1D-5  A CMOS Direct Sampling Mixer Using Switched Capacitor Filter Technique for Software-Defined Radio
Hong Phuc Ninh, Takashi Moue, Takashi Kurashina, Kenichi Okada, and Akira Matsuzawa
Department of Physical Electronics, Tokyo Institute of Technology, Japan

Background

- Current
  - Bluetooth
  - 2G/3G Cell
  - WLAN
- Future
  - NFC
- Consist of several LNAs, VCOs, Mixers, etc
- Complicated
- Large area
- Large power consumption
- Smaller size
- Lower power

Previous Work

- Multi-Tap Direct Sampling Mixer (MTDSM)
- Charge accumulated
- Charge shared
- Poor variability of filter characteristic
- Not order of the filter (second order now)
- Bad Noise Figure
- Effect of flicker noise
- Need high order of image rejection filter
- Pass-bands appear at multiples of LO (Local Oscillator)

MTDSM’s issues

- Read-out

Purpose of this work

Realize MTDSM using Switched Capacitor Filter (SCF) Technique
- Filter characteristic is reconfigurable
- Promise higher-order filtering
- NF improvement (pass-band is shifted)
- Relax image rejection filter (pass-band is shifted)

Schematic & Operation

- NF input (RF+ and RF-) are alternately input to the mixer core, so DC part will be cancelled. More clock, pass-band will be shifted.
- Promise higher-order filtering, result to more reconfigurable filter characteristic

NF Improvement

Features
- Reduce DC component, so NF is improved (about 25dB with the same simulation condition)
- Pass-bands after shifted will be 2LO far away, so the image rejection filter will be relaxed

Micrograph and Measurement Results

MTDSM for Digital Terrestrial Television (ISDB-T) 1-segment was fabricated.

Measurement results summarize

- Technology: 0.18μm CMOS process
- Local Oscillator: 900 kHz
- Bandwidth: 430 kHz
- Power Gain at 400.1 MHz input: 12.4 dB
- NF: Medium Better
- Band: Better
- Power: Better
- Area: Medium Better
- Supply Voltage VDD: 1.8 V
- LNTA + DSM core current: 15 – 20 mA
- Power consumption: 32.4 – 36 mW
- Chip area: 1150μm x 750μm

Conclusion

- A direct sampling mixer using switched capacitor filter technique is proposed.
- It improves the reconfigurability while not increasing the power, area so much.

SCF’s Features
- Easier to reconfigure
- Promise higher-order filtering
- NF improvement (pass-band shifted)
- Relax image rejection filter (pass-band is shifted)