BALUNS 101

Learn Just Enough to be Dangerous!

Important Principle:

- Don’t believe anyone who claims to be an expert on baluns.

First - Some Terms

- BALUN comes from "Balanced to Unbalanced"

  This usually means connecting a balanced load such as a dipole antenna to an unbalanced input such as a 50-ohm coaxial cable. The shield side of the cable is usually grounded.

- BALUNS can also change impedance levels. For example, 4:1, or 200Ω to 50Ω or 300Ω to 75Ω.

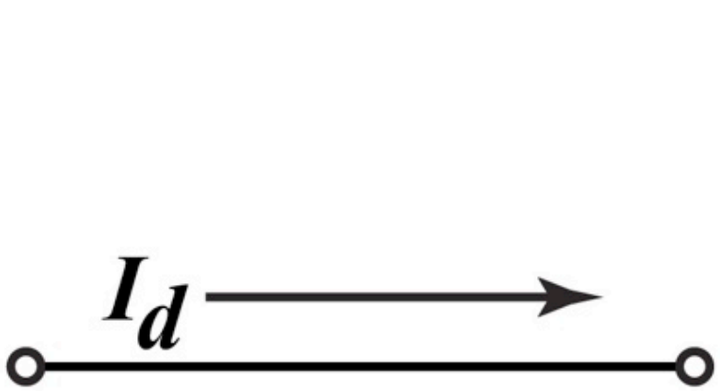
- UNUN means "Unbalanced to Unbalanced"

  This is a device inserted into a coaxial transmission line usually to reduce "common mode" currents - more on that later.

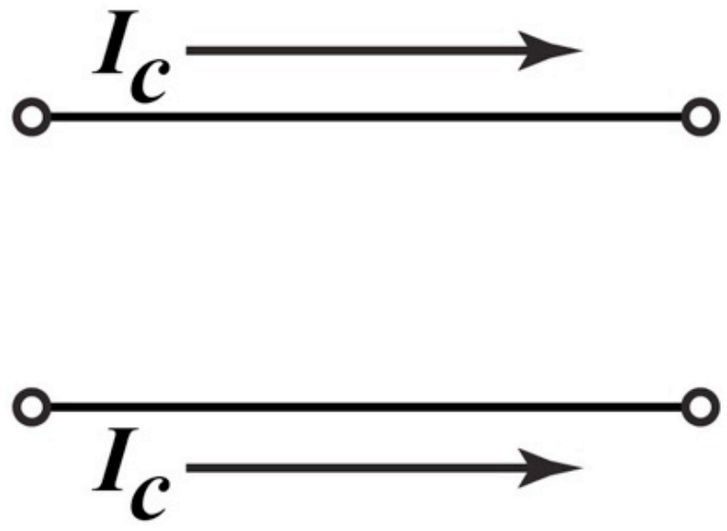
The BALUN is a Transmission Line Transformer (TLT)

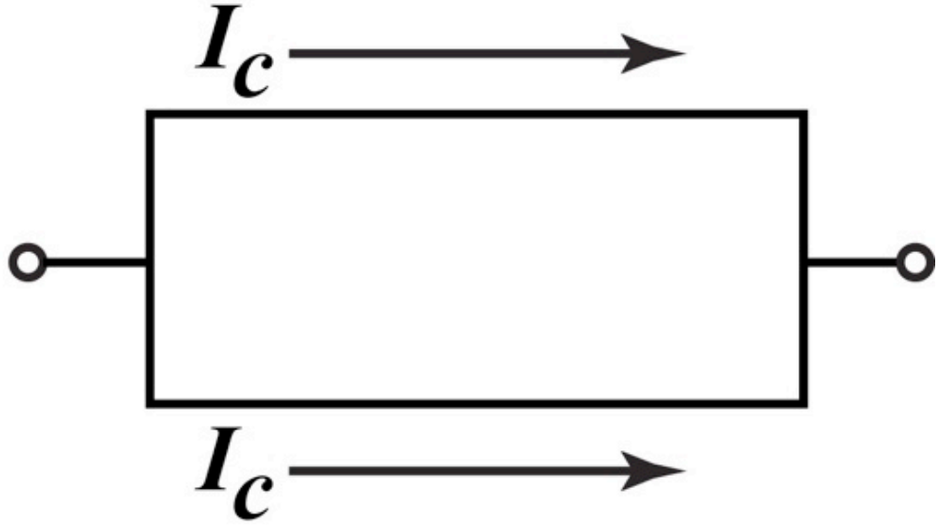
- Some BALUNS are "narrow-band" because they depend on a section of transmission line that is a particular fraction of a wavelength.
- However, most BALUNS are made from short sections of transmission lines (compared to λ) surrounded by magnetic media with their ends connected to show transformer-like properties. These have much greater bandwidths.
- In many cases the transmissions lines are bifilar or multifilar windings but can be coaxial cable or strip-line cable.

Differential vs. Common Mode Current



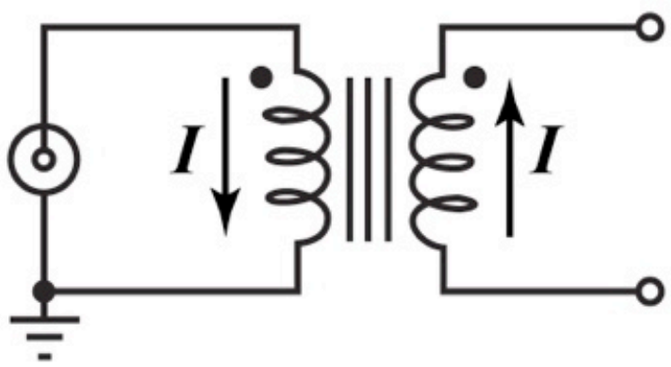
"Differential" Mode



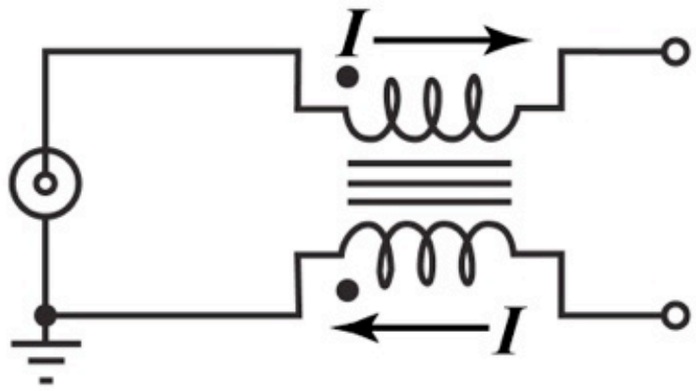


"Common" Mode

Two Types of BALUNS

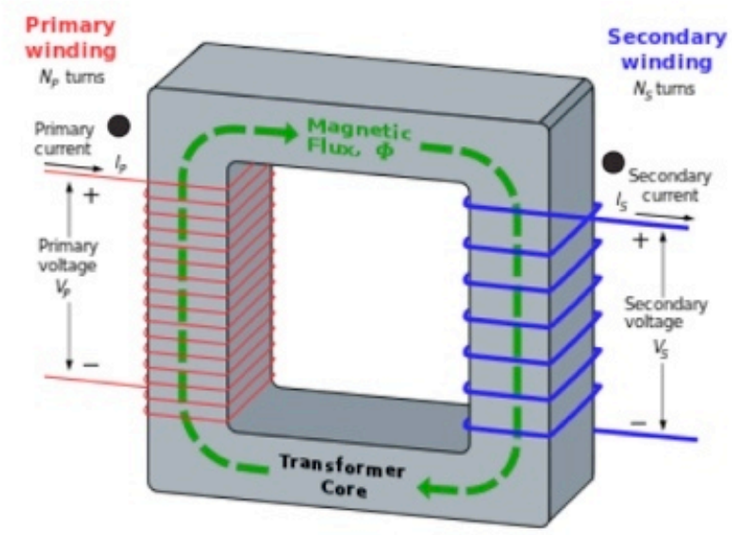


1:1 Voltage Balun



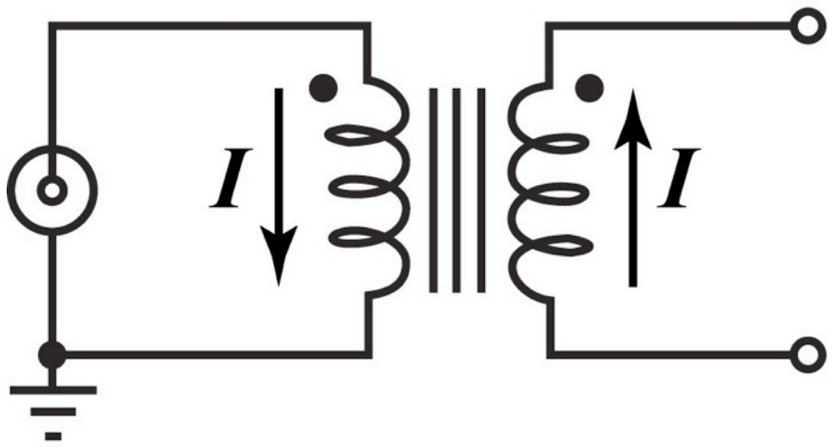
1:1 Current Balun

Dot Convention: Positively increasing instantaneous current entering the primary winding's dot end induces positive polarity voltage at the secondary winding's dot end.

