


BALUNS AND UNUNS

- 
- What is a BALUN or UNUN:
 - A device to connect different types of antennas to various feed lines. Can transform impedances, choke common mode or change balanced to unbalanced
 - BALUN – Balanced to Unbalanced
 - Balanced antenna to unbalanced feed line
 - Balanced – Dipole, Loop antenna, ladder line
 - Unbalanced – Vertical, OFD, Windom, coax
 - UNUN – Unbalanced to Unbalanced
 - Unbalanced Antenna to Unbalanced feed line



- **You can combine a transformer with a Voltage Balun or Unun:**

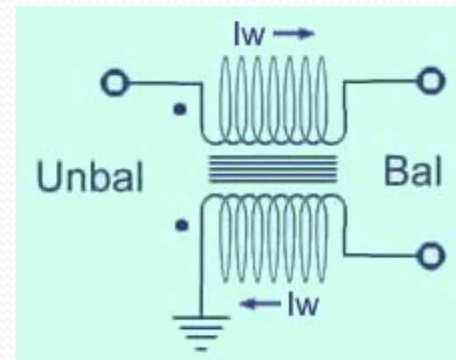
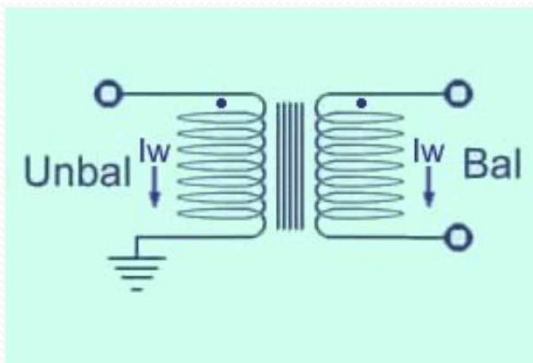
- You set up or down impedance between antenna or feed line
- Antenna resonant impedances (free space):
 - Terminated Folded Tilted Dipole – 450 ohms
 - Dipole – 72 to 74 ohms
 - Vertical – 35 to 40 ohms
 - Off Center Fed Dipole – 150 to 300 ohms
 - Sky loop – 150 to 200 ohms
 - Ham sticks - 10 to 20 ohms
- Antenna impedances vary greatly as you leave resonance and as they are near objects.

• Current vs Voltage Balun

- A current balun forces equal current on both balanced legs and is used for stopping common mode currents.
- A voltage balun forces equal voltage on each (balanced) leg and is used for impedance matching.

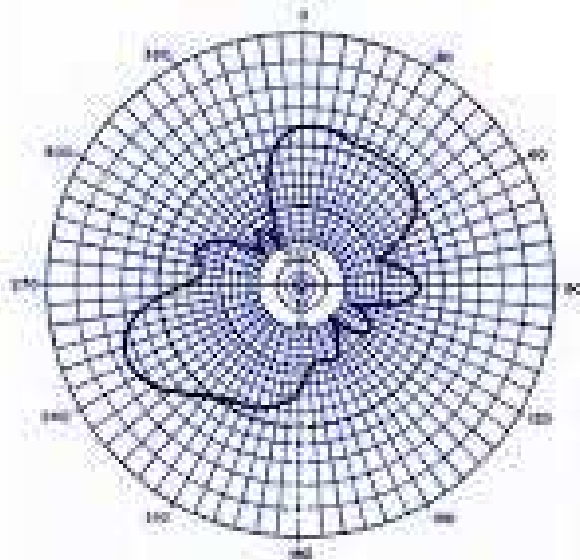
• VOLTAGE

CURRENT

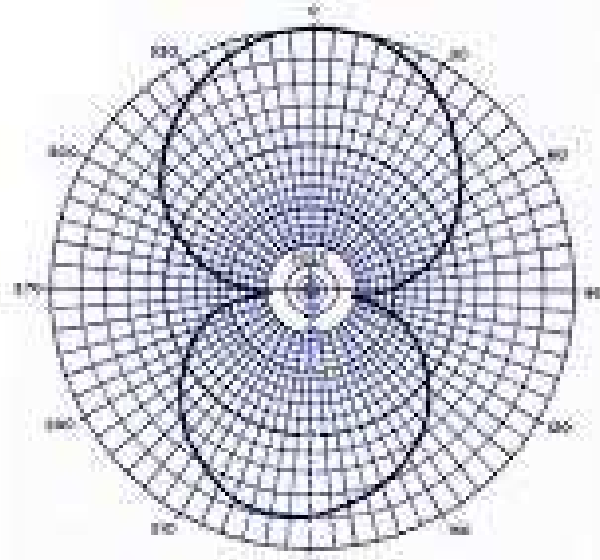


Choke Balun

- A special case of current Balun is the “choke Balun”.
- It stops common mode currents from bleeding off into the feed line wasting power, distorting the radiation pattern and causing unwanted RF leakage.

