A Single Chip UWB Receiver Based on 0.18μm CMOS Technology for Wireless Interconnection

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Ultra Wide Band Wireless Communication System

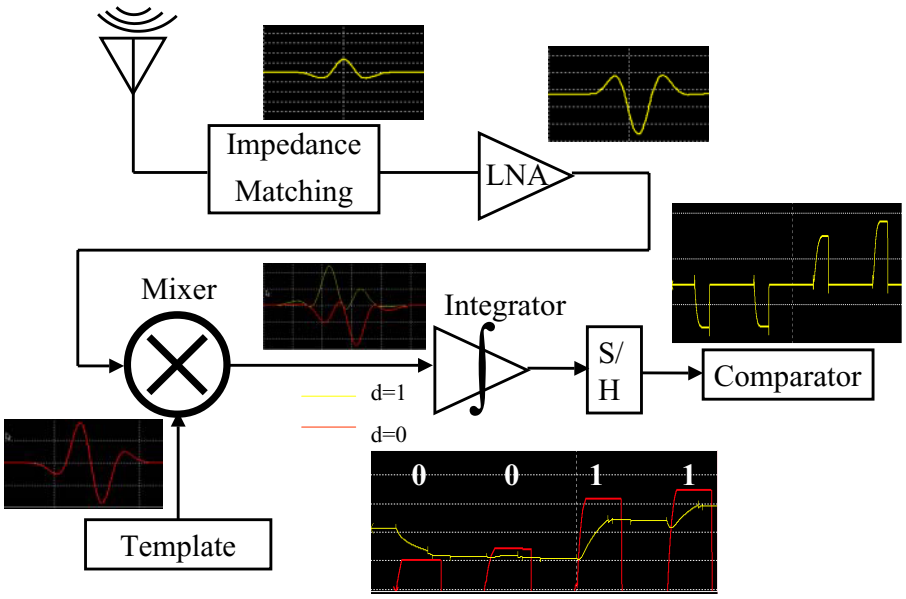
Characteristics of Ultra Wide Band System

- Base band communication using Gaussian Monopulse
- Modulation Method : Pulse Position Modulation (PPM) in Time Domain
- Multi-Channel Communication: Time Hopping Spreading Spectrum (THSS)

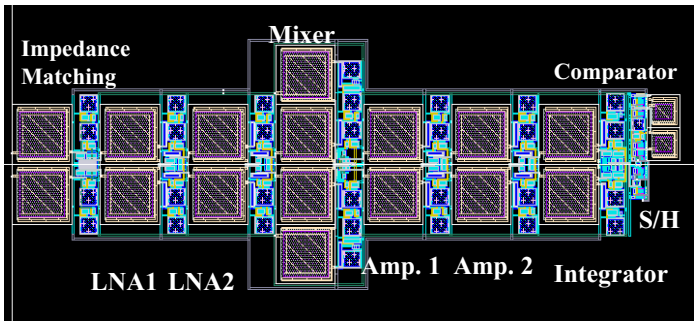
Problems

- On-chip Gaussian Monopulse Generator using CMOS Technology
- LNA and Mixer in the receiver → UWB Character is required
- PPM and THSS → Synchronization is a most difficult problem

