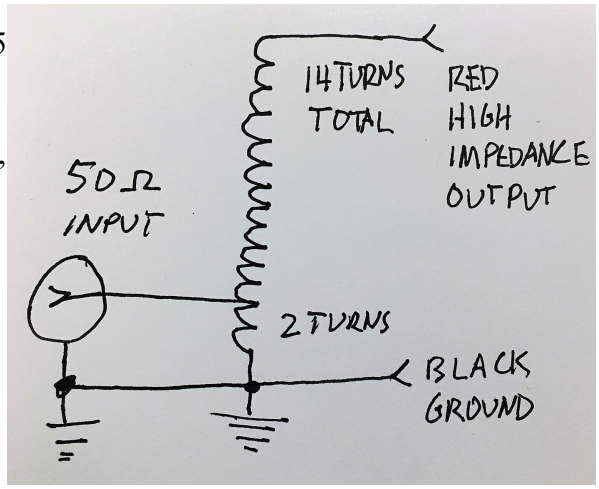
END FED HALF WAVE BALUN PROJECT

Alachua County ARES / North Florida Amateur Radio Club

September 1, 2019

DESCRIPTION

1:49 Auto-transformer Balun converts 50 ohm input to approximately 2450 ohm output. Loss approximately 1.5 dB 3-20+ MHz. (See measurement, Appendix) Constructed using 14 turns of #18 PTFE insulated stranded wire on a Teflon-tape wrapped FT-140-43 toroid, with a tap at 2 turns for the 50 ohm input. (For higher power, use a FT-240-43 toroid) Suggested power limits assuming the device is NOT IN DIRECT SUNLIGHT::



SSB, not using a voice compressor	100 W PEP
CW	50-75 watts
Digital	50 watts average

Common Mode choke: For digital you may well wish to add a 1:1 current Balun in your coax to reduce unwanted common-mode currents on the outside of your coax which can play havoc with your digital systems

Materials:

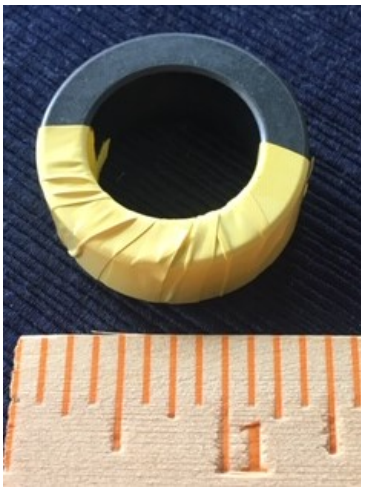
- FT-140-43 toroid. (consider kitsandparts.com)
- "Gas" type PTFE tape (Teflon) -- 13" long (cut with SHARP scissors)
- #18 PTFE white wire, 32" long
- #18 PTFE red wire, 3-1/2" long
- Pre-drilled handy electrical 1/2 high box
- 5/8"dia. hole for SO-239
- 1/16" holes for sheet metal screws (2) to hold SO-239
- 5/16" dia holes for the banana plug jacks
- #6 sheet metal screws (2)
- 2 banana plug jacks -- black for the GROUNDED connector,
- RED for the hot connector (>2k ohms impedance)
- SO-239 chassis-mount connector
- 2 #6x 3/8 or 1/2" sheet metal screws

- Electrical Handy Box
- Cover for handy box.

FOR ALACHUA COUNTY ARES -- there will already be a ground wire soldered to your SO-239 to make your building easier

INSTRUCTIONS

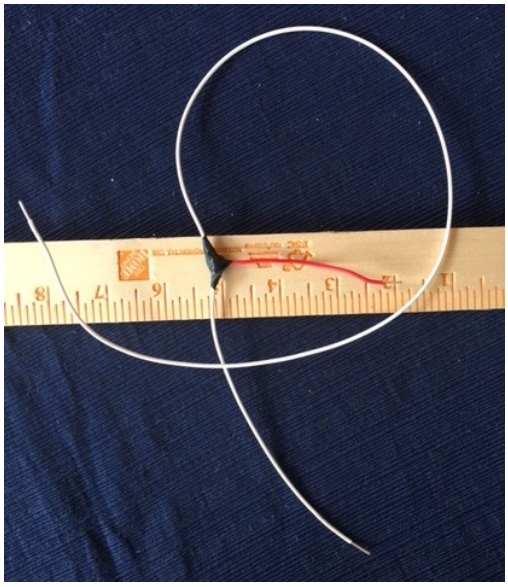
1. Prepare the banana plug jacks by carefully holding their body and tightening up the tiny screws that hold the inner connector from spinning. Don't strip them! Solder the outer nut to the threaded shaft with a hot iron so you don't have to stay there long. Insert the banana plug jacks into the box (see later picture for position) and carefully tighten. Don't strip.