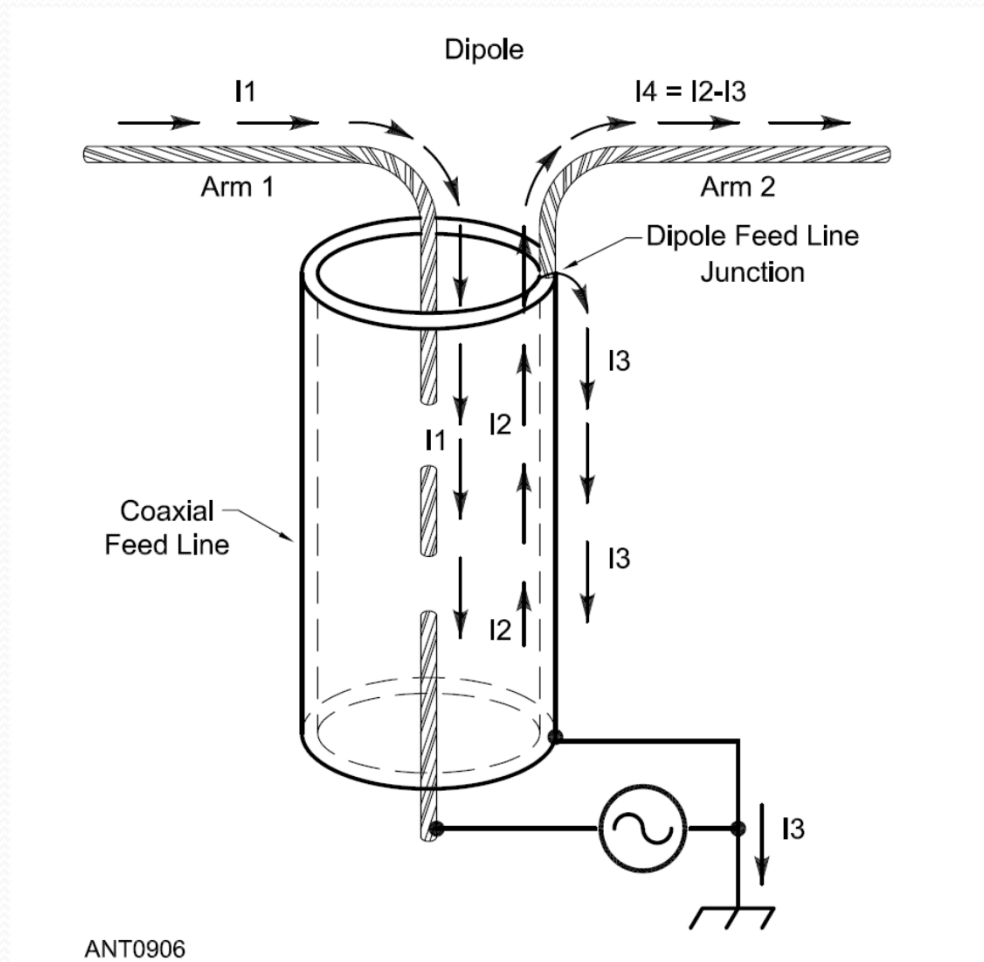


Radiation Pattern of a half-dipole Without a BALUN.



Radiation Pattern of a half-dipole With a BALUN.

• COMMON MODE CURRENTS



- **How to get rid of common mode current:**
 - Purchase a “current balun”. It forces equal current in each antenna leg.



- Wind a coax choke balun – winding depend of frequency, any where from 6 to 40 feet of coax, longer for low bands, shorter for the high bands.

