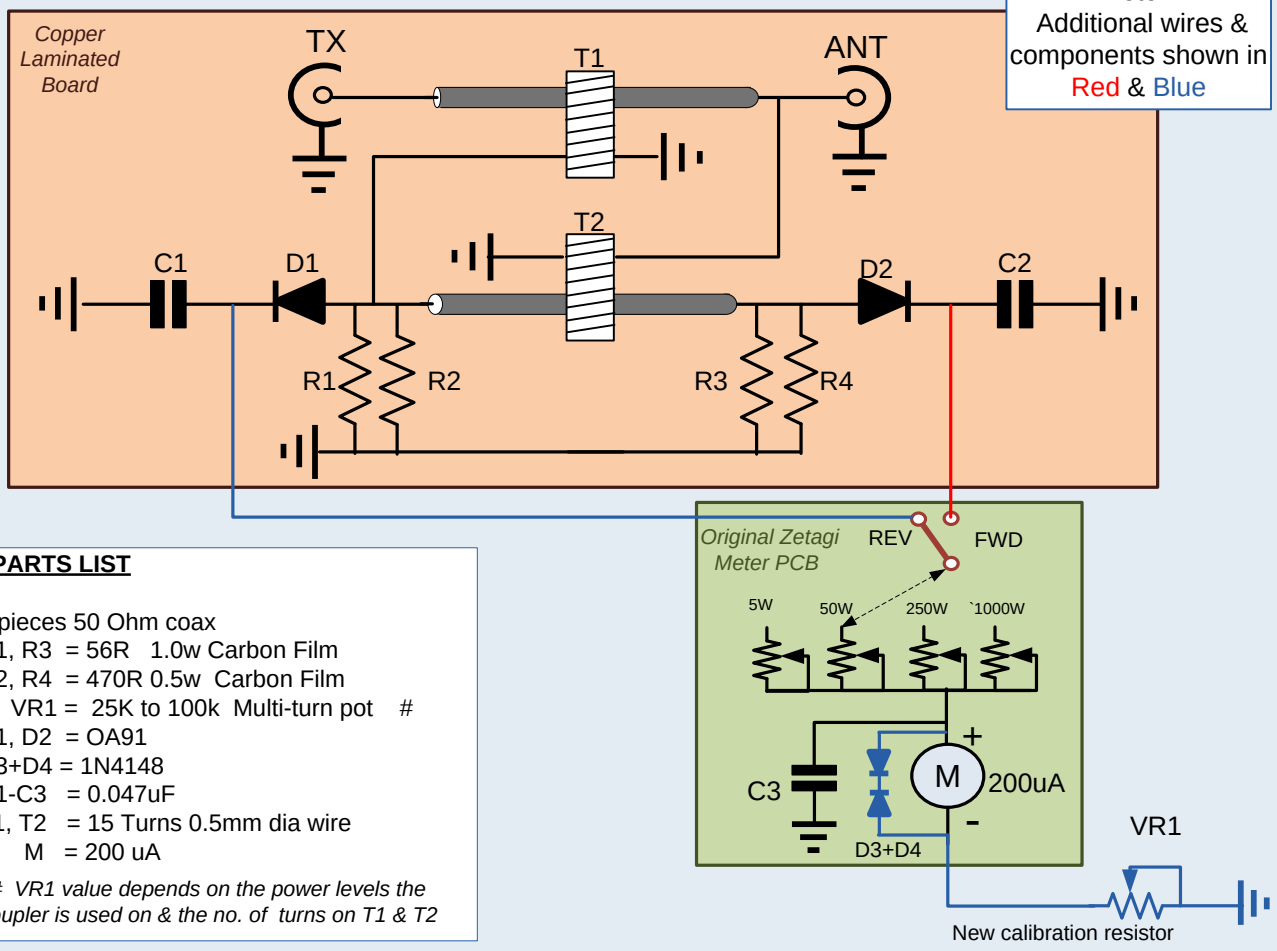
Conversion of ZETAGI HP201 SWR Wattmeter for HF Amateur Bands

Mario G8ODE

New Coupler Circuit

Tandem Coupler *



PARTS LIST

2 pieces 50 Ohm coax
R1, R3 = 56R 1.0w Carbon Film
R2, R4 = 470R 0.5w Carbon Film
VR1 = 25K to 100k Multi-turn pot #
D1, D2 = OA91
D3+D4 = 1N4148
C1-C3 = 0.047uF
T1, T2 = 15 Turns 0.5mm dia wire
M = 200 uA

 # VR1 value depends on the power levels the coupler is used on & the no. of turns on T1 & T2

Modification for the CB ZETAGI HP201 SWR Wattmeter (0-1000watts)

This modification replaces the original CB SWR sensing circuit with the Tandem Coupler based on the Sontheimer & Fredrick Directional Coupler – 1969 Patent

The meter wiring is left connected to the FWD/REV switch and new forward and reverse voltage feeds are taken from the S&F coupler. The negative of the meter is disconnected from the earth connection and is reconnected via a new variable scaling resistor to earth.

