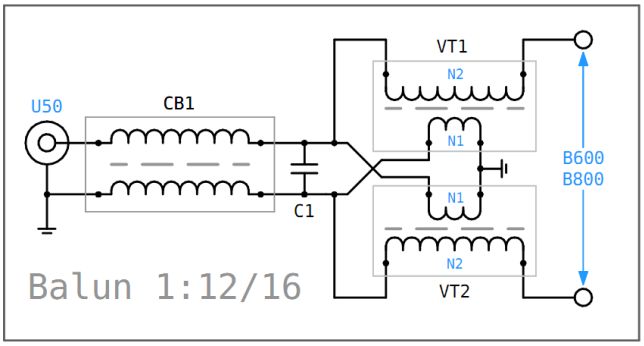
Triple coil balun 1:12

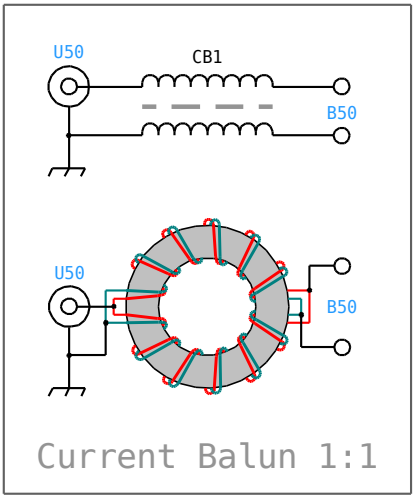
This is a short description of wide band balun tested as impedance transformer with various traveling wave transmitter antennas. This balun can handle over 100W of transmitter power. It consists of 1:1 current balun and of two voltage transformers for 600Ω load. Frequency range is 2...30MHz with the VSWR below 1:1,5. *This construction may not be optimal; further tests will be still done...*

Circuit diagram



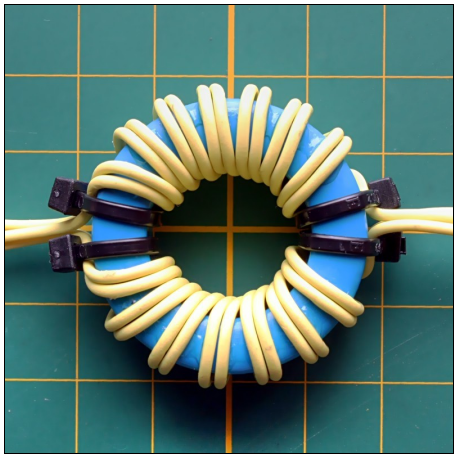
Ferrite toroid CB1 is a 1:1 current balun; it produces proper phasing for voltage transformers. Voltage transformers VT/VT2 (also ferrite toroids) rise the voltage/impedance to the desired level. Capacitor C1 is used to adjust the proper matching on higher frequencies. C*apacitor across the output was not defined.*

CB1

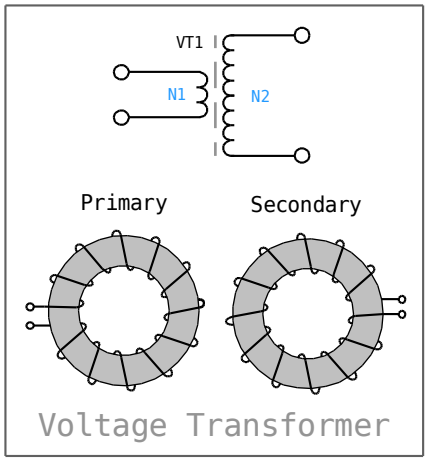


The 1:1 balun was winded over Epcos **B64290-L48-X830** toroid, material N30, Al=5460nH, ui=4300. The winding consists of two phased 100Ω transmission lines connected parallel. We used 7 turns (per side) of **0,5mm²** BetaTrans stranded high temperature industrial wire, conductor diameter 0,8mm, core 1,4mm. Also standard 0,75 mm² stranded wire works well; conductor diameter 1,1mm, core 2,0mm. The wire pairs must be kept tight together, also when connecting to the coaxial connector and to the voltage transformers. The transmission line impedance must stay near 50Ω. With 2x2x7 turns we get inductance about 260uH per wire, which gives 3kΩ impedance @2MHz, 16kΩ @10MHz and 50kΩ @30MHz. You may also want to install some 150Ω ferrite tubes over the coaxial feed line near the coaxial connector.