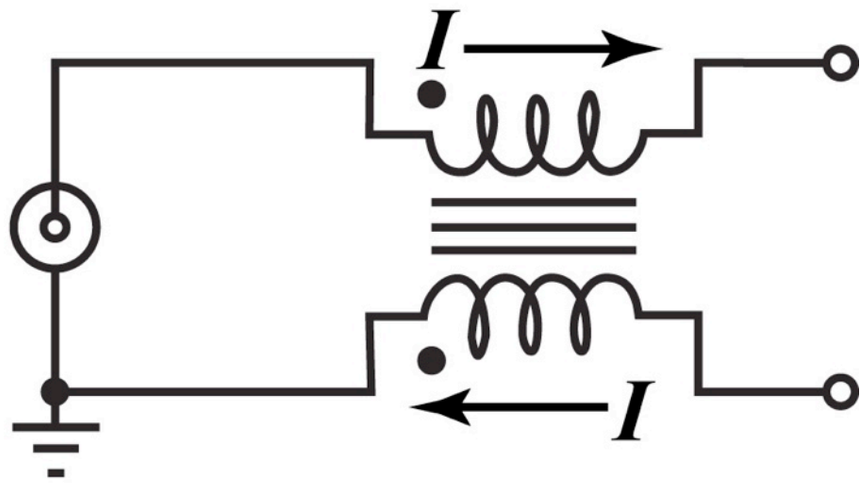


Note: When building transformers, dotted ends of the windings enter the core center from the same side.

Two Types of BALUNS



1:1 Voltage Balun

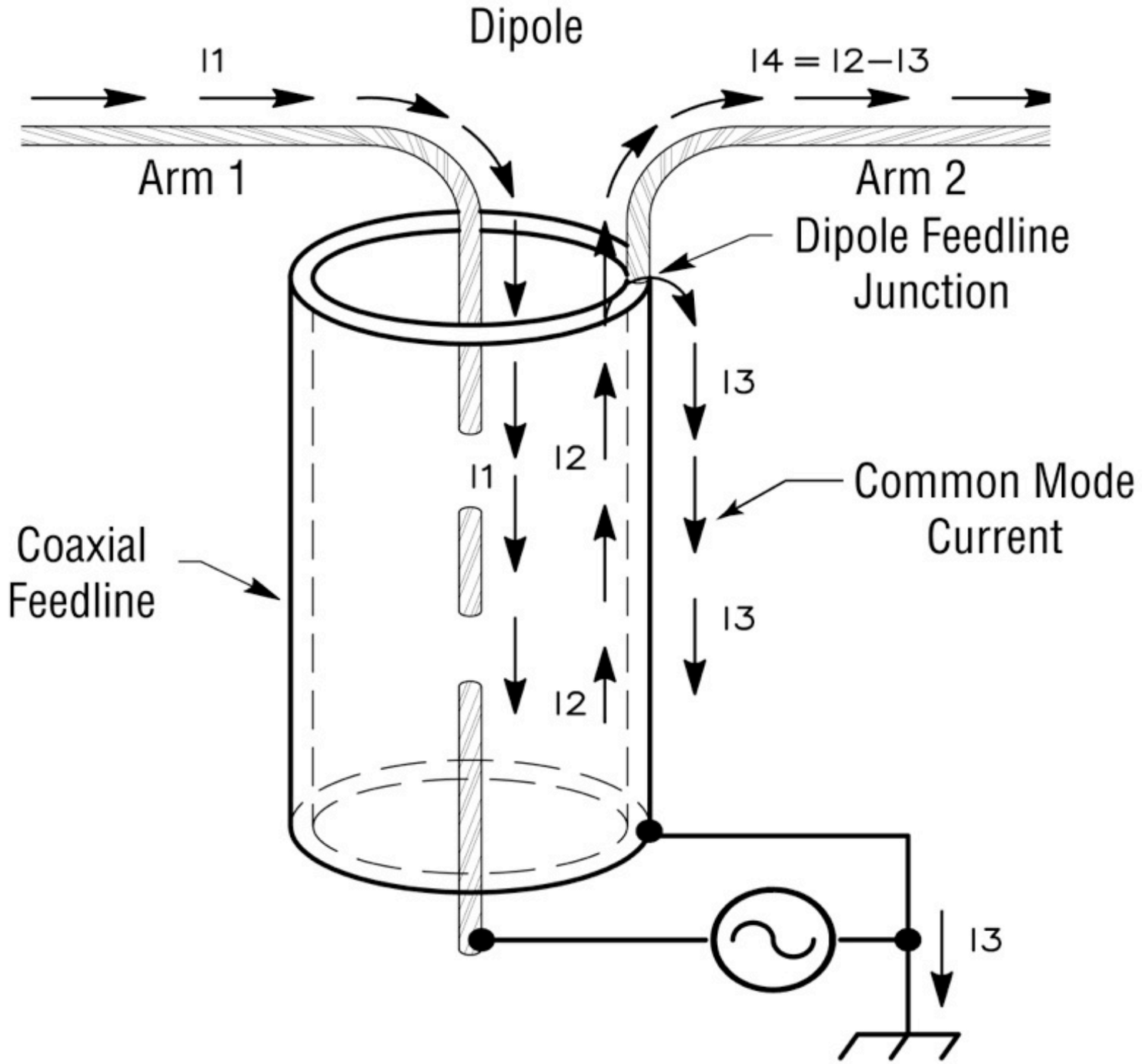


1:1 Current Balun

- Some authors claim that if the impedance ratio is greater than 1:1 it must be a Voltage BALUN.

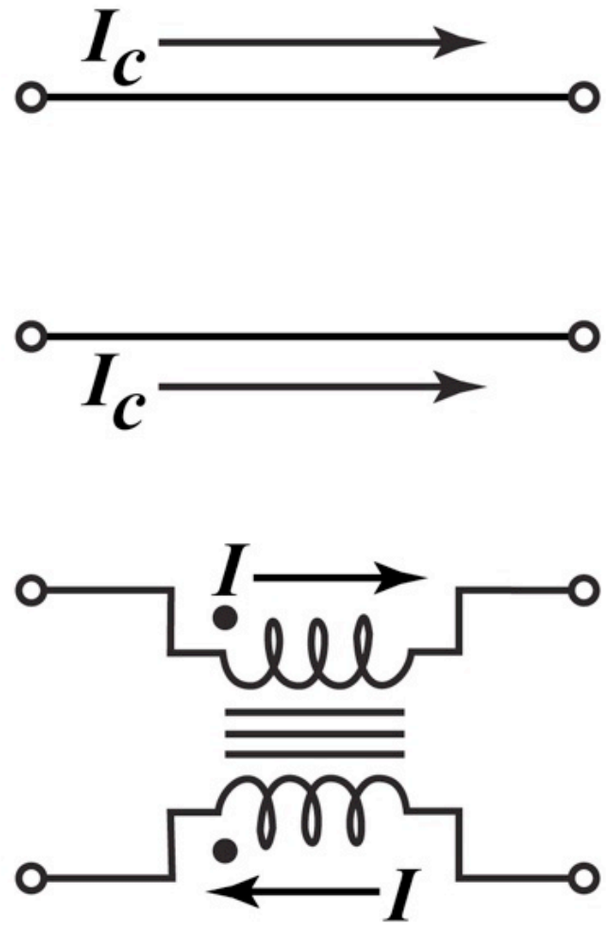
- However, this does not seem to be true, and Current BALUNs can have different impedance ratios.