UWB Receiver



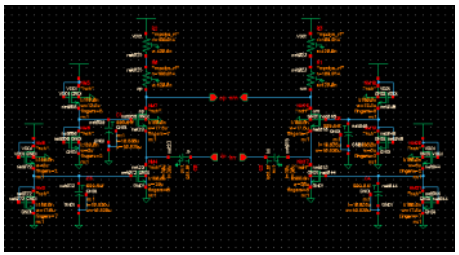
UWB Receiver Layout Design

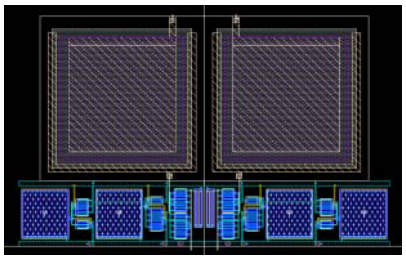


- TSMC 0.18μm rule (V_{dd}=1.8V)
- Differential implementation

UWB RECEIVER CIRCUIT DESIGN

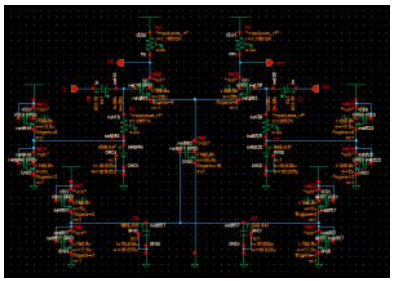
Impedance Matching(100Ω)

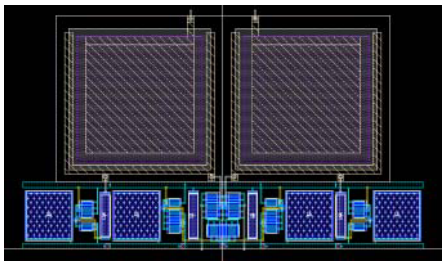




- Common Gate amplifier : $Z_{in} \sim 1/g_m$
- UWB Character

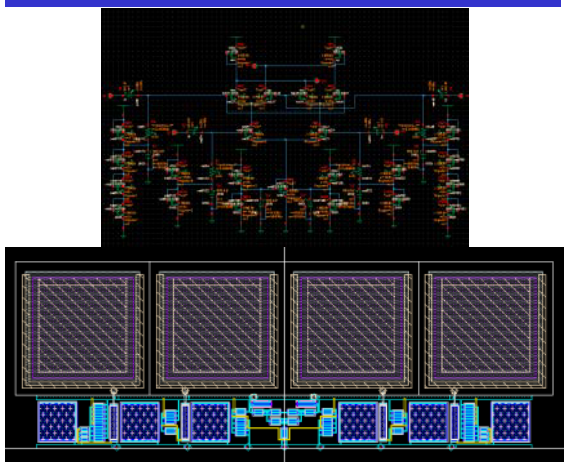
Differential LNA





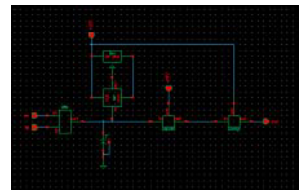
- Differential common source amplifier
- Voltage gain is low (5-10 dB at 1-10GHz) → Use two stage LNA

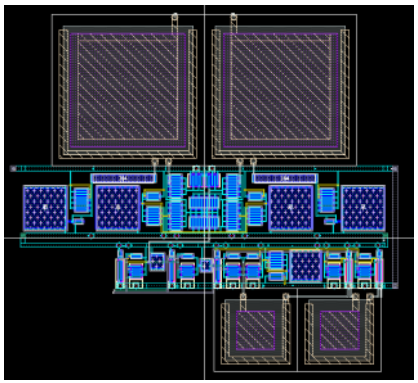
Mixer



- Gilbert type Mixer
- Differential input, template and output
- Multiplies the received signal by the template signal to perform demodulation

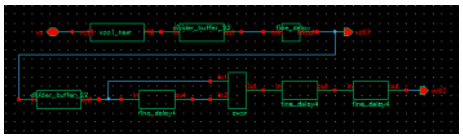
Integrator - Comparator

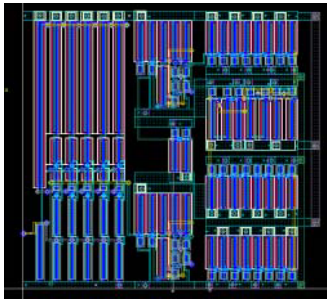




- Integration time = 1.25ns (half of chip rate)
- Comparator: Inverter chopper type Comparator

