A 24-GHz 90-nm CMOS Beamforming Receiver Front-End with Analog Baseband Phase Rotation

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Outline

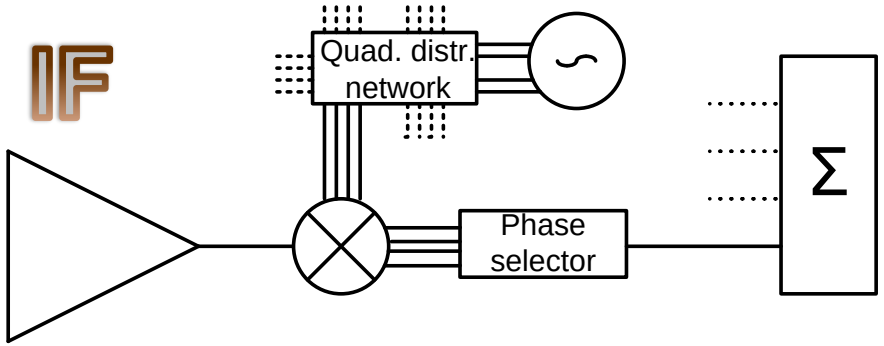
1. Introduction
2. Circuit Design
3. Measurements
4. Conclusions

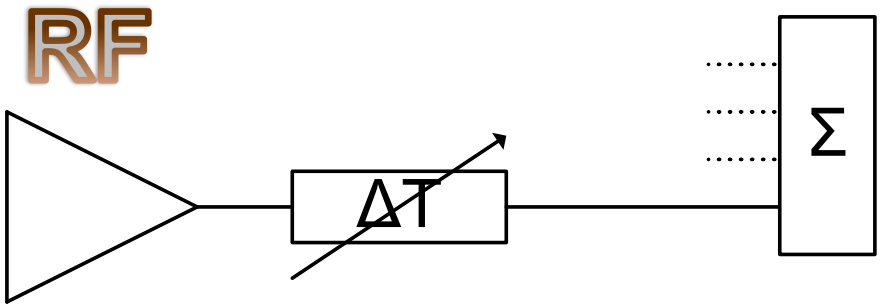
Introduction

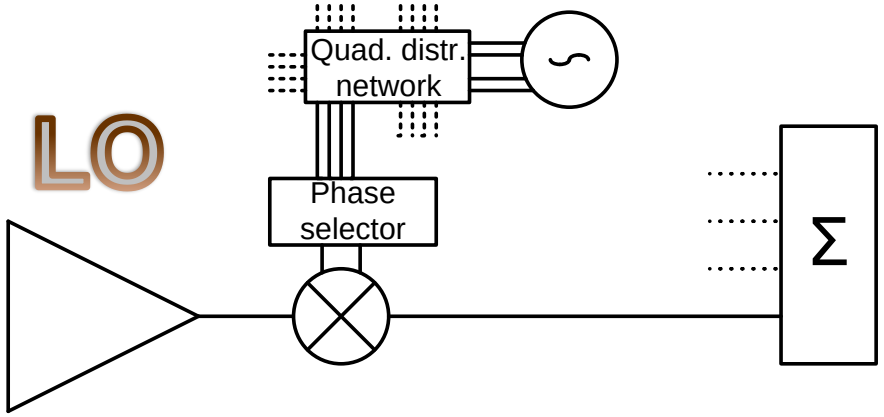
Introduction - Motivation

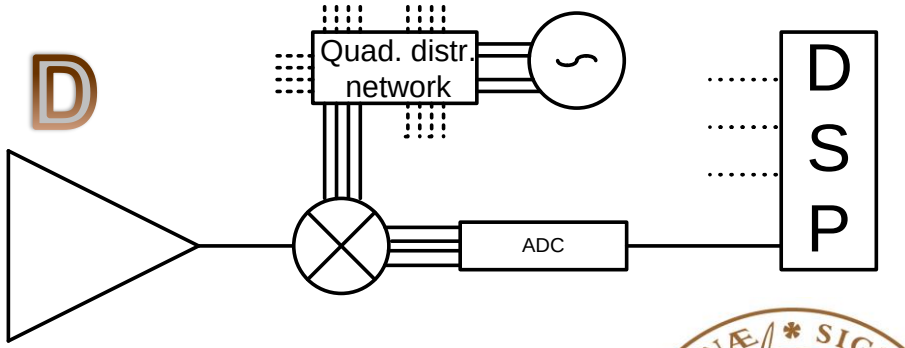
1. **Increased antenna gain**
2. **SNR improvement**
3. **Spatial filtering**