This is because the S&F circuit is more sensitive and produces a greater output than the original CB SWR sensing circuit.

The circuit uses two Murata cores 18mm OD11mm and ID 8 mm thick. These are wound with 15 turns of 0.5mm PVC insulated wire, but enamelled wire can be used if the cores don't have any sharp edges. The cores were supplied by UK Surplus Components Supplier www.surplectronics.com.

N.B. Not all types of toroids work with this circuit. Some provide accurate results at 80m but produce ever increasing errors at 20m and above. The accuracy also depends on the 50ohm line being correctly terminated R1 // R2 and R3//R4 =50ohms if available a single carbon 50Ohm resitor can be used instead.

Using the correct iron core toroids and calibrating the meter on 20m, linear results of +/- 2% are obtained between 160-10m even with 5 watts of RF. The modified Zetagi meter unit has been tested with 500 watts from a linear amplifer into a dummy load.

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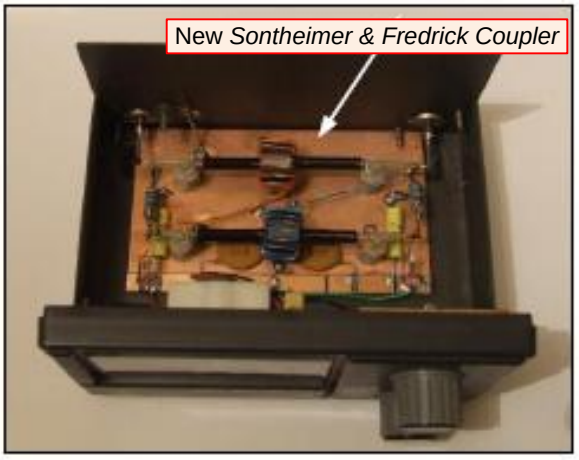

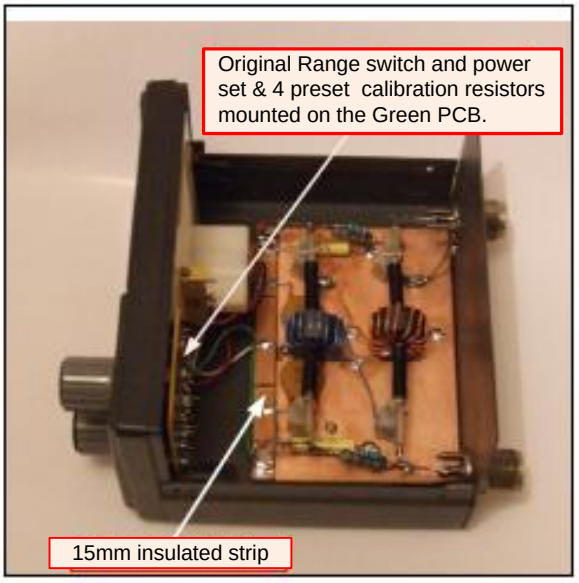

Notes

The coupler is built on single sided glass-fibre copper laminate board that forms the ground plane. A 15mm wide strip of the board is glued on top on the main board to create an insulated strip. The strip is scored with a hacksaw to create three separate copper sections. These are used to solder the two diodes and filter capacitors to and for the 0V connection to the meter.

The new scaling resistor is a 1.25inch 20 turn variable resistor and is glued to the rear of the meter. To protect the meter movement two back to back 1N4148 diodes were fitted across the meter terminals. These can be seen in the photo underneath the meter's 0.047uF RF decoupling capacitor,

.

The important and essential part of this circuit are the two short lengths of 50 ohm coax. The coupler circuit's accuracy depends on a correctly terminated 50 ohm line. Four nylon stand off pillars are used support the coaxes above the copper ground plane.