Control Voltage Generator

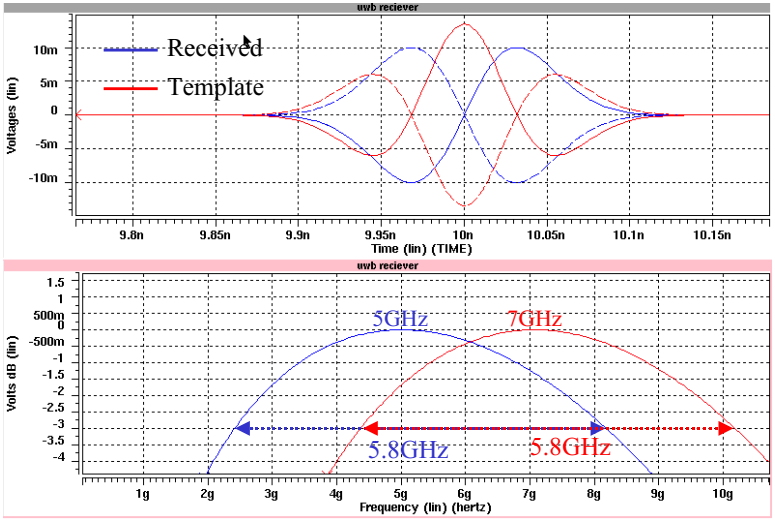




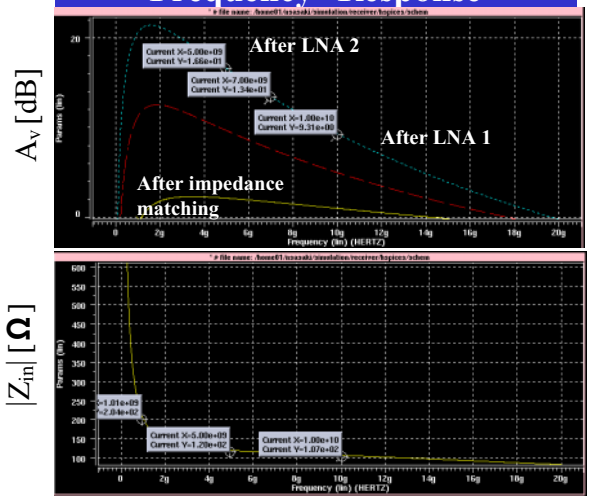
- Chip rate = 400MHz (2.5nsec)
- Used by integrator, Sample Hold Circuit and Comparator

SIMULATION RESULTS

Received/Template Signal



Frequency Response

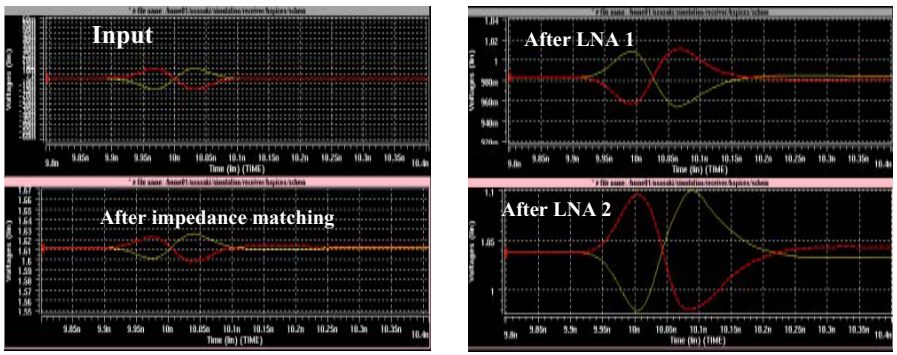


- Voltage Gain : 16.6dB at 5GHz and 9.31dB at 10GHz
- Input impedance : 200Ω at 1GHz, 120Ω at 5GHz and 107Ω at 10GHz

