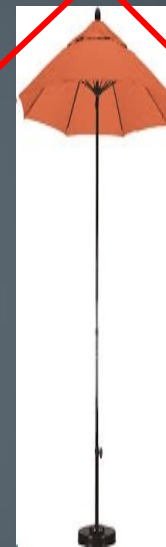


**Rig
(No Tuner)**

**BNC
Cable
10' - 25'**



**Matching Unit
49:1 Transformer**



**Support Pole
and
Base Mount**

**Antenna Wire
40m = 66'**

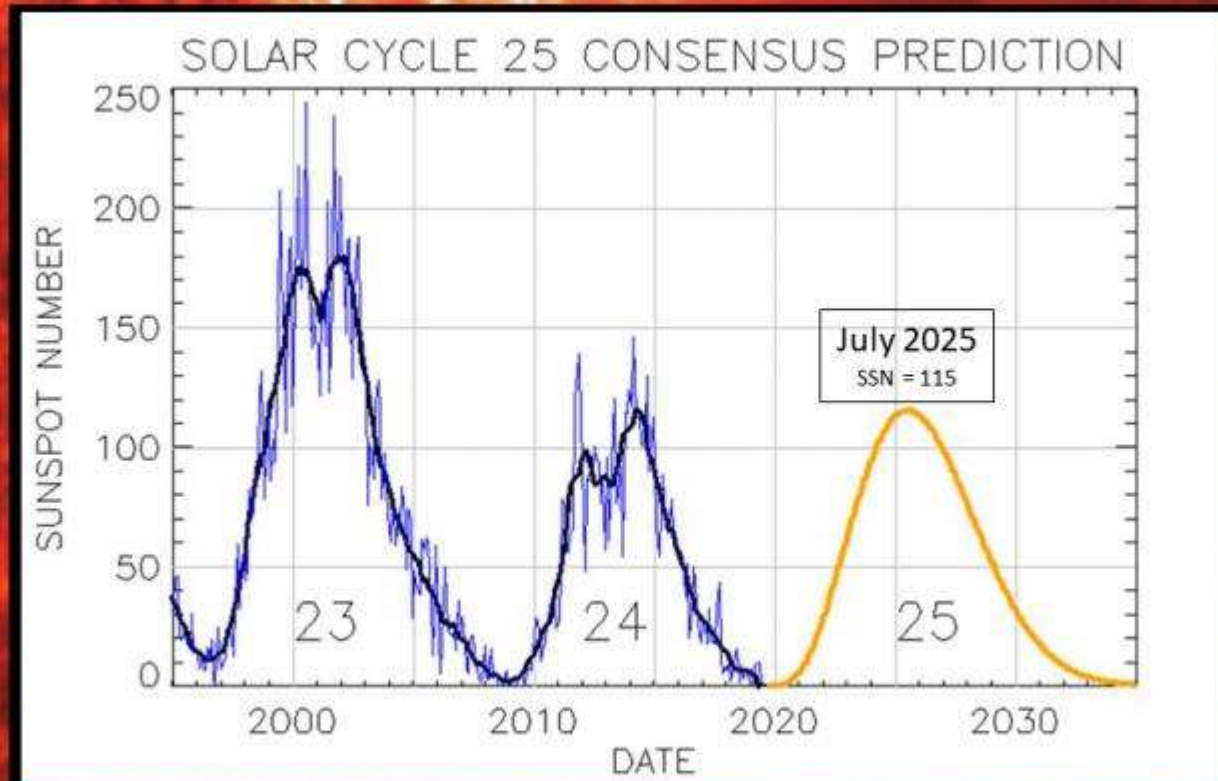
Insulator

**Rope
or
Twine**

**Ground
Stake**

Solar Cycle 25 Forecast Update

- Released December 9th, 2019 -



Solar Cycle 25 will have a peak SSN of 115 (± 10) in July 2025
Solar Cycle 24/25 minimum will occur in April, 2020 (± 6 months)

Next peak will be 2025

QRP Antennas

- Two Main Important Items:
 - How well is the antenna matched to the transmitter
 - How well does the antenna radiate
 - Our project will do well on both points.

QRP Antennas

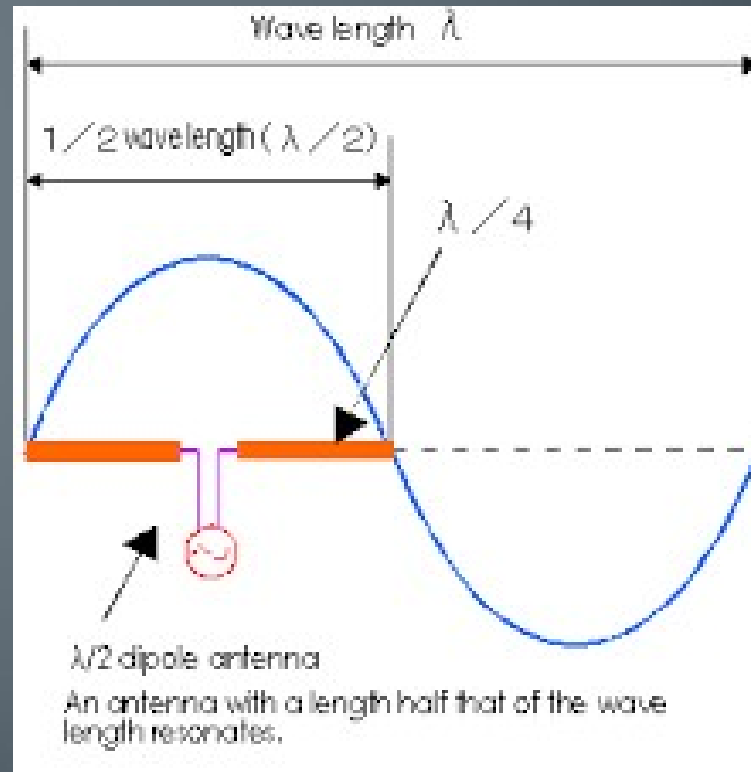
- Laws of Physics
 - We are trying to radiate a radio wave
 - The length of the wave depends on the frequency:
 - A Frequency of 7 MHz is a Wavelength of 40 meters
 - Half wavelength means 20 meters = 66 feet
 - A typical basic antenna is a half-wave dipole.
 - The reference for all other antennas
 - Can be fed in the center, at the ends, or off-center

QRP Antennas

- Laws of Physics (cont)
 - In order to radiate, a “standing wave” is needed on the antenna.
 - A standing wave should not be present on the transmission line.
 - If the antenna is too short, then the standing wave will form on the antenna AND the transmission line AND the tuner – resulting in a poorly radiated signal.

