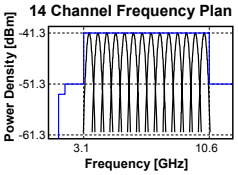
A 3.1-10.6 GHz 100 Mb/s Chipset for Pulsed-UWB

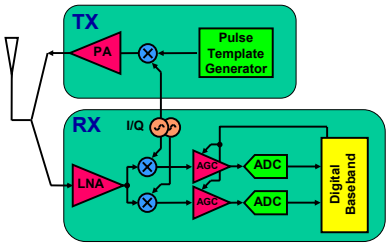
Fred S. Lee, Nathan Ackerman, Manish Bhardwaj, Raul Blazquez, Christian R. Deonier,
Brian P. Ginsburg, Johnna Powell, Vivienne Sze, David D. Wentzloff, Anantha P. Chandrakasan

Specifications

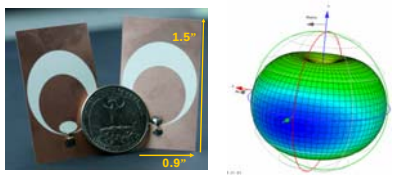


- 500 MHz-wide BPSK Gaussian-shaped pulses
- 100 Mb/s maximum data rate at 10 m
- 14 channels between 3.1 – 10.6 GHz

Block Diagram



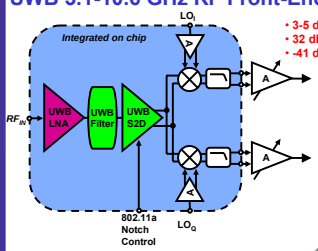
Antenna



- Achieves S_{11} < -10 dB for the entire 3.1-10.6 GHz range
- Compact, planar design
- Near omni-directional radiation (2 dB gain)

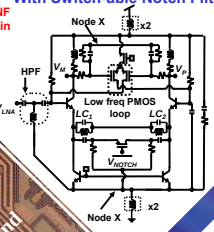
Custom 3.1-10.6 GHz 100Mb/s Chipset

UWB 3.1-10.6 GHz RF Front-End Receiver

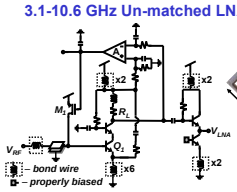


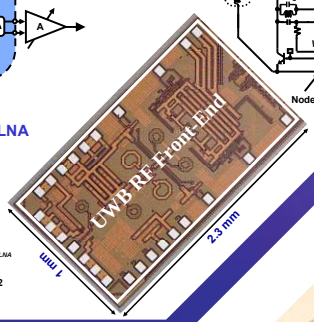
- 3-5 dB down-converted NF
- 32 dB avg conversion gain
- -41 dBm input P_{1dB}

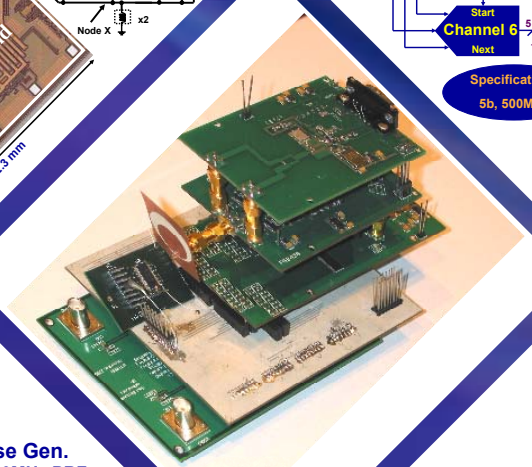
Single-to-Differential Converter With Switch-able Notch Filter



