WX7Y

Some hard to find FACTS on Winding BALUNS

I will Discuss both Commercial and some home brew BALUNS with a few examples of Baluns I have built, I looked every where for some real good step by step instructions on winding Baluns.

Commercial BALUNS

I have also Tested several commercial BALUNS using the MFJ SWR Analyzer and got very poor results from most of them above 20 meters, Here are a few that I have tested and what there results have been.

W2AU 1:1 Balun (Hi SWR above 20 Meters)

Hygain 1:1 Balun (Yes the one's on there Triband beams) (HI SWR above 20 Meters)

Radio works remote Balun (HI SWR above 20 Meters)

MFJ BALUNS that are built into there Hi power tuners (HI SWR above 20 Meters)

Commercial BALUNS That work very well

The older "Antenna West" BALUNS are the Very best I have tested and do what they advertised and are the only ones that live up to what there specked, the newer ones are under powered from what they are specked for, Palomar Baluns are very good, I would suggest buying a Balun that is higher rating then what there labeled.

Now for some Home Brew BALUNS

I have borrowed some of the ARRL's Schematic and Figure drawings to help in this discussion.

Here is how I built my BALUN

1: Decide what frequency range and power levels you want this BALUN to operate.
I have used T-200A-2 (RED) cores and T-200A-6 (YELLOW) TOROIDS CORES. The Yellow MIX in my test are wider bandwidth and will work from 160 Meters through up to10 Meters with less then 1.2:1 across the entire frequency range and up to 6 Meter with a internal SWR of 1.8:1.
Power Levels is another thing to consider before you order, A "T-200" core will handle up to 436 Watts Dissipation @ 40 Deg.C. A T-200-A Core will handle twice that power.
SO if you want a Balun that will handle full legal power with out saturating the core then you will need to Stack 2 (T-200-A) cores or 4 (T-200) Cores.

2: Call Amidon or Palomar and order your toroids or Rods that you have decided upon.
Red Type 2 = 250 KHz to about 14MHz (best RF transformer performance range)
Yellow Type 6 = 3 MHz to 56 MHz (best RF transformer performance range)

Fer-Rite Core's Amazon

Fer-rite MIX 31 = EMI Suppression 1 - 500 MHz.
Fer-rite MIX 43 = 500 KHz to 30 MHz (best RF transformer performance range)
RFI Suppression 5 to 500 Mhz.
Fer-rite MIX 61 = 20 to 500 MHz (best RF transformer performance range)
RFI Suppression .2 to 10 Mhz.

3: Wrap the Toroids with 3M #27 Fiberglass Tape (get this at a Electric Motor shop or Amazon)
when stacking Toroids wrap each Toroid separately then wrap them together
One layer is plenty on each toroid.