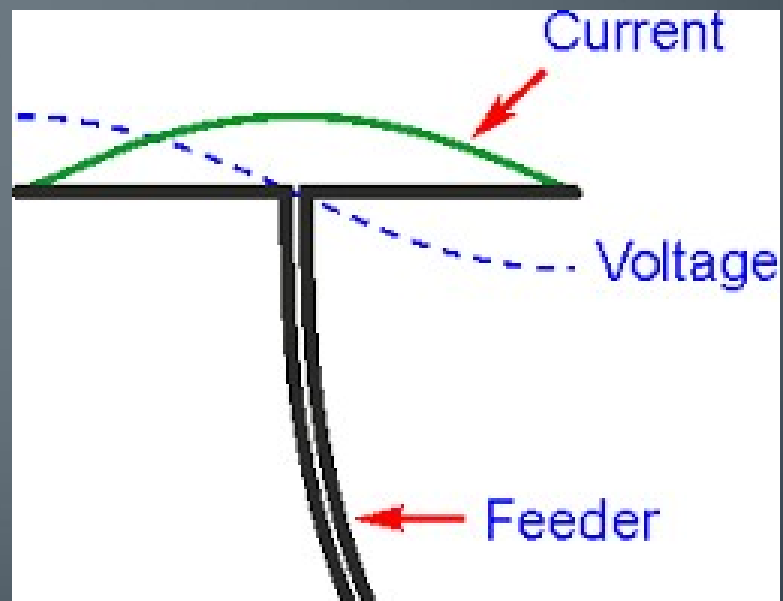
End-Fed, Half-Wave Antenna

- The Standing Wave looks like this

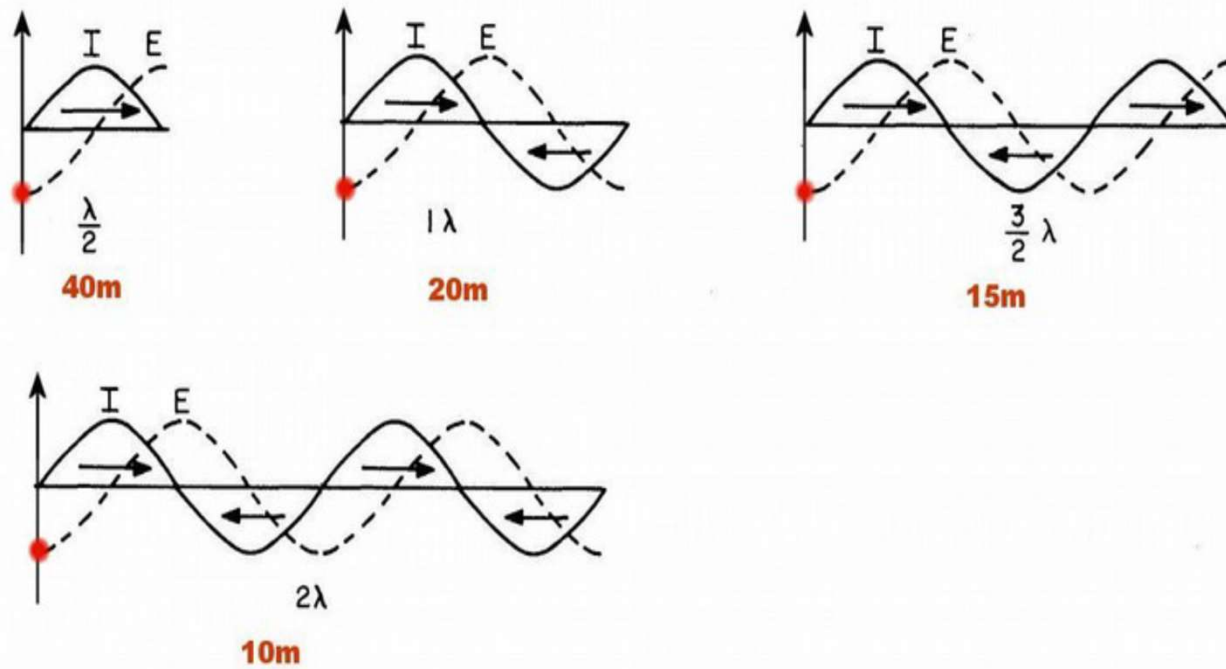


QRP Antennas

- Laws of Physics (cont)
 - Another view of the “standing wave” on the antenna
 - The current is responsible for the radiation. That’s why it’s good to get the center of the wire up as high as possible.



Standing Wave on Other Bands



QRP Antennas

- Standing Waves Example

Standing Waves on a String: both ends fixed.

- **fundamental frequency** - the lowest frequency, also called the first harmonic,

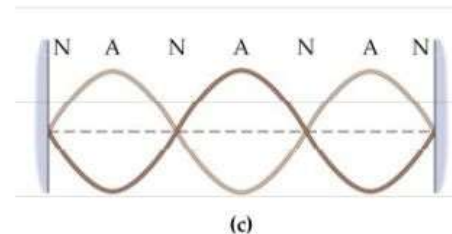
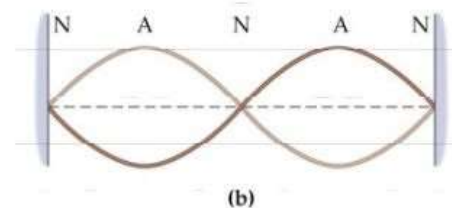
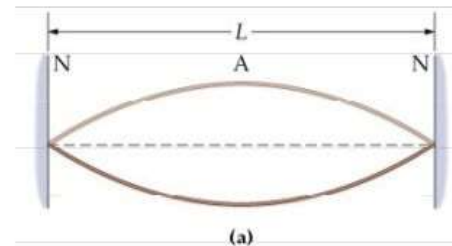
$$f_1 = v/2L \text{ and } \lambda_1 = 2L$$

- **second harmonic** - the next allowed frequency, $f_2 = 2f_1$.

