Constructing a 6:1 RF transformer

As part of a project to build a tuner-less broadband HF vertical antenna, I made several versions of the transformer used in the CHA-250B antenna using different ferrite materials.

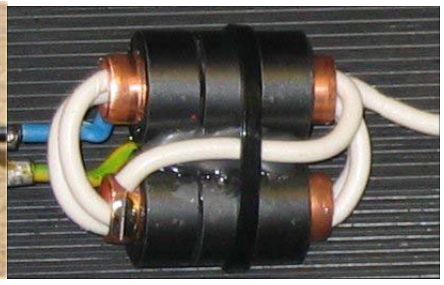
The construction was based on a series of photos taken by Iain, VK5ZDB, which can be seen at http://www.vk5zdb.com

The main part of the transformer was made by threading six ferrite EMI suppression rings (which I obtained from CPC http://cpc.farnell.com part number CBBR 6924 over two short lengths of 15mm copper water pipe. Three rings were placed on each section of pipe. The rings were placed side by side and one end of the copper pipes were joined together by soldering a 5mm earth strap between the two parts. I had to use two 50w soldering irons to get enough heat to do this.

The windings were made as per the photos on Iain's website. http://www.vk5zdb.com

Note that the first part of the secondary winding is on the outside of the core, and that the final winding is fed back on its self through the transformer core

I used the inner core from some foam filled 75 ohm satellite coax for the secondary winding, so that the insulation would stand up to several thousand volts between windings.