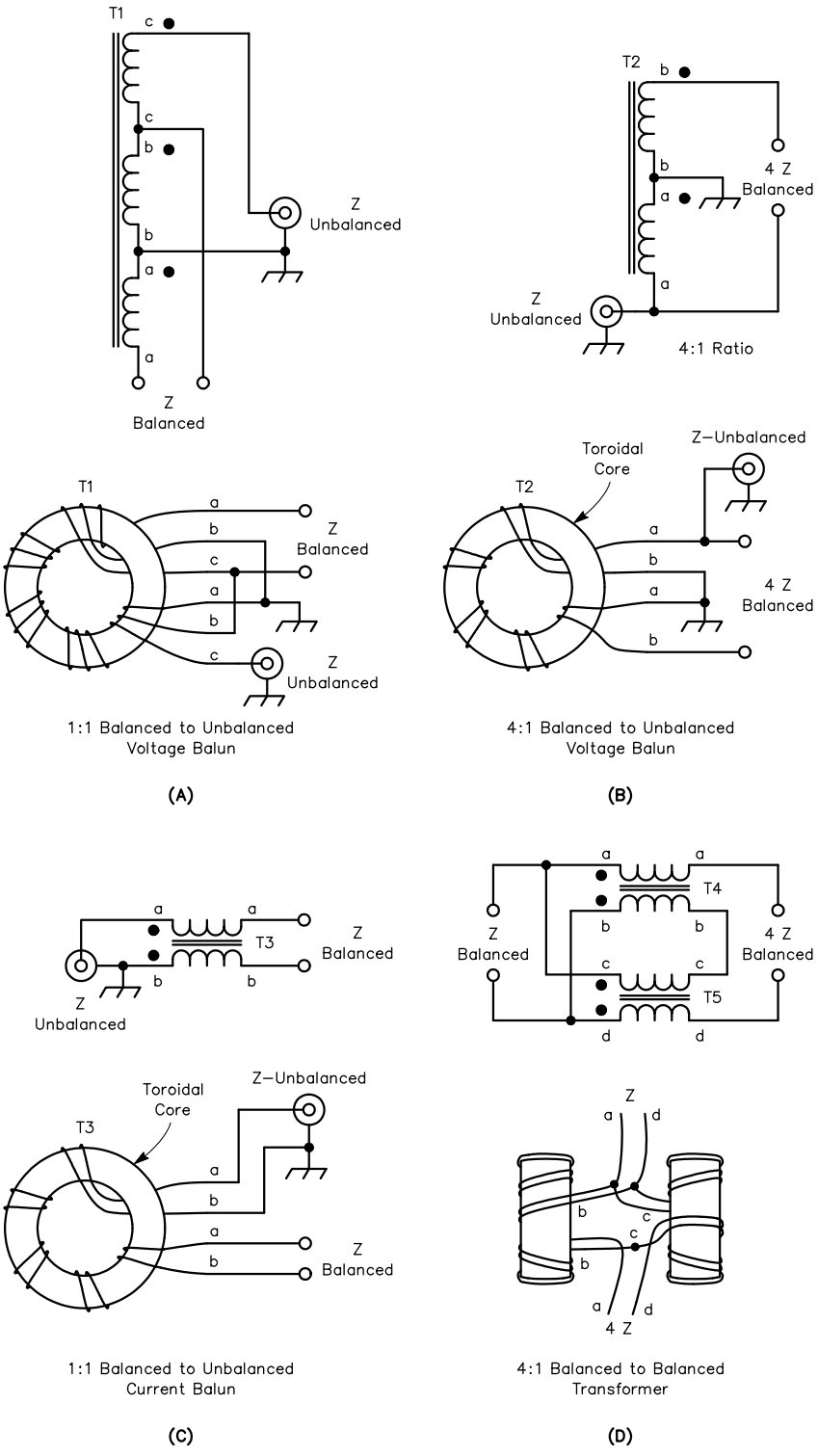
4: I used some Number 13 Enamel Wire from the Electric Motor Shop to wind the Balun when stacking 2 “T-200-A” you will need about 7 to 8 feet per winding.

5: Take the 2 or 3 peaces of wire depending on which type of Balun your winding and tape these wires together about every 3 Inches with out crossing them making sure they stay “FLAT”.

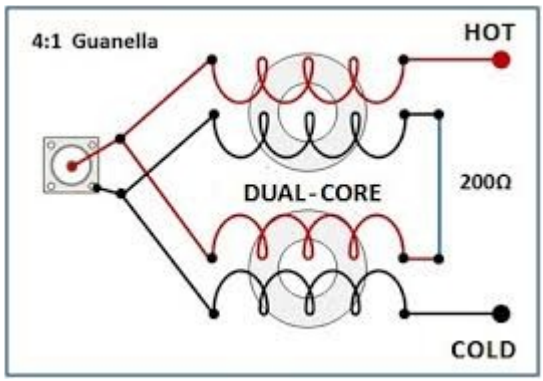
6: **VERY IMPORTANT** Now start winding the Toroid with the above prepared wire, Make sure the wires don’t cross and fit very tight against the toroid all the way around the core and are spaced equally around the Core you will need **12 turns** of wire, Leave about 30 degrees between the end and beginning winding's on the toroid.

7: Tape with the fiberglass tape all around the winding's to keep it tight and in place.

8: Install your NEW BALUN in PVC Pipe or what ever else you may have that is NON conductive material to mount it in to keep it out of the weather.



Broadband baluns. (A) 1:1 voltage balun; (B) 4:1 voltage balun; (C) 1:1 current balun; and (D) 4:1 current transformer. (D) UNUN is wound on two cores, which are separated.



4:1 Guanella Current BALUN is wound on two cores, which are separated.

4:1 Voltage Balun used on Carolina Windom Antenna's

Approximate Length of wire required to wind 1/2" Fer-rite rod.