- In general

$$f_n = nf_1 \text{ and } \lambda_n = 2L/n$$

for the n^{th} harmonic on a string of length L . v is the velocity of waves on the string.

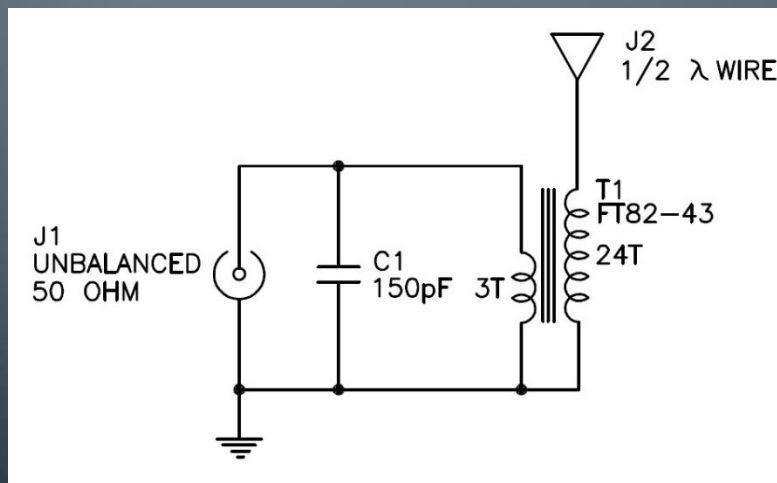


End-Fed, Half-Wave Antenna Components

- $\frac{1}{2}$ wave length of wire
- Matching transformer
- 50-ohm coax feedline (10 to 25 feet)
- Insulator
- Rope or twine
- Ground stake
- Pole
- Pole ground mount

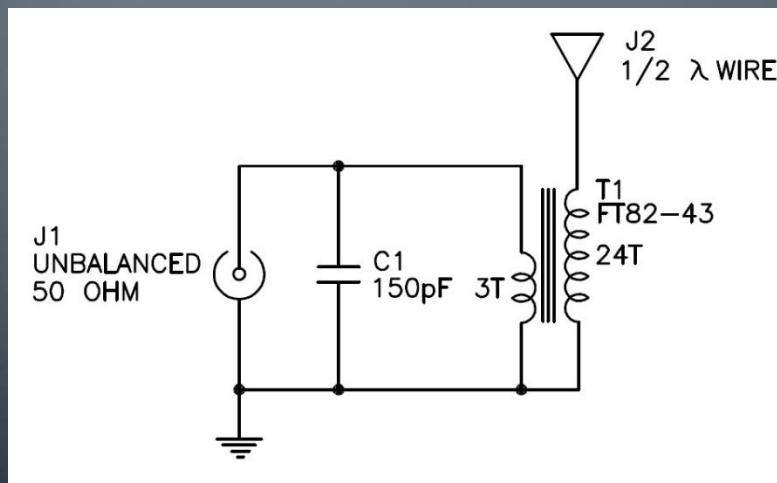
End-Fed Halfwave Antenna – Matching Transformer

<https://qrpguys.com/qrpguys-end-fed-wire-antenna>



End-Fed Halfwave Antenna – Matching Transformer

<https://qrpguys.com/qrpguys-end-fed-wire-antenna>



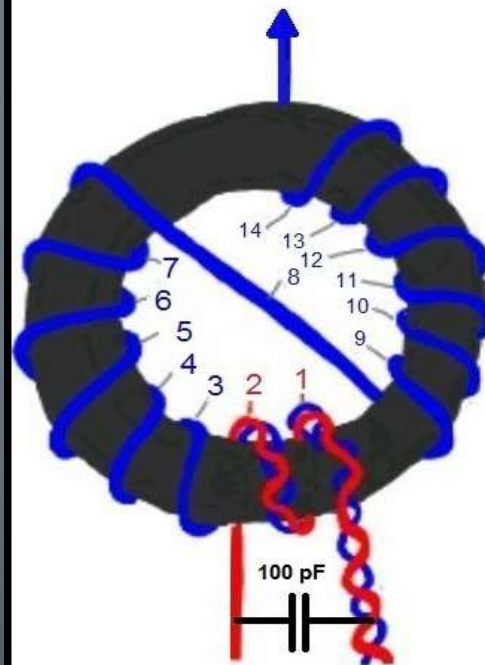
End-Fed Halfwave Antenna – Matching Transformer - Homebrew

49:1 Transformer

Primary 2 Turns.

Secondary 14 turns (Total turns)

To End Fed Half Wave Antenna.



To TX

Gnd.

Parts List

Toroid Core:

Mouser Part #623-5943003801
240-43 Toroid 12.7mm x 61mm

**Use 1, 2 or 3 cores depending on transmitter output to be used.*

Capacitor:

Mouser Part #81-DHR4E4C221K2BB
100 - 110 pF. You can use TWO
220 pF @ 15 kV in series.

Antenna:

80m - 10m use a 134' wire.
40m - 10m use a 67' wire, etc.

Wire:

14 gauge enameled wire. **

*** When using 3 toroid cores start with a Primary wire of ~13" and Secondary of ~80" long. 1 & 2 cores will use less wire.*

Revised: 07/14/2017 - K1TA

49:1 Transformer

This link is the background information for this diagram.

<http://gnarc.org/wp-content/uploads/The-End-Fed-Half-Wave-Antenna.pdf>

Get the prescribed toroid core if possible (FT-240-43). Mouser is listed below as a source, and so is <https://www.kitsandparts.com/toroids.php>, eBay, Amazon, and others. The 100 pF capacitor should be rated at 500 V to 1 kV for QRP and 15 kV for high power. (See page 16 of the link for more cap info. See page 30 for other material sources.).