Also mount the SO-239 with 2 #6 sheet metal screws.

2. Wrap about half of the toroid with "gas" type PTFE plumber's tape Do this carefully so the tape doesn't fold all up on you. This is supposed to help the toroid from cutting into the #18 Teflon wire, and it may also provide a bit more heat insulation. It is the toroid that gets hot.

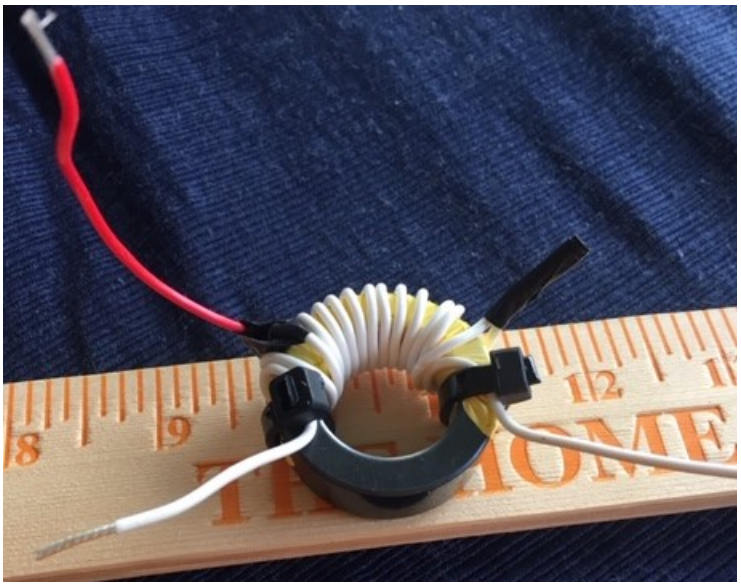
3. **At 7 inches from one end**, solder the red wire to a small cut (approx 1/8") in the PTFE insulation. A sharp wire stripper set to #18 or #20 can accomplish this. Using a small amount of electrical tape, insulate this connection



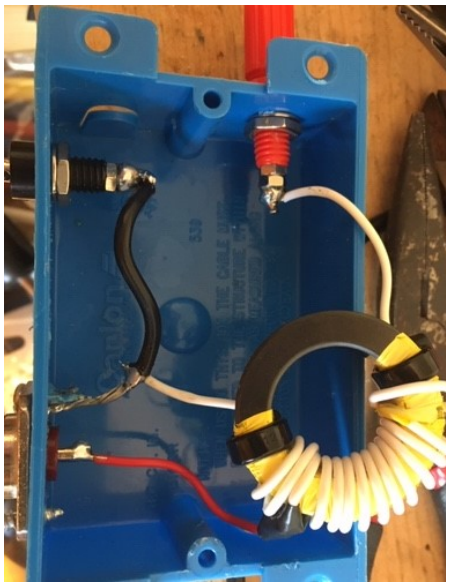
4. **We want TWO turns** (remember, one passage through the interior of the toroid is a "turn") created out of the 7" section of the white wire. Set the solder connection on the OUTSIDE of the toroid, and carefully wind two turns to one side of the solder joint. Pass the white wire through a zip tie and secure it.

5. Now continue with the LONGER end of the white wire, making the turns go in the same rotation, add 12 more turns, so that the total number of turns is now 14, and secure the end with a zip tie. *(In the photo above, there were only 13 turns;* I had to solder on some more wire to get the 14th turn).