Introduction - Topologies



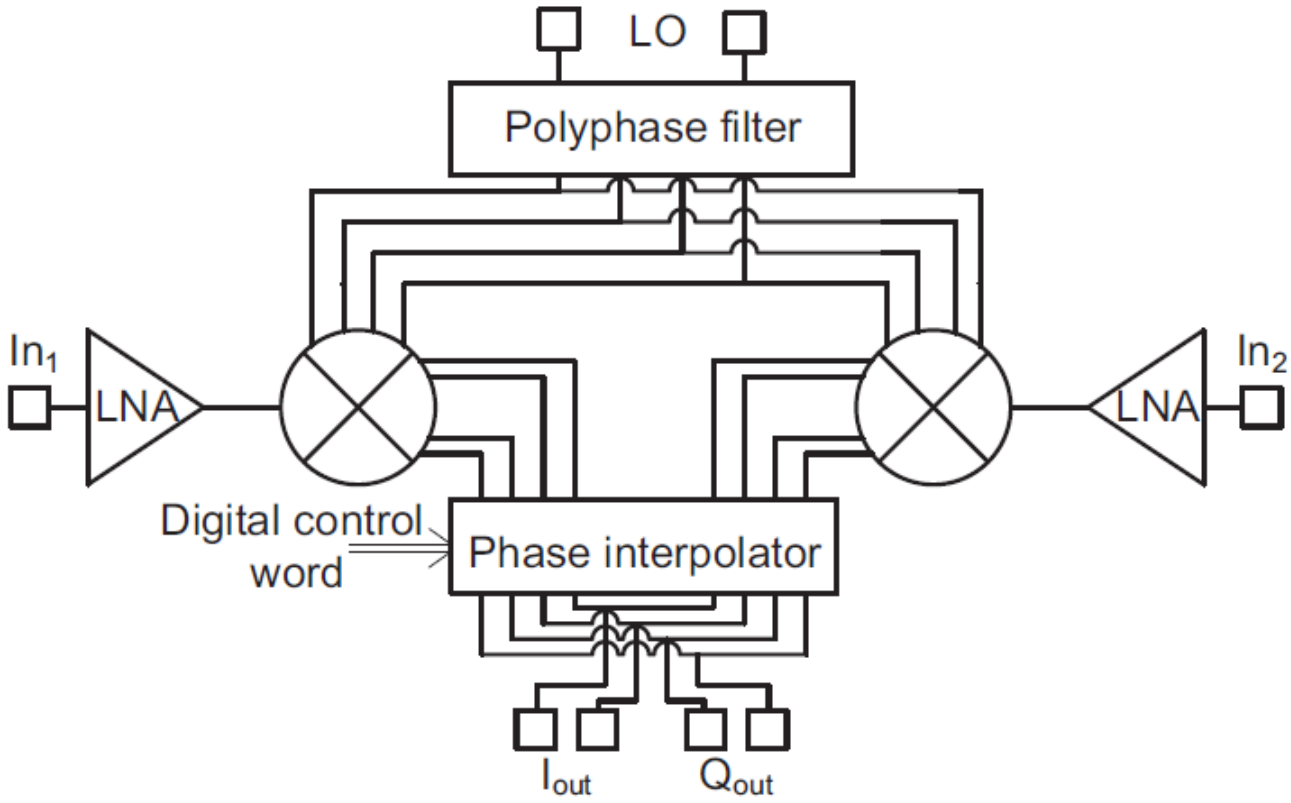




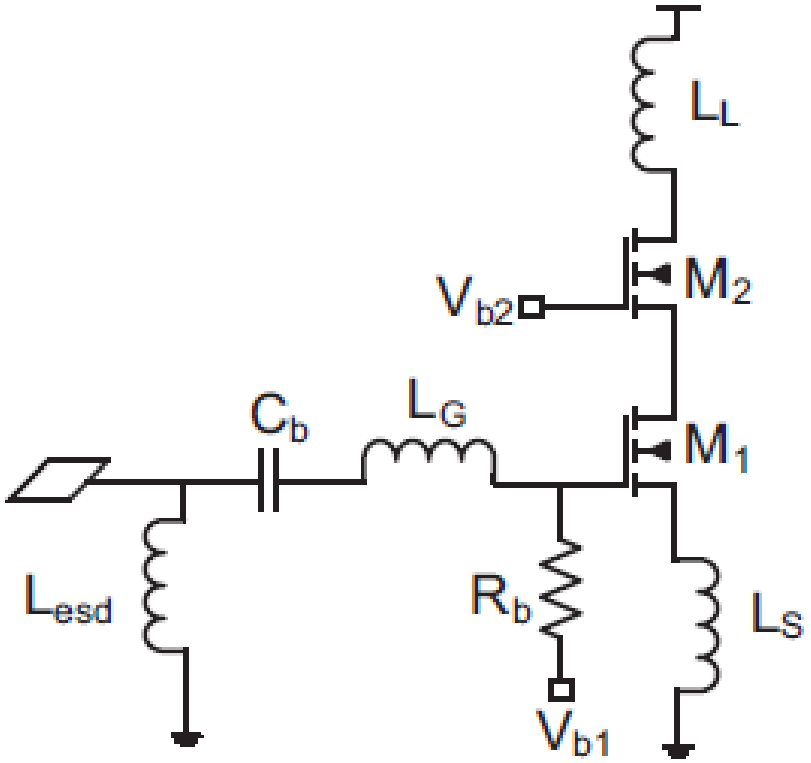


Circuit Design