End-Fed Halfwave Antenna – Coax

10 to 25 feet BNC-to-BNC

<https://www.allelectronics.com/item/cbl-29/15-bnc-bnc-cable-rq-58/1.html>



End-Fed Halfwave Antenna – Wire

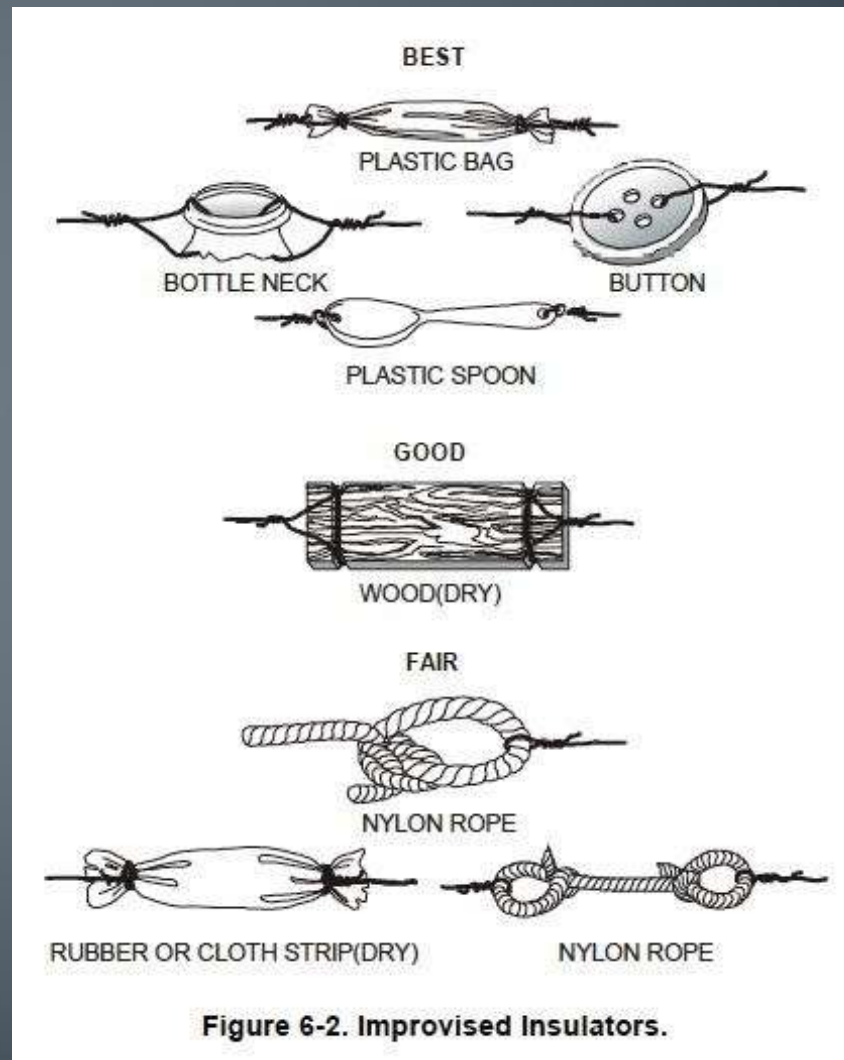
22 gauge stranded wire
\$7.44 for 100 feet

<https://www.allelectronics.com/item/22rd-100/22-ga.-red-hook-up-wire-stranded-100/1.html>



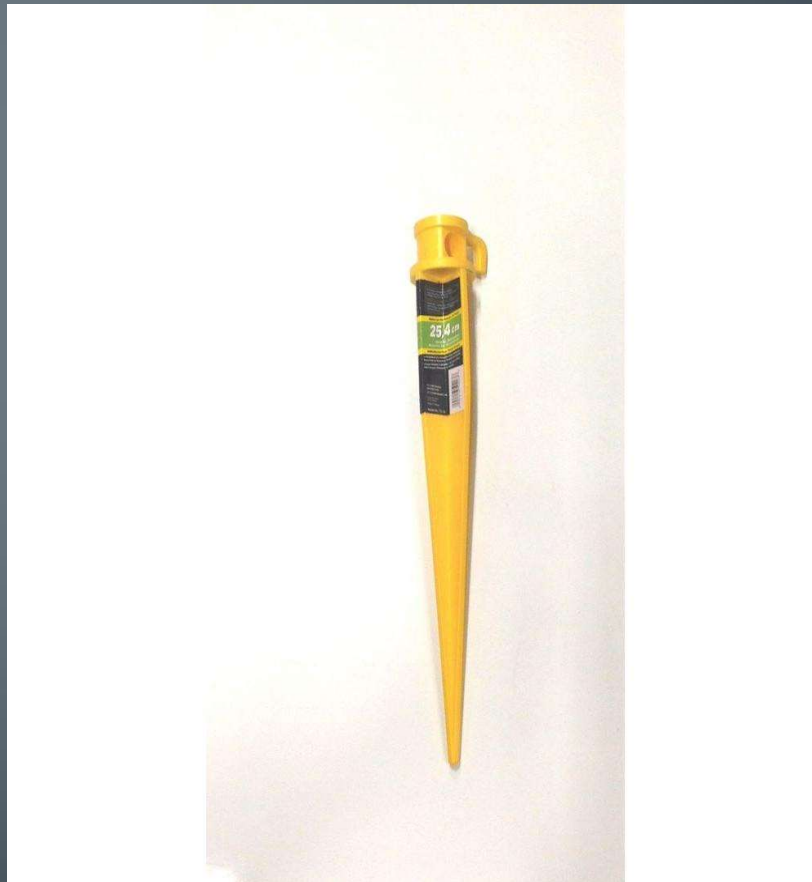
End-Fed Halfwave Antenna – Insulator

Buy one or make one



End-Fed, Half-Wave Antenna Components

- Ground stake, or tie the twine to a fence or tree



End-Fed, Half-Wave Antenna – My Results

- Made measurements of resonant frequency and SWR with various wire lengths and coax lengths. Took several days.
- Ended up with 66 foot wire and 11 foot coax
 - SWR was < 2 to 1 on 40m and 20m!
 - SWR was < 2 to 1 across the whole 40m band!
- 14006 – EA5M (me = 599)
- 14025 – EA8TL (me = 599)
- 14060 – AB0TO – St. Louis, MO - Dave @ 5 watts
- 14060 – WB9FMP – PA (me = 599 “big signal”)
- 7030 – AA3J – Ocean City, MD (me = 599)
- 7033 – W3FSA – Bethel, ME (me – 339 – QRN – 30 min QSO)
- 7024 – W3ZT – Finger Lakes near Syracuse (me = 569)
- 7029 – WA4DOX – Millwood, VA (me = 589)
- Me = KX2 @ 5 watts on internal battery

