

UNIVERSITY OF WESTMINSTER



WestminsterResearch

<http://www.wmin.ac.uk/westminsterresearch>

Miniaturised microstrip diplexers for WiMAX application

**Djuradj Budimir
L. Athukorala**

School of Informatics

Copyright © [2008] IEEE. Reprinted from the 2008 IEEE Antennas and Propagation Society International Symposium, Jul 5-11, 2008, San Diego, California. IEEE, Los Alamitos, USA, pp. 1-4. ISBN 9781424420414.

This material is posted here with permission of the IEEE. Such permission of the IEEE does not in any way imply IEEE endorsement of any of the University of Westminster's products or services. Personal use of this material is permitted. However, permission to reprint/republish this material for advertising or promotional purposes or for creating new collective works for resale or redistribution to servers or lists, or to reuse any copyrighted component of this work in other works must be obtained from the IEEE. By choosing to view this document, you agree to all provisions of the copyright laws protecting it.

The WestminsterResearch online digital archive at the University of Westminster aims to make the research output of the University available to a wider audience. Copyright and Moral Rights remain with the authors and/or copyright owners. Users are permitted to download and/or print one copy for non-commercial private study or research. Further distribution and any use of material from within this archive for profit-making enterprises or for commercial gain is strictly forbidden.

Whilst further distribution of specific materials from within this archive is forbidden, you may freely distribute the URL of the University of Westminster Eprints (<http://www.wmin.ac.uk/westminsterresearch>).

In case of abuse or copyright appearing without permission e-mail wattsn@wmin.ac.uk.

Miniaturised Microstrip Diplexers for WiMAX Applications

D. Budimir, and L. Athukorala

Wireless Communications Research Group, University of Westminster,
115 New Cavendish Street, London W1W 6UW, United Kingdom
Email: d.budimir@wmin.ac.uk

Introduction

Wireless RF and microwave communication systems are a rapidly expanding market. Such systems commonly employ filters and diplexers in RF and microwave transceivers as channel separators. Hence there is an increasing demand for low cost, low loss, small size and light weight bandpass filters and diplexers [1]. At present most microstrip diplexers at RF and microwave frequencies are produced in planar technologies such as microstrip, suspended substrate stripline and coplanar waveguide. Several approaches of design of microstrip diplexers were proposed [2]-[5].

This paper demonstrates the use of the microstrip ring resonator properties in order to achieve miniaturization of microstrip bandpass filters for diplexer and multiplexer applications. A compact microstrip diplexer for WiMAX applications (Fig. 1.) that incorporates these two filters and microstrip T-junction is presented. The proposed filters and diplexers have advantages of simplicity and compactness. Simulation results for microstrip filters and analysis and design of the proposed diplexer are presented.

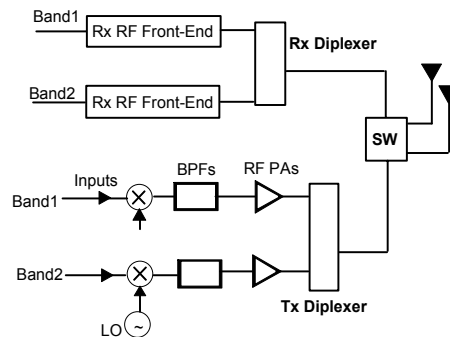


Fig. 1. Traditional structure of WiMAX RF Front-End

Proposed Filter and Diplexer Structures

The geometry of a bandpass filter using microstrip ring resonator is illustrated in Fig. 2. The microstrip ring resonator is fed by a pair of perpendicular 50Ω feed lines and each feed line is coupled with the ring by a coupled-line structure with a coupling gap of 0.4 mm. The proposed filter structure has a 1.51 mm thick dielectric substrate Rogers RT/Duroid 5880 with a relative dielectric constant of

2.2. ($\epsilon_r = 2.2$). The filter uses a single loop resonator with a size 17.5 mm x 17.5 mm.

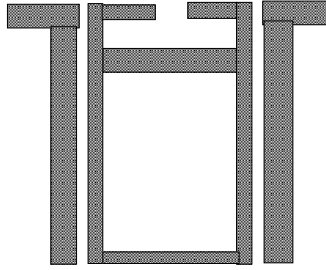


Fig. 2. Layout of the proposed microstrip filter using ring resonator

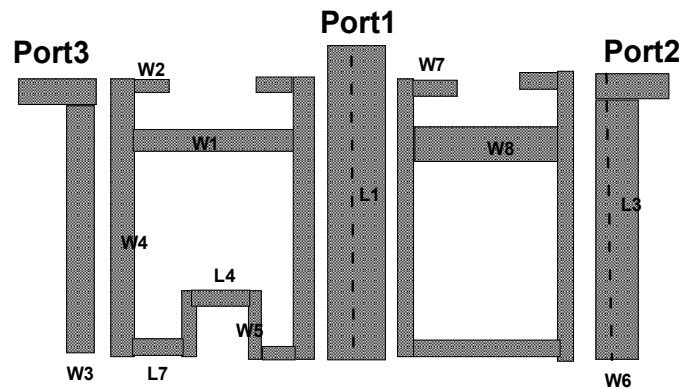


Fig. 3. Layout of proposed microstrip diplexer

The filter is designed to produce two transmission zeros, one at the upper stopband and one at the lower stopband. Fig. 3. illustrates the layout of the proposed diplexer.