The Zetagi HP201 SWR Wattmeter was recalibrated using an ex-RAF 200w absorption power meter. This was done using the original range switch & 4 scale presets that are mounted on green coloured PCB seen in the photos

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Acknowledgment to Larry Phipps N8LP for his article on this subject

The Theory of Operation of the TANDEM MATCH COUPLER based on a Patent by Sontheimer and Fredrick in 1969

Design Fundamentals:-

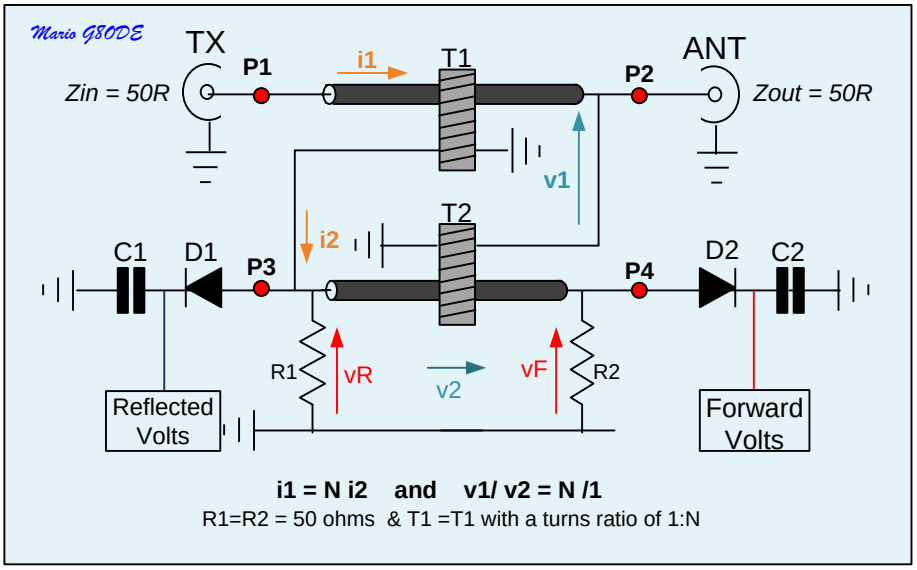
1. The Tandem Match Coupler has two transmission lines provided by two equal lengths of 50 Ohm coaxial cable.
2. T1 and T2 use toroid cores with a secondary of N turns. The 50 ohm coax forms the one turn primary winding.
3. T1 & T2 secondary of windings have a relatively high reactance that prevents excessive loading of the main transmission line.
4. T1 is a voltage transformer and T2 acts as a current transformer.

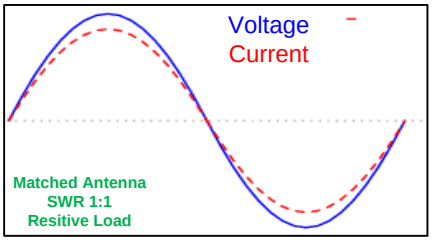
Operation:-

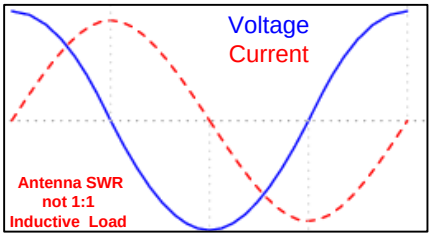
The circuit comprises of 4 ports (P1-P4). The main transmission line has ports P1 & P2 , and connects the transmitter to the antenna. The second transmission line is used for measuring and uses ports P3 and P4 that are terminated with 50 ohm non-inductive resistors.

The transformers are used to transfer scaled down samples (N:1) of the voltage & current to the second transmission line. The samples produce a scaled version of the forward and reflected voltages in the main line, and thus enables the VSWR to be measured more readily at much lower power levels.

For a detailed analysis refer to http://michaelgellis.tripod.com/direct.html







As with all good ideas when it comes to saving money some can backfire. Let me explain. Quite some time ago I was at a Radio Rally and saw this “bargain” Zetagi SWR Wattmeter. I thought “meter and ranges look useful and I reckon it will be a simple matter to modify this by gutting the CB circuit and adding my own”. A couple of months later I had some spare time and decided to build a new sensing element. I soon realised that there is more to an SWR sensing element than I had bargained for. The word bargain was to haunt me for quite a while. I tried a variety of circuits published in the RSGB and ARRL and, finally , my friend Ian G8OFZ pointed me to this tandem coupler circuit in an article published in RADCOM, but even that did not work correctly with the specified cores. So what you have here is my “bargain” attempt no.14 that finally worked when I discovered the Murata cores that were a “bargain price of £1”.That word again! But in reality I had already spent some £30 buying special cores and components for circuits that did not work. I had better clarify that statement. I found that if I got the SWR correct at 80m, the errors got progressively worse above 20m. If I got 10m correct then at 80m the SWR would show 3:1!. Even if I split the difference and calibrated initially at 20m there were huge errors at 80m and 10m. **Finally this circuit worked**. Can it be replicated? – YES -- See my ALTAI SWR METER MOD in the RSARS e-Library

My special thanks go to Ian G8OFZ and Peter G0RGB for supplying me parts for some the earlier circuits, and for the interest and encouragement I received to get this project to work.