End-Fed, Half-Wave Antenna – My Results

- Set up again on 7/9/2020
- Walked out back door – 13 minutes later was on the air
 - Pole kept collapsing and fell over once
- Set up pole and umbrella stand
- Threaded wire through the top eyelet and raised pole
- Connected insulator, string, and tied to a tree limb
- Connected coax to matcher and then to rig (KX2 - 5 watts)
- 7030 – K3LU – 599/599 near Wash DC
 - IC7300 to sloper up 70' – nice 30 minute rag chew
- 7030 – K1MNF near Concord, NH – 599/579
 - TS590S @ 5W to OCF dipole up 35'. Some QSB after 15 mins.

End-Fed, Half-Wave Antenna – My Results

- Wire length was not that critical.
- Coax length affected mostly 20m with the 40m wire.
 - I wasn't sure that I would even try 20m at the outset.
 - Some coax is needed – it's also the counterpoise.
 - I would get 6 and 15 foot cables
- It was really fun not using the tuner. I was happy with the performance of the antenna.

End-Fed, Half-Wave Antenna – Approx Feet

- 160 = 260'
- 80 = 134'
- 40 = 66'
- 30 = 46'
- 20 = 33'
- 17 = 26'
- 15 = 22'
- 10 = 17'
- 6 = 8.7'

End-Fed, Half-Wave Antenna – Links

- <http://gnarc.org/wp-content/uploads/The-End-Fed-Half-Wave-Antenna.pdf>
- <https://elginradio.wordpress.com/2017/10/17/end-fed-half-wave-antennas/>
- [http://www.infotechcomms.net/downloads/Multi band EFW.pdf](http://www.infotechcomms.net/downloads/Multi_band_EFW.pdf)
- <http://www.aa5tb.com/efha.html>
- <http://pa-11019.blogspot.com/2012/04/149-transformer-for-endfed-antennas-35.html>
- <https://www.worldwidedx.com/threads/efhw-antenna-and-49-1-unun.238644/>

End-Fed, Half-Wave Antenna – Poles

- https://www.amazon.com/Panghuhu88-Telescopic-Ultra-Light-Saltwater-Freshwater/dp/B07VCD9X2N/ref=sr_1_8?dchild=1&keywords=7.2%2Bm%2Btelescopic%2Bfishing%2Brod&qid=1583764115&sr=8-8&th=1&psc=1
-
- <https://www.ebay.com/itm/6162025-Aluminum-Sectional-Flagpole-Kit-Outdoor-Halyard-Pole-1PC-US-Flag/202062191482?hash=item2f0bd85b7a:m:mdW1ZWMan601V4ukIPYeB1g>
-
- https://www.ebay.com/itm/2-1-7-2m-Model-Carbon-Fiber-Stream-Pole-Telescopic-Freshwater-Fishing-Rods/222850736757?hash=item33e2f06275:m:mGHT7CCHSigu_07S5MaZjZg
-
- <https://www.bnmpoles.com/products/bw?variant=1581464649739>
-
- https://www.amazon.com/Flagpole-To-Go-FP-21-Portable-Flagpole/dp/B000OWM2BE/ref=sr_1_2?dchild=1&keywords=flagpole%2Bto%2Bgo%2B20%27&qid=1581302489&sr=8-2&th=1&psc=1
-
- <https://www.jackite.com/online-store/20-ft-Thick-Tip-Green-Fiberglass-Windsock-Poles-p78587340>

End-Fed, Half-Wave Antenna – Pole Mounts

- <https://www.shadeusa.com/product/earthworm-beach-umbrella-anchor/>
-
- <https://www.jackite.com/online-store/Ground-Stake-for-13-16-17-and-20-foot-Windsock-Poles-p78577396>
-
- <https://observer.wunderwood.org/2018/08/15/plastic-pipe-roof-antenna-support/>
-
- <http://www.n0lx.com/minimast.html>

Some additional pole mount ideas

- There are several ways to mount the pole in the ground. Jackite used to have a mount for the 28'/31' poles but I no longer see it on their website.
- 1. Cut one end of a piece of PVC pipe on a 45 degree angle. Slip the pole inside the other end for mounting.
- 2. Buy an umbrella mount like the Earthworm. Make sure it's wide enough to accept the pole diameter. <http://www.theearthworm.com/>
- 3. Buy a cement-base umbrella stand from Ace hardware. This works well but weighs 35 lbs.
- 4. Use a modified ACE beach umbrella sand anchor (from W2OSR in May 2018).
- 5. Bungee-cord the pole to a fence or fence pole.
- 6. Insert the pole into to a slightly larger section of PVC pipe and use U-bolts and a 3' threaded rod into the ground.
- 7. This guy has some good ideas. Download the manual from his Jackite page. Hamsource.com

Neat Roof Antenna Mount

He painted and put sand in PVC pipe

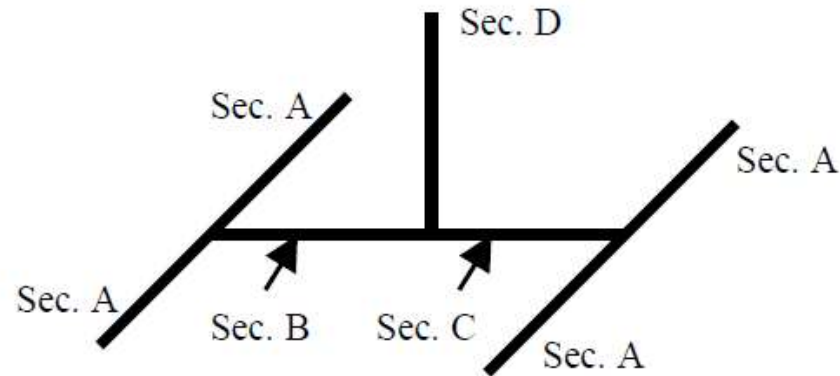


NOLX Mini Antenna Mast and PVC Base



KDØCA

- KDØCA PORTABLE HAM RADIO ANTENNA SUPPORT -
PVC BASE TO SUPPORT AN SD-20 TELESCOPING FIBERGLASS MAST



Pipe Sections A, B, and C are each 30 inches long.