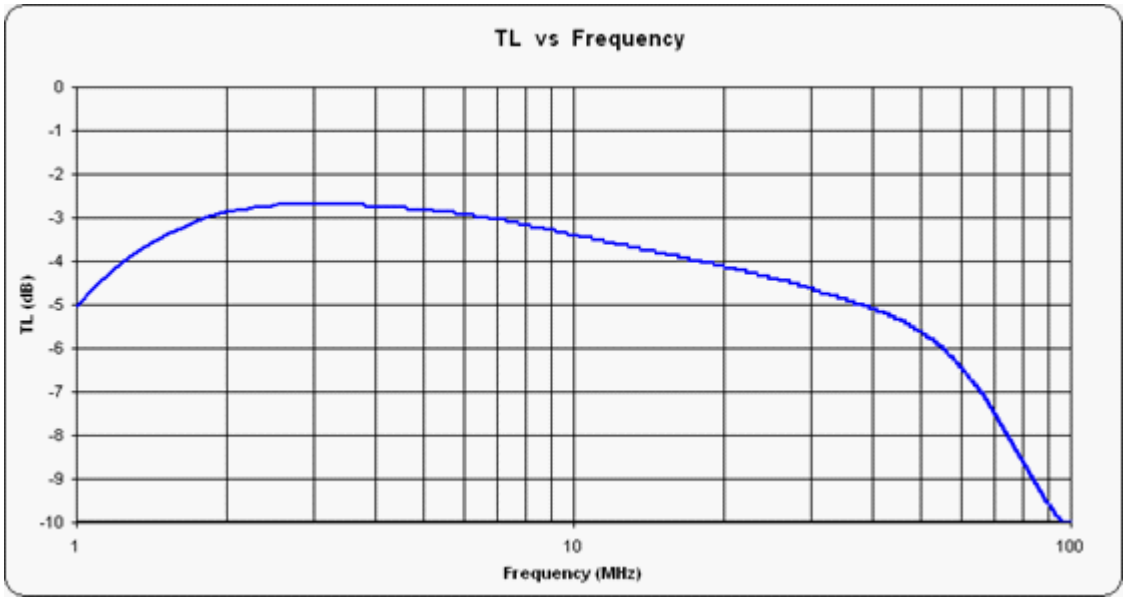


Original Transfomer

My Version

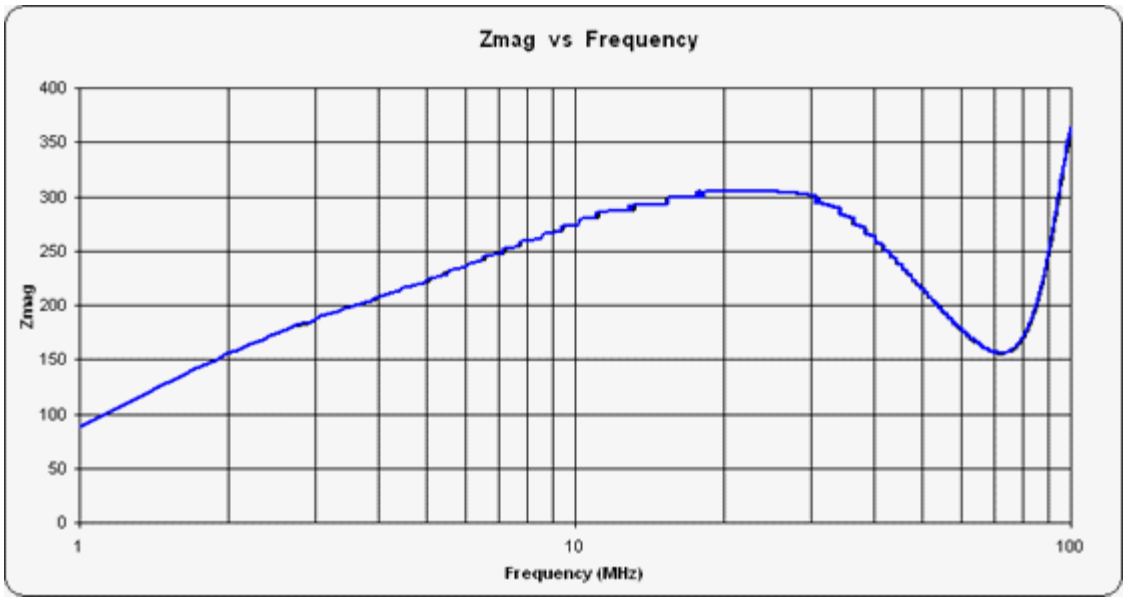
Here's the measured performance of my version using a MiniVNA.

First the through loss



Note that this is fairly high and would produce a VSWR of around 5:1 even with no antenna element connected over most of the frequency range.

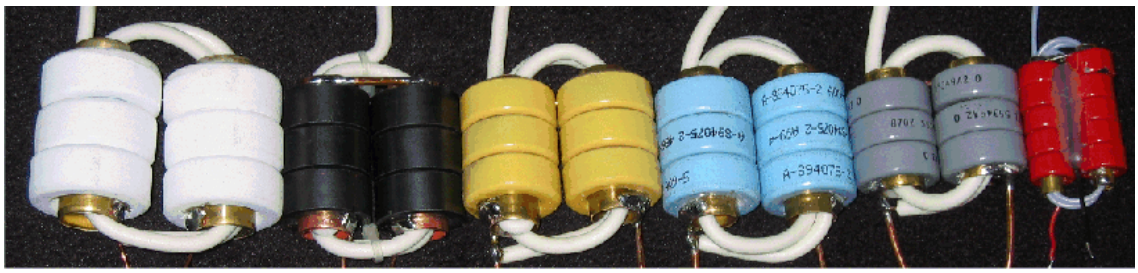
Next the output impdedance with the input terminated in a 50 ohm load.



These impdedance values follow a simliar charateristic to that measured on a genuine Comet CHA-250 transformer.

	Measured from Comet			Copy
MHz	R (ohms)	J (ohms)	Z (ohms)	Z (ohms)
1.9	112	131	172	150
3.6	207	119	239	200
7.1	325	0	325	260
10.1	326	88	338	280
14.1	220	167	276	290
18.1	130	172	216	300
21.1	95	150	178	305
24.9	70	120	139	305
29	45	100	110	300

Over the following months I tested a variety of different materials, but in all cases the Comet winding technique produced similar results. All the versions I built using ferrite cores, exhibited an almost identical through loss, impdedance ratio and frequency response curve.



It should be noted that the measured loss figures are only valid when terminated with suitable load. This is not the case when the transformer is connected to an antenna element, which will have varying impedance across its operating range. In this case the loss could be much greater or less than the measured values. So the only way to try and evaluate the performance is by making on-air measurements.

In order to test the transformer I made a cheap housing by using a modified plastic bottle.

I used a 500ml 'Retardex' mouthwash bottle for this version, but almost any size of container can be modified in the same way.

First I cut a 50mm section off the bottom.

The next step was to drill holes in the screw cap and bottle bottom for connectors.

The bottom is turned around and a connector fitted. I also added a solder tag on the outside of the connector body, in case I needed to add an earth bond to the support mast at a later stage.

The connector is then soldered to the transformer, which is inserted inside the main part of the bottle. The inverted bottom section can then be pushed inside the base of the main section. This creates a waterproof seal, with a 50mm overhang which acts a rain shield around the connector.

The top connector (in this case a 6mm brass bolt) is passed through the screw cap. This is tightened down before brass nuts and washers are placed on the bolt and fastened. This completes the assembly.

The finished unit can be secured to the supporting mast with tie-wraps. Two around the bottle, and one around the coax going into the base. This prevents the whole assembly from slipping down the mast.

Martin - G8JNJ - 05/08/2008 - V 1.5