Common Mode Current in a Feed Line



Common Mode Current in Coax can Radiate and Create RFI in Shack

Current BALUN Opposes Common Mode Currents

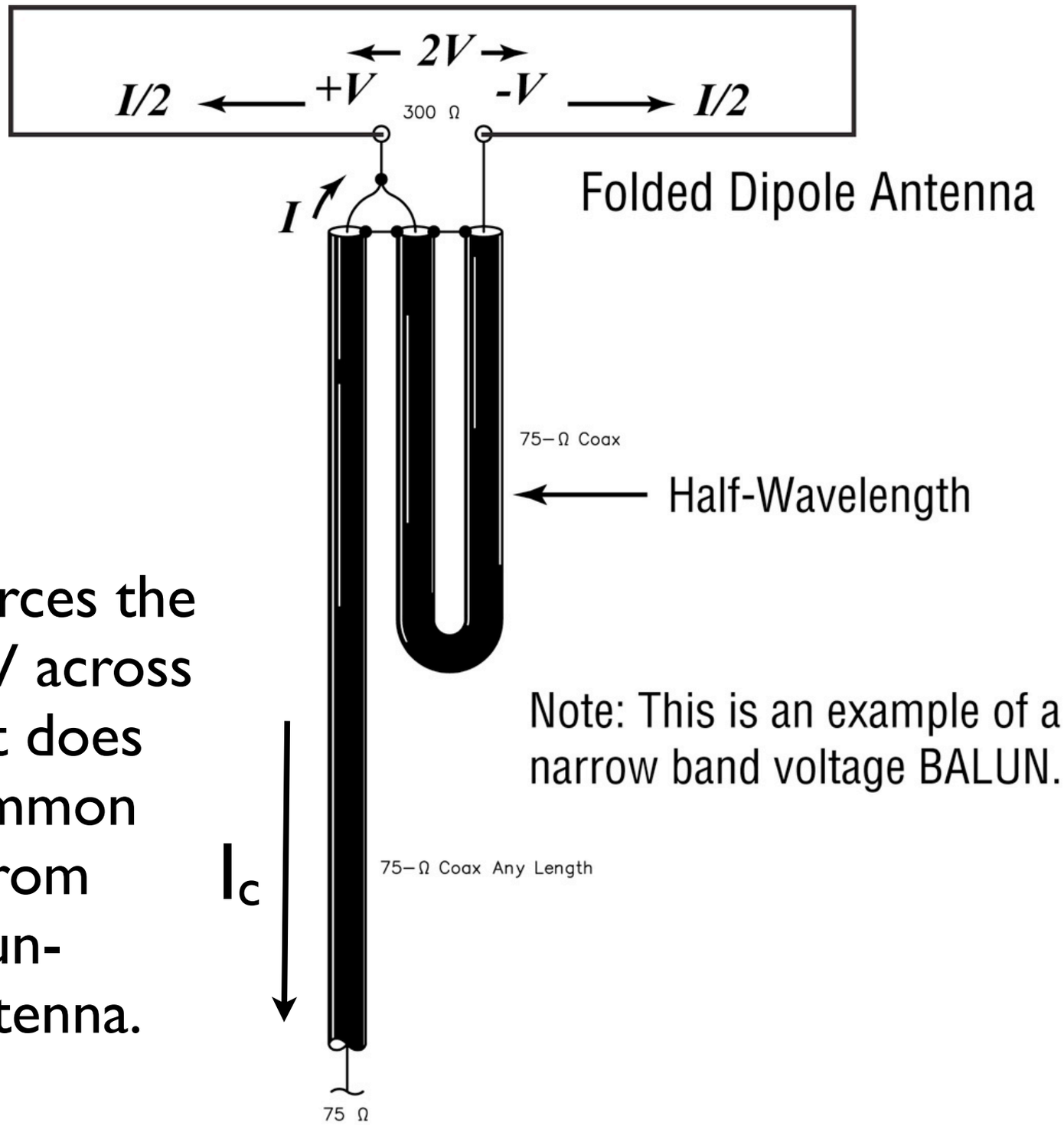


1:1 Current Balun

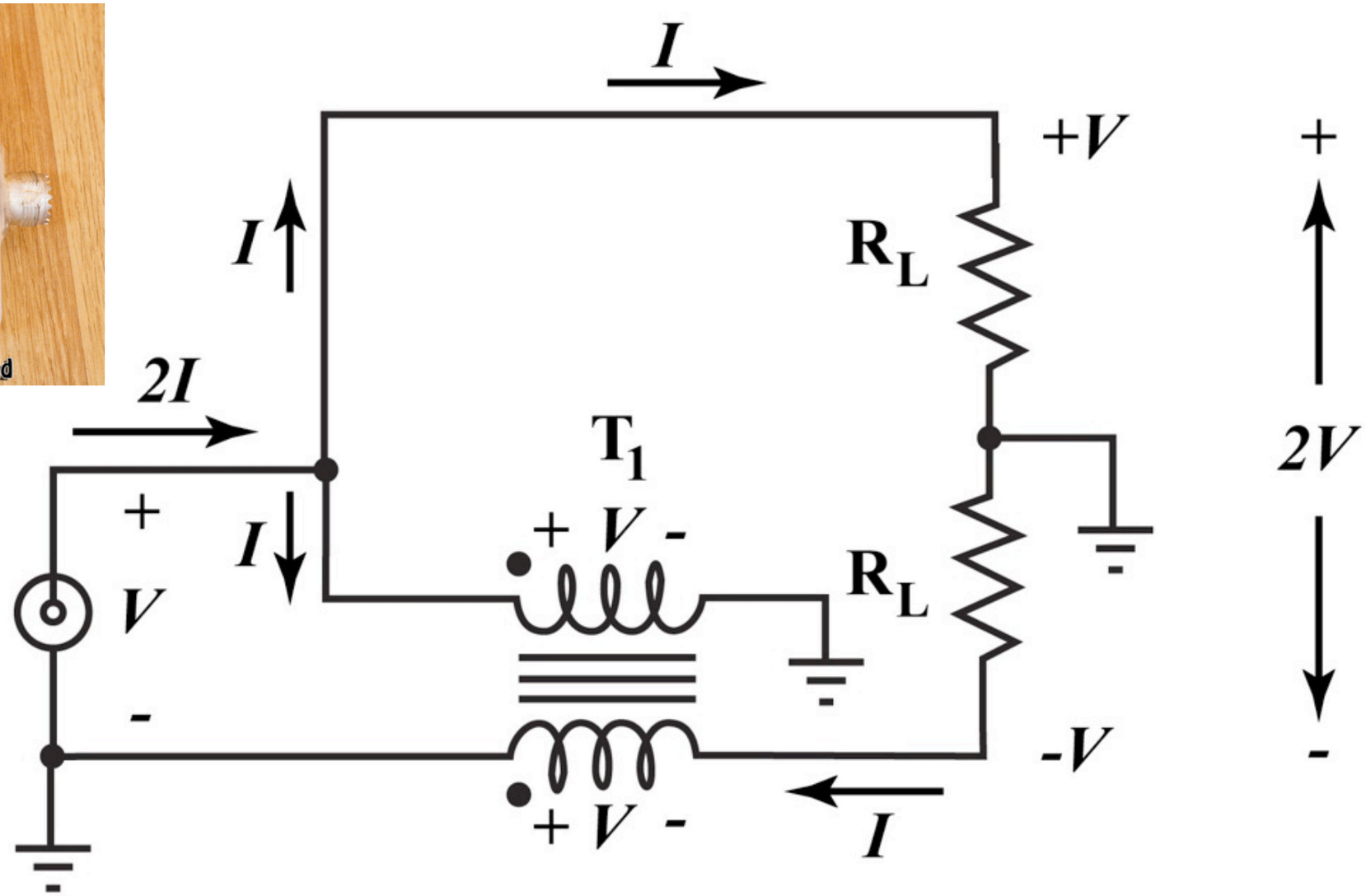
The Current BALUN opposes Common Mode currents.
Sometimes called a “Choke BALUN.”

4:1 Impedance Transform with Voltage BALUN

This BALUN forces the voltage to be 2V across the antenna, but does not prevent common mode current from factors which "un-balance" the antenna.