This is a average length using a bit more for wire thickness so figuring rod and wire thickness is .625" = 1.964" per turn depending on your wire thickness so for a Balun with 17 turns 1.964 X 17 = 33.5" APROX, Add about 10" of wire for the connections, This should get you pretty close for average wire thickness.

Notes about Voltage and Current type Balun.

Voltage baluns always try to force the output terminals to equal voltages. They sometimes introduce phase shift between each output terminal and "ground". If the impedance presented at each terminal is not exactly equal, feedline or load currents will not be equal and opposite. This means the feedline will radiate. They also do not provide common-mode isolation. A voltage balun almost certainly guarantees some feedline radiation (or reception), because there are very few "perfectly balanced" loads or perfect voltage baluns.

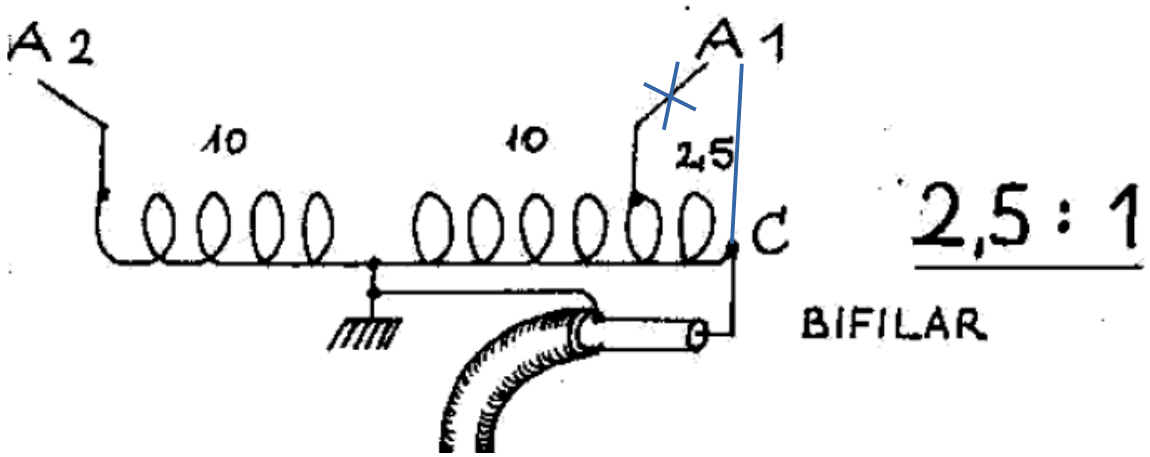
Unlike a 1:1 ratio current balun, a voltage balun will always magnetize its core in direct proportion to load voltages. In a voltage balun, load impedance directly affects core heating and flux density. Current baluns, rather than voltage baluns, should be used whenever possible. Current baluns provide better balance and often have lower loss. Current baluns, especially 1:1 ratio baluns, tolerate load impedance and balance variations much better than voltage baluns.

Current baluns can also be used as isolators or un-un's.

2:1 Baluns are a bit different

2:1 Loop Balun

2:1 Balun Wind 7 bifiliar turns on a core, connecting the ends to the loop as for a standard 4 : 1 balun. However, instead of connecting the center of the coax to one end, add 3 more turns and connect the coax to that. That gives a turns ratio of 14 (loop) to 10 (coax), which should be about right for an impedance ratio of 2 : 1. (You may need to increase the number of turns, depending on the core you are using, but I hope the principle is clear.)

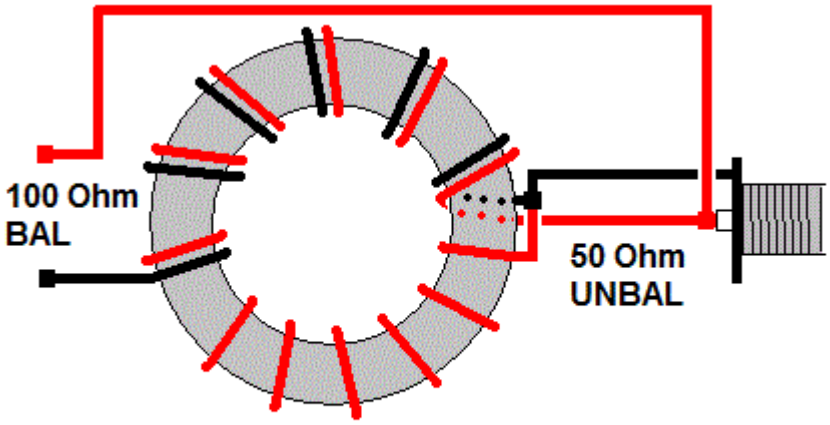


Other 2:1 Baluns

The impedance ratio is the square of the turns ratio. With the 50 ohm load connected across 2 of the three windings (7 turns each), the full 3rd winding gives a turns ratio of 21 : 14 = 1.5, an impedance ratio of 1.5 * 1.5 = 2.25, for an impedance of 2.25 * 50 = 112.5 ohms.