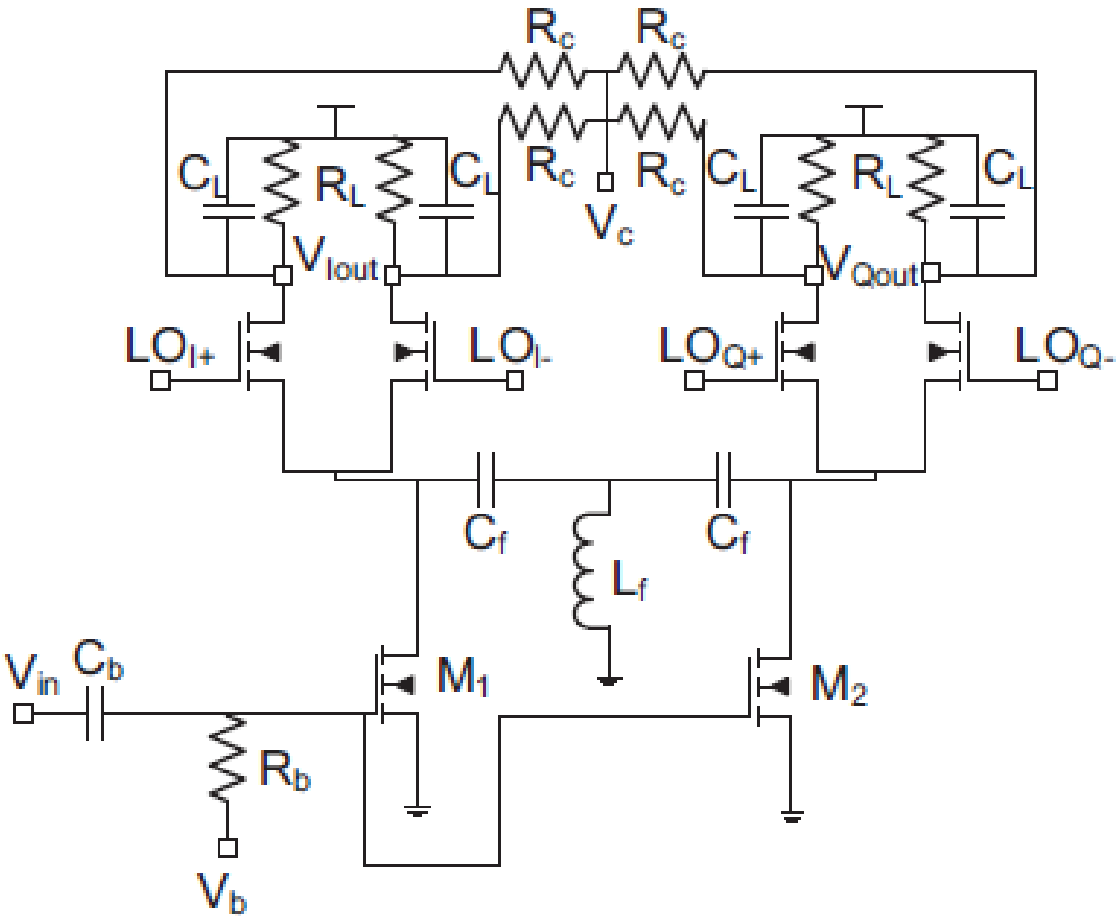
Circuit Design – Top level



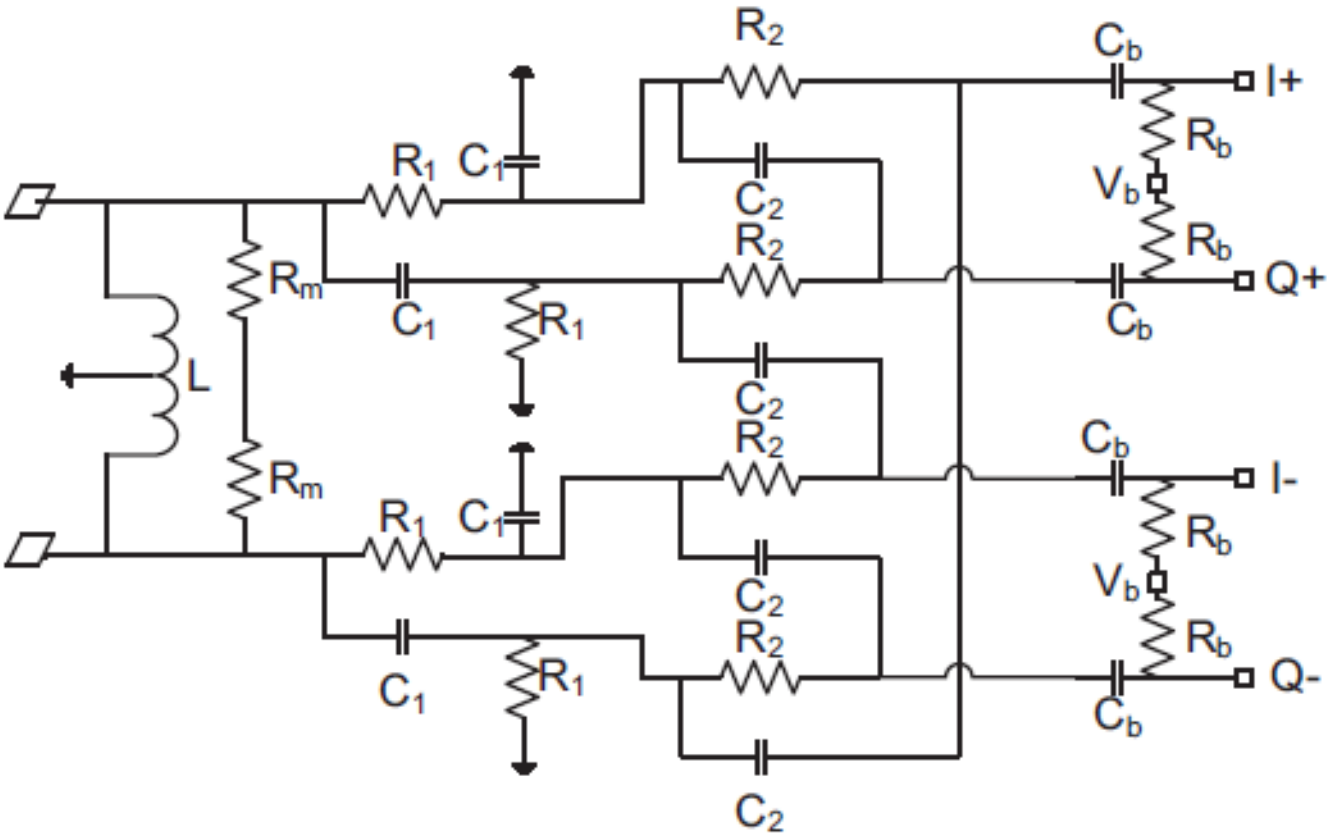
Circuit Design – Low Noise Amplifier



