WCAS 2011

First Workshop on Circuits and Systems Design

Duty-cycle Controlled Variable Gain Amplifier

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floripa design house

Outline

- Motivation
- Concept of the DC-VGA
- Design of the DC-VGA
- Simulation results
- Conclusions and future work

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Motivation

- Read-out circuit for portable medical applications.
- Reduce steps (analog blokcs) for signal conditioning.
- Adaptable gain and BW.
- Provide a suitable voltage range for the next block, e.g. ADC.

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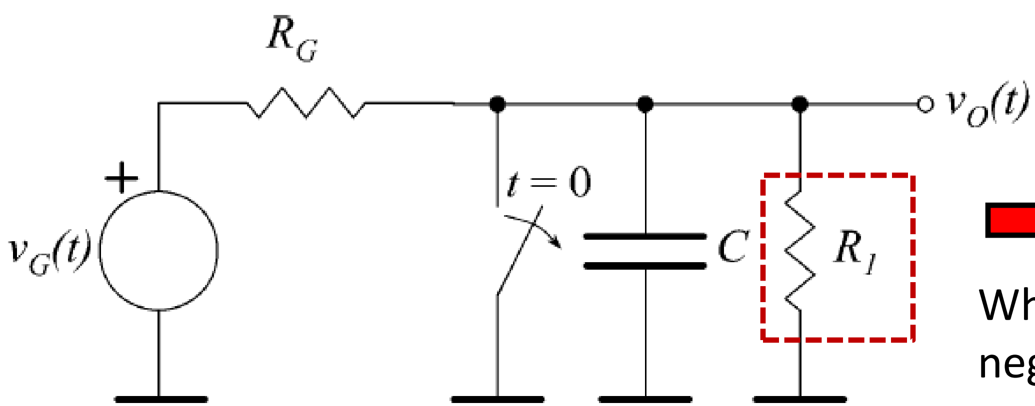
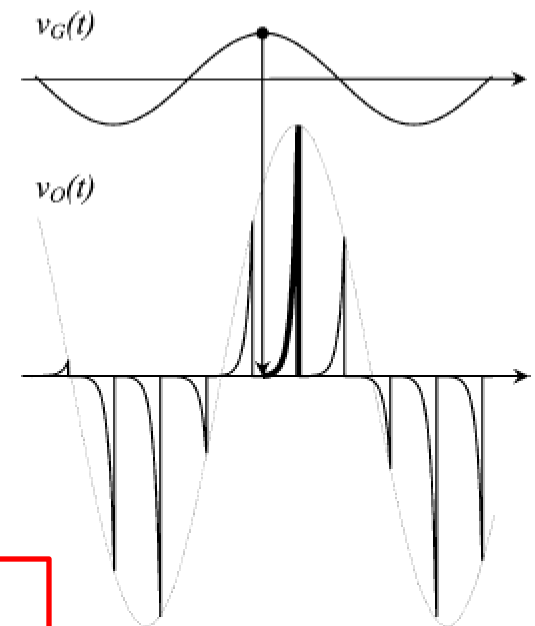
Amplification based on inestability

Concept of the DC-VGA



When negative



[Pala-Schonwalder2009]

$$K = \exp\left(\frac{t_G}{\tau}\right). \quad 0 < t \leq t_G$$

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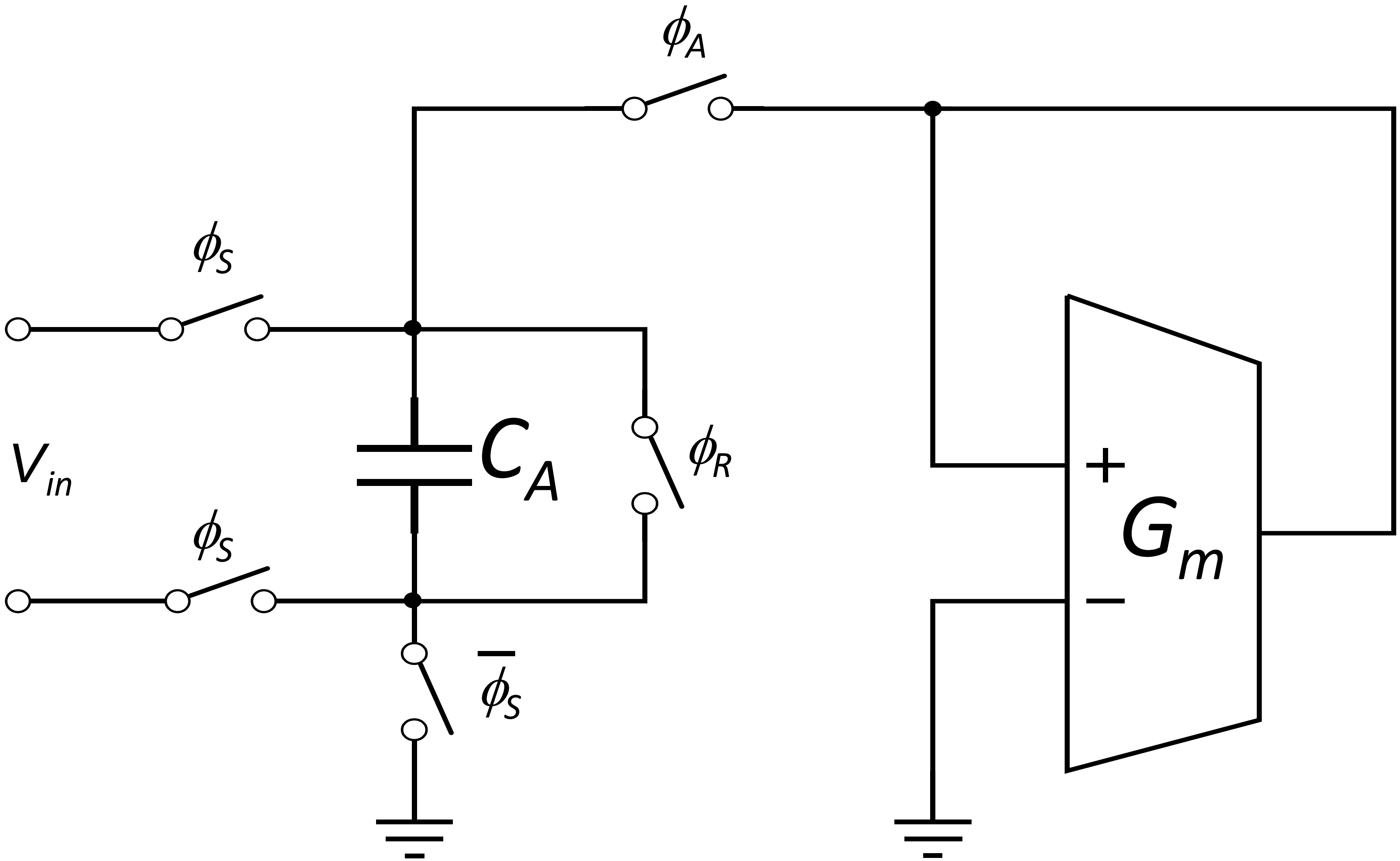
Proposed implementation of the DC-VGA