Simulation Results

In order to validate the argument made the proposed bandpass filter and diplexer structures have been designed and simulated. The bandpass filters and diplexer were simulated by using Agilent ADS *Momentum* simulator [8]. Fig. 4. shows the simulated insertion losses (S21-parameters) of the lower channel and upper channel proposed filters. The simulated insertion loss and return loss of the diplexer are shown in Fig. 5.

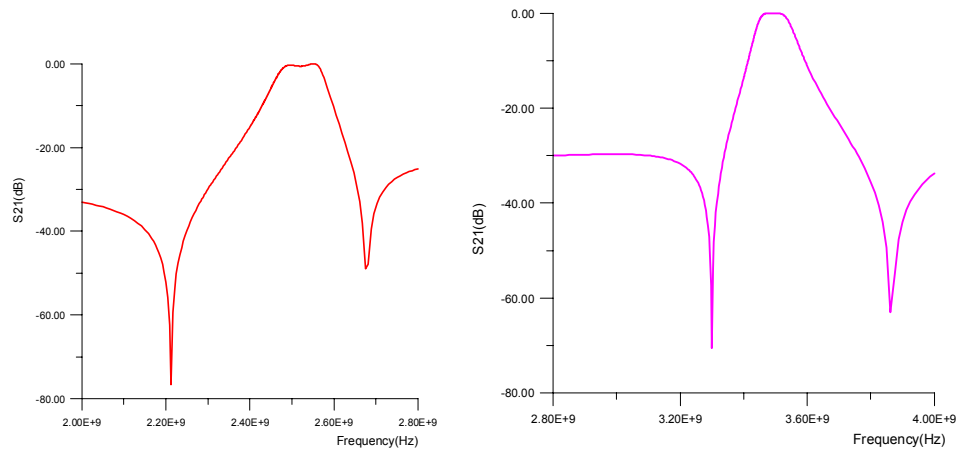


Fig. 4. Insertion Losses of (a) lower channel filter and (b) upper channel filter

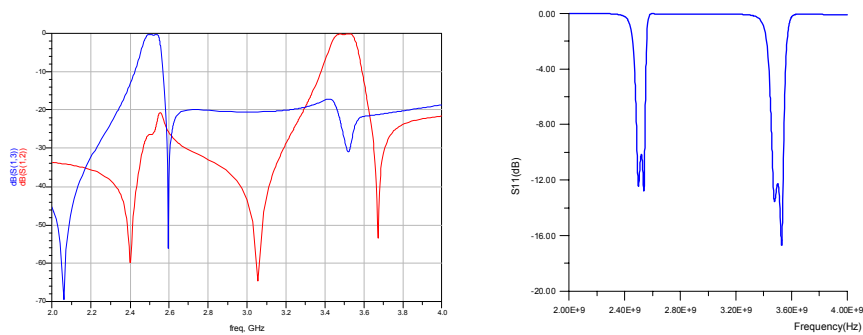


Fig. 5. Simulated insertion and return losses of the proposed diplexer

The lower channel filter (channel 1) was designed to have pass band centered at 2.5 GHz and the upper channel filter (channel 2) with pass band at 3.5 GHz. According to the simulation diplexer has very good transmission and reflection characteristics on both channels. The isolation between channels is very high.

Conclusion

Miniaturised microstrip diplexer and bandpass filters using single ring resonators with good transmission and reflection characteristics on each channel for WiMAX applications have been presented. The size of the proposed diplexer is reduced. The diplexer is easy to manufacture and the results are easily reproducible. The improvement of the performance of diplexer through introduction of additional transmission zeros is under investigation.

References:

- [1] D. Orlenko, G. Sevskiy, T. Kerksenbrock, and P. Heide, "LTCC Triplexer for WiMAX Applications". *Proceedings of the 35th European Microwave Conference*, pp. 97-99, October 2005.
- [2] S. Srisathit, S. Patisang, R. Phomlaungsri, S. Bunnjaweht, S. Cosulvit, and M. Chongcheawchamnan, 'High Isolation and Compact Size Microstrip Hairpin Diplexer', *IEEE Microwave and Wireless Components Letters*, Vol. 15, No. 2, pp. 101-103, Feb. 2005.
- [3] C. Collado, J. Pozo, J. Mateu, and J. M. O'Callaghan, "Compact Diplexer with Miniaturized Dual Loop Resonator," *Proceedings of the 35th European Microwave Conference*, pp. 109-111, October 2005.
- [4] M. T. de Melo, A. L. Bezerra, P. N. S. Filho, A. J. Belfort, "Open Loop Filter Diplexer with Internal Stubs for GSM Cellular Base Station," *Proceedings of the 36th European Microwave Conference*, pp. 564-567, September 2006.
- [5] G. L. Matthaei and E. G. Cristal, "Microstrip Diplexers Design with Common Resonator Sections for Compact Size, but High Isolation", *IEEE Trans. Microwave Theory Tech.*, vol. MTT-54, No. 5, pp. 1945-1952, May 2006.
- [6] G. L. Matthaei, L. Young and E. M. Jones, *Microwave Filters, Impedance – Matching Networks and Coupling Structures*, Artech House, 1980.
- [7] D. Zayniyev, D. Budimir, G. Zouganelis, "Microstrip filters and diplexers for WiMAX applications," *Antennas and Propagation International Symposium*, 2007 IEEE, pp. 1078-1085, June 2007
- [8] Agilent EEsof, <http://eesof.tm.agilent.com>
- [9] J.S. Hong and M.J. Lancaster, *Microstrip Filters for RF/Microwave Applications*. John Wiley & Sons, 2001.