Do-It-Yourself BALUNs...

then there is the UNUN for Long Wire Antennae.

HF 1:1 Current BALUN

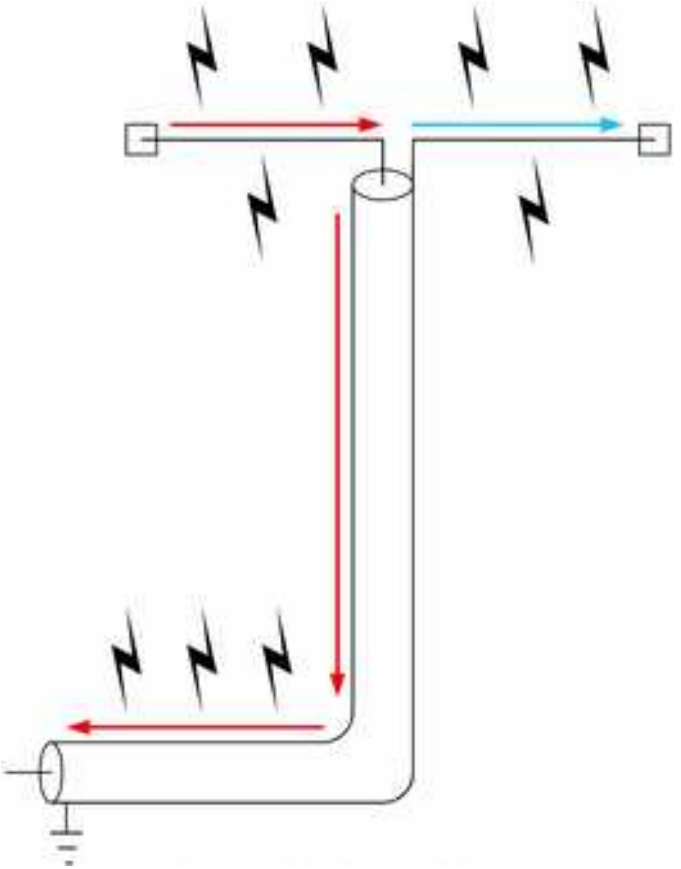
By employing a current BALUN, the currents on each leg of the Well-Balanced Resonant Dipole approach near equal balance, very little current returns on the coax. The coax does not radiate (much). There are many designs, one of which is the 1:1 current BALUN. This clever device has the effect of inserting a large impedance between the endpoint shield and the Dipole, making the current in the coaxial feed go into (transmission) the Dipole, or out of (reception) the Dipole through the coax feed. The 1:1 Current BALUN is for an adequate low-reactance half-wave Dipole, not a short-wire high reactance antenna.

Without the BALUN, Coax and Antenna both act as radiators instead of only the Dipole

RF Current will split in a direct feed of a Dipole, with some of it radiating on the coax shield, and the difference appearing on the Dipole. The degree of the split will be the relative reactance of the two, changing in ratio dependent on frequency.

This may not be a problem during transmission because the coax shield makes an antenna just as the Dipole, however, it distorts the radiation pattern and has non-linear reactance. It means you get RF in the Shack, but if you are transmitting with 100 watts this may or may not cause problems.

If you are transmitting RF in the Shack, you are also receiving RF from the Shack (reciprocity). You might be able to get your antenna far enough away from power lines, switching power supplies, computers, and other noise sources in the shack, but if your coax is actually part of the radiating antenna, then you are receiving noise from any source near the coax.