When the entire turns are added, the toroid should look somewhat like the photo to the right. *Be certain that the red wire comes off on the outside of the toroid.*

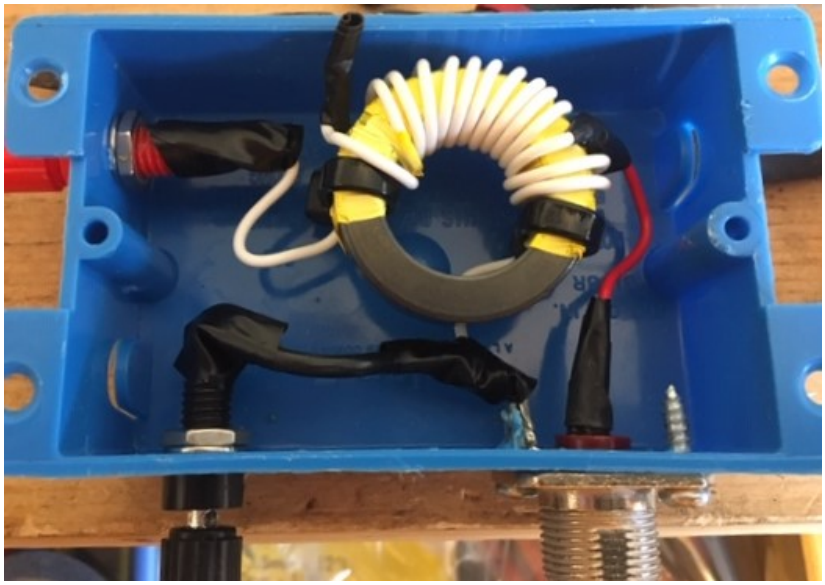


6. Make a **solder connection from the ground side of the SO-239 to the black banana plug.** Leave approximately 3/4" of bare wire at the SO-239 end, so that you can connect the short end of the toroid white wire to this.



7. **Now make your solder connections from the Toroid.** The longer end of the white wire goes to red banana plug. The shorter side of the white wire solders to the ground wire from the SO-239. The Red wire solders to the center connection of the SO-239.

- It may be easier to back out any top screws on the SO-239 to better reach the center connector for soldering.
- Try to remove extra wire if you have too much wire.
- Be careful when soldering to the banana plugs --- you want to heat those up quickly and solder quickly, because staying there too long would melt the plastic connector.



8. Wrap the soldered connections with **electrical tape** to avoid unwanted shorts

OPERATION

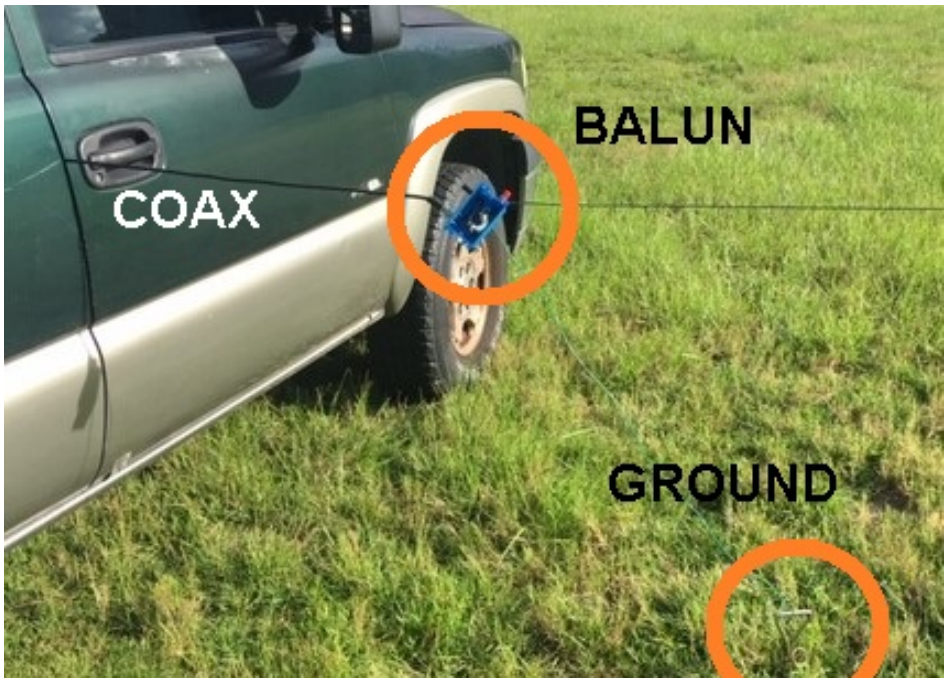
1. **This Balun is an AUTO-TRANSFORMER**. The primary winding is part of the secondary winding! Both windings share the same ground.-- the shield of the coax, and the black banana plug. Things will NOT work out properly if you ground the red terminal....

