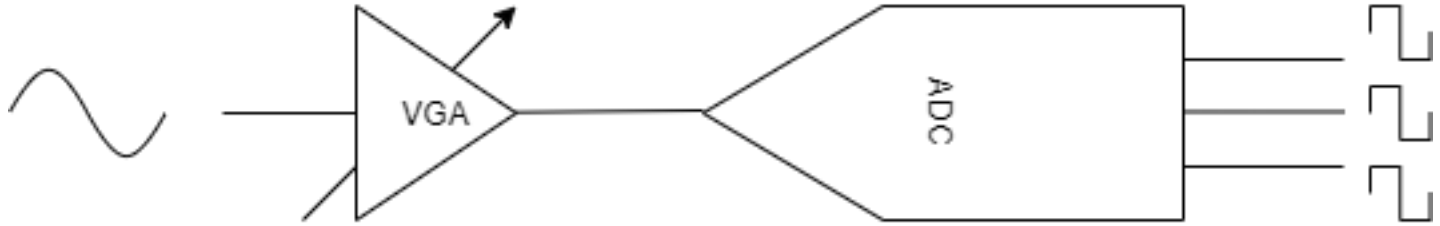
KU LEUVEN

Design of a GMSK 100 bit receiver

Project & Development Electronics and Chip Design

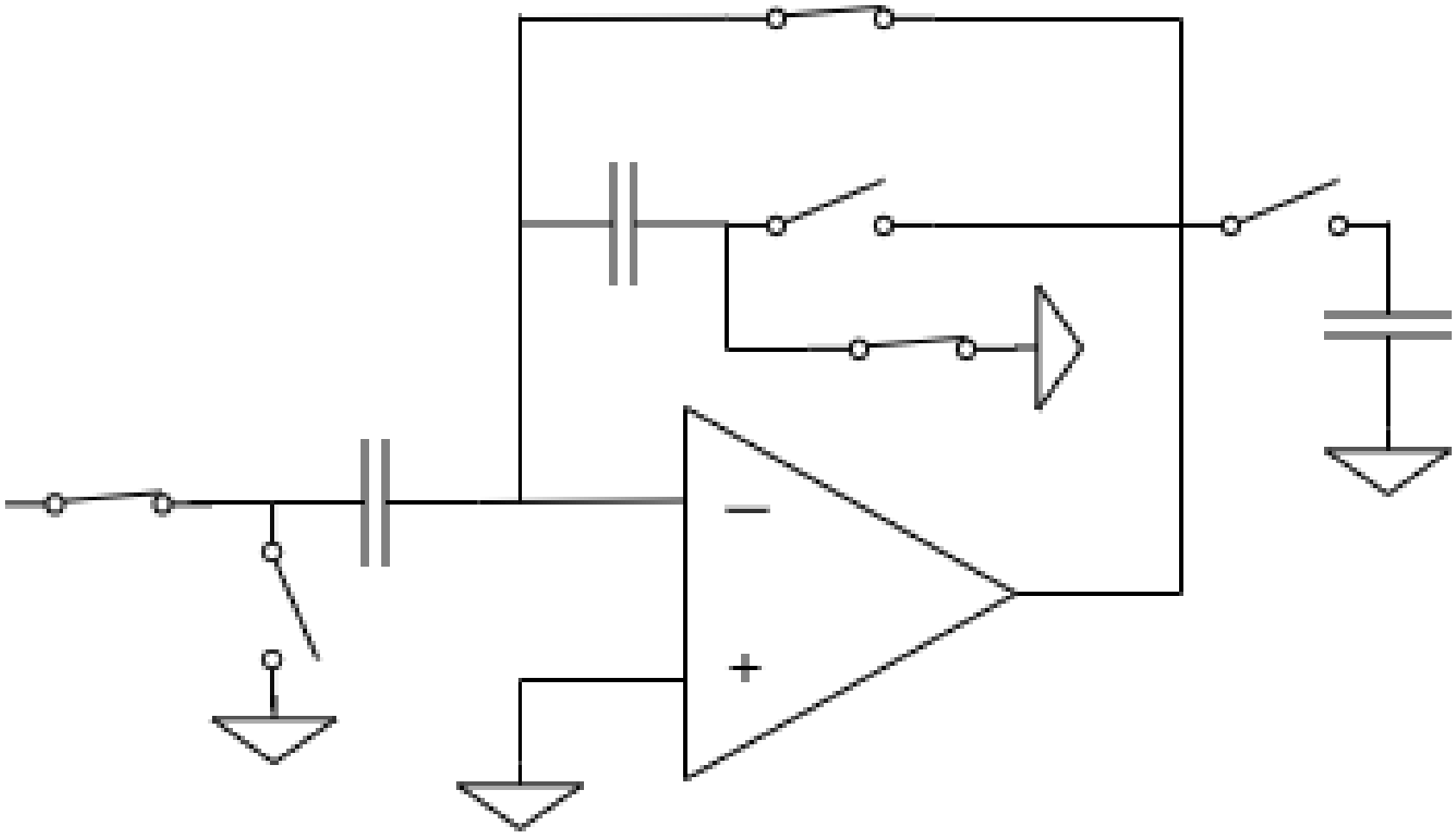
Group 4: Jonas Bertels, Jasper Depuydt, Ruben Heyrman, Ziyu Zhou