Enter the 1:1 Current BALUN

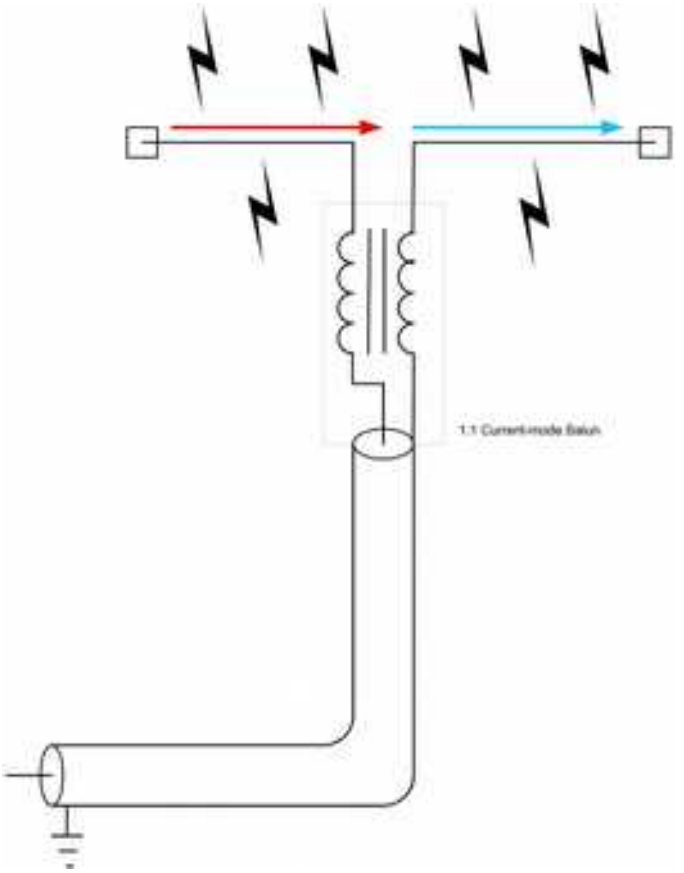
A 1:1 Current BALUN is a (Choke) transformer wound on a Toroid or rod of Ferrite magnetic material. Ideally, all of the current seen at the BALUN's unbalanced input goes into the well-balanced resonant antenna (Dipole). It forms a BALUN by choking common-mode current.

The ideal choke will...

- Be lossless
- Have identical windings
- Exhibit infinite Common-Mode impedance

Feeding the Dipole with coax

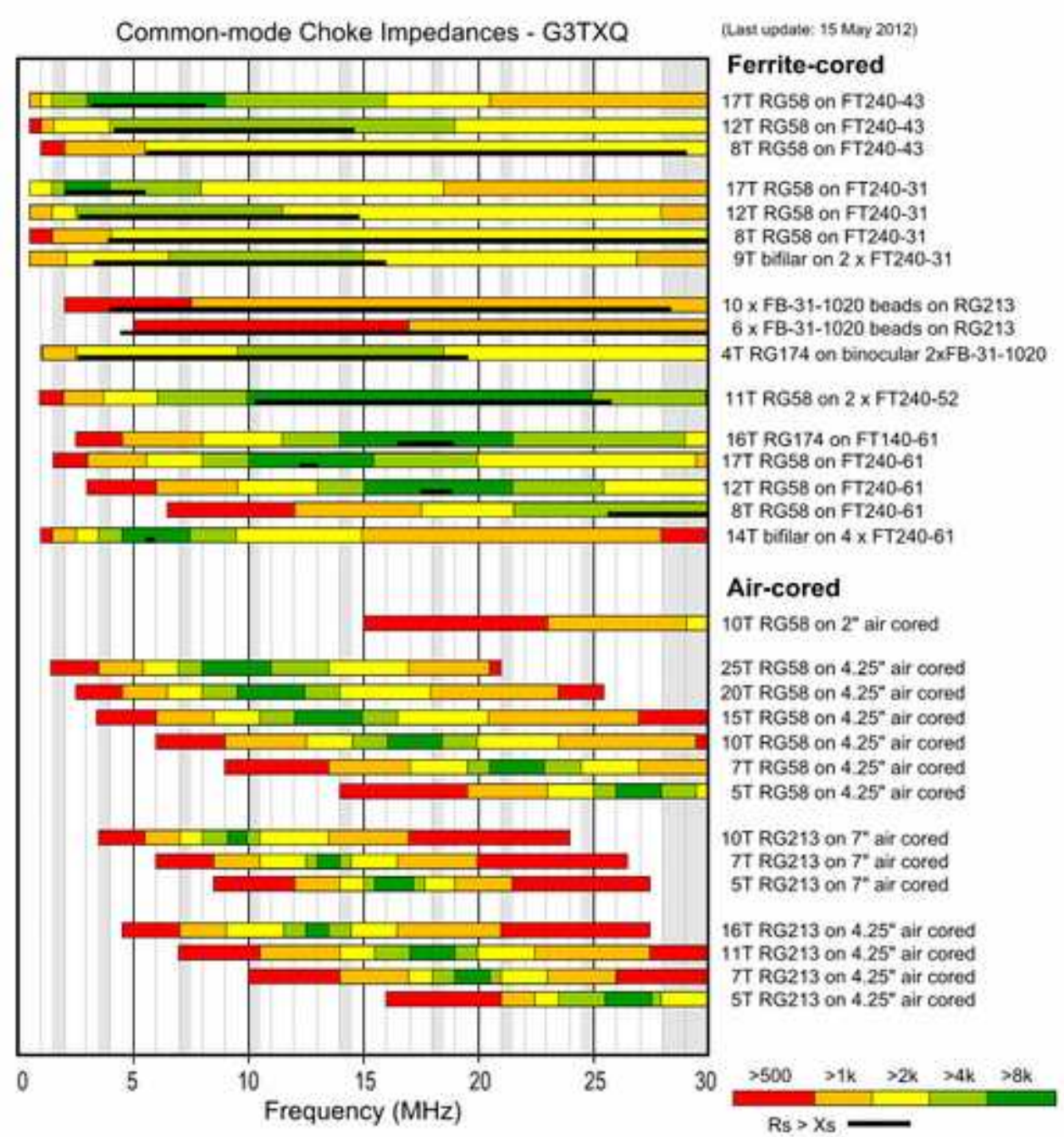
By adding a 1:1 Current BALUN to your well-balanced Resonant Dipole, you avoid the issue of the coax feed radiating. By isolating the coax with the BALUN, you significantly reduce RF in the Shack, and your antenna will behave like a Dipole. Your antenna tuning and RxTx performance will not be as affected by other objects and noise sources near the coax, because the coax is no longer a part of the antenna. If your Dipole is in a good location and your coax is not, then you will have better send and receive performance.



