1:4 GUANELLA CURRENT BALUN

1:4 Guanella Current Balun.

Requiring a balun to feed a balanced feed line from an un-balanced T-Match tuner, a 1:4 Guanella Current balun design using two L15 ferrite toroid cores was selected among other balun types. An impedance transformation balun may be required due the variations in impedances often encounter with multi-band balanced antenna system. The balun may be required to sep up or down the feed impedance presented at the T-Match tuner to improve the matching range, it is for this reason that I chose to not include the balun as an integral feature of the T-Match tuner, opting for the flexibility of an outboard balun and the ability to trial various baluns subject to the antenna system and impedances presented.
The Guanella Current balun is a low loss, broadband balun that will ideally choke off common mode currents entering the radio room and importantly provide a transition from the un-balanced output of the T-Match tuner to the balanced antenna system feed line.
While using the balun to choke off common mode currents is best achieved at the antenna end of the feed line, this is not a practical arrangement for a balanced feed line system.

Construction

The 1:4 current balun is derived from two 1:1 current baluns with each consisting of a close double bifilar winding of 8 turns wound evenly spaced around the L15 ferrite toroid core. The toroidal cores are rapped in an overlapping layer pink heavy duty Teflon plumbers tape to protect the enamelled copper wire from insulation puncture from abrasion with the toroid core.

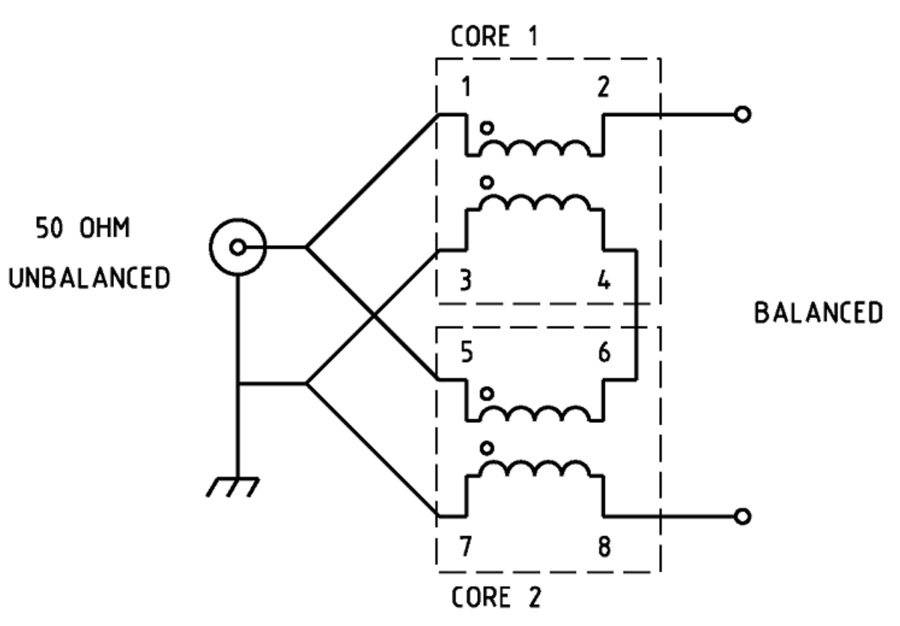

Figure 1 Schematic of the 1:4 Guanella Current balun.

