

Reconfigurable RF Front End Section of Mobile

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ABSTRACT

This paper basically represents the next generation front end mobile terminals, which could be reconfigured using MEMS technology. Besides the task of reconfigurable antenna, multiband power amplifiers, duplexer switch there is also the need of low noise amplifier, down/up converters which are to be integrated on the one chip transceiver (TRX). One also requires other component such as RF MEMS switch which diploids the repeatability of the other components which are being repeatedly used in the working of various bands. The design of a mobile device equipped with compact size and multiband internal circuit elements are the challenges which the industry is facing in today's world. Another major part which we will be discussing is the integration of MEMS technology with the CMOS based devices using ASIMPS (Application specific MEMS process).

Keywords- RF front end, Reconfigurable Antenna, RF MEMS, Multiband, Next generation

1. INTRODUCTION

The design of reconfigurable RF front end of mobile terminal using RF MEMS for next-generation communication applications has become a hot research topic in the past few years. The need for a single device to access various services, like DCS, PCS, GSM, EGSM, CDMA, WCDMA, GPS, Wi-Fi, Wi-MAX, UMTS. Besides the design of reconfigurable antenna, multiband power amplifiers, duplexer switch there is a need of LNA and down/up converters that are to be integrated into 1-chip transceiver (TRX). There is also a need to develop a reconfigurable switch which will avoid the use of repeatability of components required for different bands. [1]

RF MEMS switches have displayed excellent RF characteristics, including lower insertion loss, higher isolation, zero power consumption, small size and weight and very low inter modulation distortion, and long battery life. The power amplifier is a key component in RF circuits and must achieve a high level of operating efficiency in order to maximize the battery life and minimize the size and cost of the terminals. Film bulk acoustic resonator (FBAR) filters and duplexers are receiving increasing attentions in RF systems due to the advantages of having high power handling capability, high Q-factors, good thermal stability, require a small volume and are relatively cheap.

Integration of MEMS technology with various circuit elements such as CMOS devices is possible with the help of **ASIMPS** (Application Specific MEMS Processes). In ASIMPS, microstructures are made from conventional CMOS followed by two maskless post-CMOS process steps. The top metal layer acts as a mask & protects the CMOS. The result is fine line, fine gap microstructures with low parasitic capacitance, multiple isolated conductors per structure, and built-in piezoresistors.

2. Overview of different section of RF Front mobile terminal

2.1 Multiband Power Amplifier (PA)

The CMOS technology based fabricated reconfigurable power amplifier has multi stages and operates in multibands with sufficient gain, power added efficiency at the adjustable supply voltage of 3.5V to 5V in each operating bands, although work is going on reduce the size of the circuit to make it practically possible. The circuit size is reduced but at high frequencies the gain of

the FET degrades and the insertion loss of the switch also increases.

2.2 Phase Shifter

These devices are presently being manufactured using CMOS technology and currently being used in the wireless applications.

2.3 Micro machined Low Noise Amplifier

For the Multi standard CMOS based LNA we need to configure wide input matching bandwidth, low power, low noise and for that we need to set the value of input transistor Q , and its value is even lower than the value which is being set by noise frequency condition.

2.4 RF-MEMS Switches

The actuation voltage of the RF MEMS based switches is found to be high ranging. These high voltages has to be reduced with a constraint that isolation loss and return loss should be optimum. The low voltage metal to metal contact switch has been developed with switching speeds of in range of microsecond. But the metal to metal contacts degrade and deform the switch performance due to high current flow which causes the failure mechanism of the switch. There is a need of an improvement in design of metal to metal contact switch so that it does not fail in on state

2.5 Micromachined passive components (duplexers, inductors, capacitors and resistors)

FBAR devices are 50% to 80% smaller than conventional ceramic duplexers, enabling ever-smaller mobile handsets with enough room to incorporate things such as PDA, MP-3, and GPS capabilities. Compared with conventional surface acoustic wave (SAW) devices, the FBAR-based device also offers a better power handling capability with smaller device size. FBAR-based duplexers for CDMA have been designed by Agilent but no results were found for GSM.

The commonly used on-chip inductors are planar spiral inductors. They have poorer quality factor (Q) and do not scale in size as transistors do. The problem is even worse in conducting substrates such as silicon. Various technologies were proposed to improve inductor including patterned ground shields, tapered spirals, and groove-etched suspended