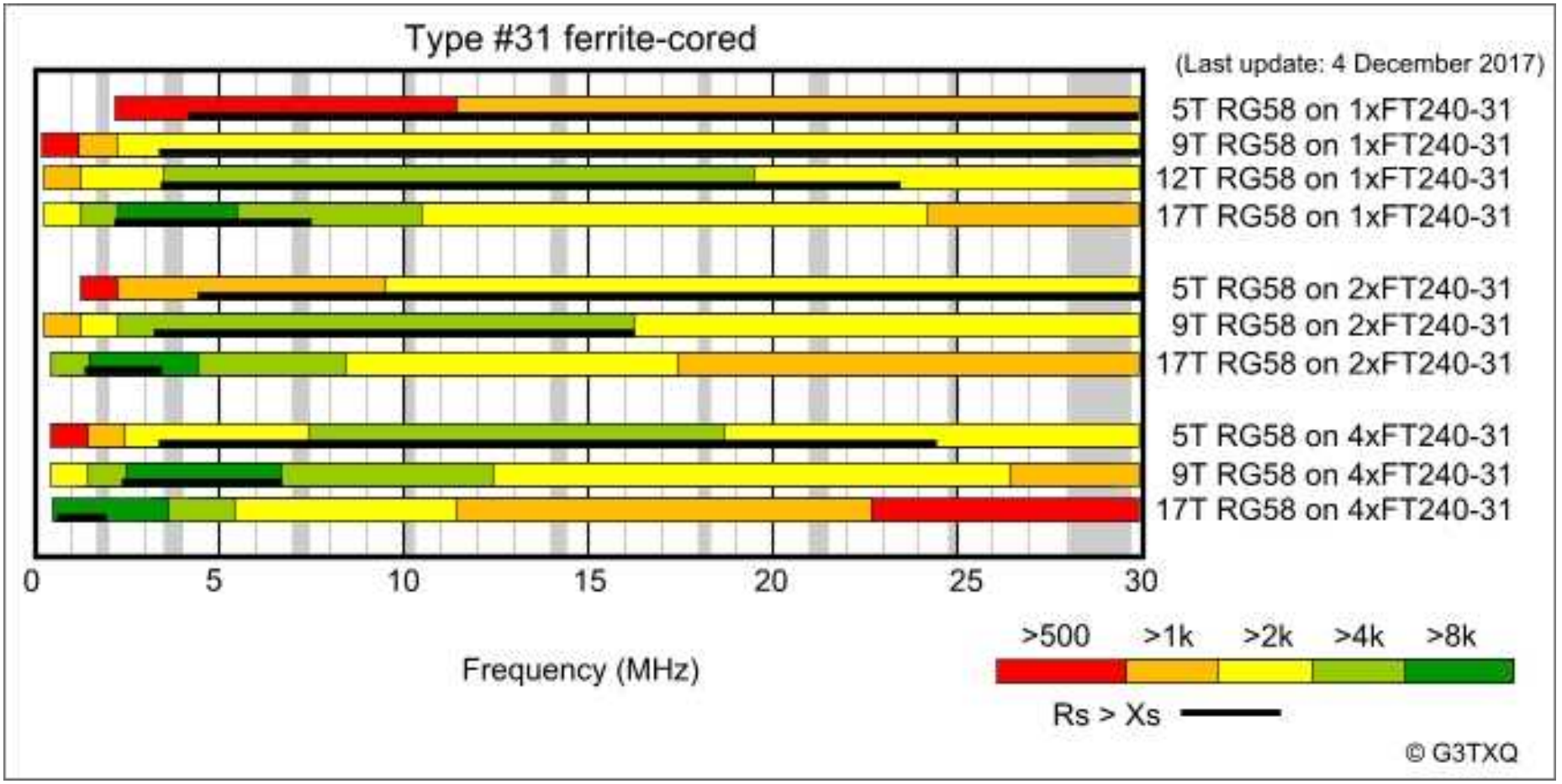
Choose a Ferrite Core

Choose a high impedance that is Resistive over the frequency range of interest. For HF, the

FT240-31.



Type #31 Ferrite-core



Measurements on combinations of 5 turns, 9 turns, 12 turns and 17 turns on single, 2-stacked and 4-stacked

Reasons for using the 1:1 Current BALUN

- To reduce common mode current on the feed line.
- Feeding a Dipole directly with coax is unbalanced causing high Voltage Standing Wave Ratio (VSWR) and unwanted RF in the shield. With a Dipole, you want to feed equal current into each side of the symmetrical antenna (Dipole).
- A multi-band antenna is never a perfect match causing an undesirable VSWR, where the BALUN acts as a common mode choke to reduce Radio Frequency Interference (RFI) also called RF in the Shack.
- Feeds the antenna maximum possible RF and wastes minimum RF.
- To match a higher impedance, unbalanced, or short-wire antenna with the 50 Ohm coax (transceiver final) use a 1:4, 1:9, or 1:16 BALUN.

Things to watch out for

The BALUN can overheat, arc, and change characteristics at high power.

- 100W = 70V, 1.4A - #18 wire
- 500W = 158V, 3.1A - #14 wire
- 1000W = 224V, 4.5A - #12 wire

Under-engineered BALUNs may get hot during continuous high power transmissions. Arcing is promoted by heat. Heat causes the core to lose effectiveness, further contributing to heating and RF reflecting back into the Shack; very bad at high power.

Cautions to be aware of

- High wattage is high voltage; requires attention to insulation for high wattage or mismatch, both produce high voltages.
- Use low gauge wire to reduce heat and RF loses.
- Large cores to reduce saturation when applying high wattage, mismatch, or low frequencies (80-160M) operation.
- Water incursion is a big problem, be especially mindful when enclosing BALUNs to keep water away.