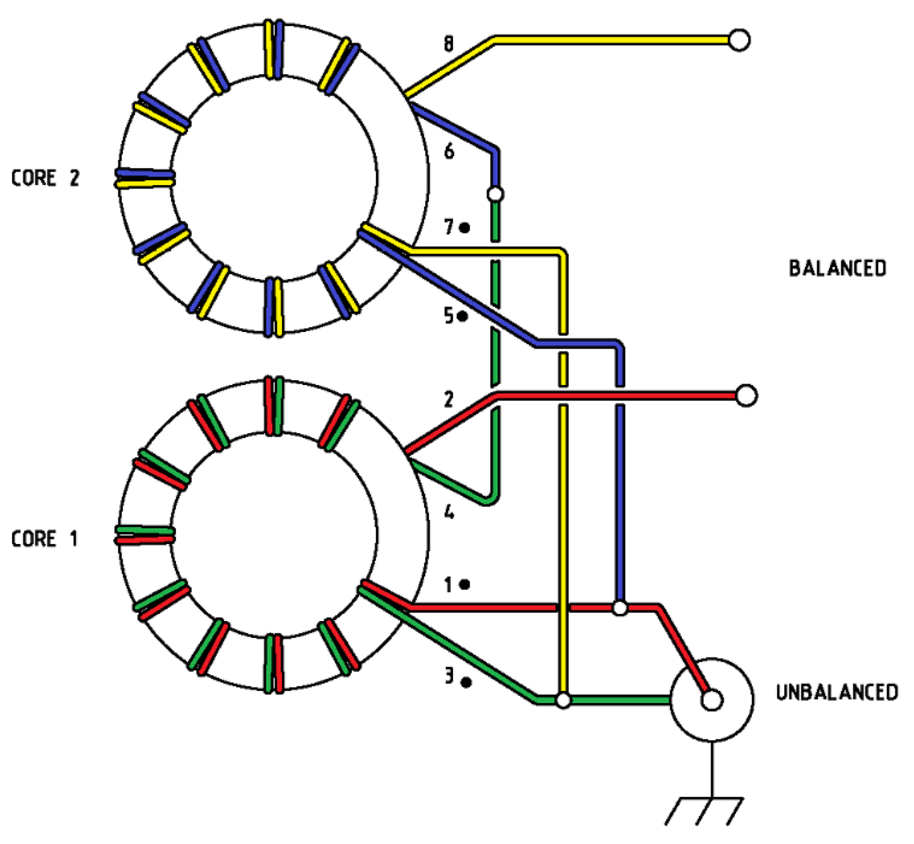

Figure 2 Wiring of the 1:4 Guanella Current balun.

Note this drawing shows winding connections and not the number of turns required. See article for details.

Parts list.

- 2 x L15 ferrite toroid core. Jaycar Cat. No. LO-1238
- Pink heavy duty Teflon plumbers tape.
- About 2 x 600mm of 1.25mm Enamelled copper wire.
- Two Gold Banana Socket Binding Post - Black. Jaycar Cat. No. PT-0431
- SO-239 UHF chassis mount connector
- Sealed Polycarbonate Enclosures 82 x 80 x 55mm from Jaycar Cat. No. HB-6230. See Fig 3 for details

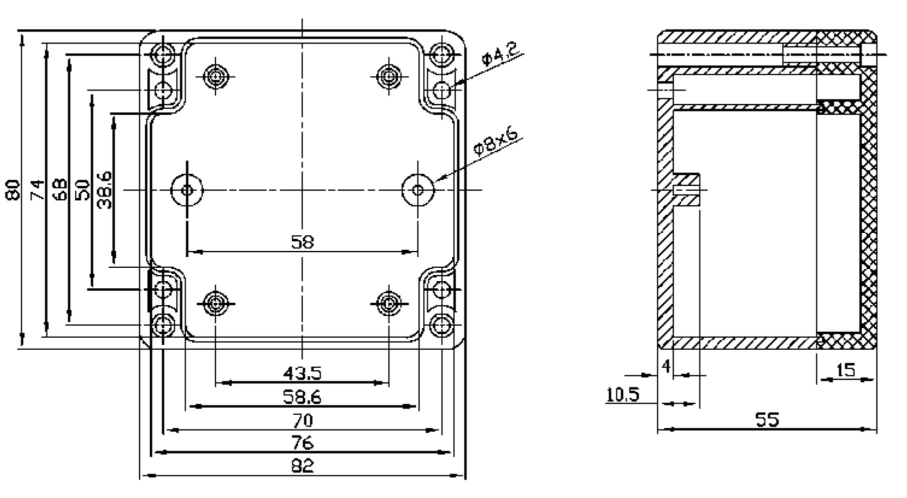

Figure 3 Sealed Polycarbonate Enclosures 82 x 80 x 55mm details. Designed to IP65 of IEC 529 and NEMA 4