Your ground connection should be SHORT(like 3 feet) and to REAL GROUND if at all possible (a corkscrew device, or a real ground rod, or a long spike might do).

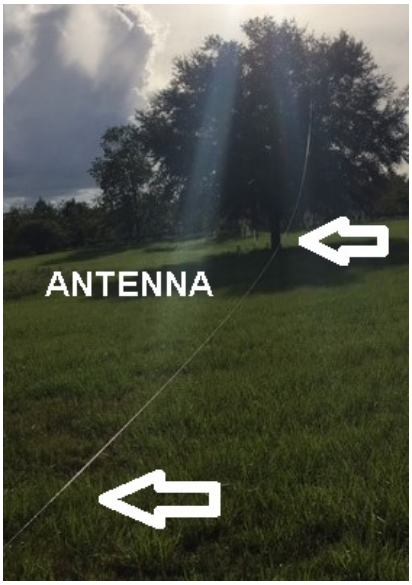
2. This is a RESONANT antenna system. Use a half-wavelength (468/F in megahertz) length of antenna wire, connected to the red terminal, lifted upwards and away, to an insulator at the far end. The antenna will be properly fed at the fundamental frequency and ALL HARMONICS of that frequency. High voltage will exist at both ends of the wire. Keep both ends where passers-by will not likely contact them.

3. Run 50 ohm coax from the Balun to your transceiver, hopefully also installing a 1:1 UNUN (current-balun choke of unwanted unbalance currents) and possibly also through an SWR meter.