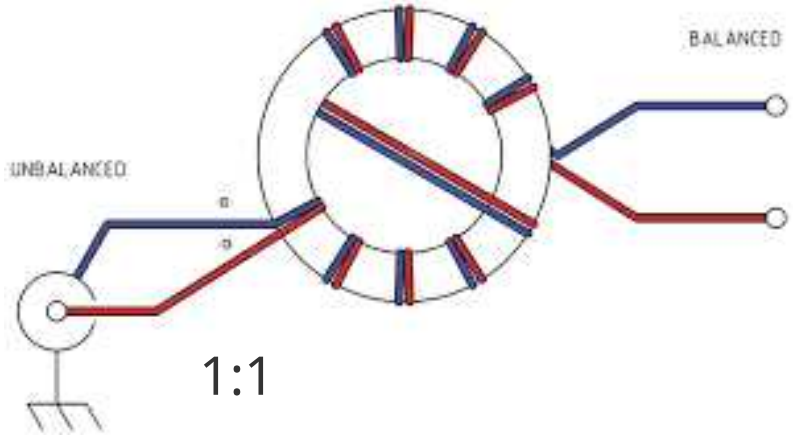
Construction

- All BALUNs have some non-linear contribution to your total antenna system.
- A good BALUN will have a small amount of reflected energy and insertion loss.
- Arrange a 30° space between the ends of the windings. This minimizes unwanted capacitance and inductance cancellation.
- Compressing the turns increases inductance. Spreading the turns decreases capacitance.
- Keep leads short to lower ‘Q’ and Standing Wave Ratio (SWR); Q is figure of merit, the ratio of Energy passed to Antenna to Energy dissipated as heat.

Choosing Materials

- Adequate Weather-proof plastic box, typically 4x4 inches selected to fit the core size, Eyelets, and connectors.
- 3 Stainless Steel Eyelets, washers, and nuts.
- 2 brass bolts, washers, and nuts.
- Single-sided sticky Teflon plumbers Tape.
- Silicone wire (gauge appropriate), although silicone wire is preferred, PVC will do.
- SO-239 Chassis-mount connector, stainless steel screws, washers, and nuts.
- Raytech Wonder Gel - Insulating Gel (optional).
- 2 inch T.R.U. CDT-36 Industrial Grade Duct Tape. Waterproof and UV Resistant (optional).

Single Core Balanced Windings



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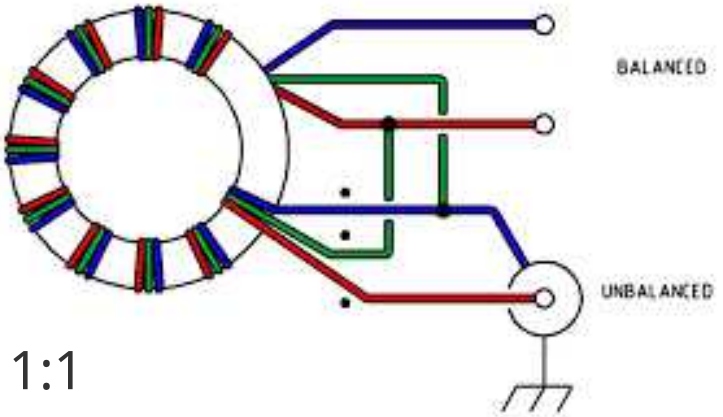

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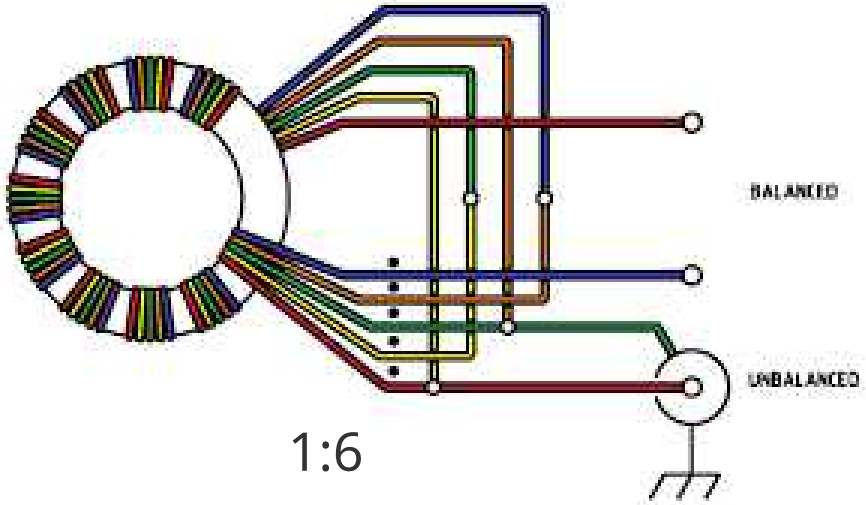

