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WiseSkin RTD 2013

FNSNF

Ultra Low Power Radio for WiseSkin Communication system

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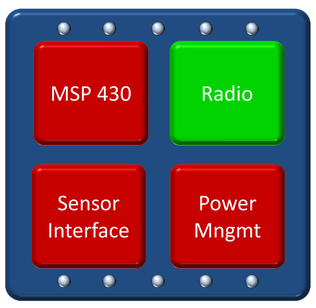
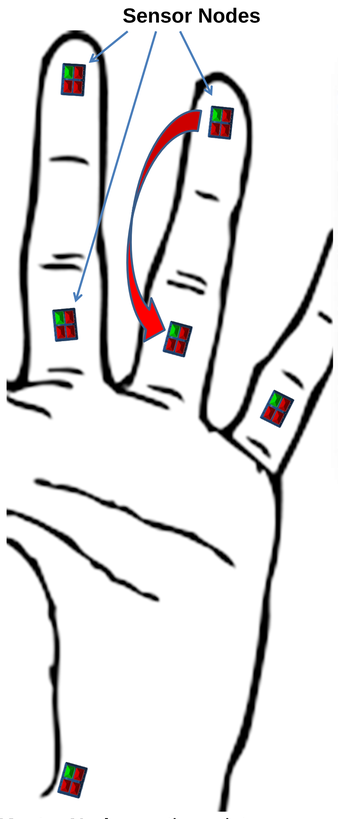


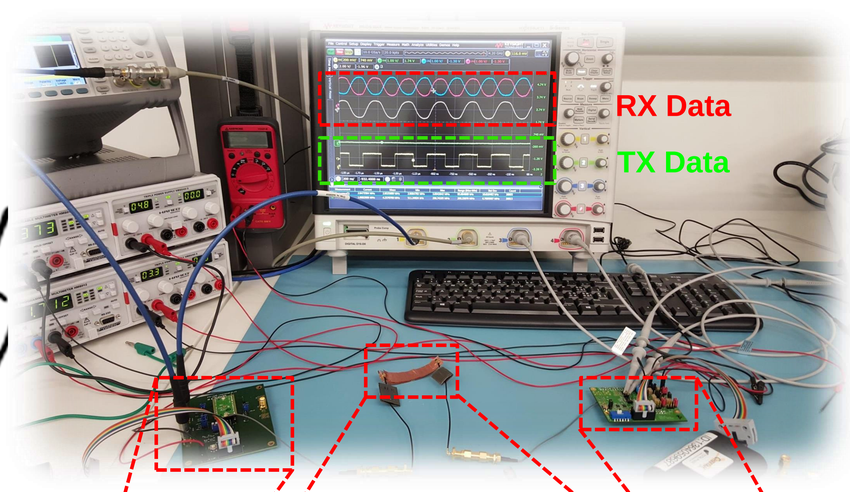
The WiseSkin concept for tactile prosthetics targets the restoration of a natural sense of touch to persons using prosthetics. In order to achieve flexibility, freedom of movement and comfort, the sensing capabilities built into the artificial skin must be unobtrusive, highly miniaturized and ultra-low power (ULP). Advances in the fields of micro and nanotechnology as well as biological systems enable ever more powerful miniaturized sensor devices, opening the door to new solutions. Our aim is to develop a high density wireless sensor network embedded in an artificial skin that offers scalability, robustness, ease of use and manufacturability. Work presented here focuses on the Ultra Wide Band FM receiver that will be a part of the miniature radio used for communication between the sensor nodes

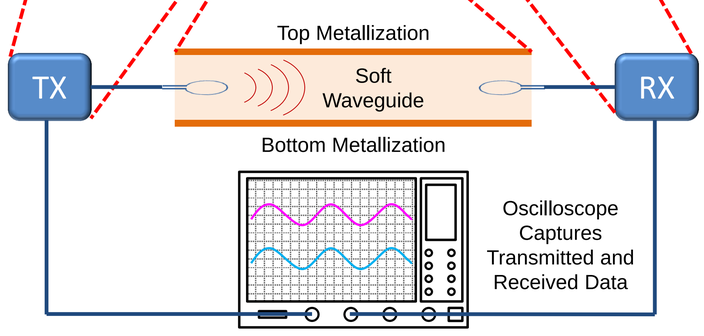
Communication inside a Waveguide

- The WiseSkin system targets low power communication over distances of several centimeters inside a flexible waveguide
- The presented test-setup demonstrates transmission of a UWB-FM signal through such a waveguide, over a distance corresponding to the length of a finger