4 A test setup looked like the photo here and gives you an idea of how to utilize this antenna.

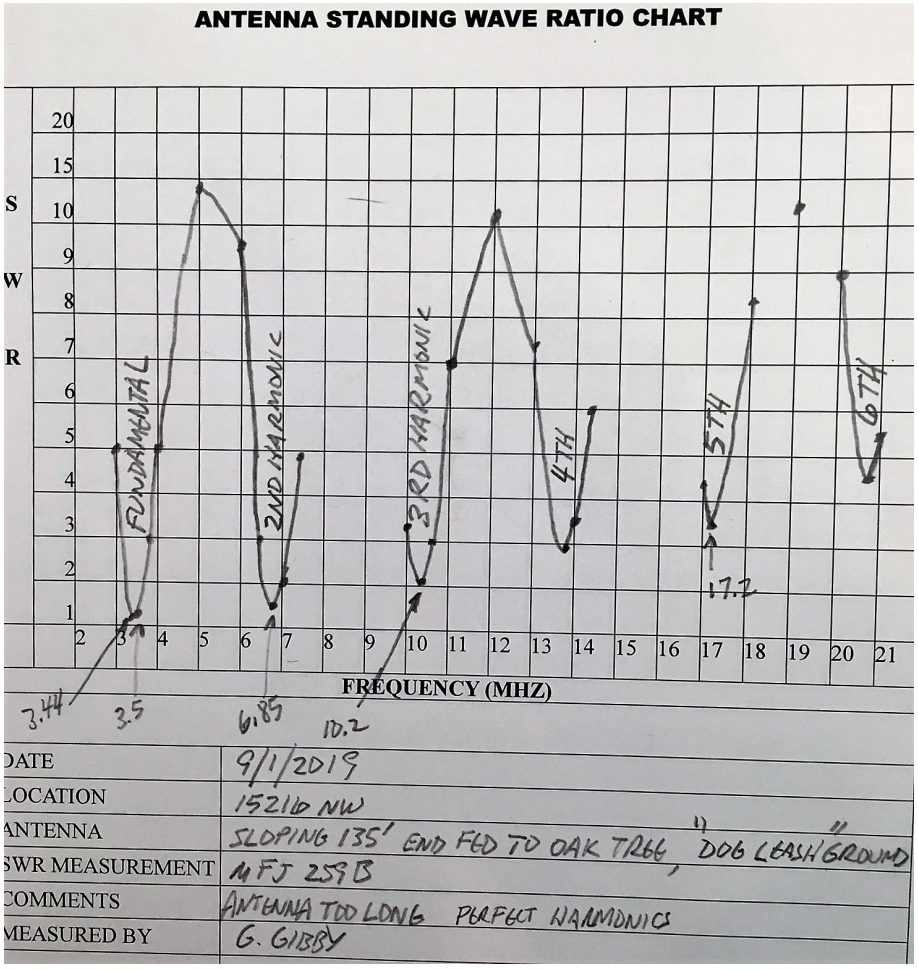


With the Antenna being 135 feet of #14 stranded wire pulled up into an oak tree. I was surprised at how much tension was required to try and elevate this--- you may want to put a small loop in the wire (won't add too much inductance) and use another small rope to tension it, as you do not want a lot of tension on the banana plug jack.



5. SWR RESULTS:

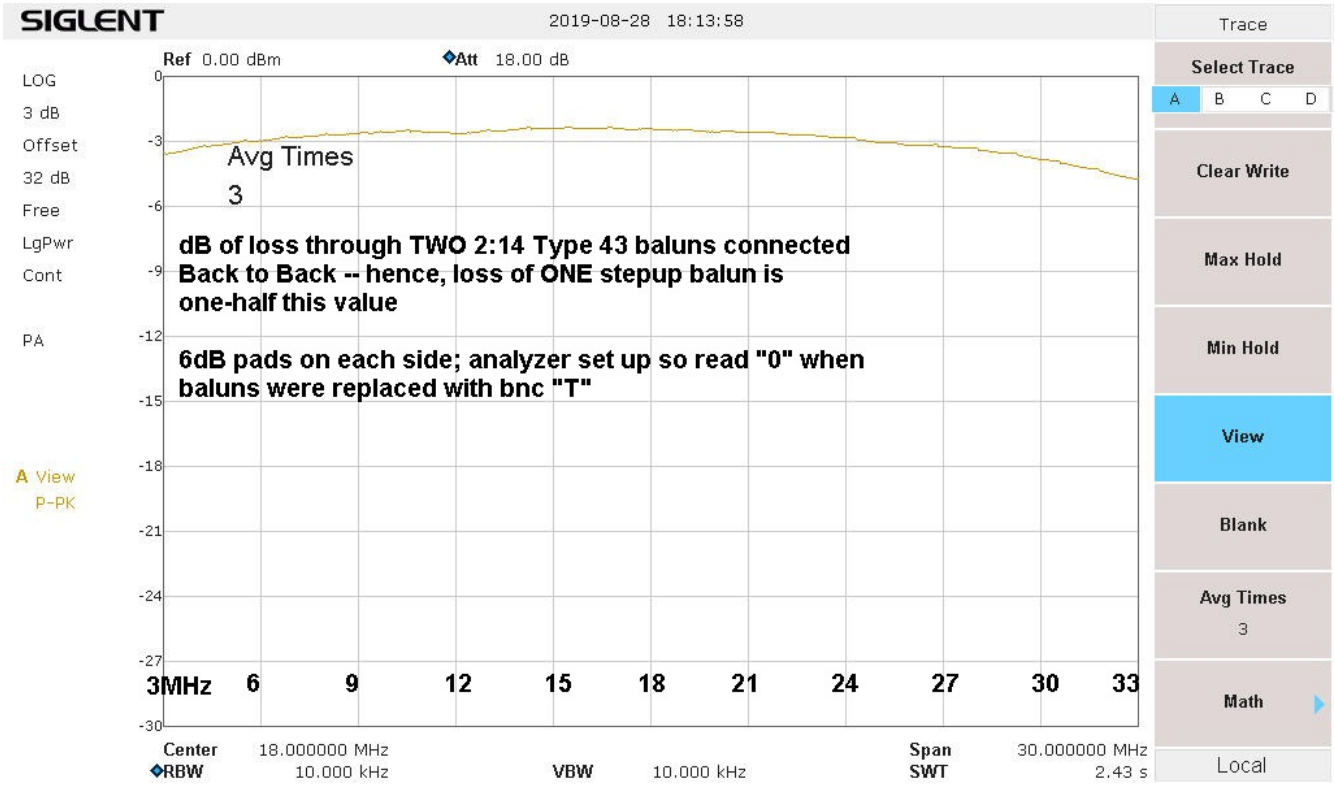
These results suggest the antenna is approximately 100-150 kHz too-low in resonance on the 80 meter band. A bit of math with the (468/F) formula suggests to remove 3 or 4 feet of wire to move the resonance up to just about 3.6 MHz.