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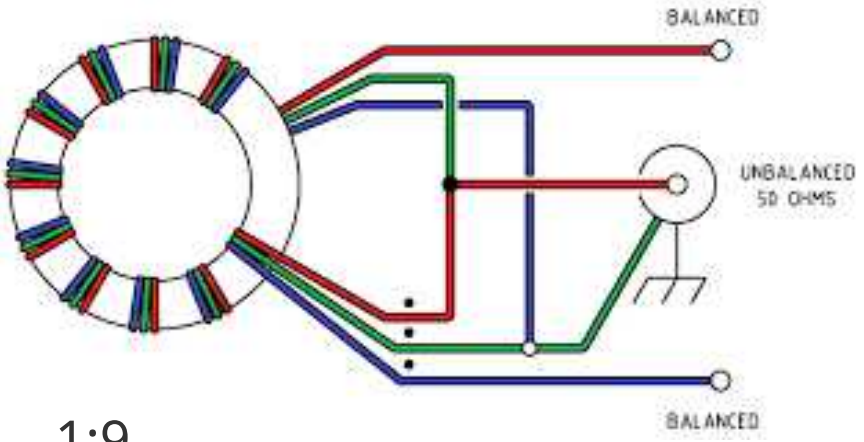

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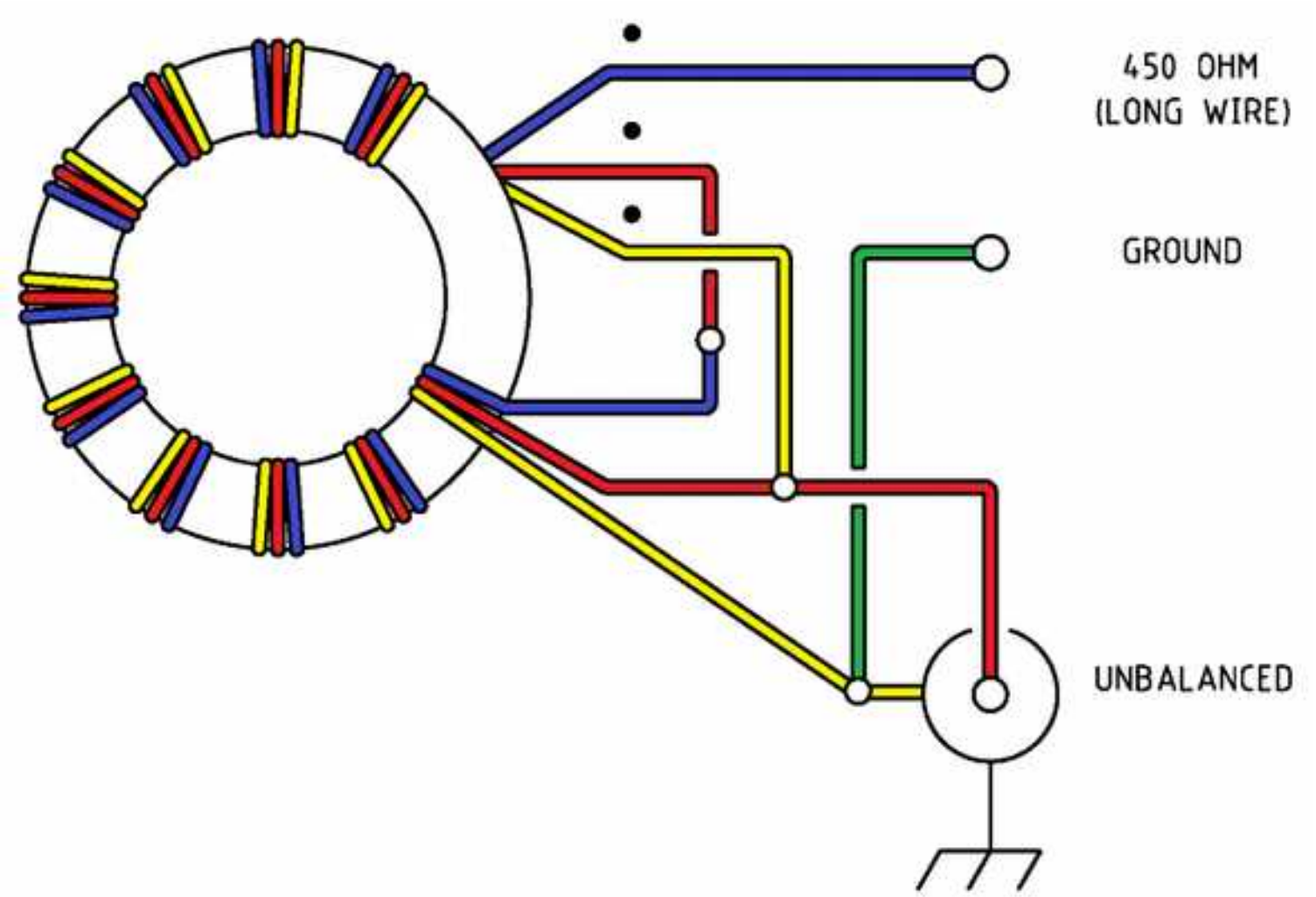
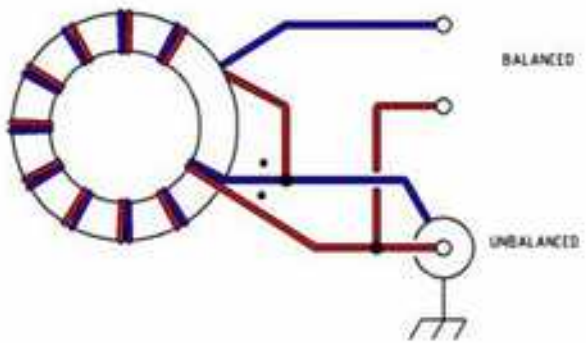
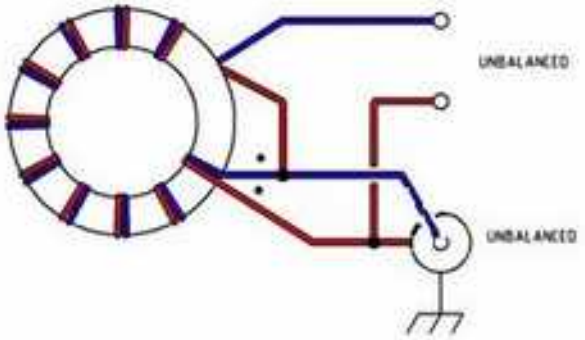
The Long Wire end-fed UNUN