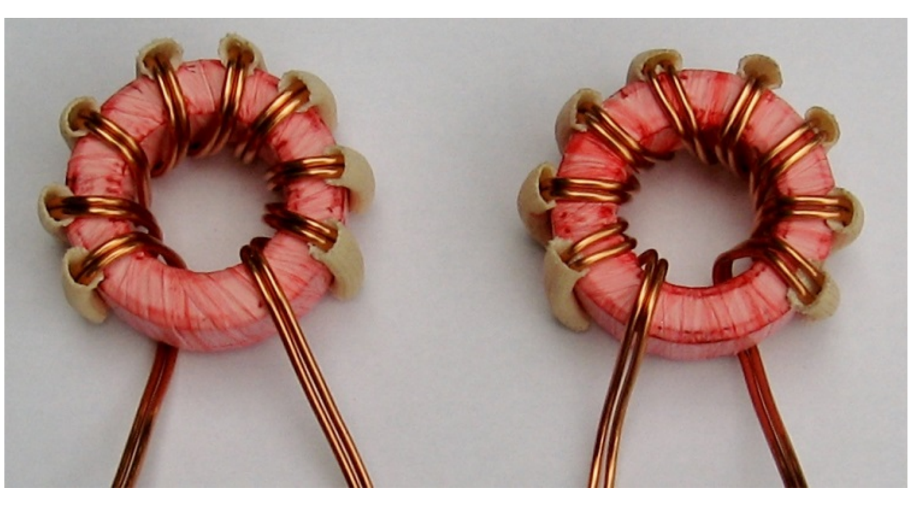

Photo 1 1:4 Guanella current balun individual core windings assembled.

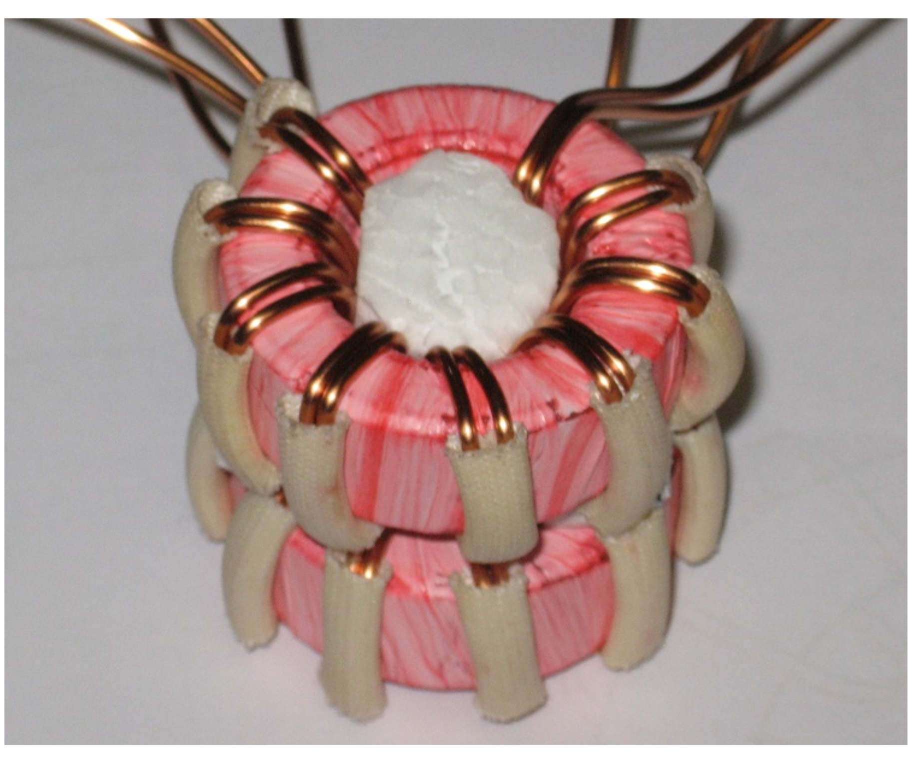

Photo 2 1:4 Guanella current balun. individual core windings stack assembled.