Pipe section D is 42 inches long.

All PVC pipe and Tees are $\frac{3}{4}$ inch ID.

Please let me know how things work
out for you. Or, if you have any
other questions.

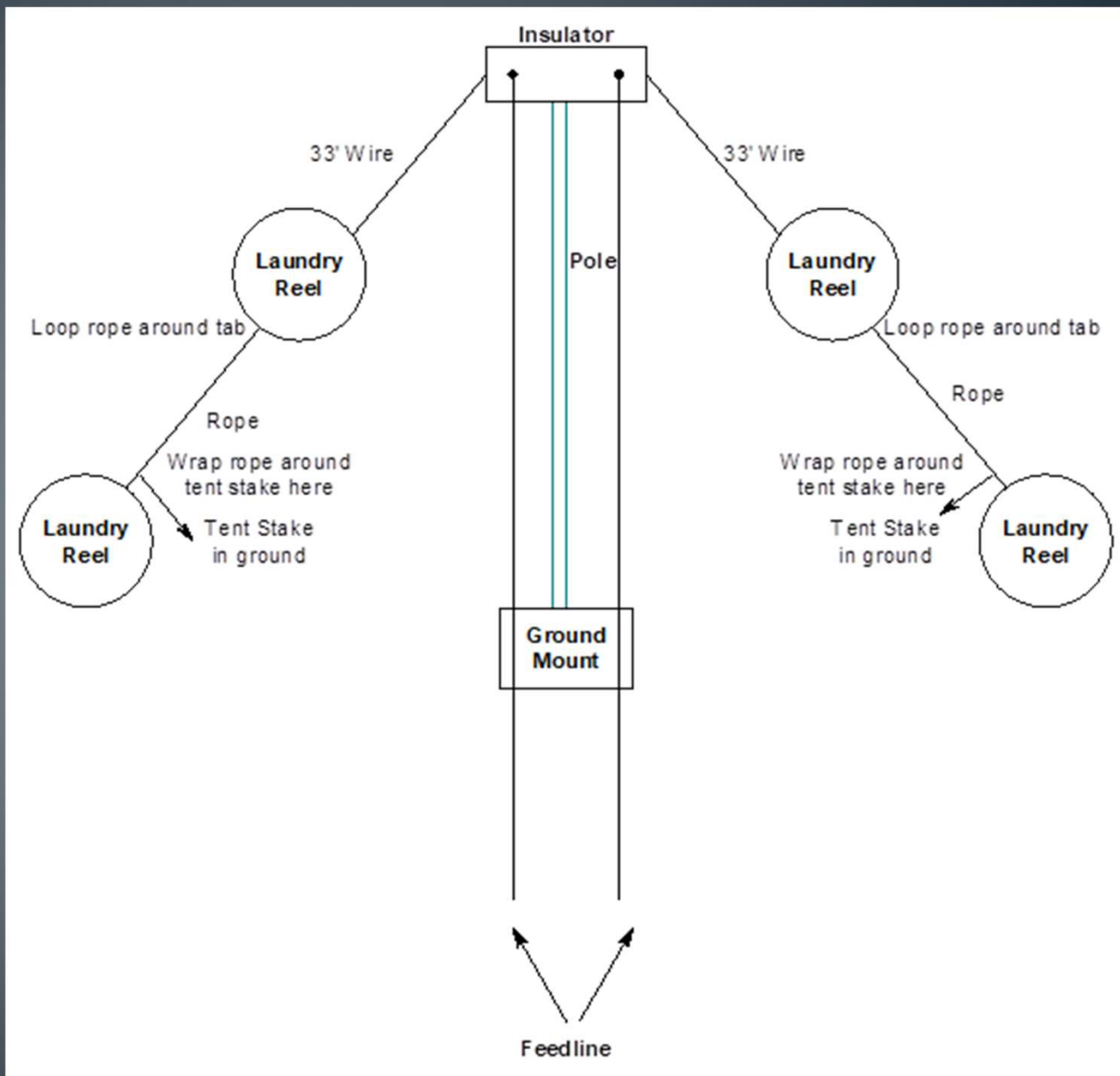
Thank you! CUL
73,

John W2XS

Portable 40m to 10m Inverted V Antenna used by W2XS

I have tried many antennas for QRP portable operating: center-fed dipoles, end-fed half wave wires, end-fed “random” length wires, loaded verticals, etc. While many of them worked fine, my favorite is still the center-fed dipole (or, inverted vee) fed with twinlead. It is the best performer overall, takes only a few minutes to set up in the field, and works on all bands from 40m to 10m. It needs a tuner and a balun (or, a “balanced” tuner), but the results have always been good. I have even used it at home a few times when my main antenna succumbed to the high winds of a storm.

The prices that I am listing are “ballpark” prices just for estimating. You can do a search for the items here and find the best prices.



The Pole (\$85)

Several companies are offering the Fiberglass telescopic masts now. I've mainly used the Jackite 27-foot pole but the 31-foot is also a good choice.



<https://www.jackite.com/antenna>

https://www.bestnest.com/bestnest/RTProduct.asp?SKU=JAC-FIBPOLE-GRN-31&src=froogle&kw=JAC-FIBPOLE-GRN-31&gclid=EAIaIQobChMIx-3E1Ov83wIVAorICh0vEwc1EAQYAyABEgJ4SPD_BwE

The MFJ model 1910 33' pole looks interesting, and several people in the club have them and like them.

