Design of 4 GHz UWB Pulse Generator with Simultaneous Optimization of Sidelobe Suppression and Bandwidth

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ABSTRACT

This work presents and OOK driven IR-UWB pulse generator (PG) with simultaneous optimization of sidelobe suppression and bandwidth by utilizing a triangular enveloped UWB pulse, which also eliminates the need for an off-chip filter. The prototype PG implemented in 65-nm CMOS process shows 577 mV_{pp} pulse amplitude, a BW_{-10dB} of 1.12 GHz and more than 25 dB sidelobe suppression in 1.7–3.1 GHz band at an energy consumption of 33 pJ/pulse, occupying 0.64 mm^2 area.

INTRODUCTION

- IR-UWB is promising technology for high data rate communications with very low effective power levels.
- A UWB pulse must comply with the FCC spectral mask in all frequency ranges.
- A triangular shaped pulse can be utilized to stay within FCC limits without need for an additional pulse shaping filter.
- LO-based pulse generation schemes have been presented in literature, but edge-combination based architecture provides more flexibility in design.

PULSE GENERATOR DESIGN

- Current starved inverters (CSI) based delay cells produce timing characteristics to generate a triangular shaped current, i_{inj}.
- The *RLC* load converts the injected current to voltage by extracting the fundament component of i_{inj}.
- The load quality factor must be very low ($Q_T \approx 2$) to ensure low amplitude residual pulses, which affect the shape of the pulse.
- The pulse center frequency can be manually tuned by varying the tuning voltage of the tuning device in CSI.