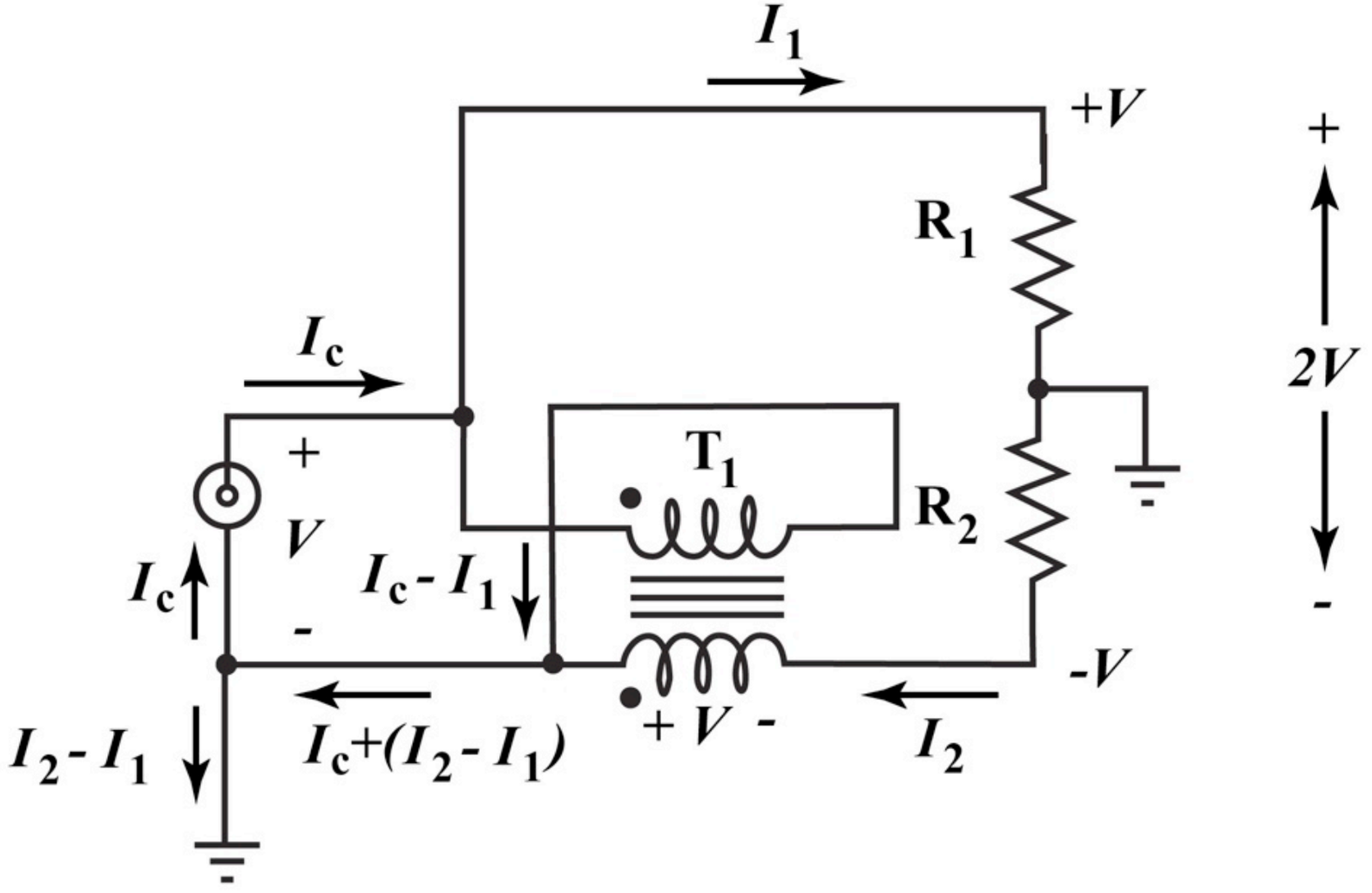


A Broadband 4:1 Voltage BALUN



The Ruthroff 4:1 Voltage Balun with Symmetrical Load

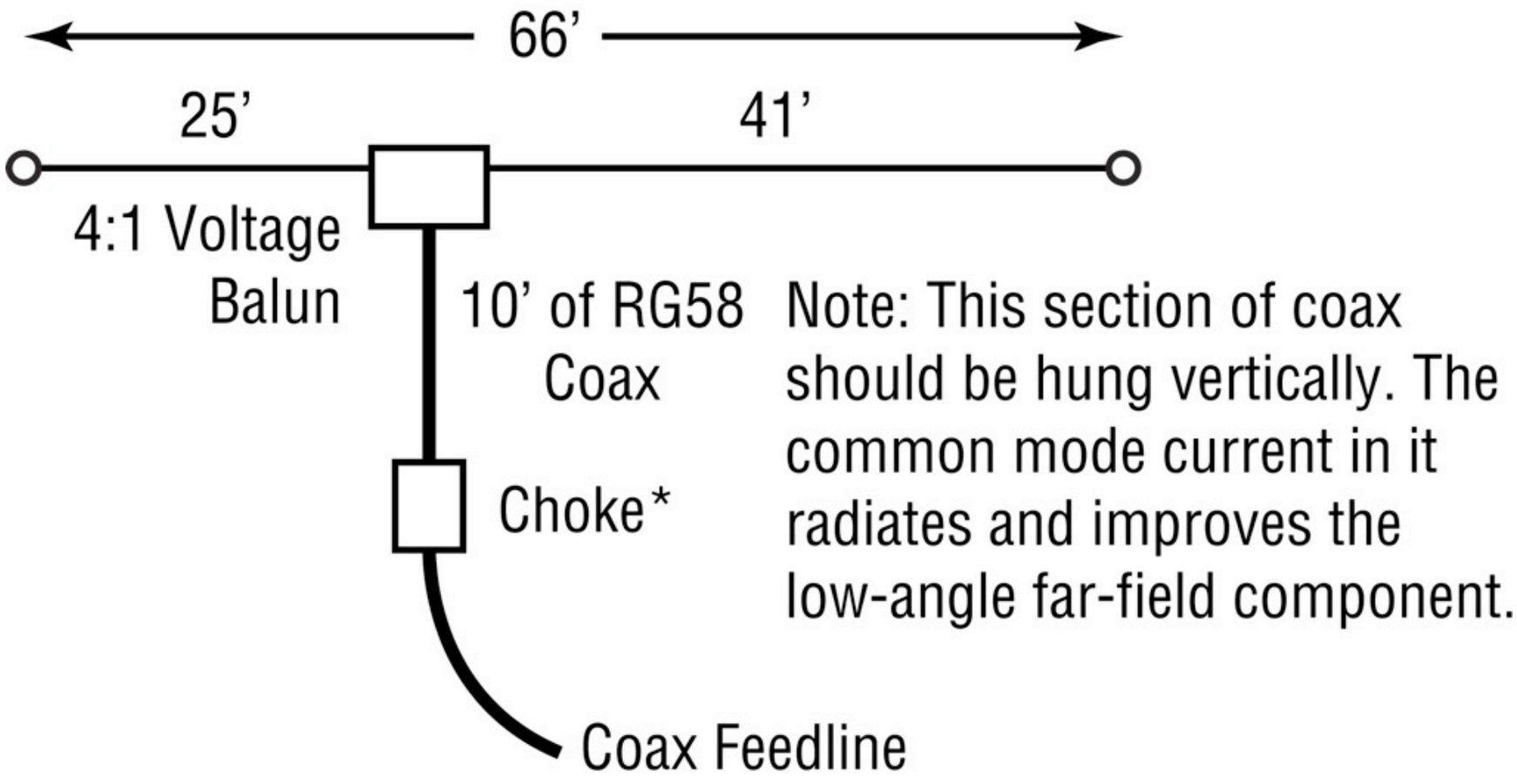
Ruthroff 4:1 Voltage BALUN with Unbalanced Load



Note: Unless the loads are symmetrical (balanced) and $I_2 - I_1 = 0$, some excess current flows through the ground connection as "common mode" current.

The Ruthroff 4:1 Voltage Balun

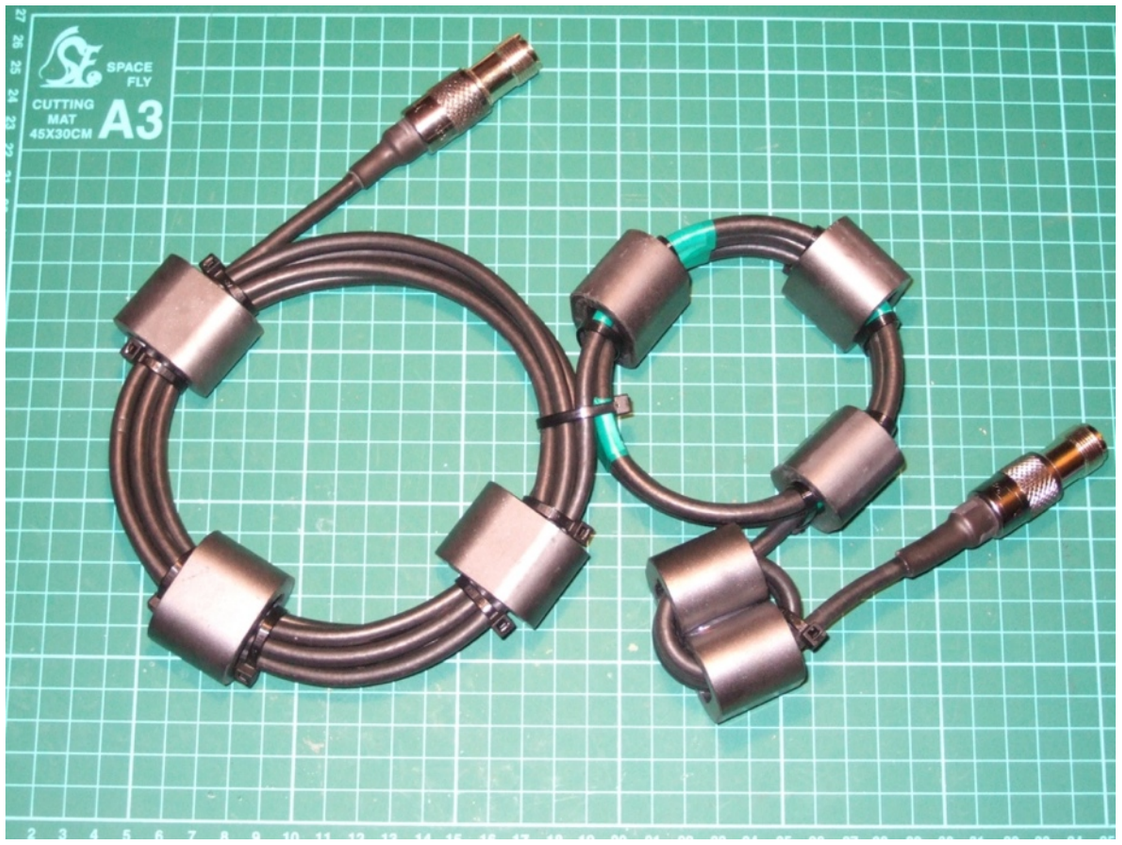
New Carolina Windom Antenna

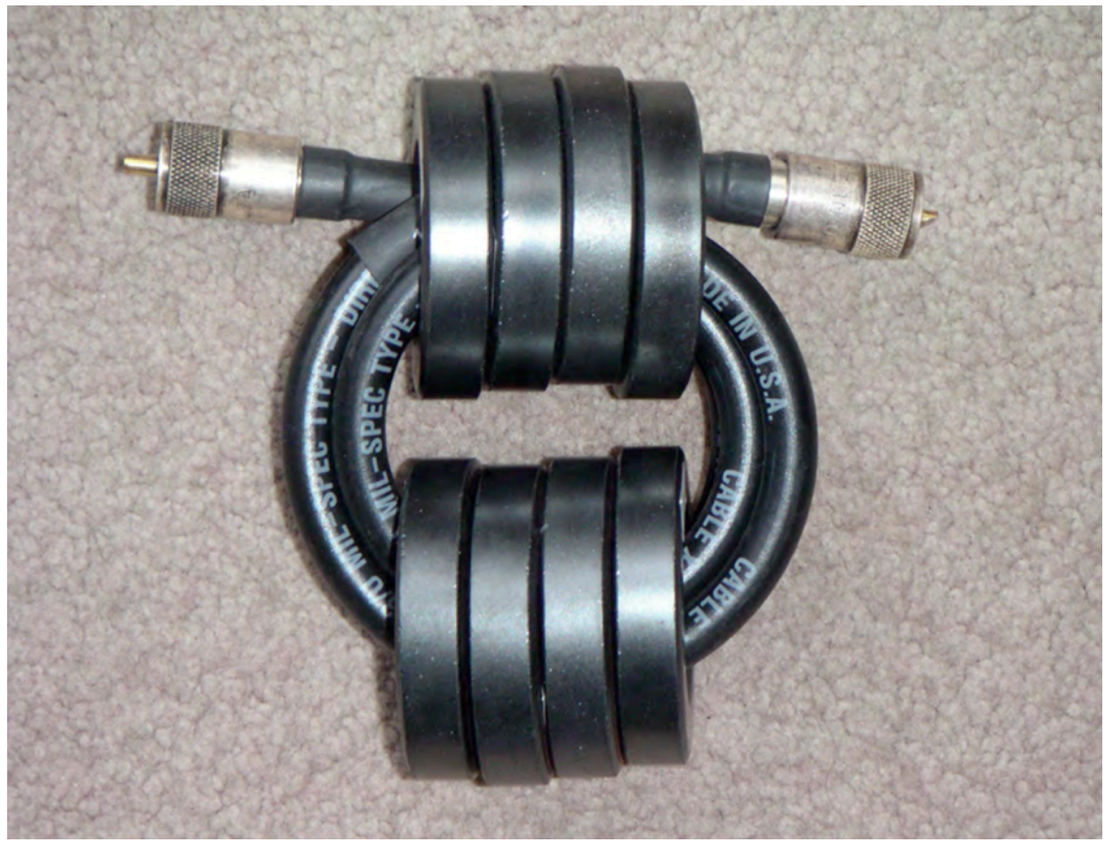


The “New Carolina Windom” Antenna for 40, 20, 15, and 10 meters

*The Choke can be made with tubular ferrite cores slipped over a short section of coaxial cable.