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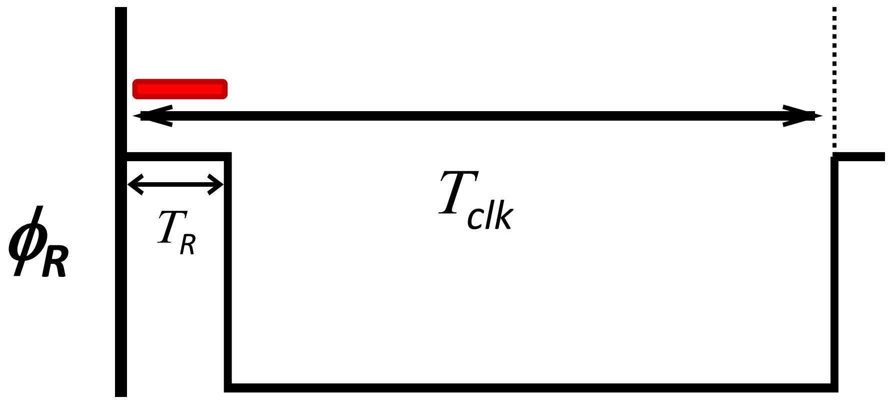
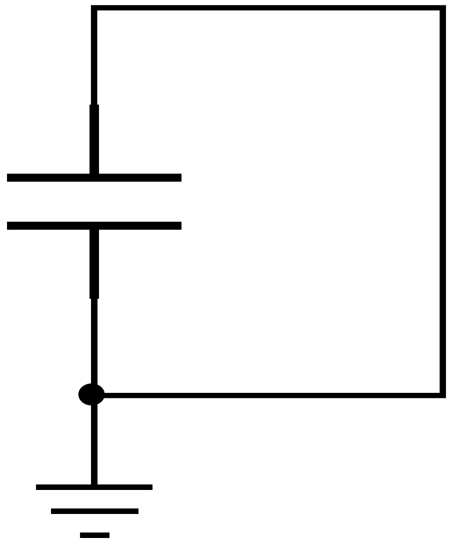
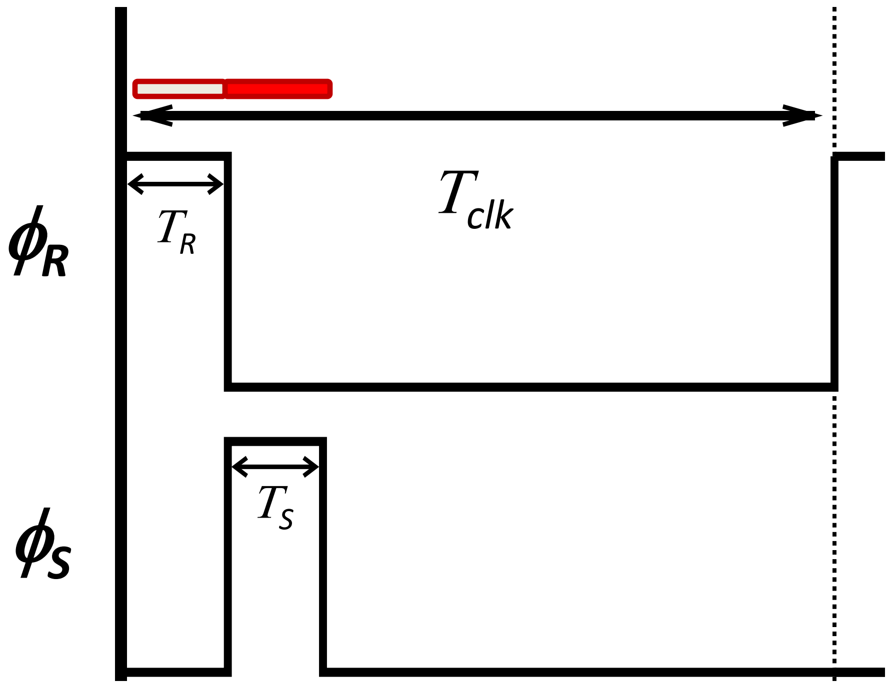
Timing diagram (1)



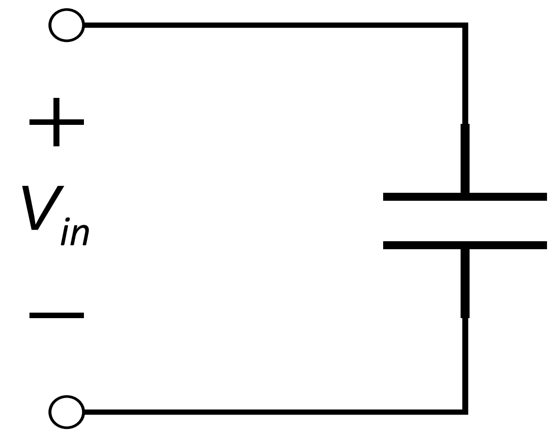
Reset (T_R)



Timing diagram (2)



Sampling (T_S)