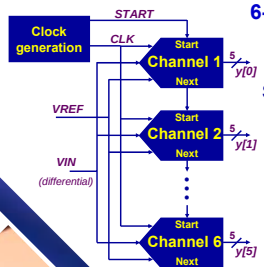
3.1-10.6 GHz Un-matched LNA



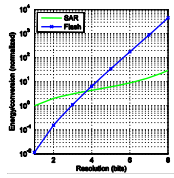




6-Channel Time-Interleaved Successive Approximation Register (SAR) ADC

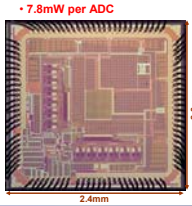


SAR has linear scaling of comparators vs. exponential for flash



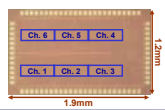
0.18µm CMOS Dual-ADC Prototype

- Self-timing
- Preamplifier duty-cycling
- Full custom dynamic logic
- 7.8mW per ADC

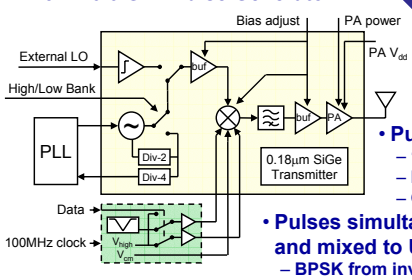


65nm CMOS ADC Prototype

- Split capacitor array
- Optimized latch strobing
- 6mW, Nyquist performance

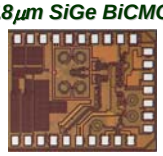


3.1-10.6 GHz Pulse Generator

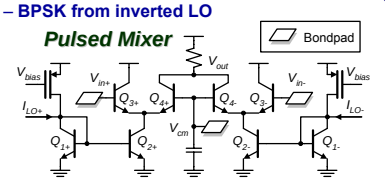


- Pulse Gen.
  - 100MHz PRF
  - BPSK modulation
  - Gaussian shaping
- Pulses simultaneously shaped and mixed to UWB band
  - BPSK from inverted LO

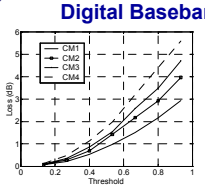
0.18µm SiGe BiCMOS



Pulsed Mixer



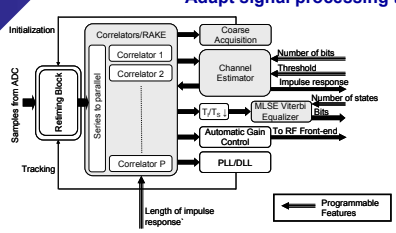
Digital Baseband Processor

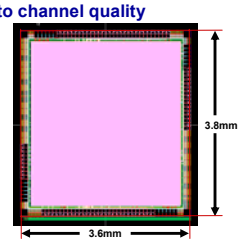


MINIMUM POWER OF ECHOES

Energy ∝ 1/Threshold

Trade-off processing energy with QoS
Adapt signal processing to channel quality



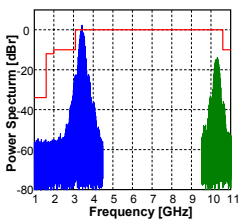


Measurement Results

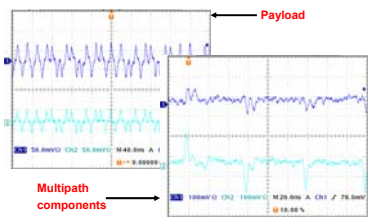
Chipset Summary

Block	Process	Power [mW]
Transmitter	0.18 µm BiCMOS	31.1
Front-end receiver	0.18 µm BiCMOS	54.3
Dual 500 MS/s ADC	0.18 µm CMOS	7.8
Digital back-end	0.18 µm CMOS	85 (est.)
Commercial PLL		75
Total Power Consumption		253

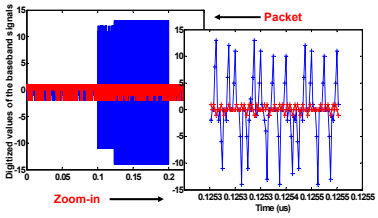
TX Spectrum Plot



Analog Baseband RX I/Q Signals



Digitized RX I/Q Signals



Research sponsored by the Hewlett Packard-MIT Alliance, the National Science Foundation, DARPA, the ARL Collaborative Technology Alliance, and the NDSEG Fellowship