Choke UNUNs



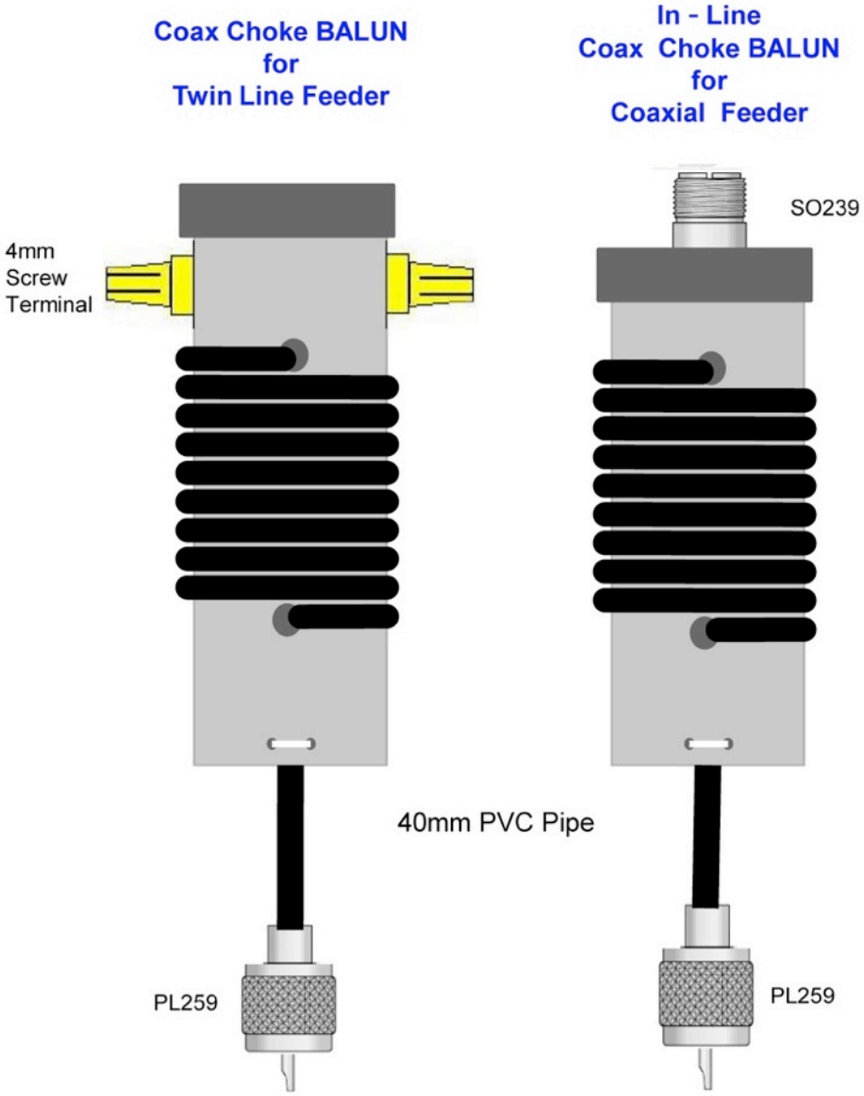


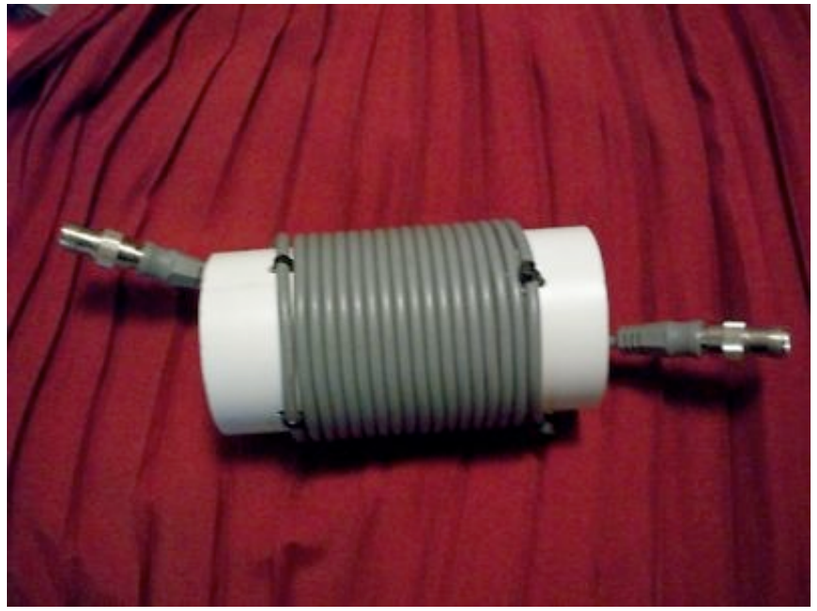
Choke UNUNs

DX Engineering FCC050-HO5-A

160 to 6 meters, 2kW CW/5kW SSB

“Ugly” Choke UNUNs





Usually 15 to 22 feet of RG-8 coax wound on a form 4 to 6 inches in diameter.

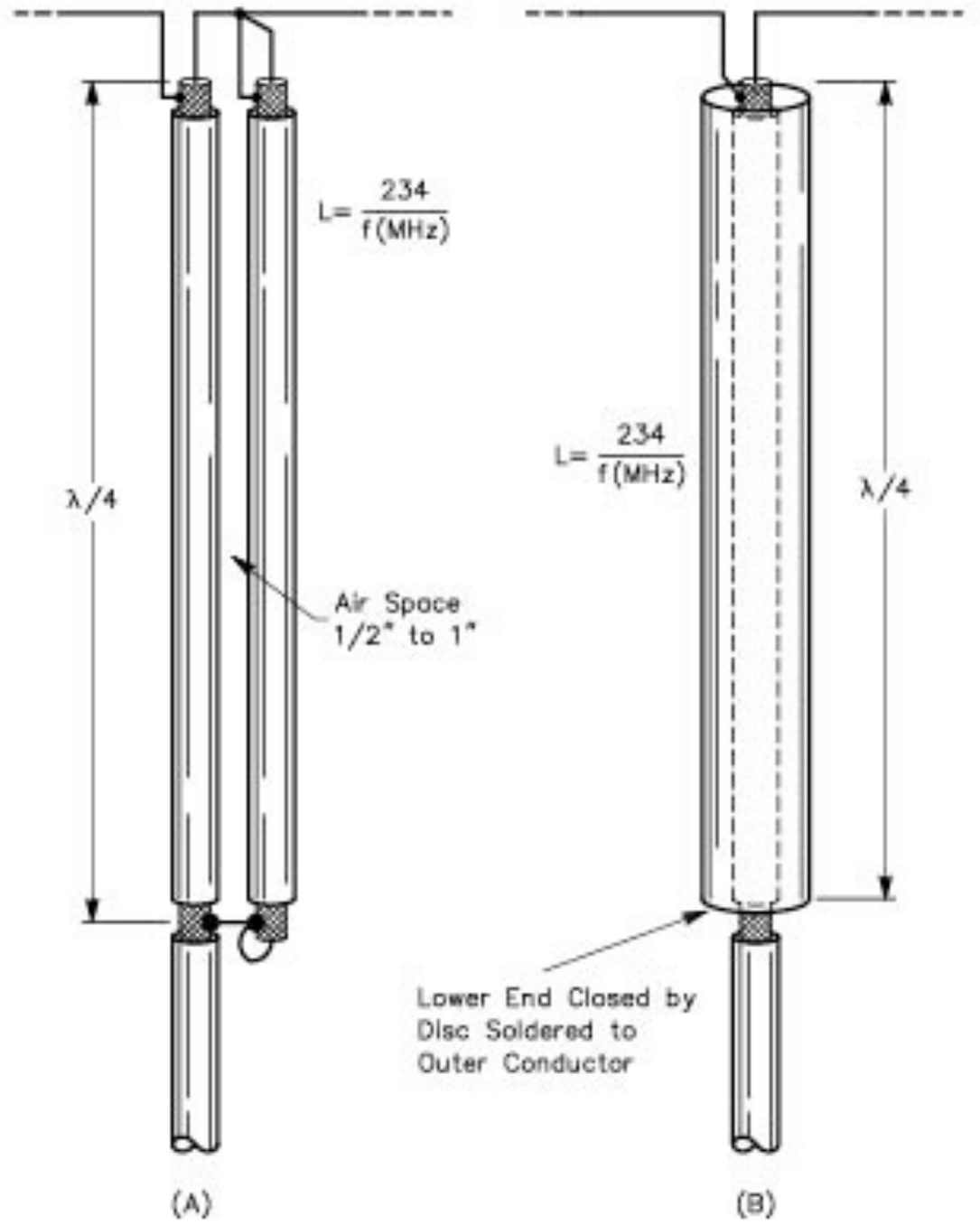
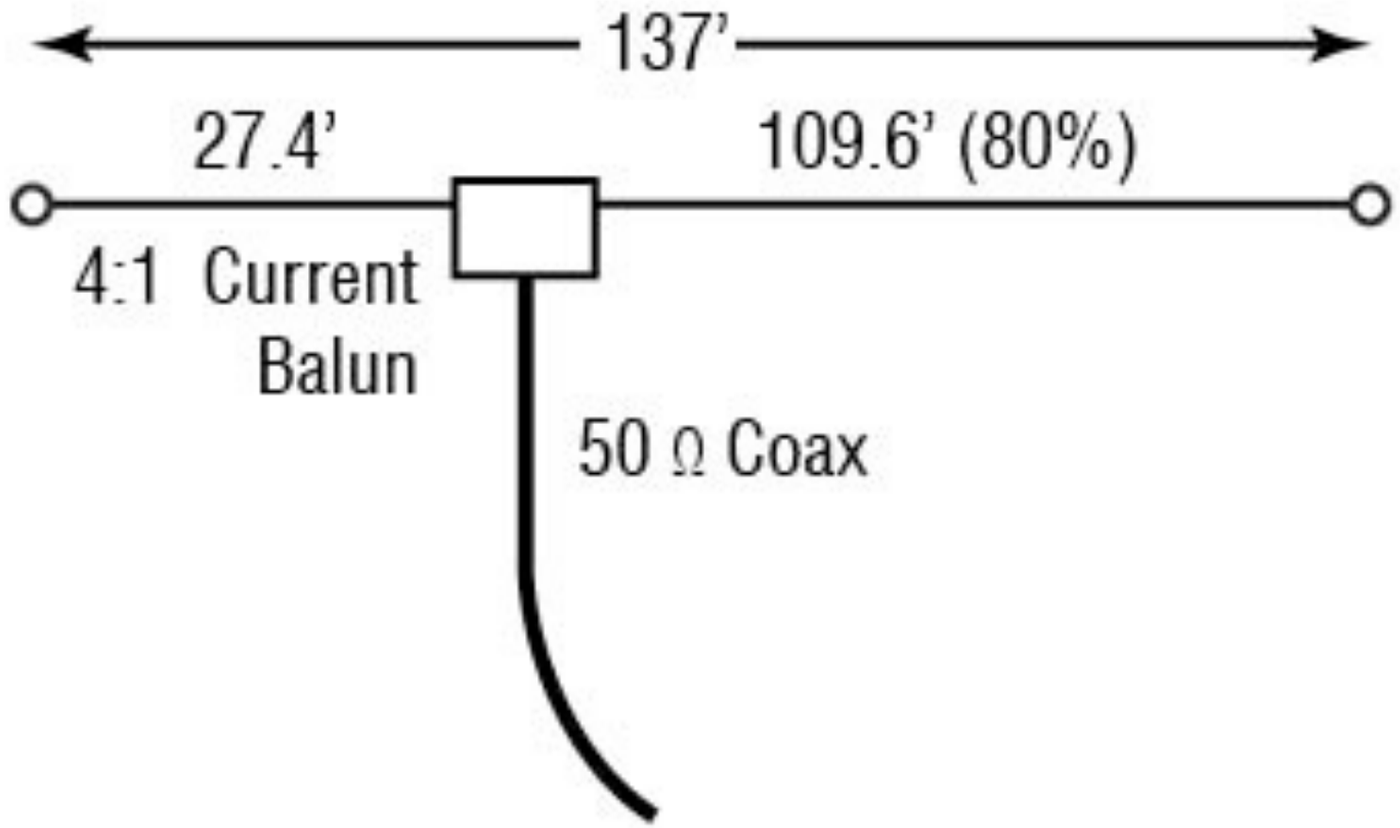