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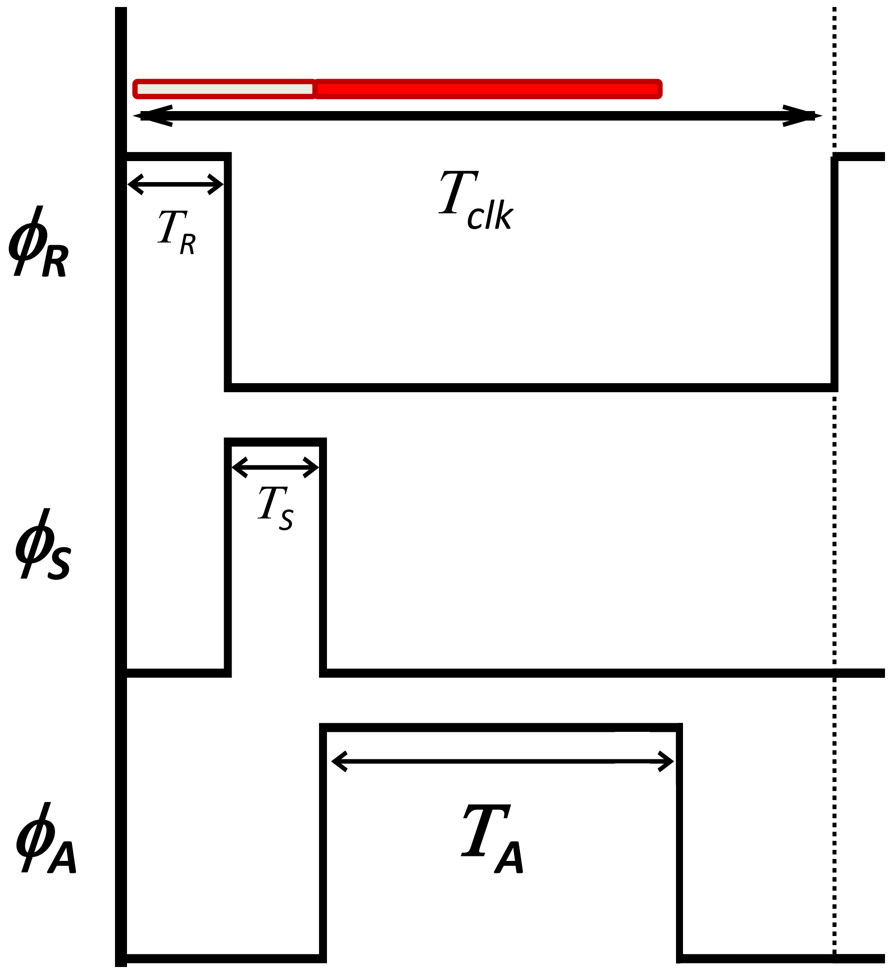
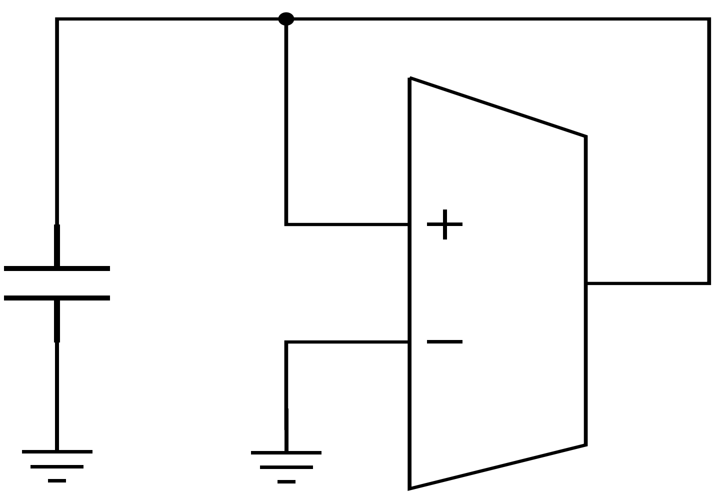
Timing diagram (3)

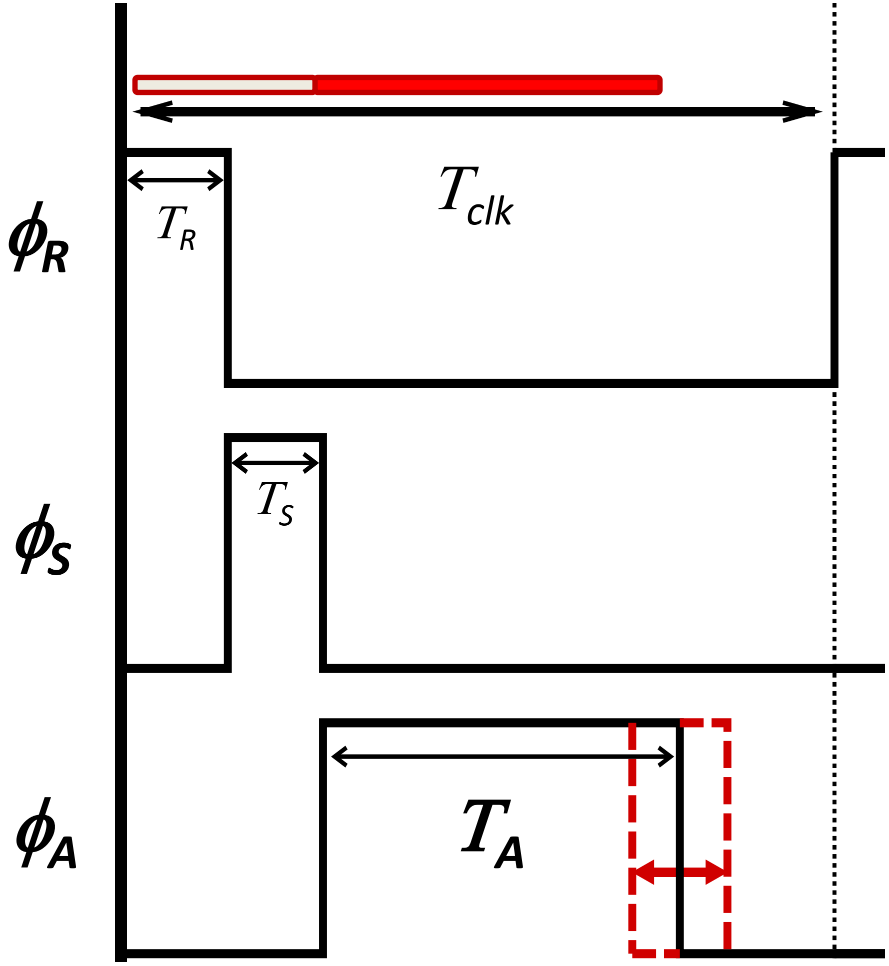


Amplification (T_A)