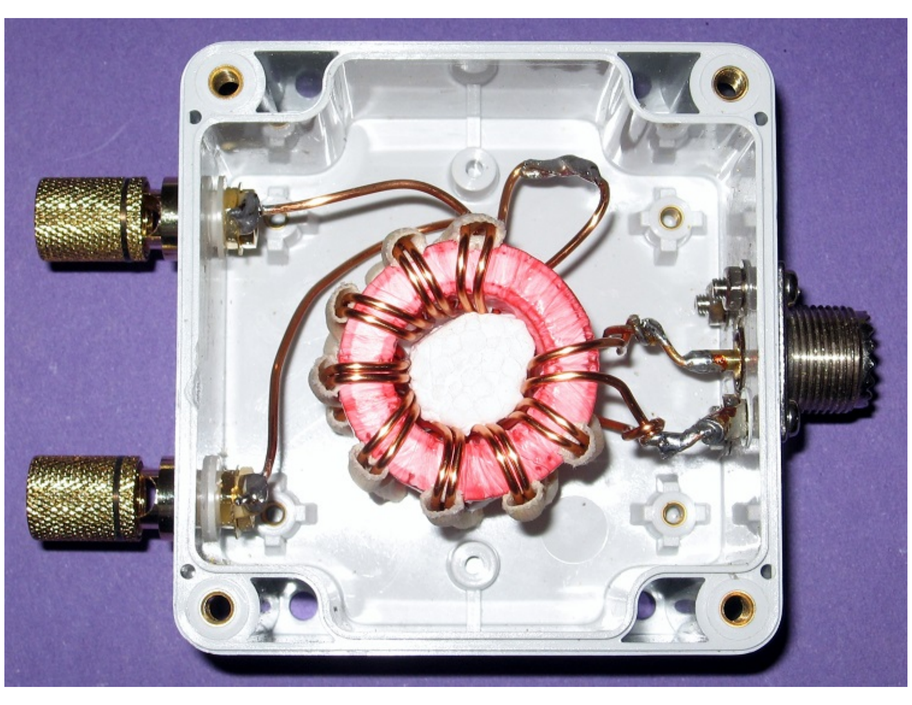

Photo 3 1:4 Guanella current balun assembled.

The evaluation of the efficiency of the balun over the desired bandwidth (1.8 - 30MHz) was carried out by testing the impedance that could be seen from unbalanced side to a resistive load applied to the balanced side using an antenna analyser. The efficiency is shown to be relatively flat from below 1.8MHz to above 30MHz. The below antenna analyser plot viewing a 200ohm resistive load attached to the balanced side of the balun and measured at a nominal impedance of 50ohms presented as anticipated an approximate 50ohm load to the analyser and ideally produced about a 1:1 SWR. The results are more or less what was expected and demonstrates that the balun's 1:4 current transformation occurs efficiently from well below 1.8 to well above 30MHz