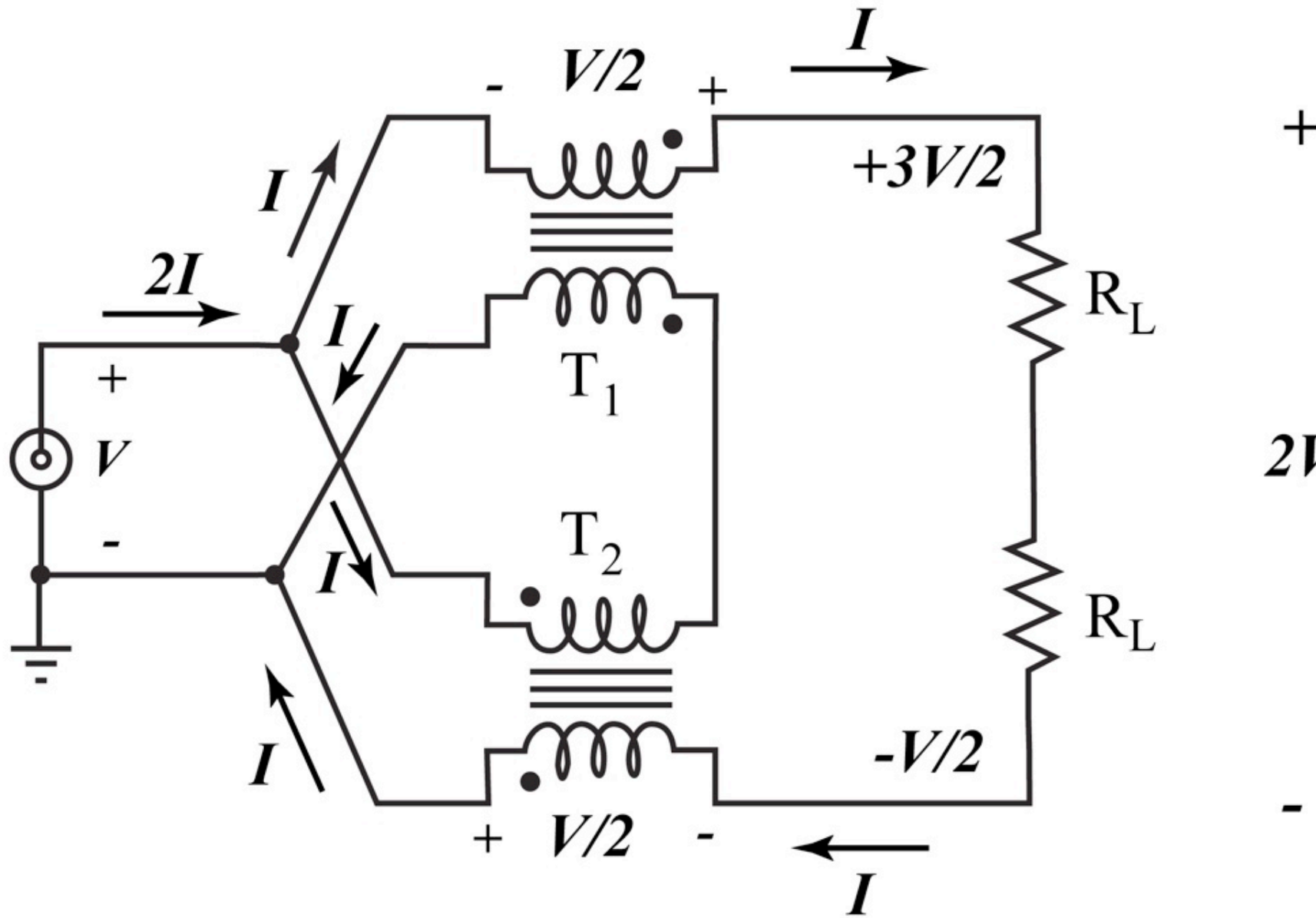
Fig 35—Fixed-balun methods for balancing the termination when a coaxial cable is connected to a balanced antenna. These baluns work at a single frequency. The balun at B is known as a "sleeve balun" and is often found at VHF.



Off Center Fed (OCF) Dipole (80:20)

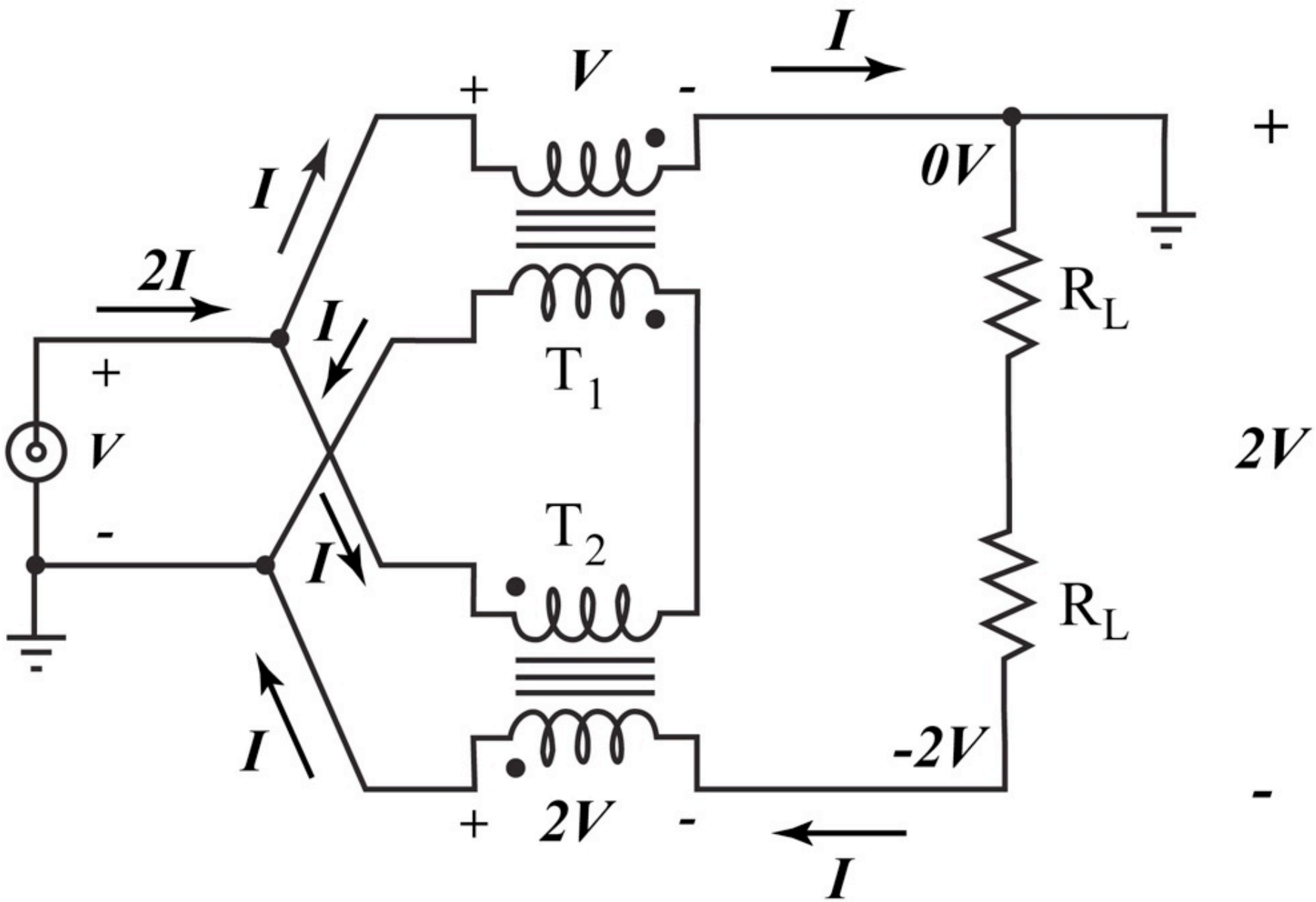
Note: I have seen ratios reported of 84:16, 80:20, 66:34, and the “traditional” 62:38.
W8JI claims this antenna has better than 2:1 SWR
on 80, 40, 30, 20, 15, 12, and 10 meters.
(http://www.w8ji.com/windom_off_center_fed.htm)