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Appendix 1
Derivation of the Tandem Coupler

EXTRACT FROM PATENT

Feb. 4, 1969 C. G. SONTHEIMER ET AL 3,426,298

BROADBAND DIRECTIONAL COUPLER

Filed April 19, 1966 Sheet 2 of 3

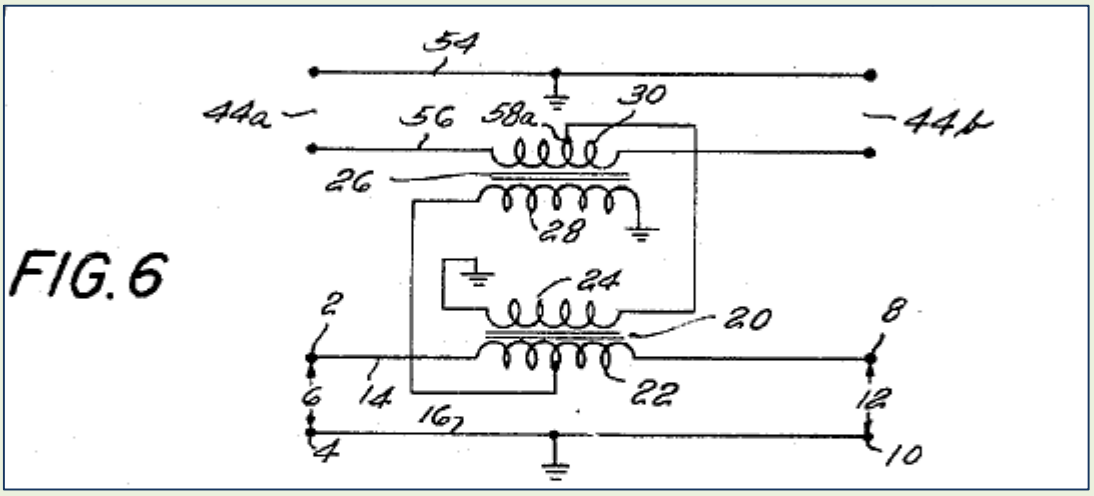
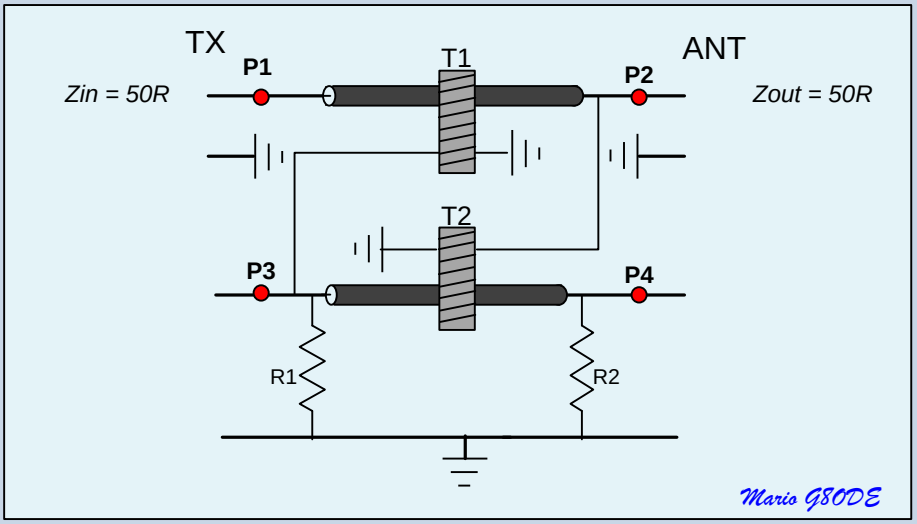


FIG. 6

You can view the entire US Patent on this link http://www.g3ynh.info/zdocs/refs/Sontheimer/us3426298.html

THE PRACTICAL SIMPLIFIED CIRCUIT



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