<https://www.mfjenterprises.com/Product.php?productid=MFJ-1910>

Spiderbeam has a nice 40' pole for \$109:

http://www.spiderbeam.us/product_info.php?info=p3_Spiderbeam%20HD%2012m%20fiberglass%20pole.html

The Camping Laundry Reel (\$4 each)

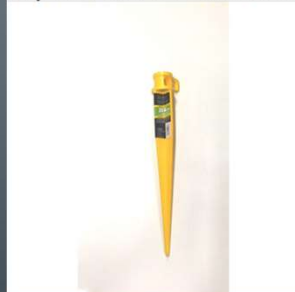
This is my favorite part of this antenna. Buy 4 of them. Use two for the antenna wire by removing the rope (I use 33 feet on each side). Use the other two as they are as ropes to secure the antenna ends to the ground stakes. Walmart, etc., sells these things. The come apart very easily and I clean them once in a while.



<https://www.amazon.com/Coghlans-Laundry-Reel/dp/B06WVRV53Y>

Tent Stakes (\$4)

Any kind will do. Use 2 of them, one for each leg of the antenna.



The Center Insulator (\$2)

I use a small piece of Plexiglas for the center insulator with 3 small holes drilled in it. I use a twist-tie to secure it to the ring on the top section of the pole. I have also used a small PVC pipe coupling section from the local hardware store.

The Feedline (\$6)

300-ohm TV-type twin lead is getting harder to find. I bought 50 feet from Radio Shack. I see that Fry's Electronics is selling 50 feet for \$6! I intend to buy some while I can.

https://www.frys.com/product/5231747?source=google&gclid=EAIaIQobChMIn8Wj7e_83wIVDIvICh1mnwj0EAQYAiABEgJuJ_D_BwE

There was a discussion of this very topic on a forum on eHam.net:

<https://www.eham.net/ehamforum/smf/index.php?topic=96625.0>

The Pole Ground Mount (\$5 to \$35)

There are several ways to mount the pole in the ground. Jackite used to have a mount for the 28'/31' poles but I no longer see it on their website.

1. Cut one end of a piece of PVC pipe on a 45 degree angle. Slip the pole inside the other end for mounting.
2. Buy an umbrella mount like the Earthworm. Make sure it's wide enough to accept the pole diameter.
<http://www.theearthworm.com/>
Buy a cement-base umbrella stand from Ace hardware. This works well but weighs 35 lbs.
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5. Insert the pole into a slightly larger section of PVC pipe and use U-bolts and a 3' threaded rod into the ground.
6. This guy has some good ideas. Download the manual from his Jackite page. Hamsource.com

The Tuner and Balun (\$40 + \$15)

I use the built-in tuners of my Elecraft KX2 and K1 rigs. To connect to the antenna feedline, I use a 4:1 balun. Several companies make the baluns, including Elecraft and QRP Guys. Balanced tuners are available from QRP Guys and also QRP Kits, among others.

<https://elecraft.com/products/bl2-balun>

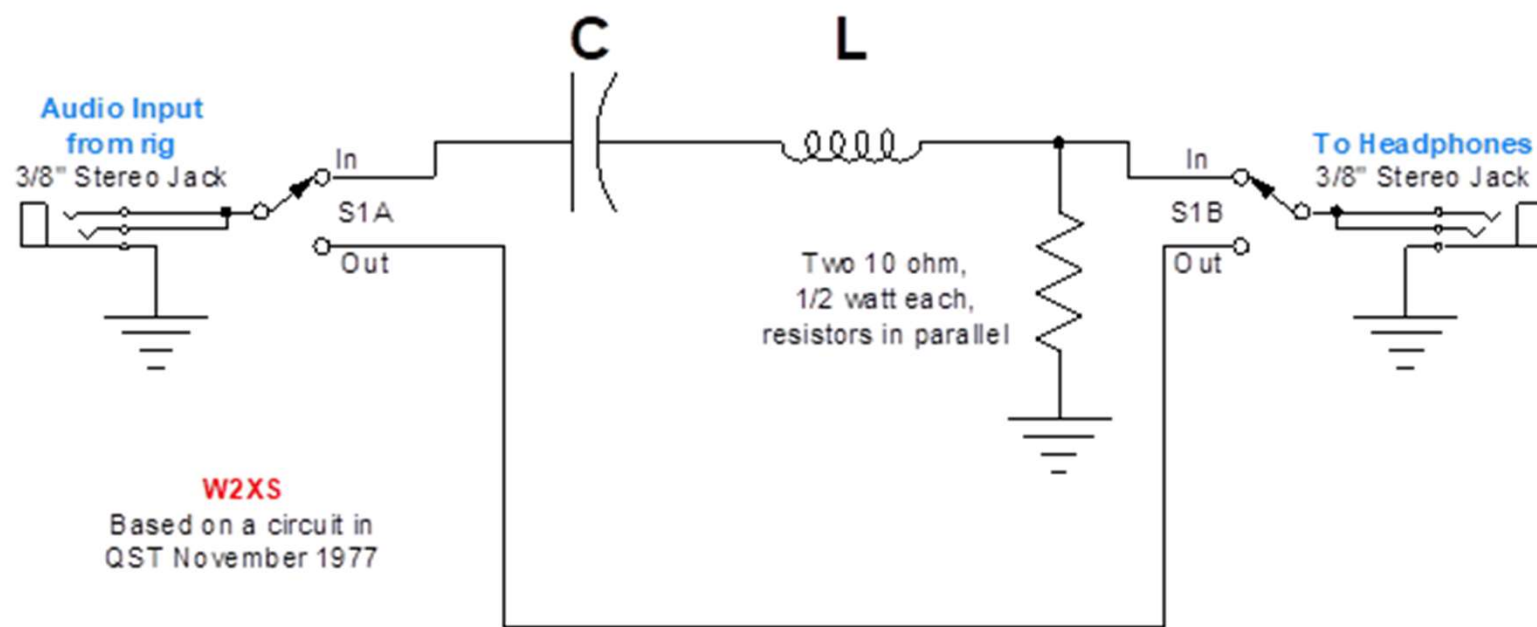
<https://qrpguys.com/qrpguys-11-41-voltage-baluns>

<https://qrpguys.com/multi-tuner>

https://www.qrpkits.com/blt_plus.html

W2XS AUDIO FILTER

Simple Passive Audio Filter



This simple audio filter will help remove annoying hiss and rumble from the output of a typical QRP rig (or a boatanchor!). It was originally published by W3MT in the November, 1977 issue of QST. ARRL members may download the original article from the ARRL Periodical Archive. I have used this circuit in one form or another for many years.