To lower the ratio from 2.25 : 1 to 2 : 1 you need to use fewer turns on the last winding.
By using only 6 turns the ratio becomes 20 : 14, or about 1.43 : 1, giving an impedance ratio of 2.04 : 1, which is very close to the target of 2 : 1.

So if you are only interested in the 2 : 1 ratio, you leave terminal #6 unconnected and hook your load 1 turn back up the winding. You could just remove the last turn, but it often is easier to wind all three wires together onto the core and ignore the last turn.



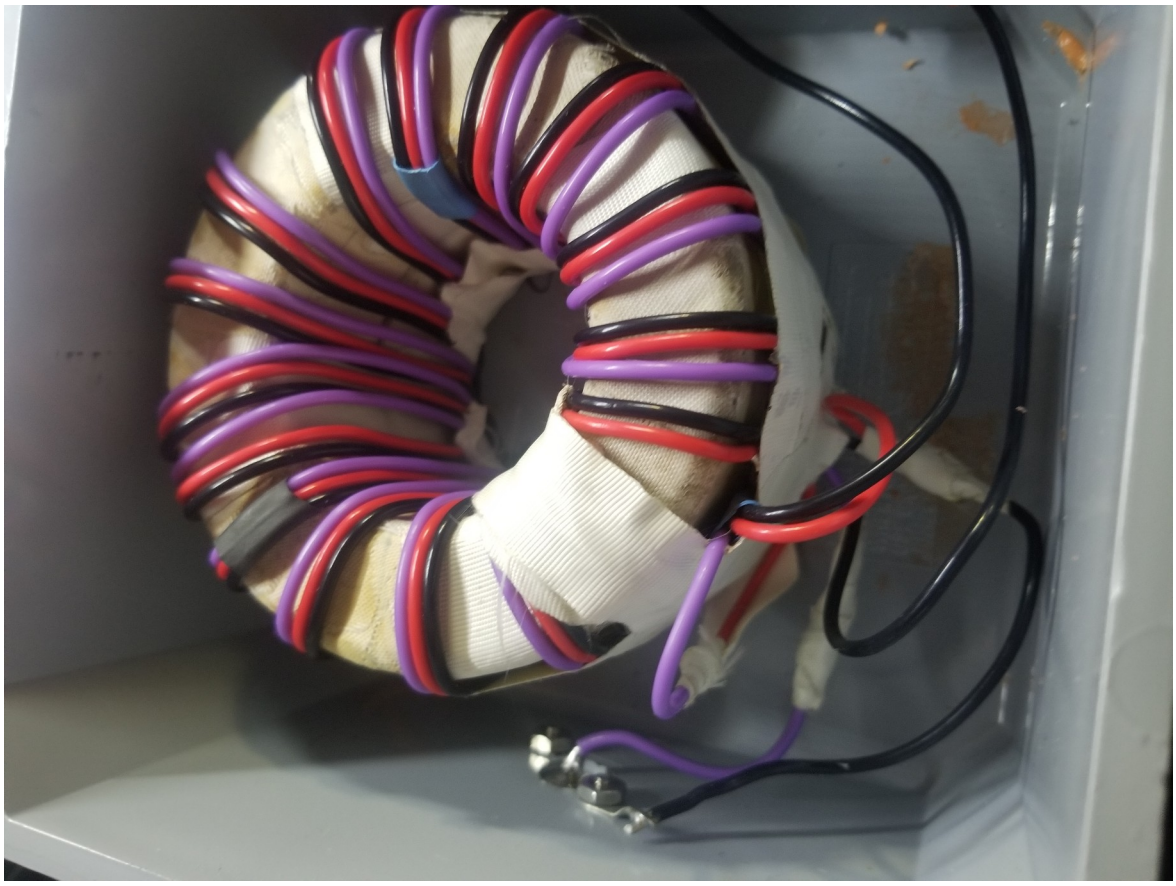
2:1 BALUN

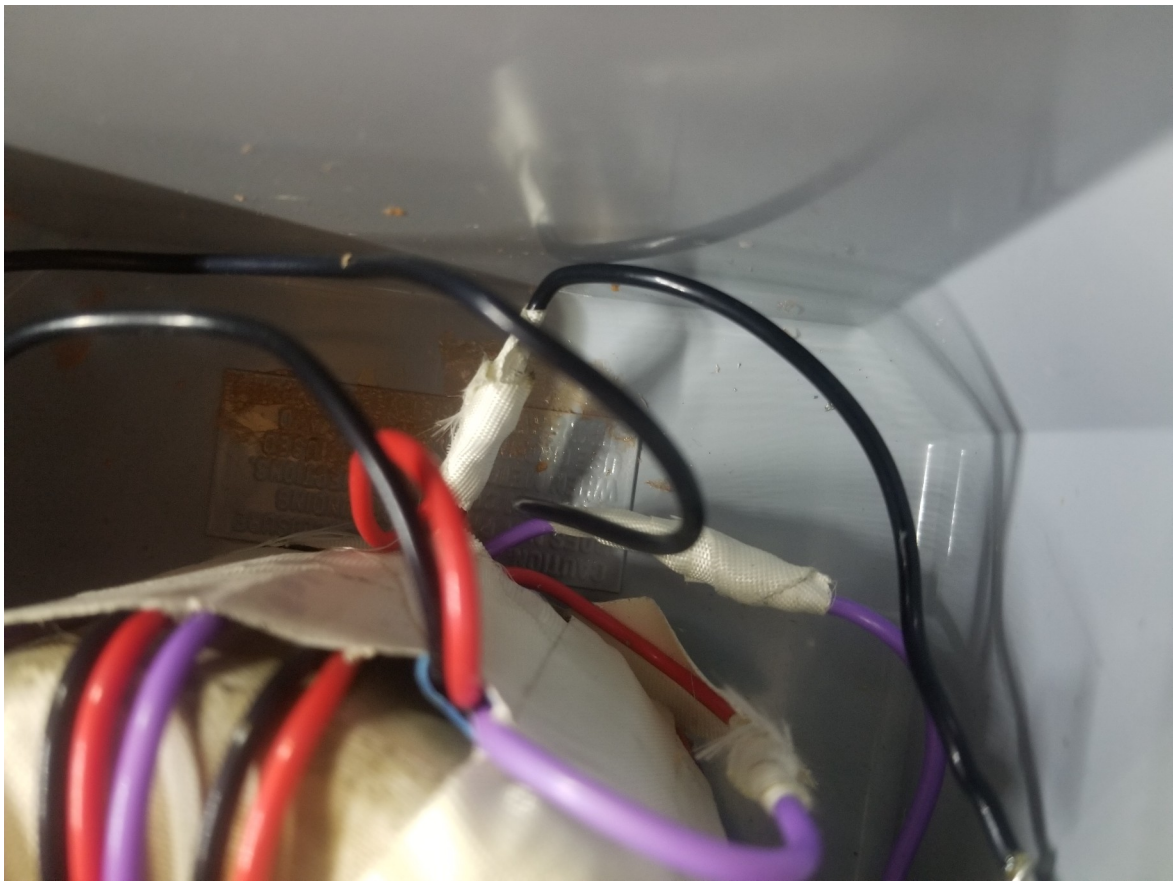
Well that's about it I guess I hope this helps someone out. If you have questions you may contact me at

I found that instead of winding the Balun with bi-filler winding's and a single winding as the above diagram shows to wind a tri-filler winding like a 1:1 Balun has and loop the 3rd winding to the end of the 2nd winding and remove 1 turn from the 3rd winding on a toroid like a 2" but use as many turns as you can fit on the toroid.

I built a 7KW version using 2 T400A-2 (RED) stacked toroids with 15 turns of each wire (or what ever fits on the toroid) and removed 1 to 1.5 turns from the 3rd winding, that gave very good results using a 200 OHM resister on the output measuring at 50 OHM impedance showed less then 1.8:1 from <1 to 16MHz and other then 18 to 23MHz (which has a 3:1 SWR) then up to about 60MHz below 2.8 SWR.

NOT sure how efficiently this balun works yet but will give it a go on my 160M loop on all bands.





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