4:1 Guanella Current BALUN



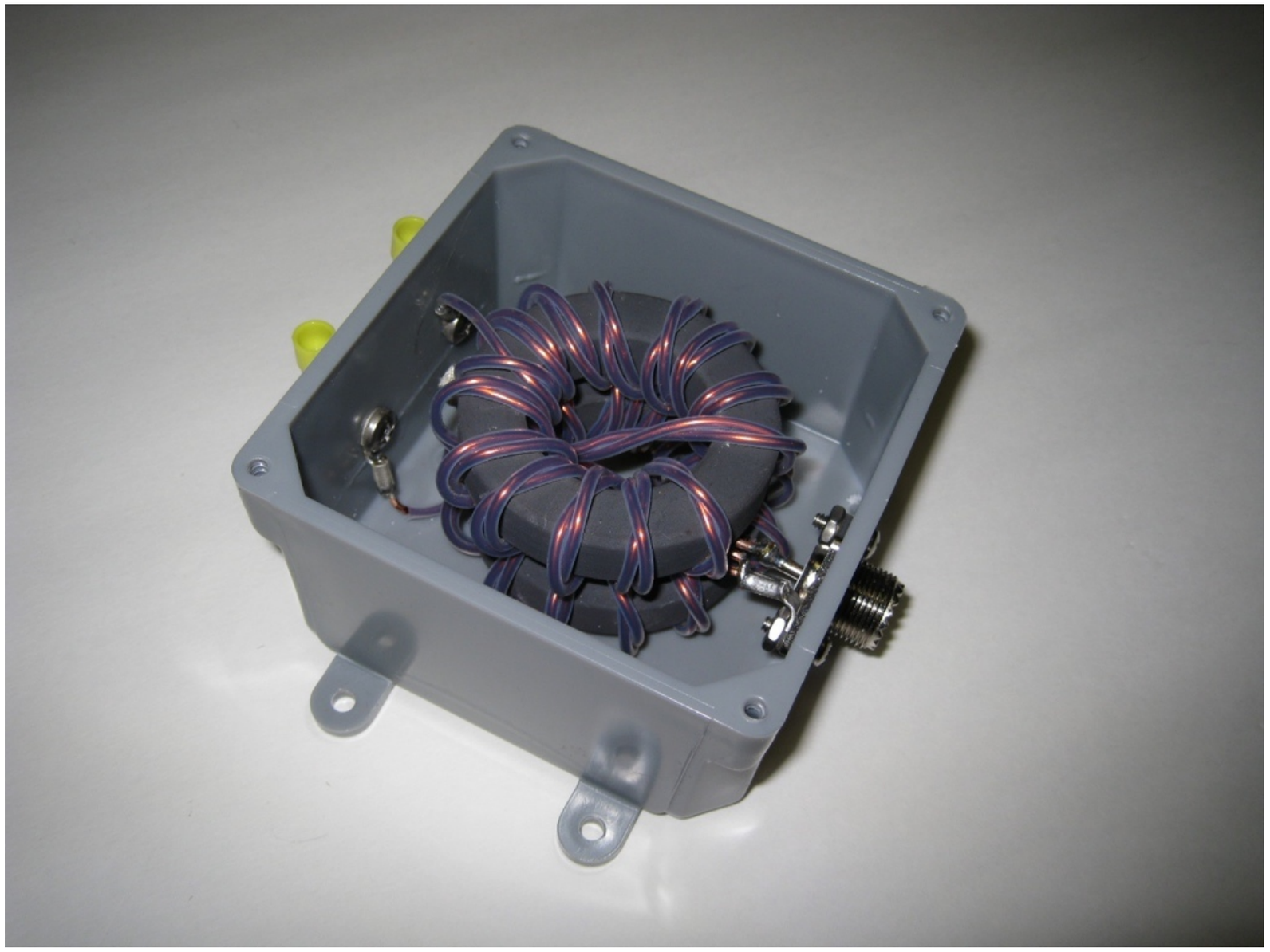
The Guanella 4:1 Current Balun with Floating Load

4:1 Guanella Current BALUN



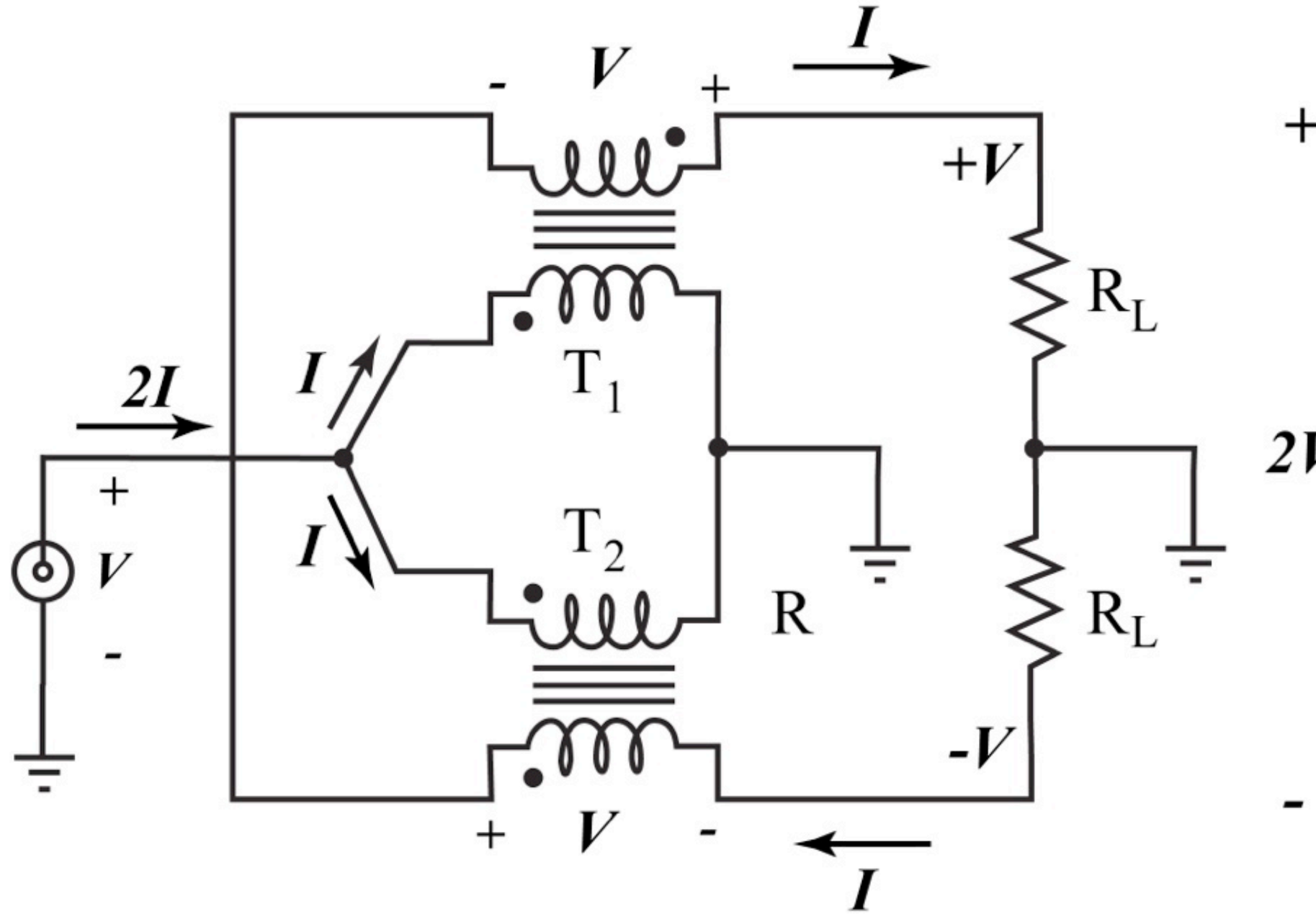
The Guanella 4:1 Current Balun with Unbalanced Load

4:1 Guanella Current BALUN



Guanella BALUN should be made with two cores.