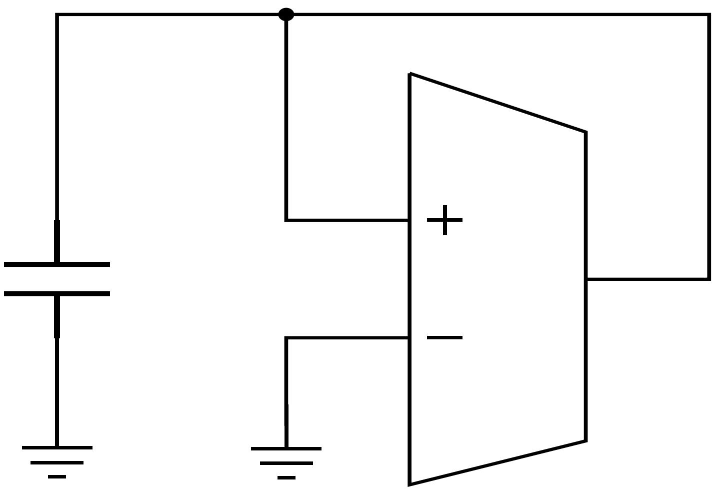


Timing diagram (3)

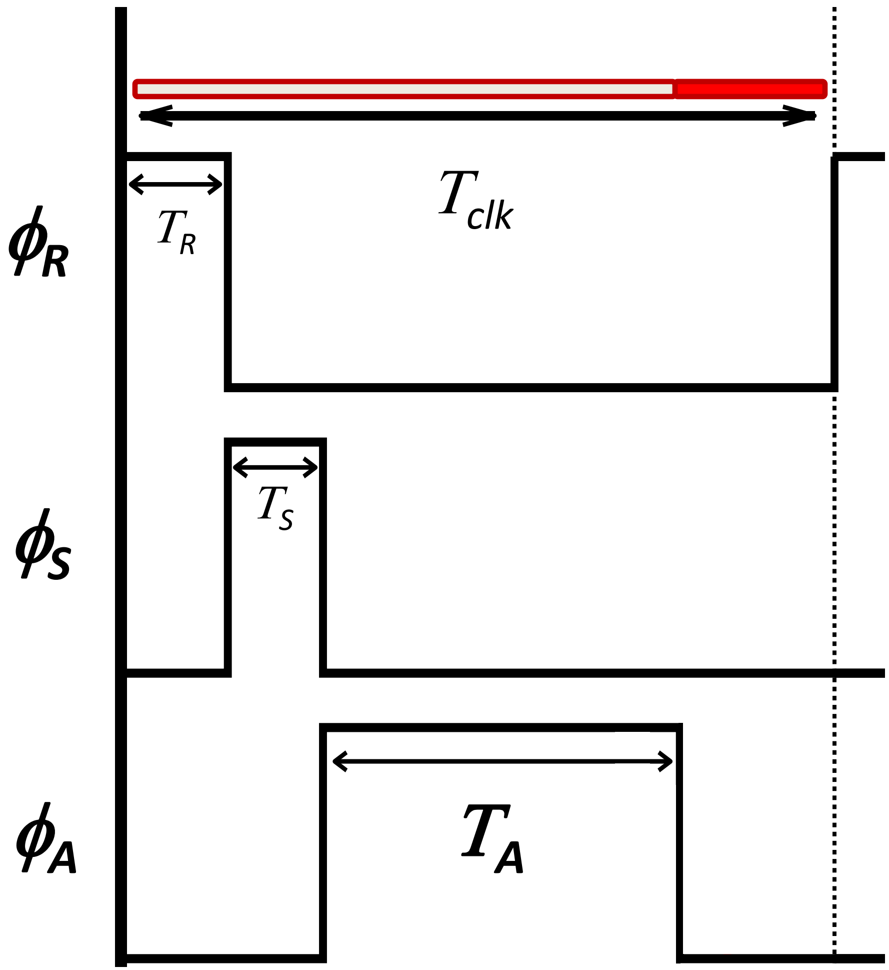
Concept of the DC-VGA



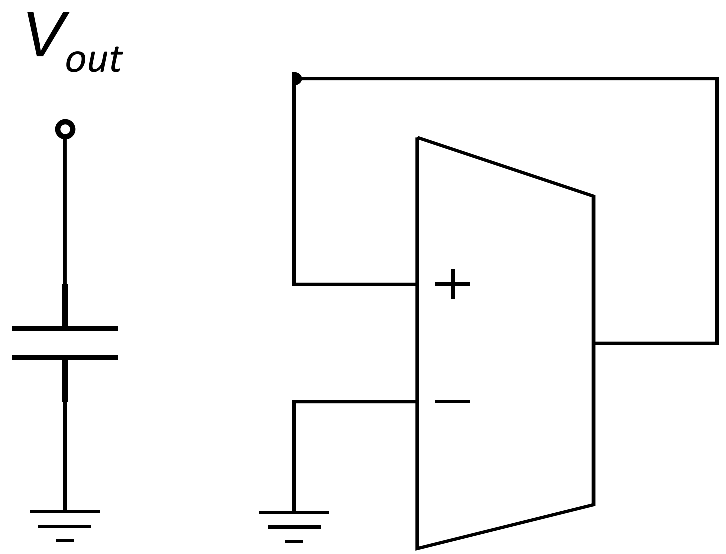
Amplification (T_A)



Timing diagram (4)



Hold (T_H)



