1. Introduction

A MMMB (Multi-mode Multi-band) transceiver system for WLAN(IEEE 802.11n) m-WiMAX(IEEE 802.16e) has been proposed which will be compatible for the Next Generation Network. [1-2] In this paper, the proposed transceiver system is 2×2 MIMO (Multiple-input Multiple-output) OFDM (Orthogonal Frequency Division Multiplexing) operation, which covers all the frequency bands of 2.3–5.825 GHz. The proposed transceiver system is composed of tunable antennas, switchable FEM (front-end module) and reconfigurable RFIC. As various frequency bands are used, performance of FEM is contributed to that of transceiver system. In this reason, the passive part of 2×2 MIMO switchable FEM are fabricated by MEMS (Micro-mechanical-electro systems) and LTCC (Low Temperature Co-fired Ceramics) technology, while the active part of the transceiver system is fabricated by CMOS technology.

2. Front-End Module

Rapid changes in communication environment induce improved and new telecommunication services. Wireless service is required to handle large amounts of data like music, multimedia etc. and to be available in a wide space at the same time. For these requirements, MIMO and MMMB are studied. MIMO technology would process high-capacity data. And MMMB technology is sure that QoS (quality of service), security and compatibility are not impaired. The transceiver system consists of the tunable antenna, switchable FEM and reconfigurable RFIC. In this paper, 2×2 MIMO switchable FEM is developed using MEMS technology as shown in figure 1.

Fig. 1  2×2 MIMO switchable FEM Block Diagram.

To acquire advantages of MIMO and MMMB, FEM should have good characteristics in terms of insertion loss and attenuation etc. By employing LTCC technology, it could realize that miniaturizing RF passive and providing high RF performance. The 2×2 MIMO switchable FEM is composed of two LTCC-based band pass filters for WLAN application, one LTCC-based band pass filter and one FBAR filter for WiMAX application, and three RF switches for mode, frequency, and Tx/Rx selections. Especially LTCC-based band pass filter is embedded in LTCC substrate. FBAR is integrated by flip-chip bonding and RF switches is integrated by wire bonding on LTCC substrate. Figure 2 shows 3D inner structure of 2×2 MIMO switchable FEM.

Fig. 2  3D inner circuit structure of 2×2 MIMO switchable FEM.
WiMAX frequency band (2.5~2.7 GHz), maximum insertion loss and return loss are measured about 4 dB and 15 dB, respectively, At WLAN frequency bands, 2.4~2.5 GHz and 5.15~5.85 GHz, measured maximum insertion loss are about 5 dB and 5 dB, and measured return loss are about 14 dB and 20 dB, respectively.

Fig. 3 Fabrication Results: Top view of 2×2 MIMO switchable FEM and FBAR filter.

Fig. 4 Measurement results of 2×2 MIMO switchable FEM module: (a) WLAN(2.4~2.5 GHz), (b) WLAN(5.15~5.85 GHz), (c) WiMAX(2.5~2.7 GHz), (d) WiMAX(5.725~5.825 GHz)

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<td>WLAN</td>
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<td>2.4~2.5 GHz</td>
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<td>Measured Max. Insertion Loss</td>
<td>5 dB</td>
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<td>Measured Min. Return Loss</td>
<td>14 dB</td>
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<td>Measured Min. Attenuation</td>
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3. Conclusions
In this paper, the switchable RF FEM for 2×2 MIMO transceiver system is developed. The 2×2 MIMO switchable FEM for WLAN/WiMAX transceiver system is composed of one FBAR filter for WiMAX application, one LTCC-based band pass filter, and two LTCC-based band pass filters for WLAN application. Future work is developing 2×2 MIMO transceiver system integrated with the proposed FEM, tunable antenna and reconfigurable RFIC.

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References