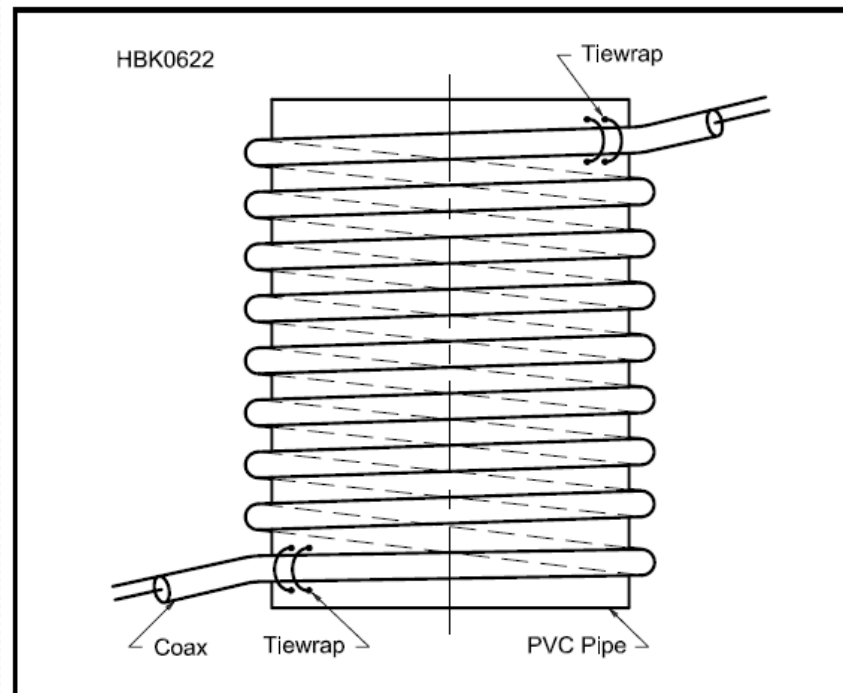


Figure 24.53 — Winding a coaxial choke balun as a single-layer solenoid may increase impedance and self-resonant frequency compared to a flat-coil choke.

- Add ferrite bead choke. Use 500-1000 Ω of impedance.





Design Considerations

- Toroid winding, choke beads (rated in choking ohms)
- Ferrite vs Iron cores
 - Iron cores can handle more power
 - Ferrite saturates at a lower given power than iron, but has wider frequency capability
- Permeability (power handling)
 - When a core exceeds rated permeability, the coil acts like plain wire.
- Voltage breakdown of windings
- Useable frequency (which mix to use)
- Efficiency (power loss)

Mix #	Material	Permeability	RFI/EMI Suppression Range	Tuned Circuits	Baluns
31 (1)	MnZn	1500	1-250 Mhz	< 30 Mhz	1:1 only
43 (2)	NiZn	800	20-250 Mhz	< 30 Mhz	3-60 Mhz
52 (3)	NiZn	250	<500 Mhz	< 10 Mhz	1-60 Mhz
61 (4)	NiZn	125	200-1000 Mhz	<25 Mhz	1-200 Mhz
77 (5)	MnZn	2000	<5 Mhz	.01-5 Mhz	<10 Mhz

Notes

(1) Mix 31 excellent for 1-10 Mhz common mode suppression, then about same as 43, NOT recommended for multi-ratio baluns due to material characteristics and power handling capability – ok for low power ham radio balun applications (<500 watts)

(2) Mix 43 excellent for common mode chokes from 20-250 Mhz, Use Mix 31 below 20 Mhz for higher choking impedance.

(3) Mix 52 good overall use for RFI/EMI from 1-30 Mhz as common mode choke. Also same 250 permeability as many of Jerry Sevick's (W2FMI) balun designs

(4) Mix 61 will withstand high power in multi ratio (2:1, 4:1, 9:1) baluns/ununs

(5) Mix 77 very useful for RFI/EMI suppression of AM broadcast and 160 meter frequencies, 160 meter to-40 meter baluns/ununs

Winding a Balun

- Mono-fillar, bi-fillar, tri-fillar etc.
- How many parallel wires are wound on the core

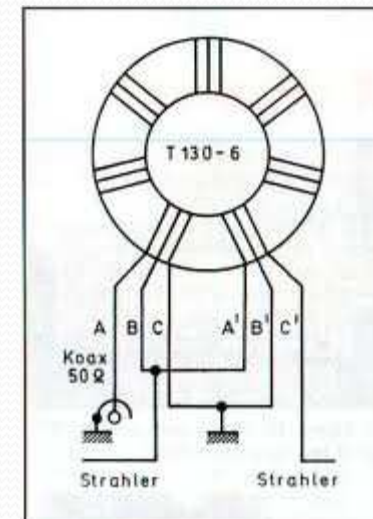
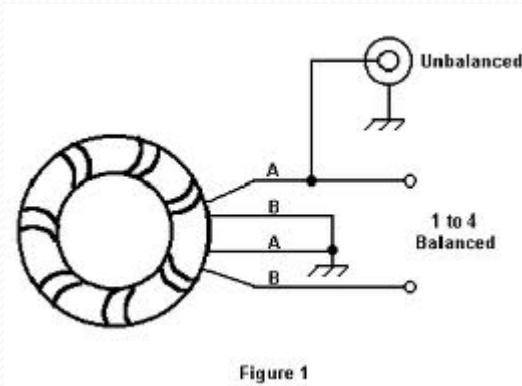