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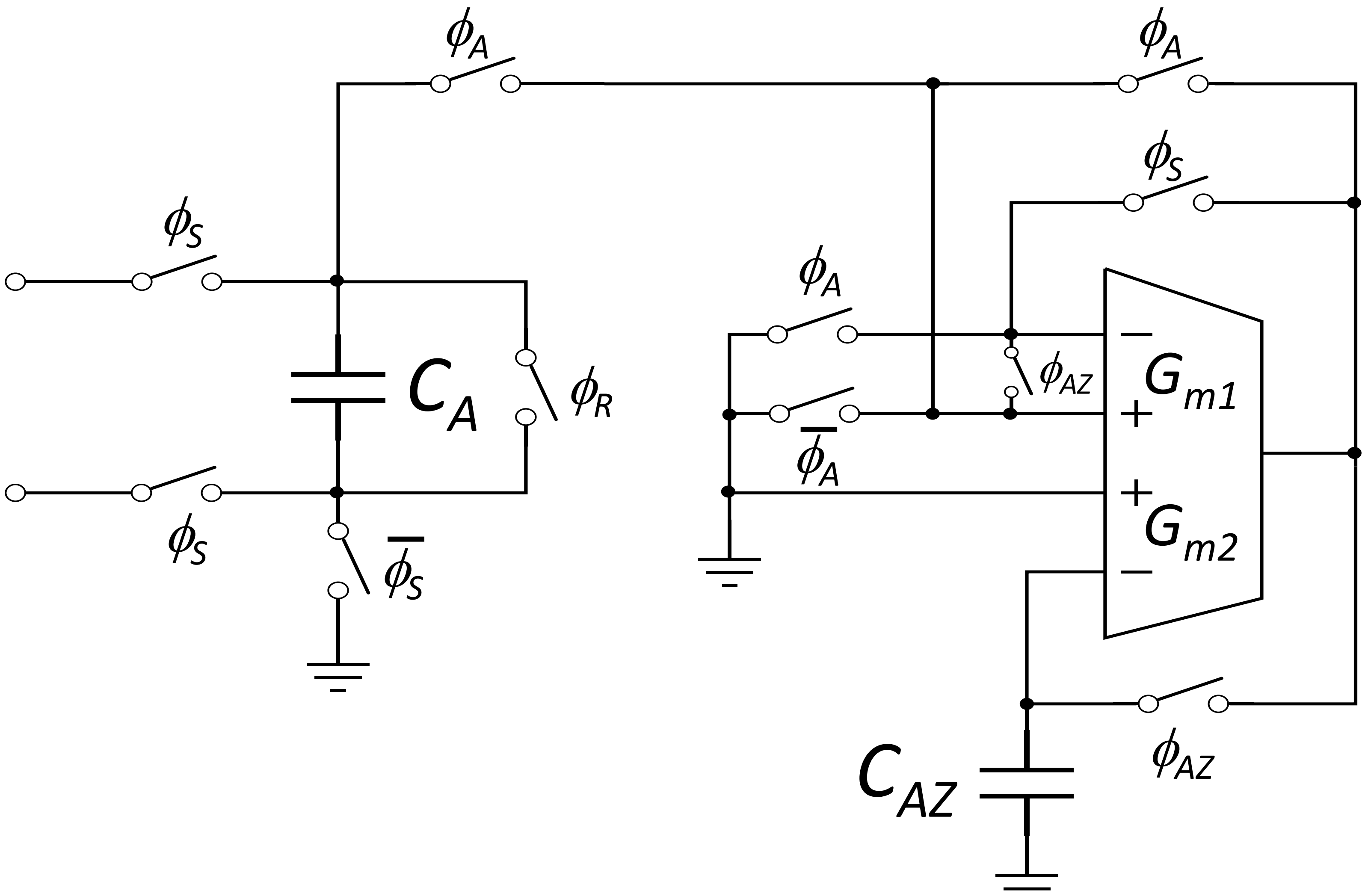
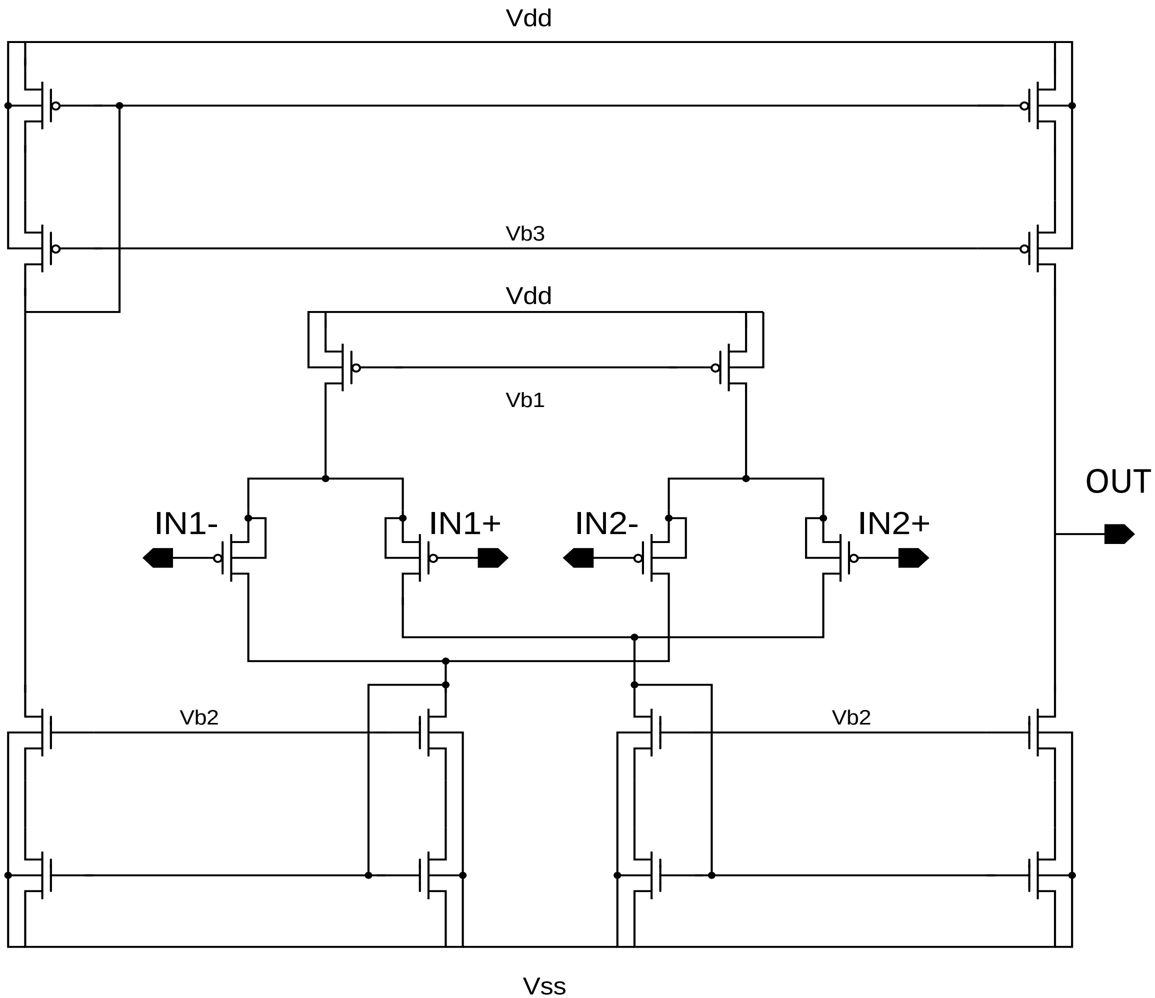
DC-VGA schematic including AZ loop



Two input-port OTA schematic

Consider:

