DIY FERRITE DIRECTIONAL COUPLER

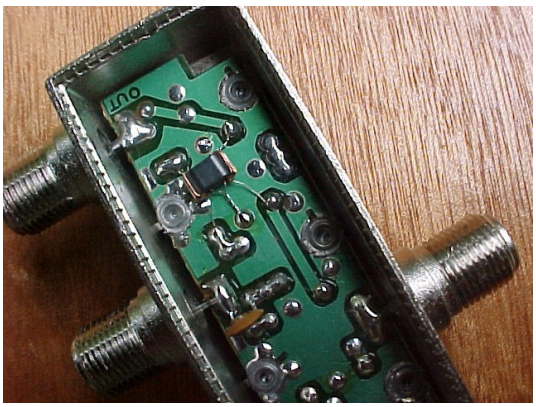
Author:- P.Ward, 1530 Calulu Rd, Bairnsdale, Victoria 3875, Australia
Based on the author's original article, "Ferrite Directional Couplar","Proceedings from the Fifth Annual Technical Conference", 2002, P11

Construction of ferrite Directional Couplers suitable for accurate instrumentation use to over 500 MHz is based on 'over the counter' TV couplers

An article freely available on the internet, 'RF Directional Couplers', by M. Ellis discusses the mathematical analysis of ferrite directional coupler operation. Readers should seek out the article for themselves. The original article has a program to illustrate the analysis, and I have provided macros in RF1.XLS, Worksheet #34, which will allow the reader to explore various scenarios of load, coupling, etc. (Download RF1.XLS from the '(Unofficial) NEC Archives' at www.qsl.net/wb6tpu/swindex.html)

Basically, simple couplers of the form illustrated are used commonly in commercial TV distribution networks. The author decided to verify if any of the commonly available models would be useful as directional couplers in simple scalar analysers.

Lots of different samples were purchased, and the best I found were those from an Australian company who have a suitable coupler, part FA1-20. Although advertised as '20 dB', they are actually 16 dB ferrite couplers, with resistive attenuators added to give the 20 dB advertised.

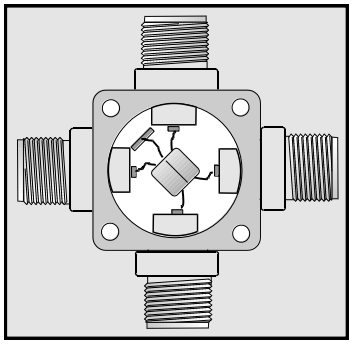


Left:- The tiny ferrite coupler has to be removed with tweezers, and great care. The author tried hand winding couplers on suitable TV balun cores, but was never able to equal these commercial miniatures at the higher frequencies.

Salvaged balun cores from TV sets are a good starting point for experimentation, but this author found hand winds on these cores were only useful to about 200 MHz

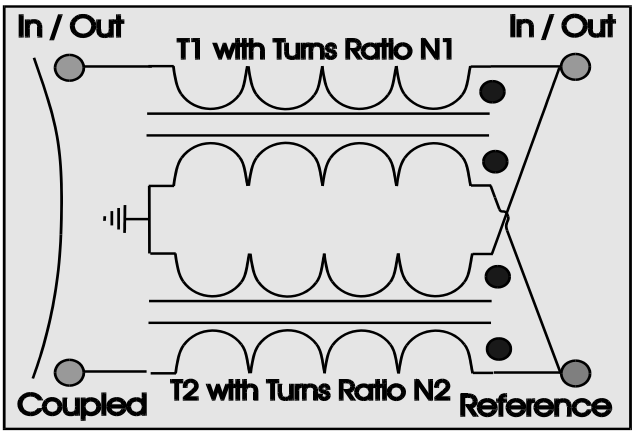
When mounted as shown below, the coupler performed very favourably when compared with a Wiltron 60N50 bridge to 500 MHz, and I have no doubt that if a little

Right:- the coupler hangs on its wires in this simple construction. Because of the difficulty of soldering the fine 'center leg' to the brass block, a copper foil is taken down one side, clamped by top and bottom plate. Wire is easily soldered to the foil.
Left:- Assembled coupler.



thought is applied to a construction techniques, the coupler should be useful to 1 GHz

Right:- The winding of these couplers is not complex. The difficulty lies in obtaining and winding a suitable core with the symmetry required. The associated spreadsheet mentioned earlier in he text explains the required ratios.



Readers should note that ferrite couplers do not have a native impedance, but rather act as ‘50 ohm’ couplers when the ports are so terminated.

Left:- The bridge ready to use, with a 20 dB attenuator on the RF input, a 50 ohm standard termination on the Reference port, and a 6 dB attenuator on the Coupled line to the detector (which will also have a 6 dB attenuator)

Directivity is better than 25 dB, which is totally adequate for general VSWR investigations.

(Readers who want higher directivity should investigate the article ‘High Directivity RF Coupler’, Electronics world, Oct. 1996 for very simply constructed PCB ‘stripline with overlay’ designs .

The author uses these couplers in conjunction with a R&S ‘SMS’ Signal Generator, ICOM ‘R7000’ receiver, and Advantech ‘PCL818’ Labcard. The computer steps the generator and receiver, whilst the Labcard reads the RSSI. Software then gives a plot of the sweep which stands well beside more expensive instrumentation. The setup has also been adapted to use the RSSI output from a WINRADIO card.