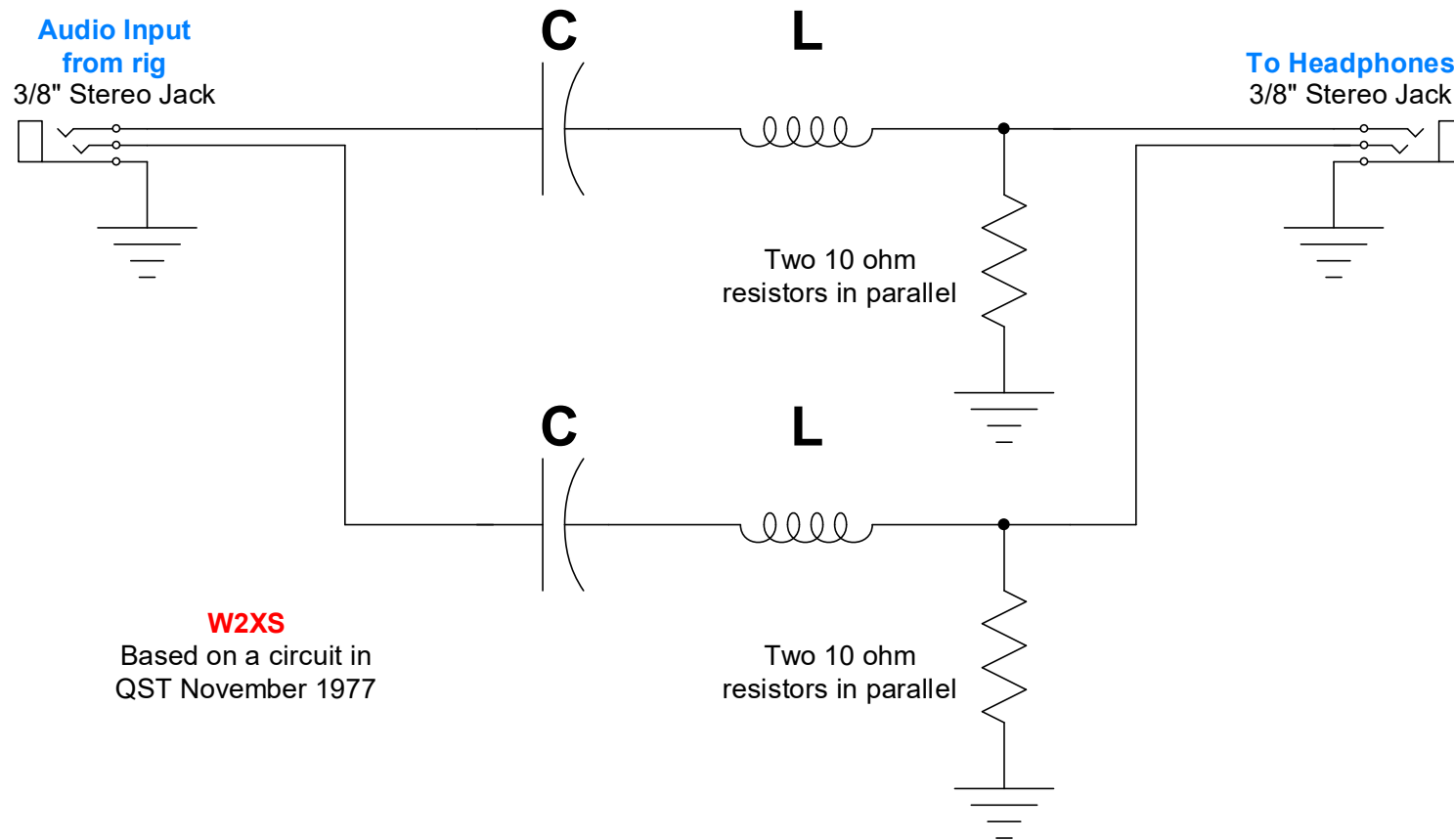
The circuit is simple. L and C resonate at the frequency of the pitch that is desired. I have calculated some numbers to help pick the values based on what might be available in the junk box. Recommended capacitor types are polypropylene film capacitors. Old telephone company toroids work nicely in this application. KK7B used Toko 10RB inductors in some of his audio filters.

Desired Pitch(in Hz)	With L = 20 mH	With L = 40 mH	With L = 80 mH
400	C = 8 uF	C = 4 uF	C = 2 uF
500	C = 5 uF	C = 3 uF	C = 1.3 uF
600	C = 4 uF	C = 2 uF	C = 0.9 uF
700	C = 3 uF	C = 1.3 uF	C = 0.7 uF
800	C = 2 uF	C = 1 uF	C = 0.5 uF

In some filters, I left out the two 10 ohm resistors. This makes the overall bandwidth the widest. It may work OK for sideband like that. The bandwidth is narrowest (and the Q is highest) with those resistors in the circuit. Also, you may eliminate the switch and just plug the filter in when needed.

I do not advise using the circuit above with a rig that actually has stereo outputs, like the Elecraft K3. In that case, duplicate the circuit on the left and right sides, as shown below

Simple Passive Audio Filter - Elecraft K3



Some Interesting Links

- <http://www.qrparci.org/links/qrp-kits-bits-and-supplies>
- <http://www.g4fon.net/MagLoopTwo.htm>
- <https://observer.wunderwood.org/2018/08/15/plastic-pipe-roof-antenna-support/>
- <https://www.dropbox.com/sh/j63lkeqnuq19wr5/AABntvxiTnrOWTKuYA6AMwwVa?dl=0>
- <https://www.americanradiohistory.com/index.htm>
- <http://www.reversebeacon.net/dxsd1/dxsd1.php?f=0&c=wv0h&t=dx>
- <https://qrpver.com/transceivers/all-band-10-band-hf-sdr-transceiver-minion-sdr.html>
- https://www.nonstopsystems.com/radio/frank_radio_antenna_multiband_end-fed.htm
- <http://www.hamuniverse.com/antennas.html>
- https://qsl.net/va3iul/Antenna/Wire%20Antennas%20for%20Ham%20Radio/Wire_antennas_for_ham_radio.htm