- Gm
- Linearity
- Offset / Av
- Power
- f_k/ Area



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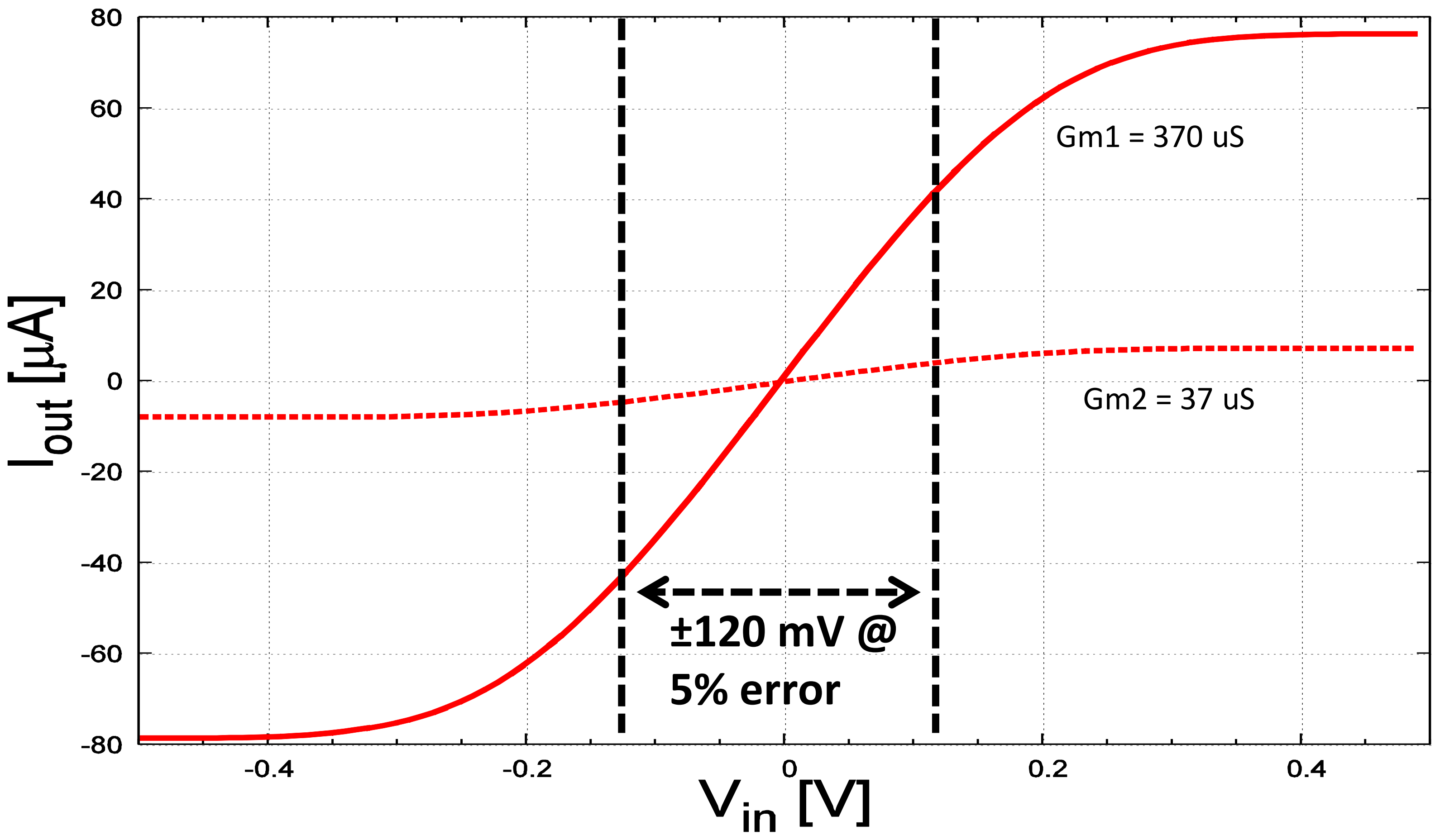
OTA G_m and linearity

Simulation results



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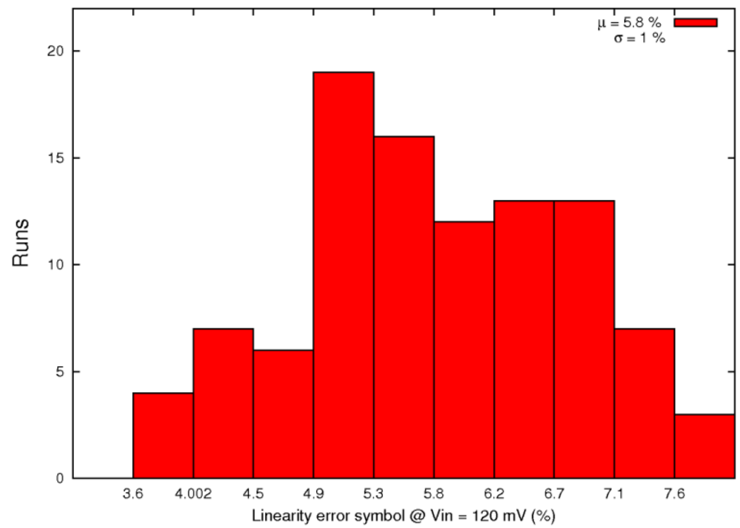
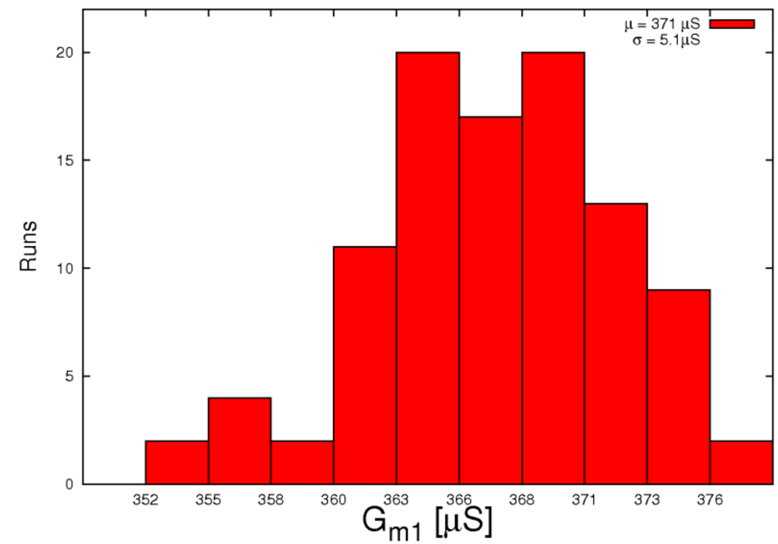
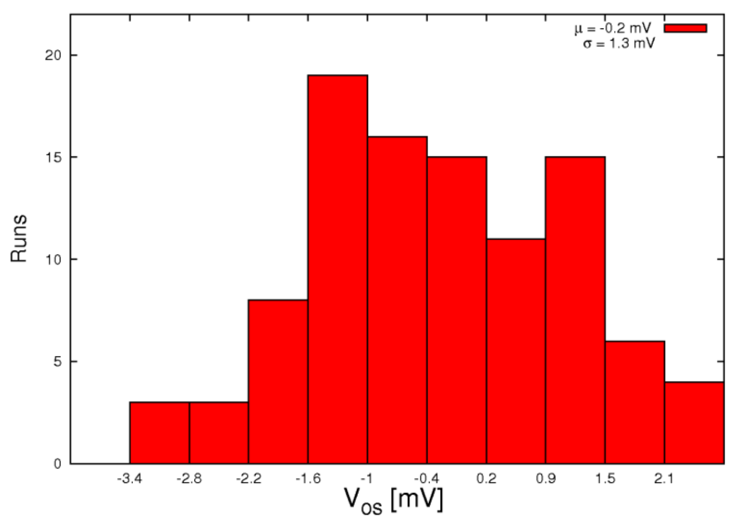
MC simulations for the OTA