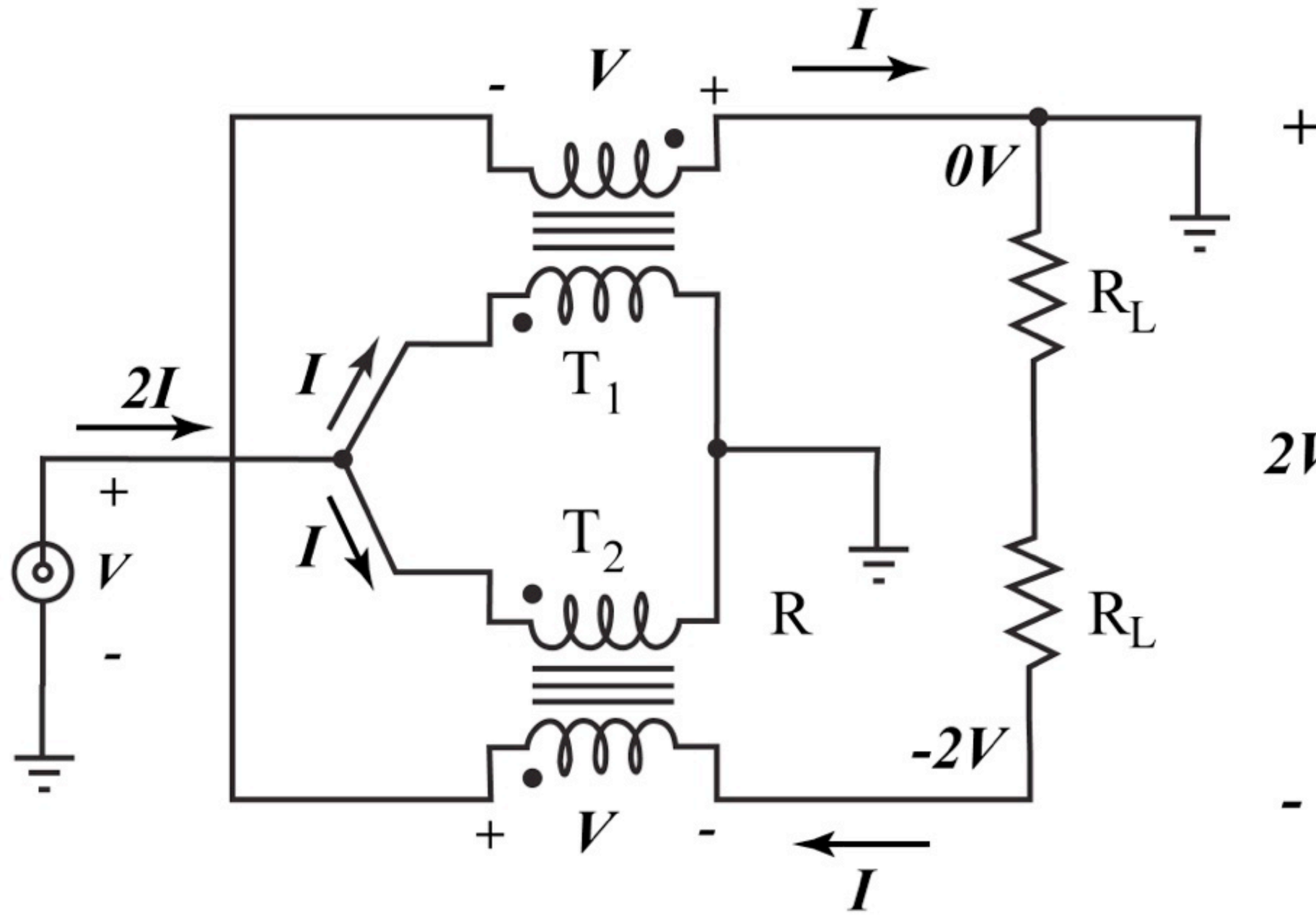
Improved 4:1 Current BALUN



An Improved 4:1 Current Balun with Symmetrical Load

(http://www.home.earthlink.net/~christrask/Trask4to1Balun.pdf)

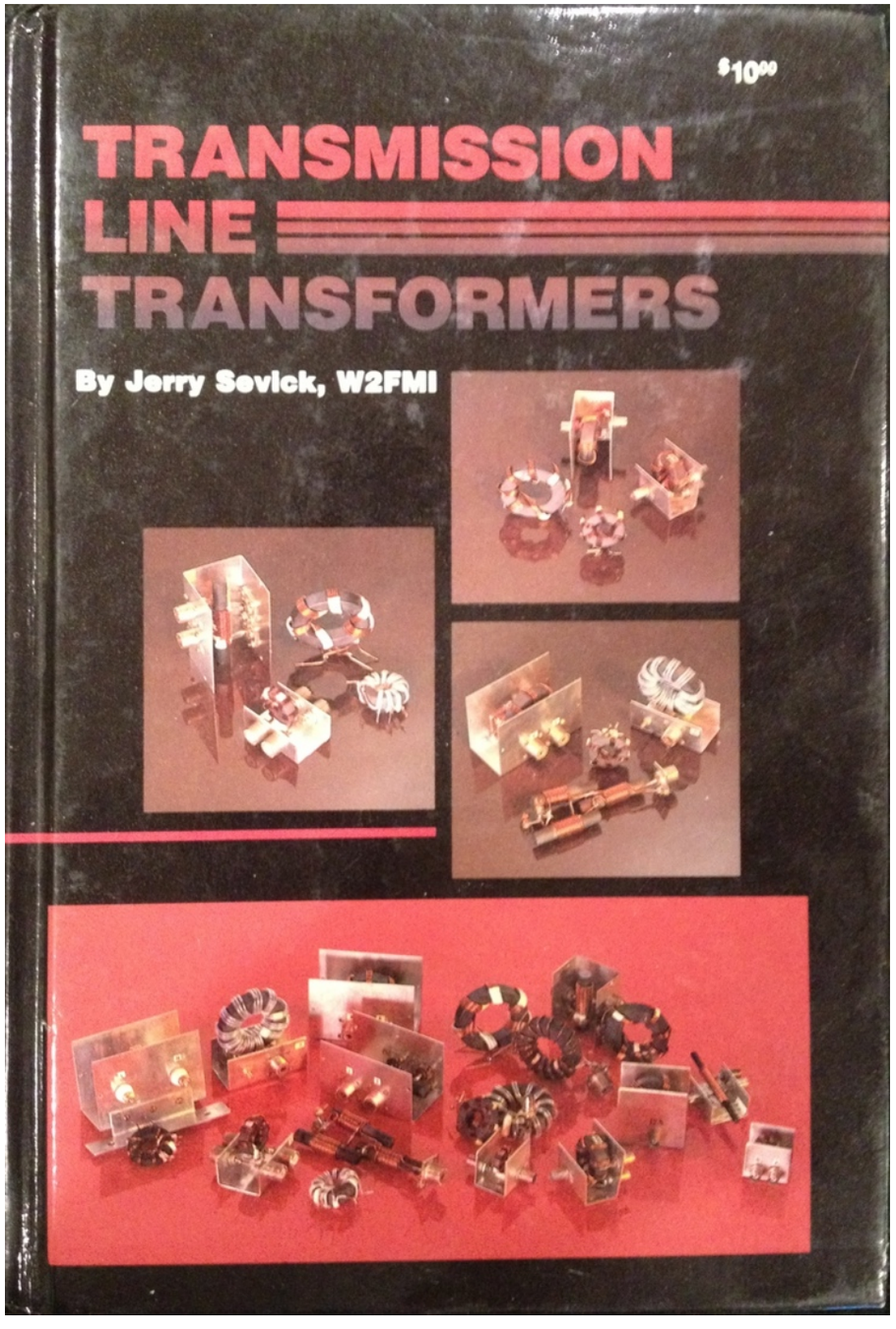
Improved 4:1 Current BALUN

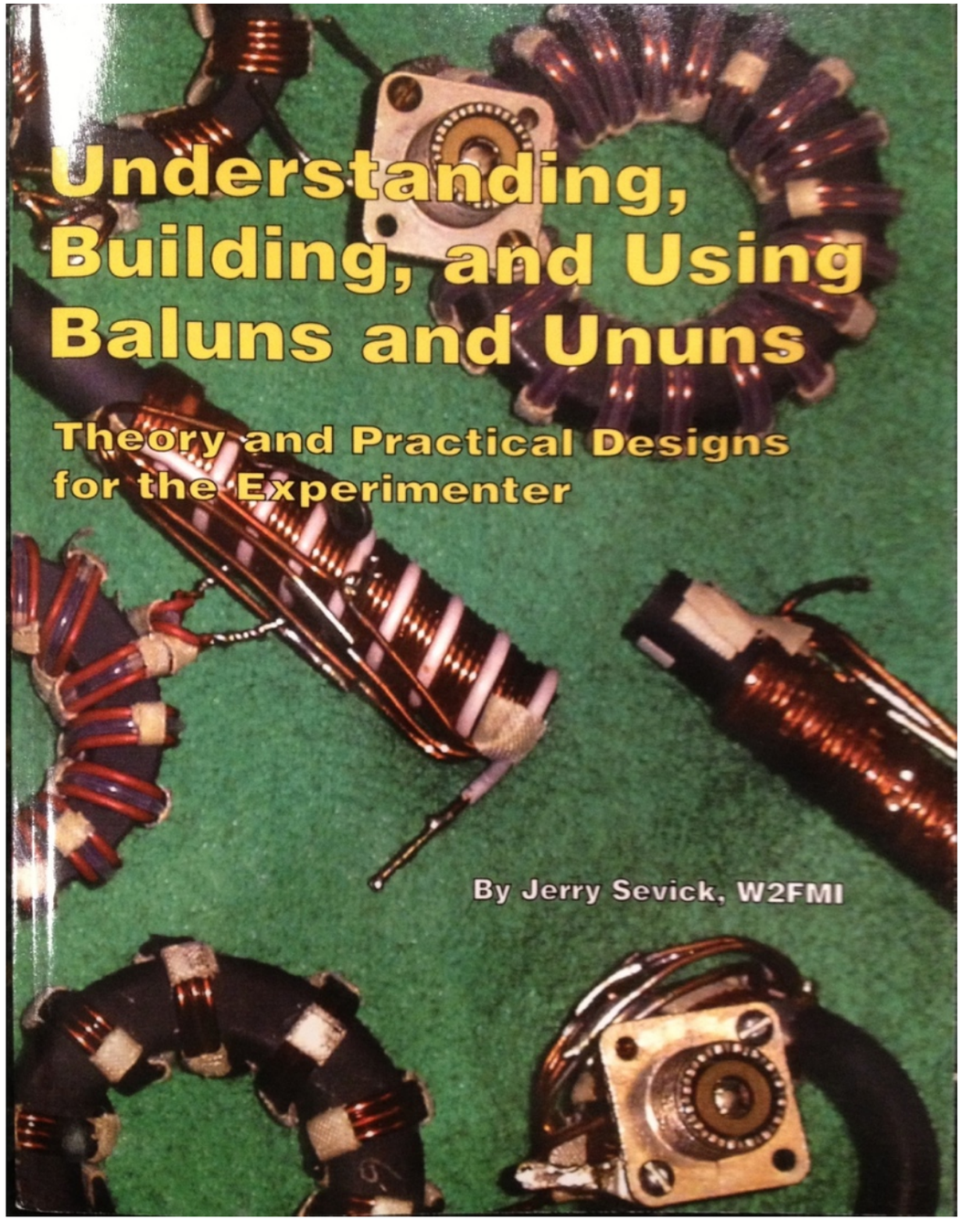


An Improved 4:1 Current Balun with Unbalanced Load
(http://www.home.earthlink.net/~christrask/Trask4to1Balun.pdf)

This BALUN can be wound on a single core.

References





Jerry Sevick, W2FMI (SK)