Time domain Analysis

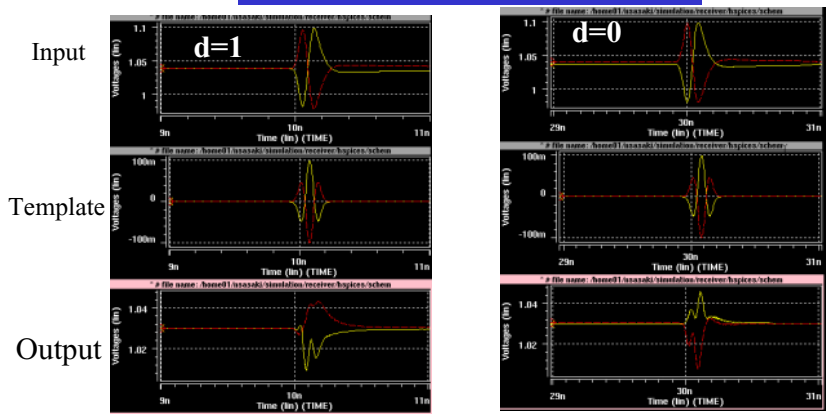
— Input – before Mixer —

Input: 1st derivative of Gaussian



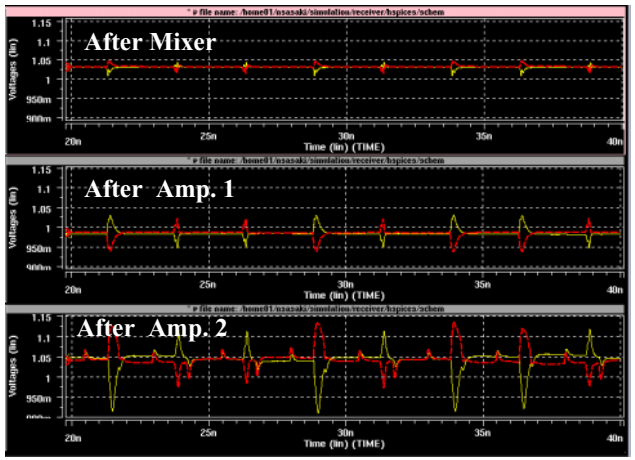
- Voltage Gain after LNA 2 = 15.6dB for Gaussian monocycle (center frequency = 5GHz, 3dB bandwidth=5.8GHz)

Time domain Analysis
—Mixer Input / Output —

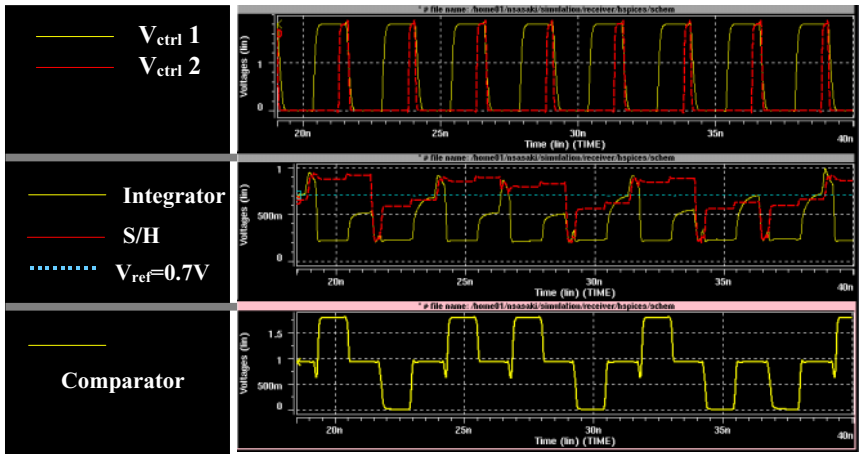


- Succeed to demodulate data from the pulse position modulated signal using second derivative Gaussian template.

Time domain Analysis
— Mixer ～Before Integrator —



Time domain Analysis
— Integrator ～ Comparator —



- Analog signal is converted to digital signal after integrator – comparator.
- In comparator, V_{ref}=0.7V.

CONCLUSION

- In HSPICE Simulation, UWB Receiver demodulates Pulse Position Modulated data from received Gaussian monocycle.
- Two stage LNA Voltage Gain : 16.6dB at 5GHz, 9.3dB at 10GHz.
- Voltage gain for Gaussian monocycle (center Frequency = 5GHz is 15.6dB.
- Input Impedance $|Z_{in}|$=200Ω at 1GHz, 120Ω at 5GHz, 107Ω at 10GHz.