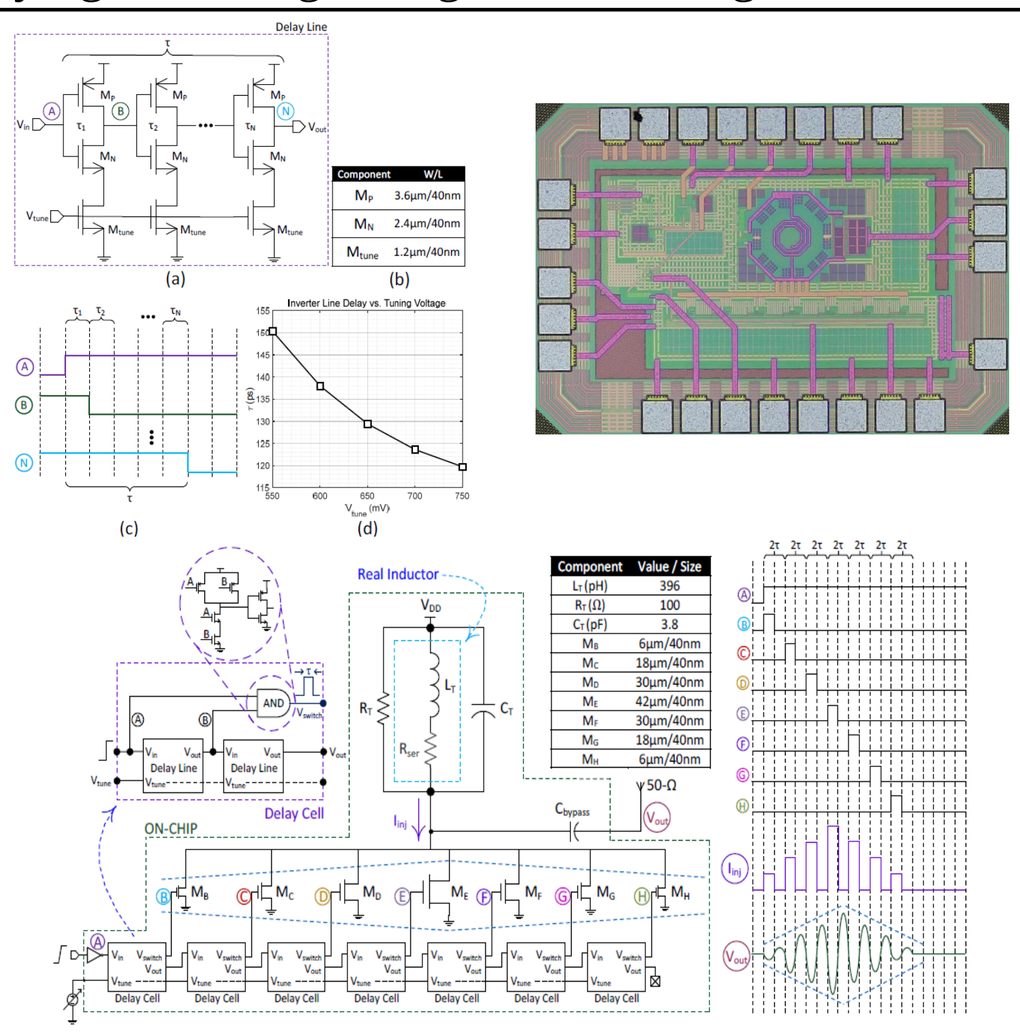

Fig. 1. Implemented architecture with delay line, delay cell and chip micrograph

SIMULATED AND MEASURED RESULTS

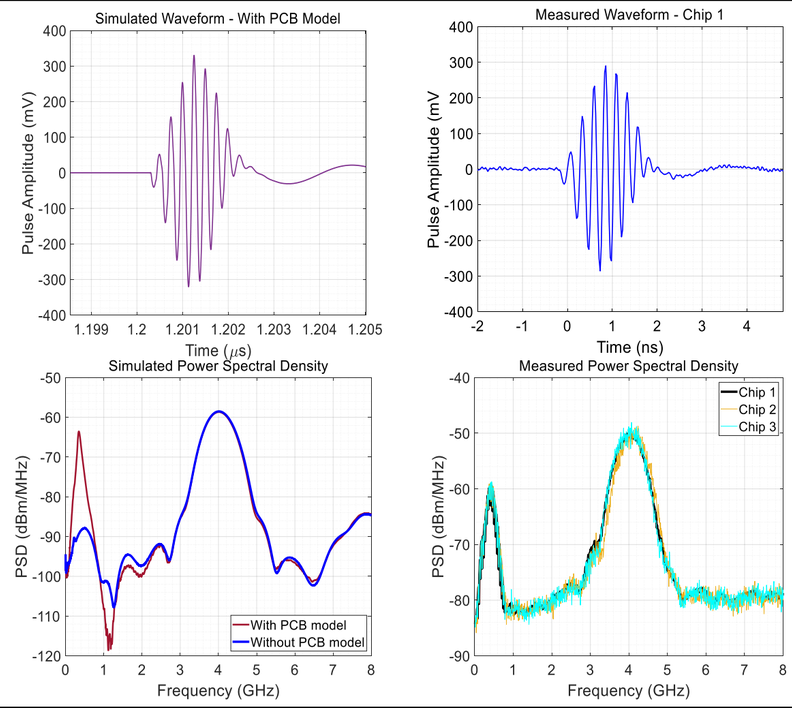

Fig. 2 Simulated and Measured UWB pulse and its PSD

DISCUSSION

- The pulse peak-to-peak amplitude is 577 mV_{pp}.
- The amount of measured sidelobe suppression is 27 dB.
- The BW_{-10dB} is 1.12 GHz with a center frequency of 4 GHz.
- The measured energy consumption per pulse is 33 pJ/pulse at a PRF of 10 MHz.

PERFORMANCE COMPARISON

	This Work	[1]	[2]
Modulation	OOK	PPM	PPM
V_{pp} (mV)	577	400	< 100
BW_{-10dB} (GHz)	1.12	0.737	0.7
Suppression (dB)	27	13	14
Energy (pJ/pulse)	33	19	22.6

CONCLUSION

- This work proposed a UWB PG with simultaneously optimized sidelobe suppression and bandwidth.
- Implemented in 65-nm CMOS process, the proposed PG shows best performance in terms of sidelobe suppression, pulse peak-to-peak amplitude, and bandwidth.

REFERENCES

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