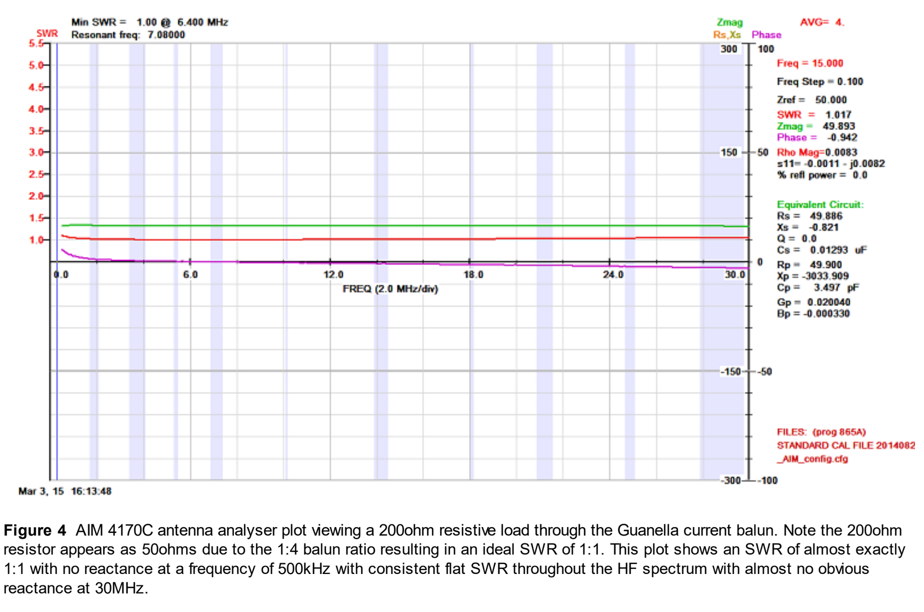

Figure 4 AIM 4170C antenna analyser plot viewing a 200ohm resistive load through the Guanella current balun. Note the 200ohm resistor appears as 50ohms due to the 1:4 balun ratio resulting in an ideal SWR of 1:1. This plot shows an SWR of almost exactly 1:1 with no reactance at a frequency of 500kHz with consistent flat SWR throughout the HF spectrum with almost no obvious reactance at 30MHz.

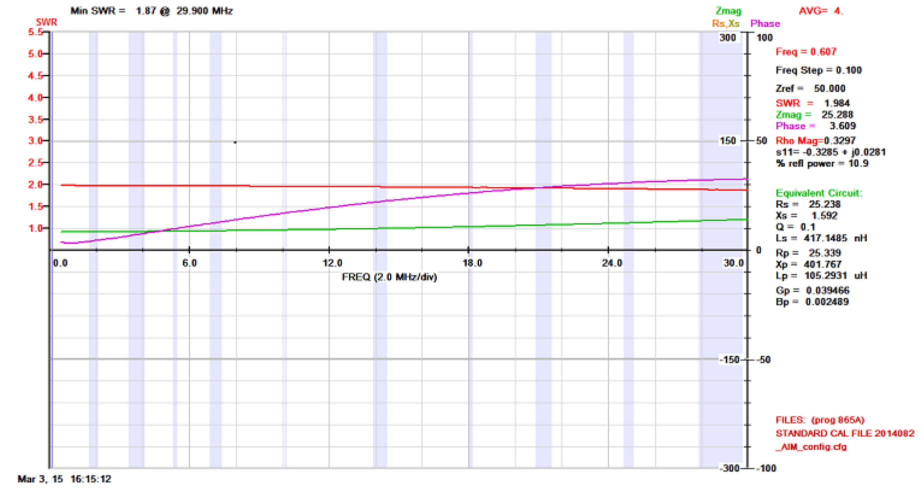

Figure 5 AIM 4170C antenna analyser plot viewing a 100ohm resistive load through the Guanella current balun. Note the 100ohm resistor appears as 25ohms due to the 1:4 balun ratio resulting in an ideal SWR of 2:1. This plot shows an SWR of approximately 2:1 from 500kHz through to 30MHz and with modest inductive reactance towards the upper frequencies.