Master Node – gathers data from all sensor nodes

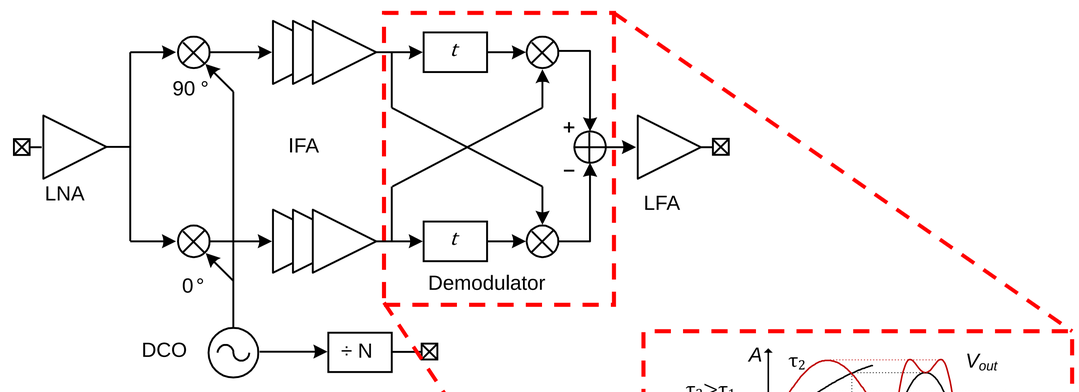




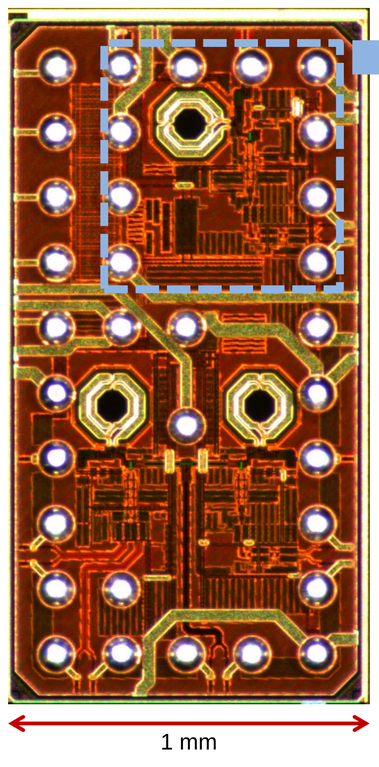
- The aim of this work is development of an ultra-low power receiver that will be used for communication between the sensor nodes

UWB-FM Receiver

- The implemented UWB-FM receiver saves power by down-converting the input signal first and amplifying it at lower frequencies

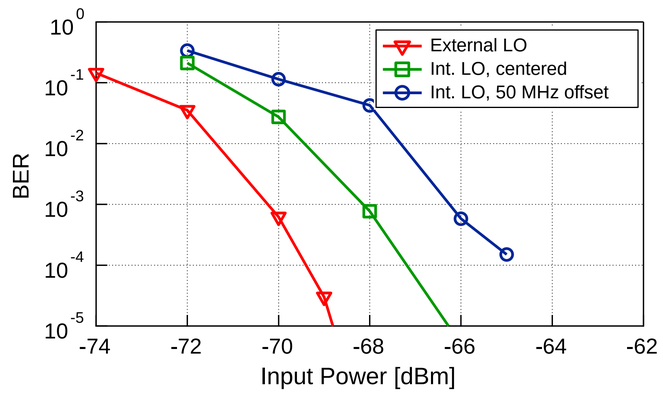


- DCO is a simple low-power, free-running oscillator.
- Carrier frequency is not stable but can be tolerated owing to the wideband nature of the input signal
- Demodulator placed at IF instead of RF
- A factor of 100 power reduction compared to previous delay-line demodulators



Receiver Core

- Area 0.5 mm²
- Power consumption 420 µW
- Sensitivity -68 dBm
- 65 nm CMOS technology



- Use of a low quality ring oscillator results in only 2dB loss in sensitivity, but saves power
- Obtained sensitivity is good enough for communication inside a waveguide
- Currently the lowest power receiver among the ones reported in the literature

Next Steps

- Further improvement and power reduction of the UWB-FM receiver
  - There is still potential for architectural improvements
  - Further circuit-level optimization
- Development and integration of a UWB-FM transmitter
- Optimization of the radio for the specific needs of the developed protocol
  - Delay minimization
  - Global power consumption reduction
  - Scalability
- Integration of the implemented radio into the miniature sensor nodes

📖 V. Kopta, D. Barras, C. Enz, "A 420µW, 4 GHz Approximate Zero IF FM-UWB Receiver for Short-Range Communications", RFIC 2016