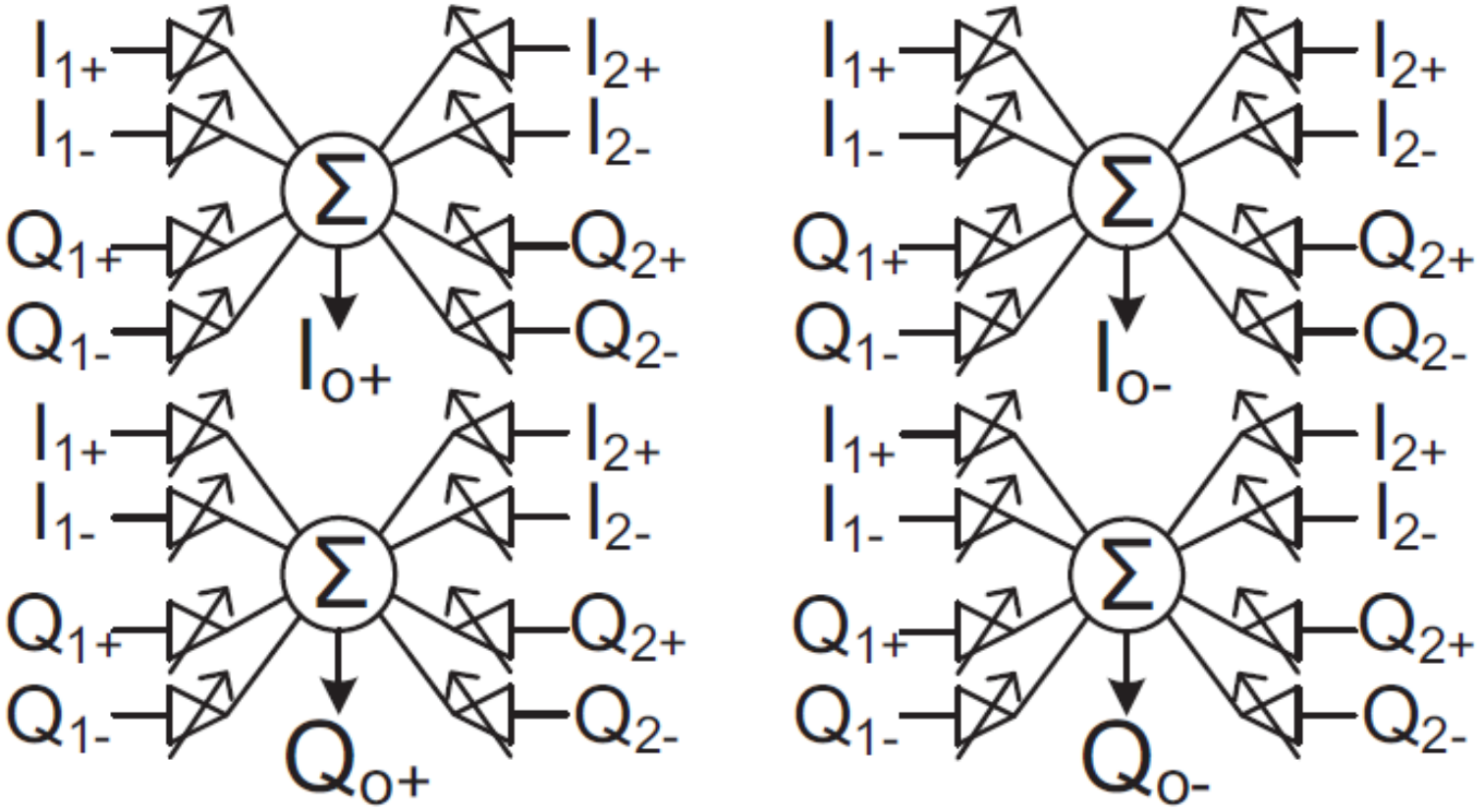
Circuit Design - Mixer



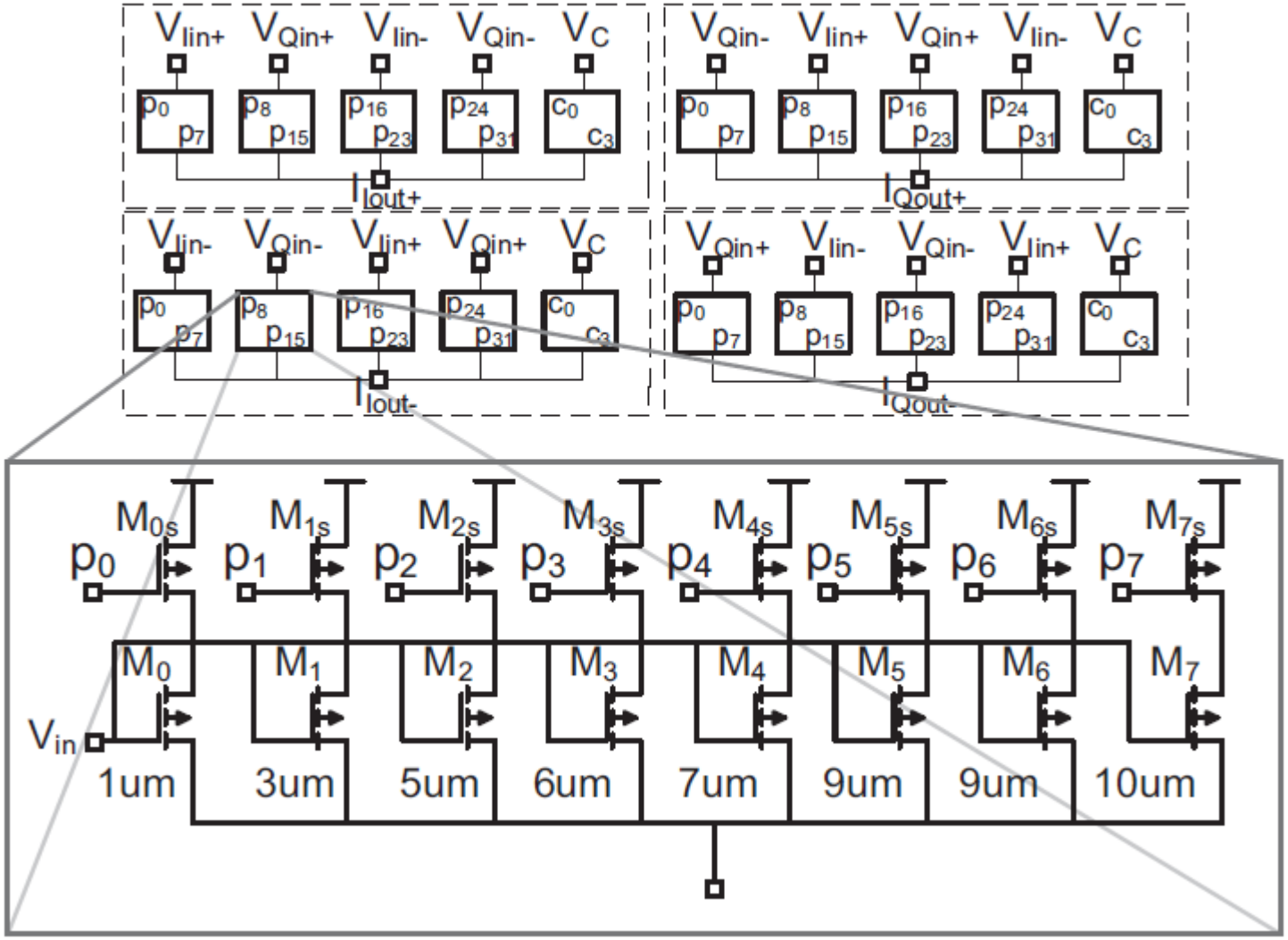
Circuit Design – Polyphase filter