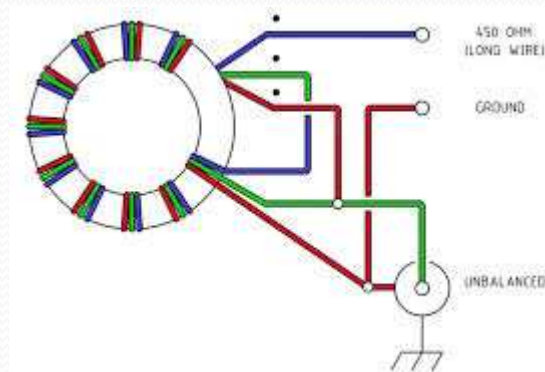
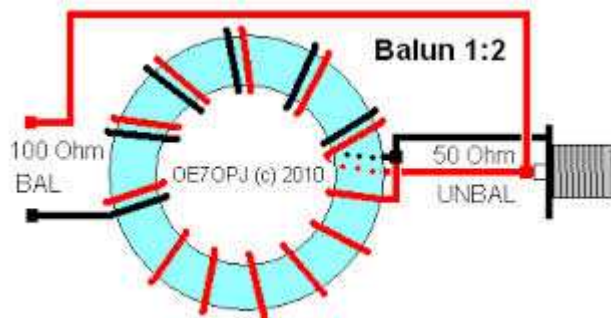
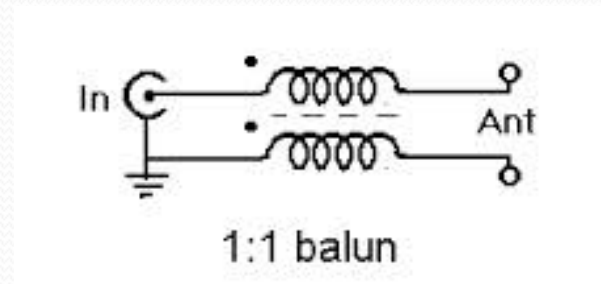
Bild 8: Anschlussschema des Ringkernbaluns 1:1.

Different Designs

- 4:1 Balun




1:1 Current (choke) balun

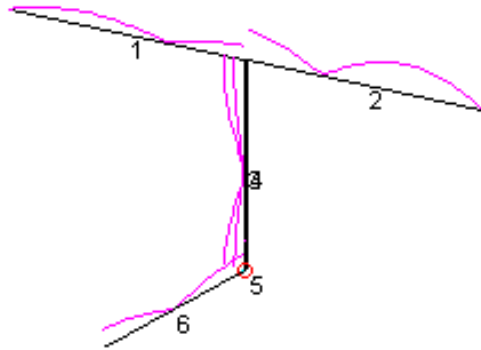


C. Balun or no balun? (Amateur Radio (G3TXQ) - G5RV Antenna)

- It is good engineering practice to fit a 1:1 current balun at any coax/balanced transition in an antenna system; it helps prevent common-mode currents on the outside surface of the coax braid which may cause "RF in the shack" problems when transmitting and local noise pick-up when receiving. Varney advocated a balun in his original article, but in his 1984 Radio Communication article he changed his mind because he felt that the reactive loads could result in heating of the windings and saturation of its core. Even then he advocated a "coaxial cable HF choke".
- With modern ferrite materials, and our better understanding of balun characteristics than in Varney's day, there is no reason not to include a ferrite-cored 1:1 Guanella balun at the ladderline/coax interface.
- The diagram on the right shows what can happen if you don't include the balun; it is an EZNEC model of a G5RV antenna system. Wires 1 & 2 represent the antenna, wires 3 & 4 the vertical ladderline section, and wire 6 the coax section. The purple lines show the current distribution along the wires.

- 
- The currents in the two dipole legs are unequal; this will cause "skewing" of the azimuth patterns
 - The currents in the two ladderline legs are unequal; this will cause radiation from the vertical section on transmitting.
 - There is considerable common-mode current flowing on the coax - coax which ends up close to the radio and other household equipment; this can cause RFI problems on Tx, and on Rx noise from that equipment can be injected at the coax/ladderline junction
 - Now see how the situation improves when we include a 1:1 balun (or common-mode choke) - the currents in the two dipole legs and the two ladderline legs are well-balanced, and there is negligible common-mode current on the coax.

EZNEC+



No BALUN

With BALUN

EZNEC+