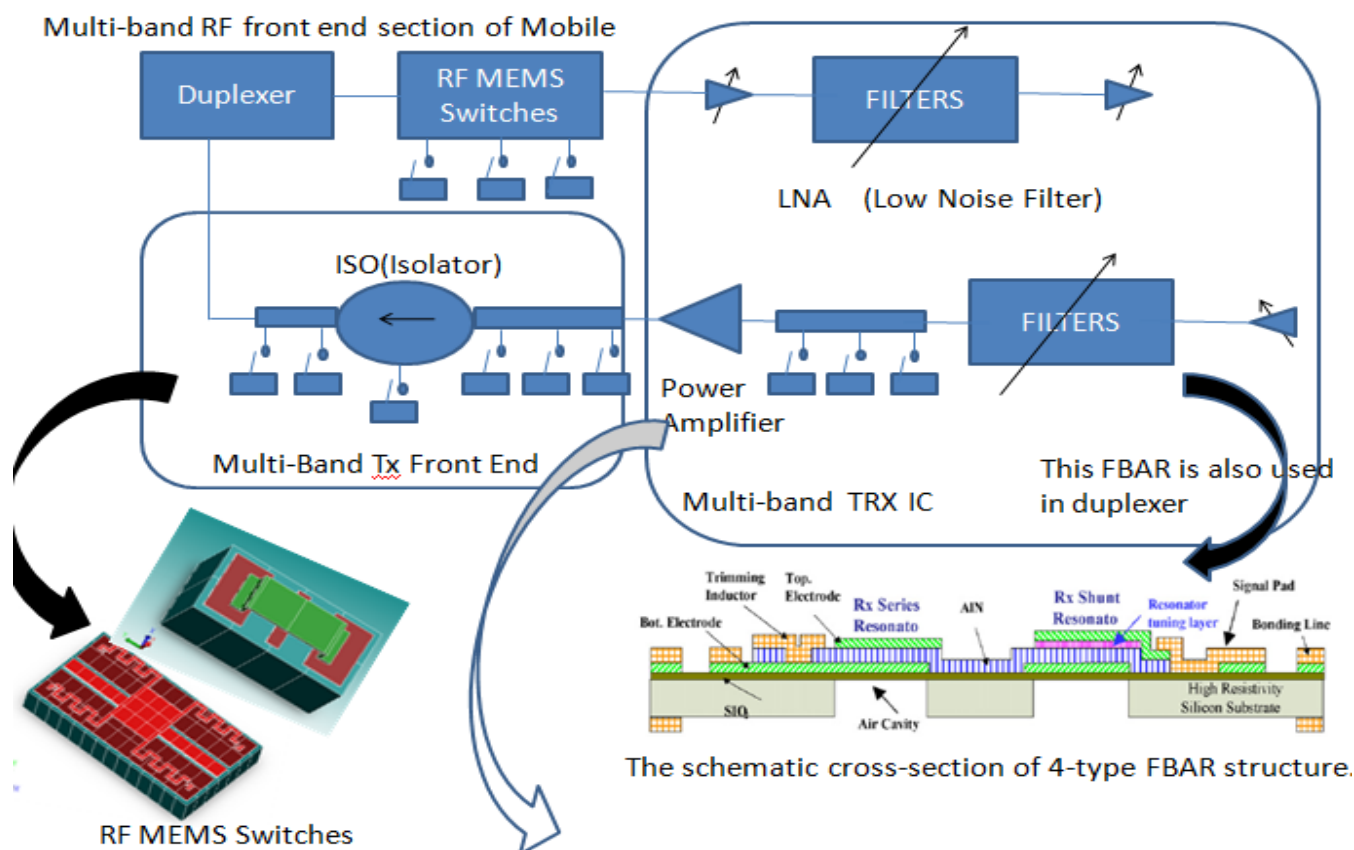
inductor but still low-loss and high-density inductors are of major research interest in the fabrication of inductors.

3. ASIMPS (Application specific MEMS process)

Monolithic integration of MEMS processing technology with standard CMOS processes enables the combination of novel sensing and actuation functionality on traditional computing and communication devices allowing the ubiquitous digital computer to interact with the world around it.

Potential devices to be designed and fabricated in the process include accelerometers, gyroscopes, radio frequency (RF) MEMS communication systems (with resonator oscillators, RF filters and high- Q inductors), infrared sensors and imagers, electro thermal converters, and force sensors. In addition to individual devices, the technology enables integration of multiple devices on the same chip with supporting electronics. For example, high- Q inductors and micromechanical resonators can be combined for CMOS RF applications.

The structures are made from the silicon substrate, including the back-end-of-line CMOS metal dielectric stack located on top of the substrate. The backside silicon deep reactive-ion etch step is setup to provide a silicon plate with a $50\text{ }\mu\text{m} \pm 10\text{ }\mu\text{m}$ thickness on the front side of the chip. The micro structures are then patterned from the front side with a separate silicon DRIE step.



Block Diagram of 3 Stage Power Amplifier

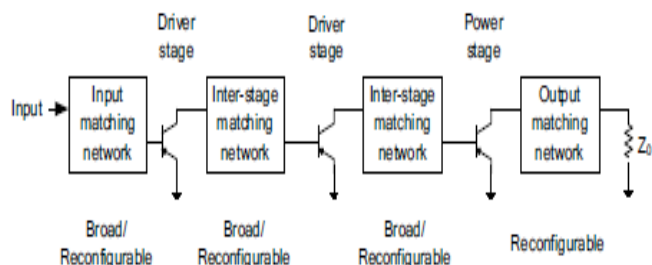


Figure 1: Multi Band Front End Section of Mobile

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