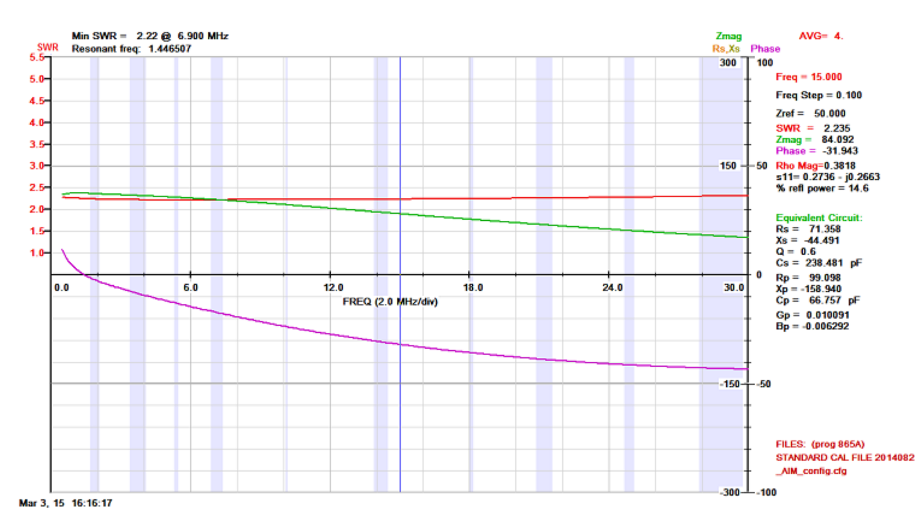

Figure 6 AIM 4170C antenna analyser plot viewing a 450ohm resistive load through the Guanella current balun. Note the 450ohm resistor appears as 112ohms due to the 1:4 balun ratio resulting in an ideal SWR of 2.2:1. This plot shows an SWR of approximately 2.5:1 at 500kHz through to 30MHz and with significant capacitive reactance towards the mid and upper frequencies.

AIM 4170C antenna analyser explanation;

SWR	Standing Wave Ratio.
Zmag	Total Impedance.
Rs	Resistive component of the total impedance
Theta	Phase angle between voltage and current. + indicates inductive reactance while - indicates capacitive reactance.

Also see other baluns and ununs:

BALUN 1:1 CHOKE & 1:4 BALUN HF ladder feed-line to coaxial cable combination choke and 1:4 balun. (0.1MHz - 30MHz).
BALUN 1:1 CHOKING Choking balun for lower HF and MF bands. (200kHz - 10MHz).
CHOKING 1:1 BALUN - HF BANDS Reisert choking balun. (1.0MHz - 30MHz). FT240-43 Ferrite Toroid Core.
CHOKING 1:1 BALUN - HF BANDS Reisert choking balun (1.5MHz - 30MHz). FT140-43 Ferrite Toroid Core.
CHOKING 1:1 BALUN - LOW VHF BAND Choking balun. (10MHz - 60MHz). FT140-43 Ferrite Toroid Core.
BALUN 1:1 CURRENT 1:1 Guanella Current balun using a L15 ferrite core (1.8 - 30MHz).
BALUN 1:4 CURRENT 1:4 Guanella Current balun using a L15 ferrite core (1.8 - 30MHz).
BALUN 1:4 SINGLE CORE CURRENT 1:4 Guanella Current Balun, single FT240-43 ferrite toroid cores. (0.3MHz - 30MHz).
BALUN 1:1 VOLTAGE 1:1 Ruthroff voltage balun using a T-200-2 powdered iron toroid core (1.8 - 30MHz).
BALUN 4:1 VOLTAGE 4:1 Ruthroff voltage balun using a T-200-2 powdered iron toroid core (1.8 - 30MHz).
BALUN 6:1 VOLTAGE - VERSION 1 6:1 Voltage balun using a L15 ferrite toroid core (1.8 - 30MHz).
BALUN 6:1 VOLTAGE - VERSION 2 6:1 Voltage balun using a FT140-43 Ferrite Toroid Core (1.8 - 30MHz)
BALUN 9:1 VOLTAGE - VERSION 1 9:1 Voltage balun using a L15 ferrite toroid core (1.8 - 30MHz).
BALUN 9:1 VOLTAGE - VERSION 2 9:1 Voltage balun using a FT140-43 Ferrite Toroid Core (0.5 - 60MHz).
UNUN 9:1 VOLTAGE 9:1 voltage unun using a T-200-2 powdered iron toroid core (1.8 - 30MHz).
UNUN 9:1 VOLTAGE VERSION 2 9:1 voltage unun using a L15 ferrite core (1.8 - 30MHz).
UNUN 9:1 VOLTAGE VERSION 3 9:1 voltage unun using a FT140-43 ferrite core (0.5 - 60MHz).

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Video of the practical construction and background of a higher powered version of this balun. This YouTube video was the inspiration for my version of the 1:4 current balun and provides a great construction example.

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