



RECORD-BREAKING ADCs IN ADVANCED CMOS TECHNOLOGY

Imec's ultra-low-power analog to digital converters (ADC) with record figures of merit target wireless SDR, 60Ghz communication and sensor networks applications.

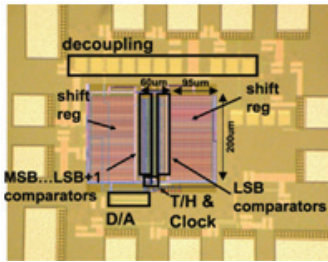
APPLICATION 1: HIGH-DATA-RATE SHORT-RANGE COMMUNICATION

A number of recent standards target high data-rate communication at relatively short distances, such as ultrawideband (UWB) communication or emerging standards in the 60GHz frequency range. Typical applications are cable replacement for high datarate applications such as video streaming or fast file downloads simultaneously. UWB communication is gaining importance for ultra-low-power communication in wireless sensor networks.

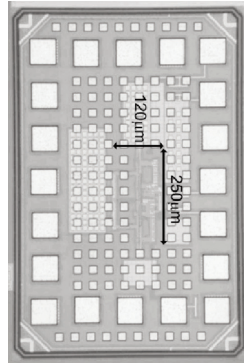
All these standards have in common that they are using relatively simple modulation schemes and very wide channel bandwidths, resulting in low-resolution and very high-sample-rate requirements for the analog-to-digital converters.

APPLICATION 2: RECONFIGURABLE RADIOS

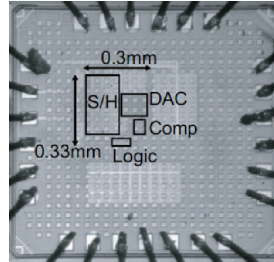
Imec realized the world's first true software-defined radio front-end IC which can be widely programmed to operate with all present and future standards in the frequency range between 174MHz and 6GHz. The SAR ADC is a perfect match for this reconfigurable radio front-end. Whereas the multi-standard flexibility translates into the support of a wide range of RF frequencies, channel bandwidths and dynamic range for the RF front-end, for the analog-to-digital converter it means scalability in the number of bits and in the sample rate. At the same time, low power consumption is of utmost importance for next-generation handheld and battery-powered devices.



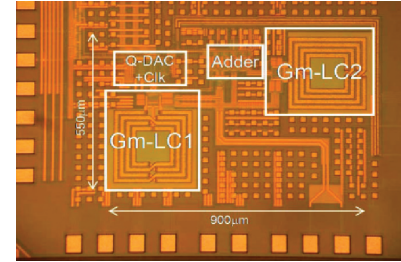
01 Comparator-based asynchronous binary search ADC



02 Interleaved pipelined ADC



03 Low power SAR ADC



04 RF bandpass sigma-delta ADC

01 COMPARATOR-BASED ASYNCHRONOUS BINARY SEARCH ADC

- ▶ Technology: 90nm digital CMOS
- ▶ Resolution: 7-bit
- ▶ Sample rate: 0-150Msamples/s
- ▶ Power: 0-133µW
- ▶ Figure of merit: 10fj/conversion step
- ▶ NL: <0.48LSB
- ▶ DNL: <0.93LSB
- ▶ ADC core size: 60x250µm²

02 INTERLEAVED PIPELINED ADC

- ▶ Technology: 40nm digital CMOS
- ▶ Resolution: 6-bit
- ▶ Sample rate: 2.2Gsamples/s
- ▶ Power: 2.6mW
- ▶ Figure of merit: 40fj/conversion step
- ▶ INL: <0.8LSB
- ▶ DNL: <0.8LSB
- ▶ ADC core size: 120x250µm²

03 LOW POWER SAR ADC

- ▶ Technology: 40nm digital CMOS
- ▶ Resolution: 10 bit (scalable)
- ▶ Sample rate: 0 - 60Msamples/s
- ▶ Power: 0 - 1.2mW
- ▶ Figure of merit: 34fj/conversion step
- ▶ INL: <0.8LSB
- ▶ DNL: <1.4LSB
- ▶ ADC core size: 330x300µm²

04 RF BANDPASS SIGMA-DELTA ADC

- ▶ Technology: 40nm digital CMOS
- ▶ application: 80 MHz bandwidth in full 2.4 GHz ISM
- ▶ WLAN 11b/g
- ▶ Bluetooth
- ▶ Zigbee
- ▶ Resolution: 6.5 ENOB
- ▶ Power: 52.8mW
- ▶ Figure of merit: 3.6pj/conversion step

APPLICATION 3: TOWARDS SOFTWARE RECEIVER

New radio architectures will be required to support ongoing reconfigurability, cost, power and functional requirements in emerging wireless systems. In this context an evolution towards digital RF transceivers is mandatory. These are radio architectures that are, first of all, optimized for deeply scaled digital-only CMOS technologies with as main goal to ease the implementation of both the analog and the digital functionality into the same system-on-chip (SoC), allowing to reduce the cost. Secondly, these architectures target to move as much as possible of the analog functionality to the digital domain. This enables reduced cost and power, easier scaling towards next technology nodes and easier reconfigurability. Ultimately, such architecture would place the analog to digital conversion at the antenna. Although significant progress is still needed in ADC technology, first prototypes show the potential of an RF bandpass sigma-delta ADC for this application. A roadmap until 2013 has been defined to further improve the resolution and realize the dream of a true software radio.

MORE INFORMATION

Business Development contact
greenradios@imec.be

Joris Van Driessche
Manager imec green radios program
T: +32 16 28 85 45
Joris.VanDriessche@imec.be

imec Kapeldreef 75, 3001 Leuven, Belgium www.imec.be

Imec is a registered trademark for the activities of IMEC International (a legal entity set up under Belgian law as a "stichting van openbaar nut"), imec Belgium (IMEC vzw supported by the Flemish Government), IMEC the Netherlands (Stichting IMEC Nederland, part of Holst Centre which is supported by the Dutch government) and imec Taiwan (IMEC Taiwan Co.).