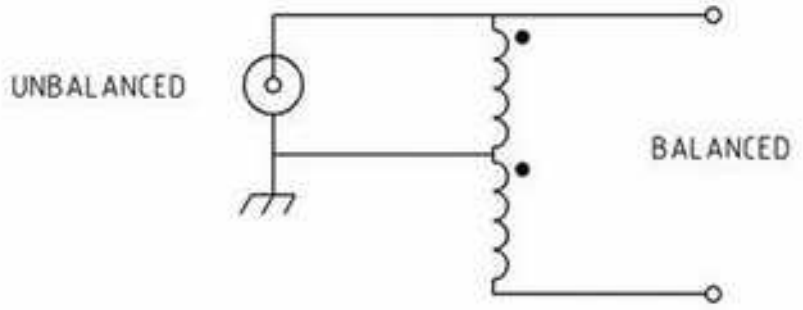
When is a BALUN not a BALUN? When it is an UNUN.

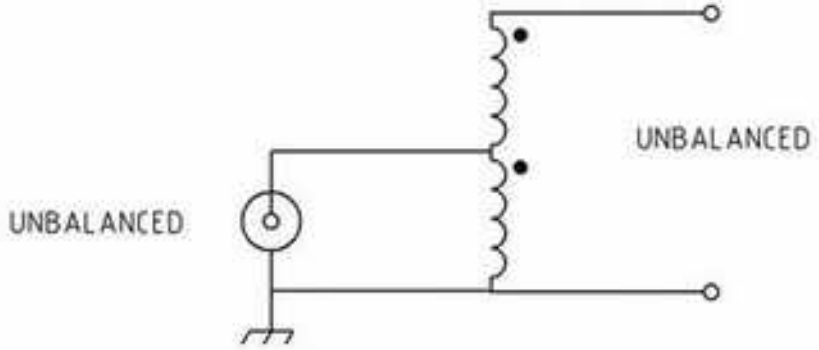


4:1 Balun



4:1 Unun





Links

- Winding a 1:4 Current Balun with 8 turns.
  https://www.youtube.com/watch?v=AJHfzeqaW5U&t=78s
- Intro to Baluns.
  https://www.youtube.com/watch?v=IbIZ8CwGCXw&t=644s
- #65: Understanding Toroid Cores (very technical)
  https://youtu.be/Yh7_XuHqbRI