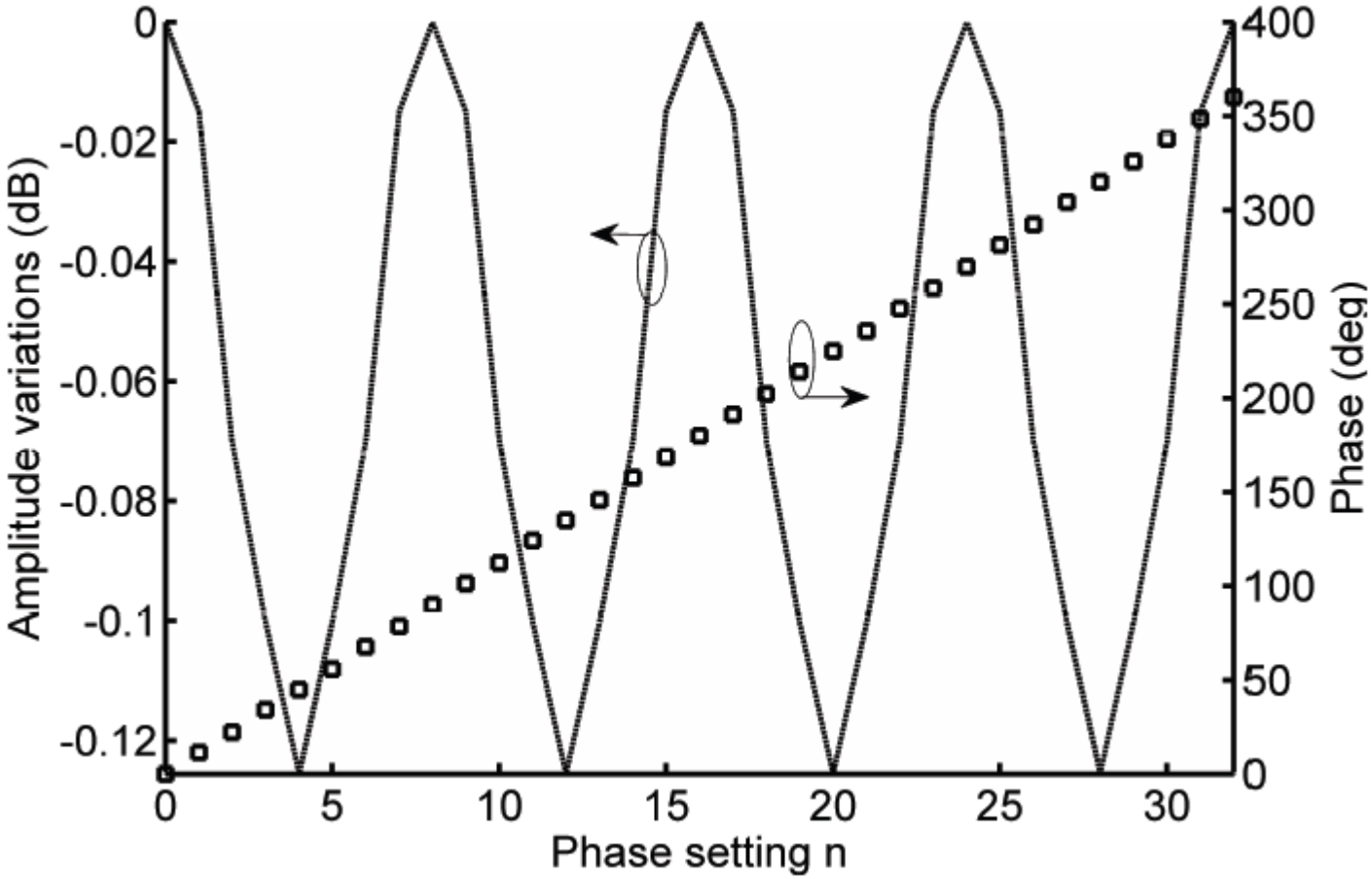
Circuit Design – Phase rotation - concept



Circuit Design – Phase rotation – Impl.