Simulation results







- Linearity error and G_{m1} variation represents a max Gain error of 5%.
- The offset variation was the expected during design stage.

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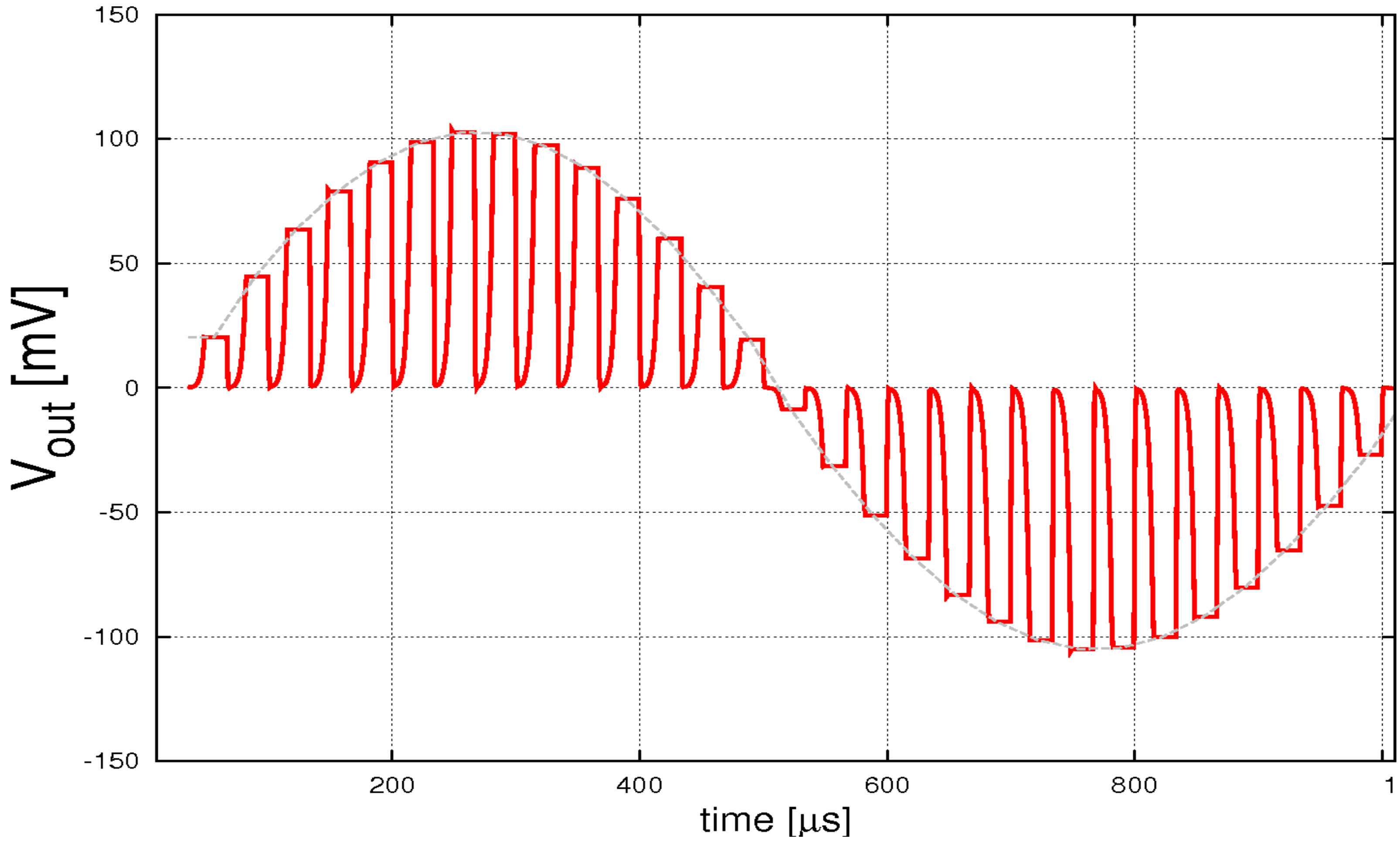
Output voltage signal obtained from the DC-VGA