Picture of CB1



VT1/VT2



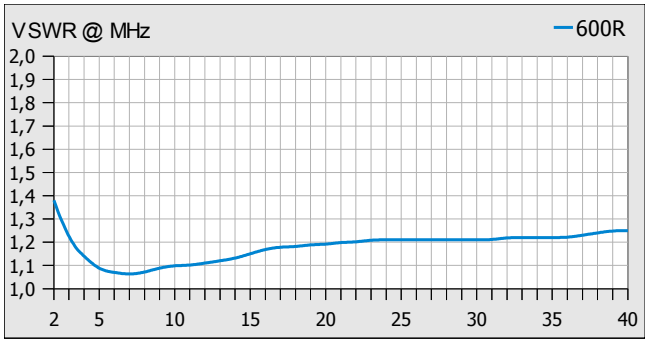
The voltage transformers were winded over Ferroxcube ferrite toroid **TN36/23/15-4C65**, Al=170nH, ui=125.
On primary we used lacquered solid copper wire, diameter **1,2mm**.
On secondary we used stranded industrial wire, **Radox 125**, **0,25mm²**, conductor diameter 0,6mm, core 1,45mm.
On primary we winded **N1=6 turns**, wire ends near each other.
On secondary we winded **N2=15 turns for 600Ω** output.
These values may not be optimal.
Look at the details on following pictures. Pay attention for the correct phasing of the primary coils during assembly. Notice also that the common point of the primaries is connected directly into the coaxial connector's ground terminal.

Capacitor C1

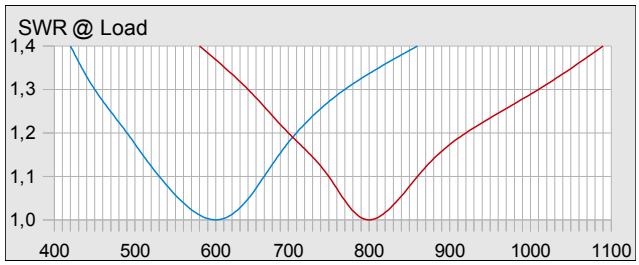
This capacitor is needed to compensate the winding capacitance. We used ceramic capacitors with voltage ratings of 500 to 1000V. If you use different wire types, you should tune this capacitance value with antenna analyzer. Starting value is near **47pF/1000V**. We winded the transformers so that some of the secondary turns were near the primary winding, some were far (low capacitance). Look at the following pictures for details. By this we get the SWR value low enough near 10MHz. With C1 we tuned the SWR value low at the 30-40MHz range. The *experimental* C1 value is:

C1 = 33pF 1000V @ **600Ω** balun

600Ω/33pF transformers:



SWR value behavior with various load impedance:



High impedance baluns are commonly used with resistor terminated traveling wave antennas, like T2FD and terminated V-beams. Usually it's difficult to define/get the exact resistance value for the terminator. On this chart we see that the exact resistor value is not so critical; in real life the traveling wave antenna itself causes much more deviation into the antenna's SWR curve than minor difference on resistance value.

Mechanical issues

High impedance balun is sensitive to metal objects near the coils. It's best to pack this type of balun into a large plastic enclosure. (I have packed several baluns into aluminum boxes with poor success.) With metal boxes also the capacitance of feed-trough insulators and connectors may cause some drop of performance. 50Ω wires should be kept tightly near each other and output wires far from each other and far from metal objects. The baluns should be assembled with 10-20mm minimum distance from each other.

Enclosure & wiring

Document History

2.0 01.05.2012
Details of 1:16 balun removed: It seems to be very hard to get working properly.