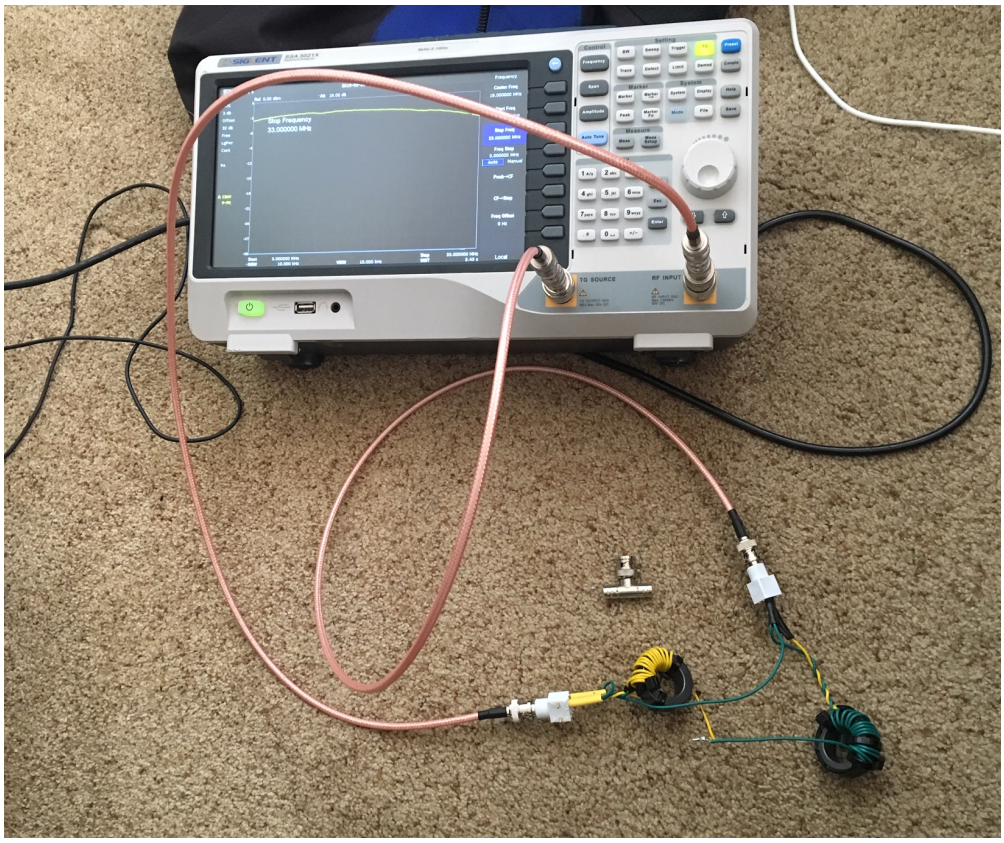


APPENDIX: Estimated Losses of The Balun Itself

Two baluns were connected "back to back" and driven from attenuation-pad isolated 50 ohm tracking generator output, and input of a Siglent spectrum analyzer to estimate the losses of TWO baluns, and the results indicated approximately 3 dB total losses, suggesting the losses of one Balun by itself in a matched environment are 1.5 dB. The pilot baluns for this test were wound with #20 hookup wire, whereas #18 will be used in the actual design, possibly lowering the ohmic losses slightly.

There will be other losses due to mismatch to the antenna, coax losses, etc., and I don't quite know how to estimate those. However, in a 5-minute "key down" test through the two dummy loads into a 50 ohm load (transceiver saw 3:1 SWR) with approximately 20 watts, the cores (not the wires) got quite warm, showing that there are indeed losses in the ferrite. The suggested power levels were drawn from extrapolations of that test. Remember that if you exceed 130 degrees C, you will permanently damage the ferrite.




Stop Frequency
33.000000 MHz
TG SOURCE
RF INPUT