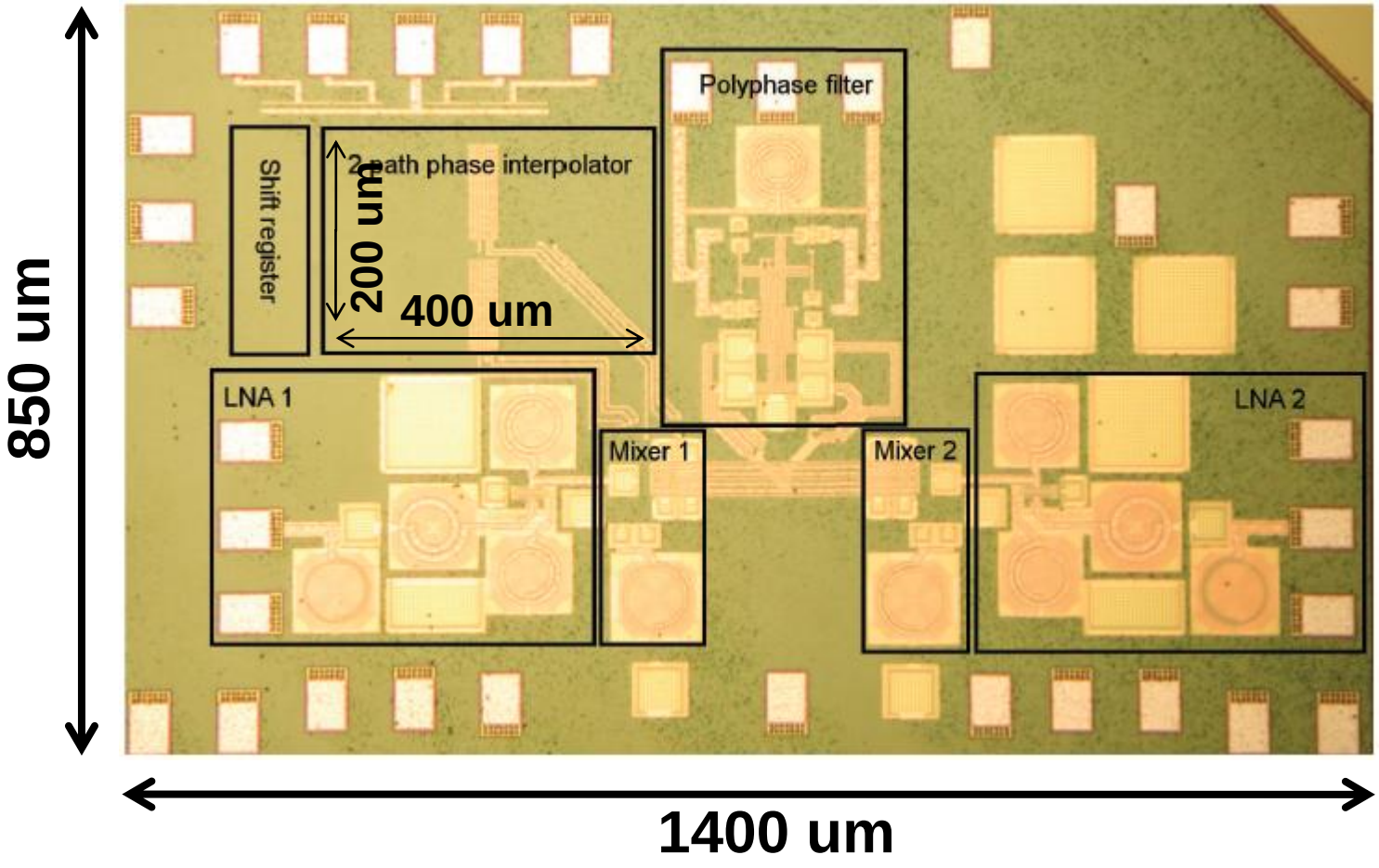


Circuit Design – Phase rotation – Simulation



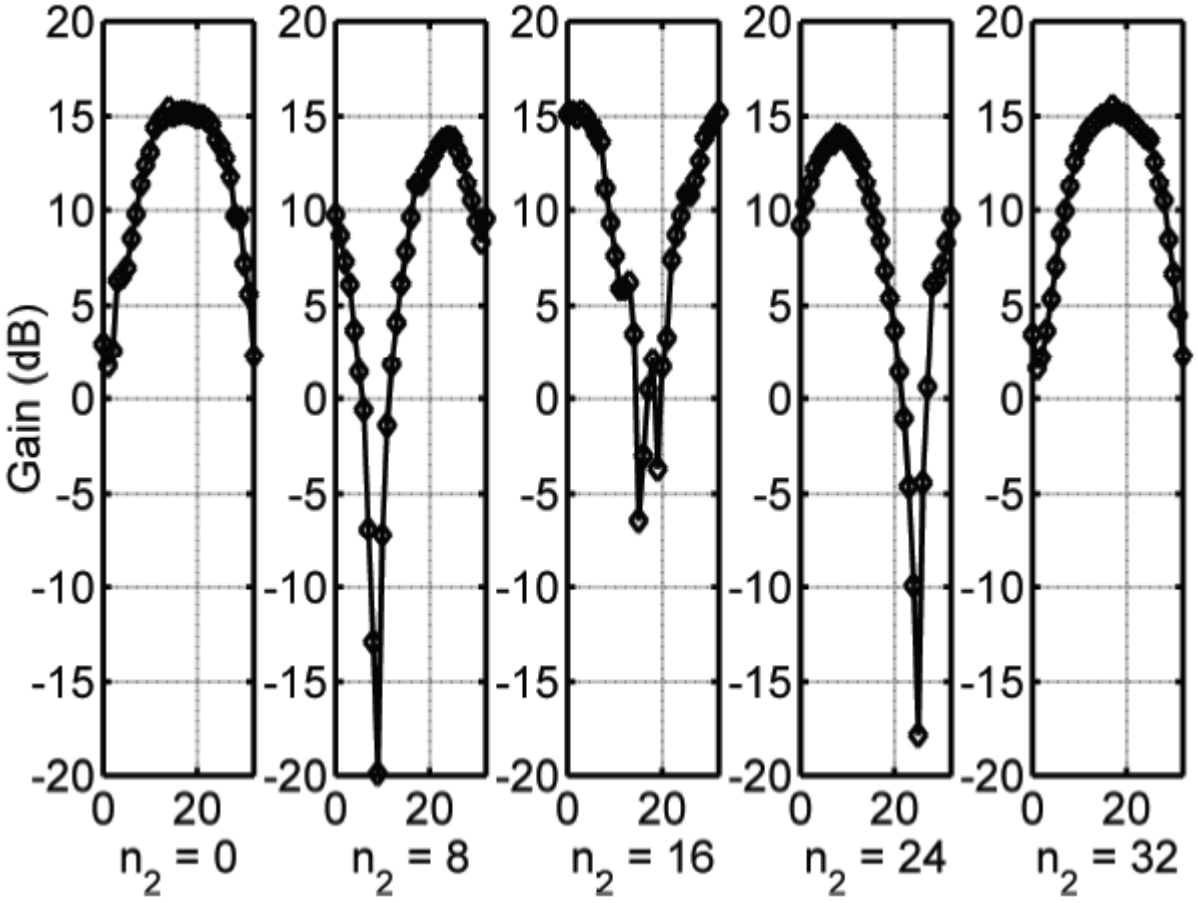
Measurements

Measurement - Die photo



28 mA x 1.2 V = 33.6 mW

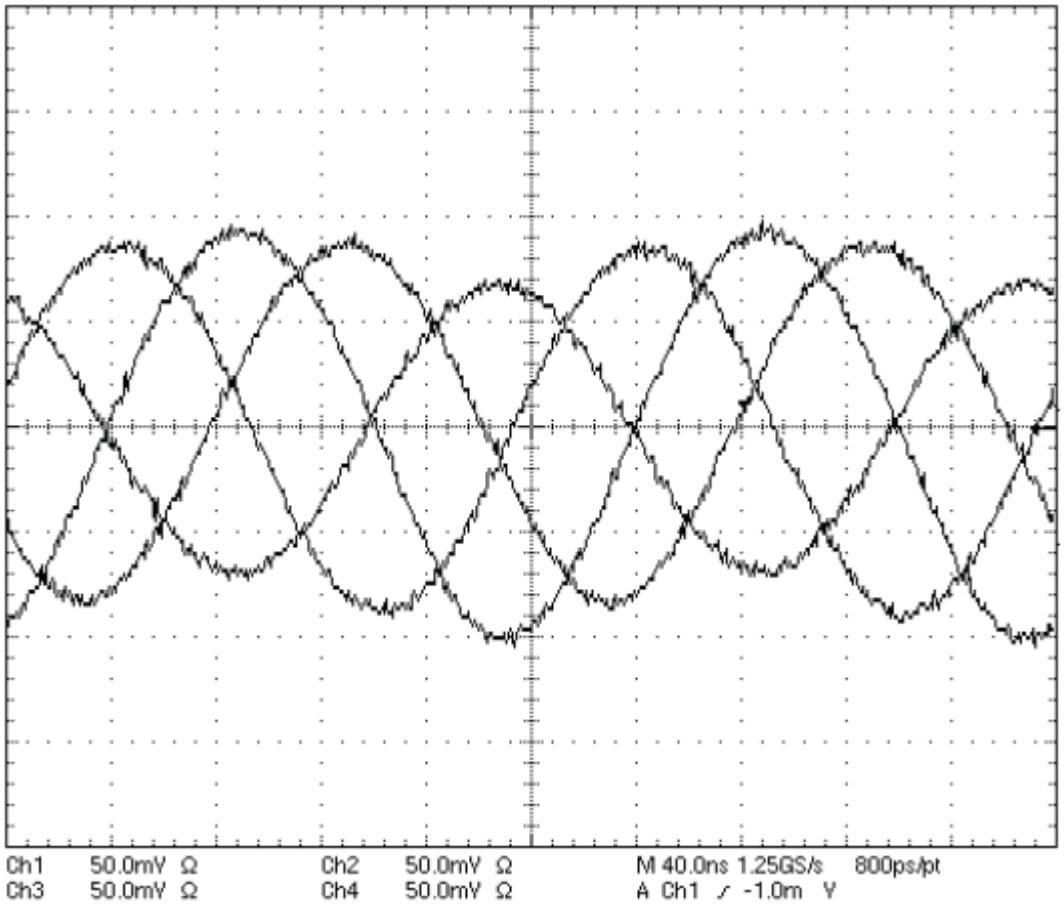
Measurement – Beamforming



> 15 dB deep nulls

x-axis: Phase setting n_1 (degrees = n_1 * 11)