Simulation results



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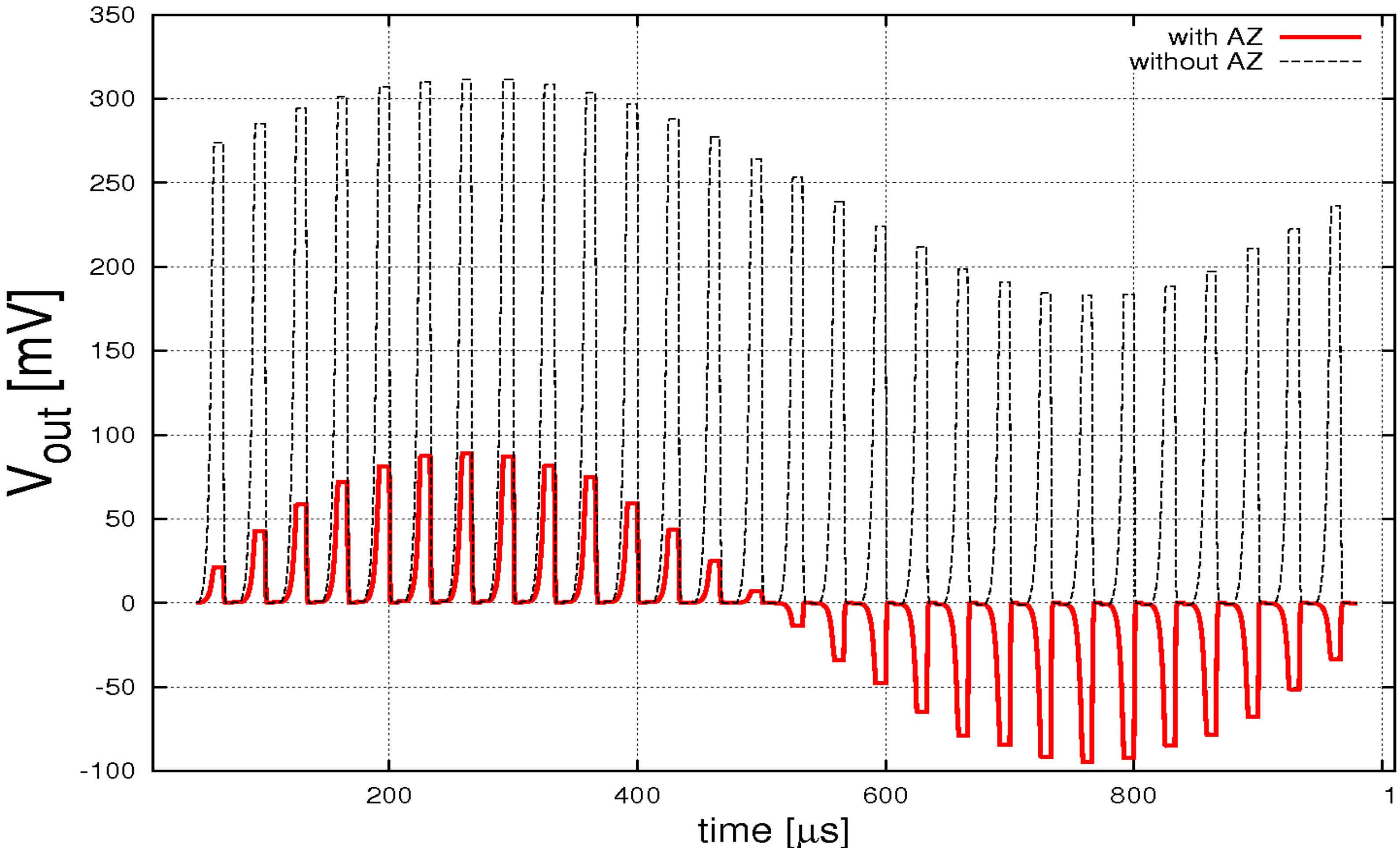
Comparison of the response without AZ loop

Simulation results



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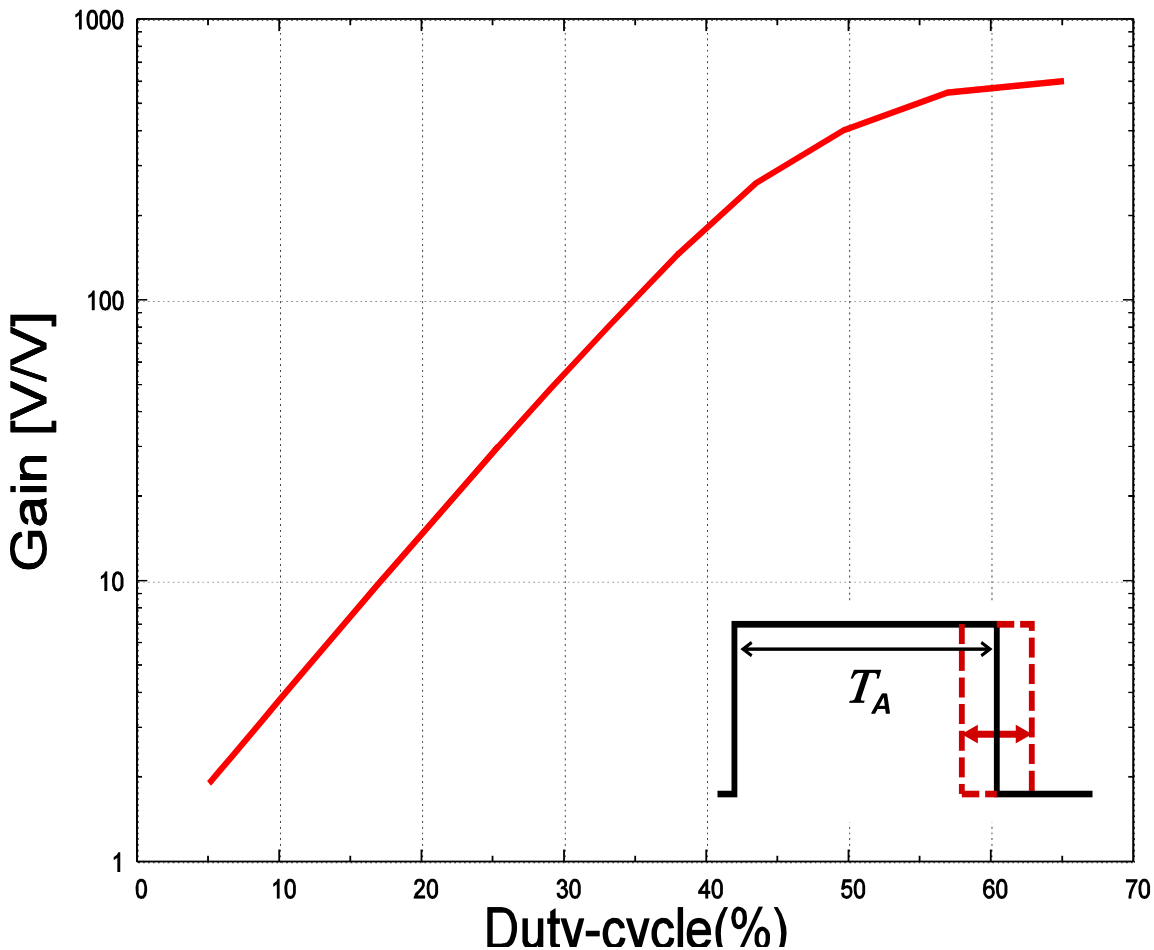
Variable gain by duty-cycle

Simulation results



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Conclusions and future work

- A VGA controled by duty-cycle was presented. Simulated post-layout results proved that it is suitable for amplification of biomedical signals.
- Some improvements in power consumption and area can be done depending on the application.
- Waiting for prototype to be tested inside AGC for biomedical signals.

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Thank you for your attention

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