Measurement – Time domain output

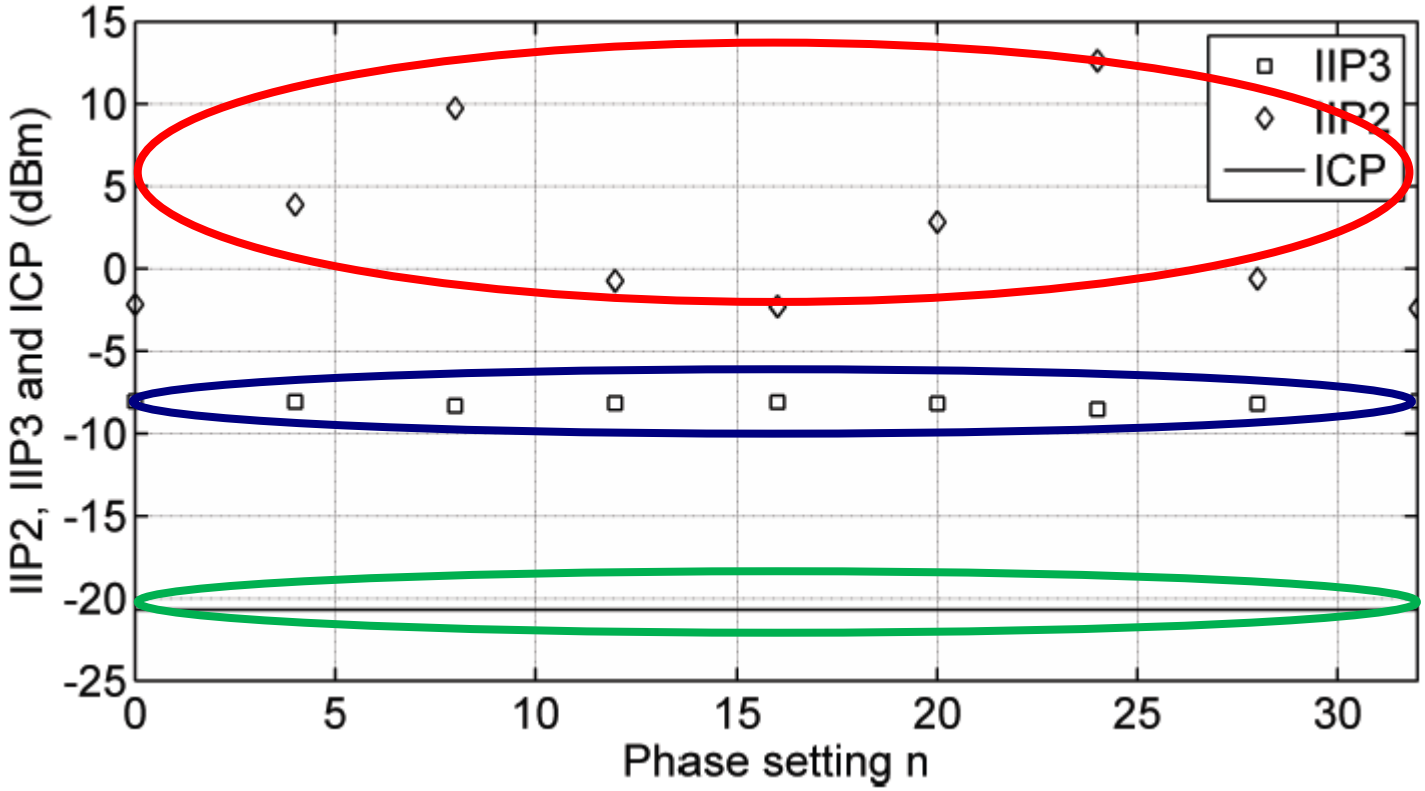


Measurement - Linearity

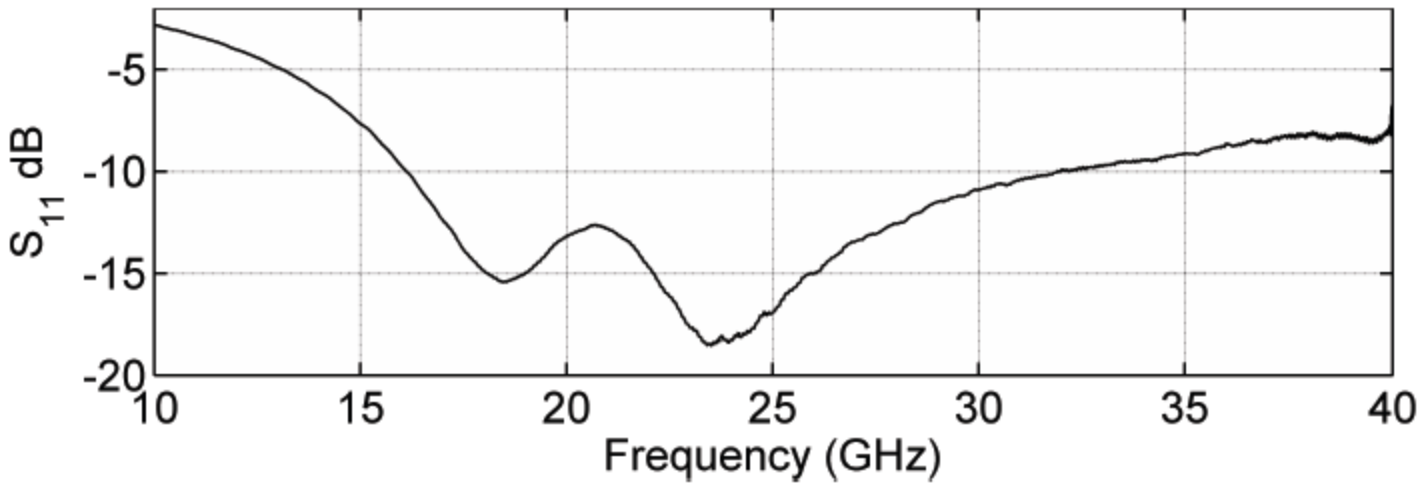
IIP2

IIP3

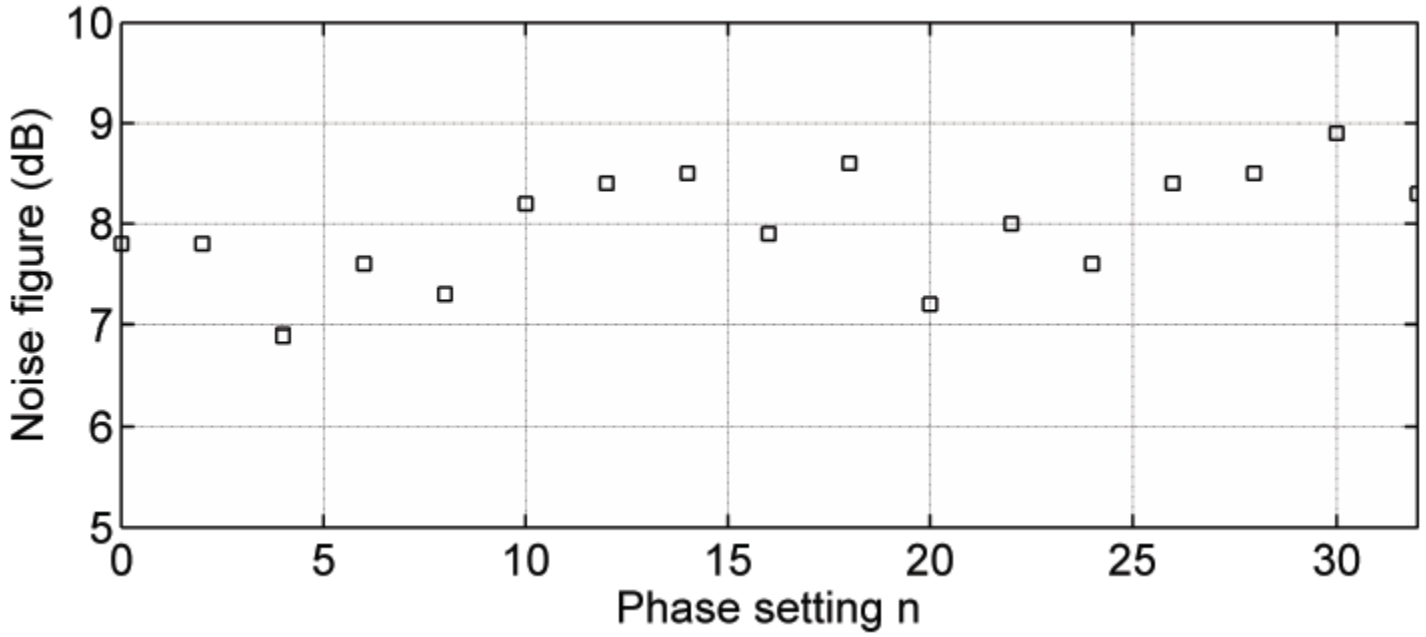
ICP



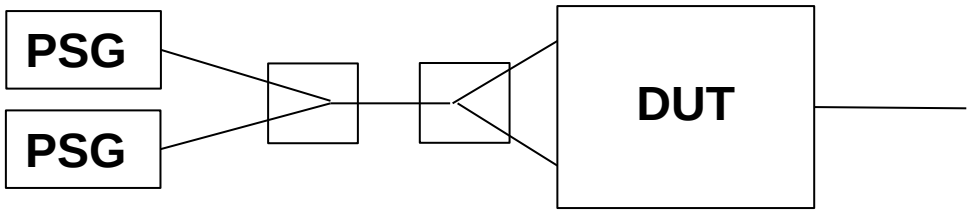
Measurement – S_{11}

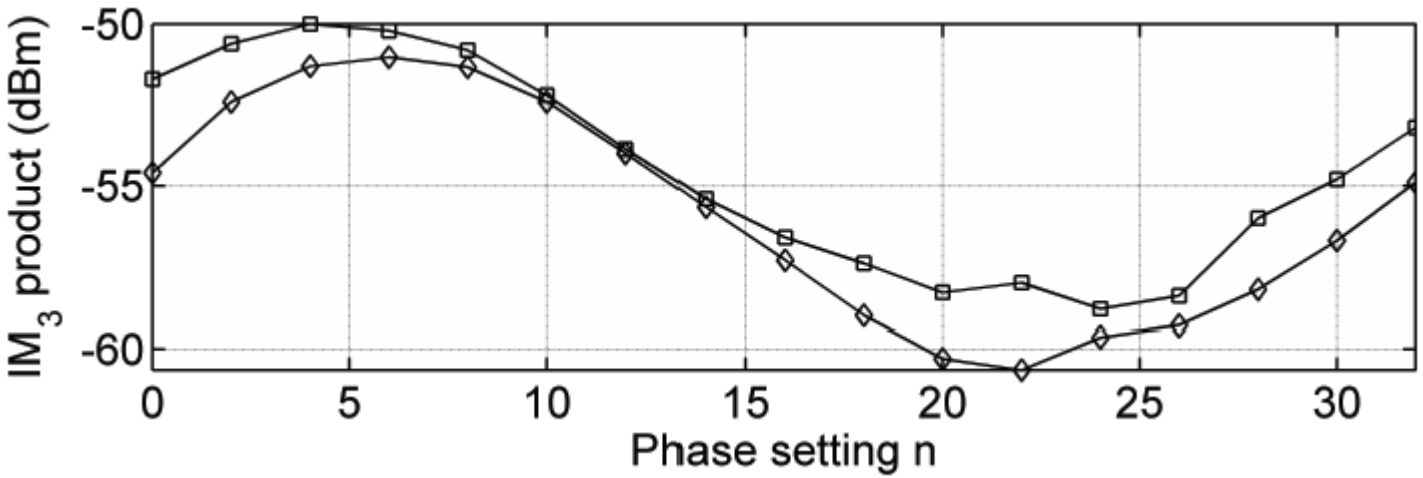


Measurement – Noise figure



Measurement – Two path linearity





Conclusion

A front-end implementing IF-beamforming with two receivers has been presented. It has a digital beamcontrol with 11 degrees resolution.

Although there is room for improvements the results shows that analog baseband phase rotation is a promising architecture for beamforming receivers.

Acknowledgment

- High Speed Wireless Center (HSWC)
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