Analog Front-End



Switched-capacitor amplifier

- 50 kHz sampling
- 5 to 500 closed-loop gain
- 1V output swing



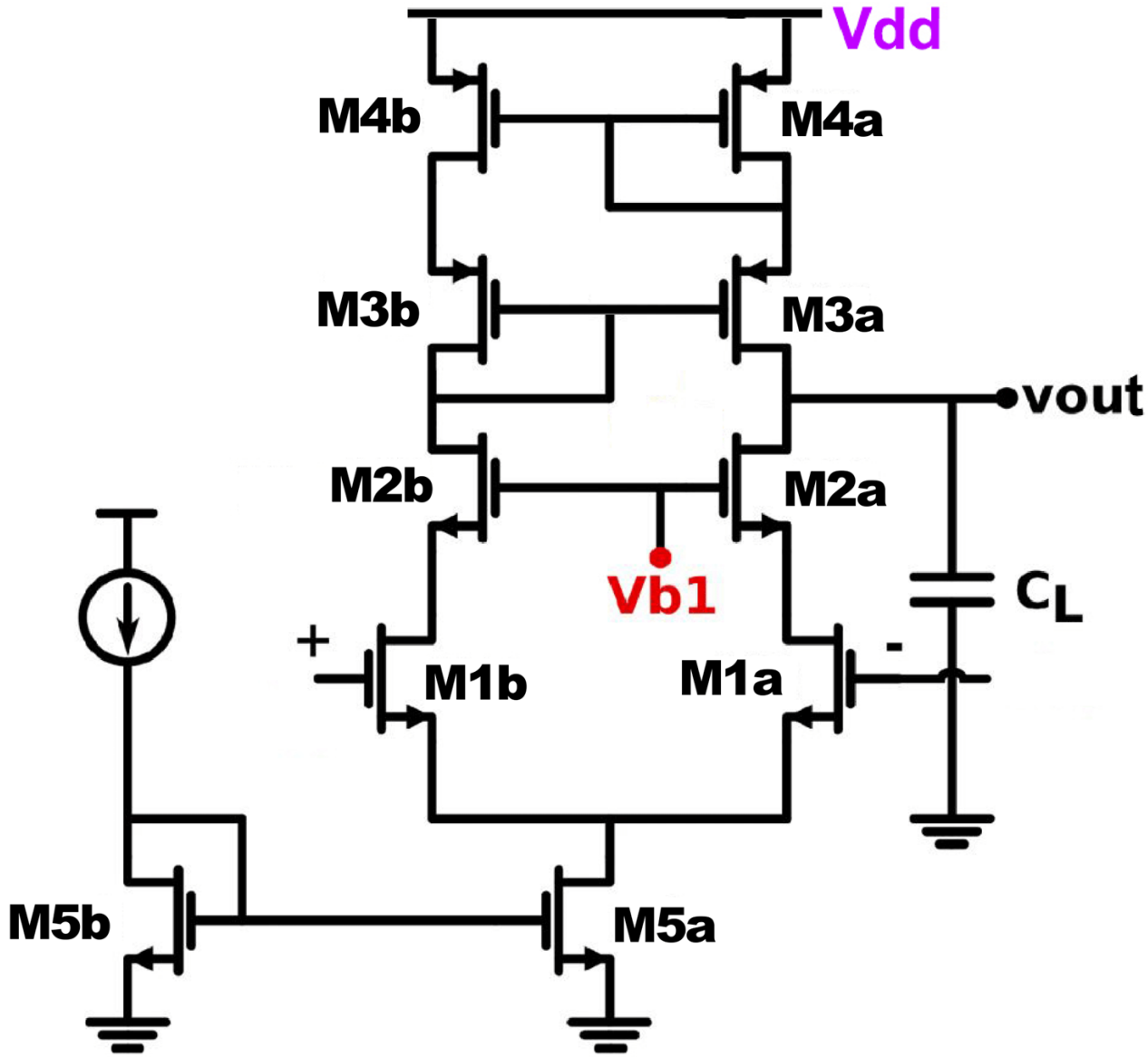
Telescopic OTA

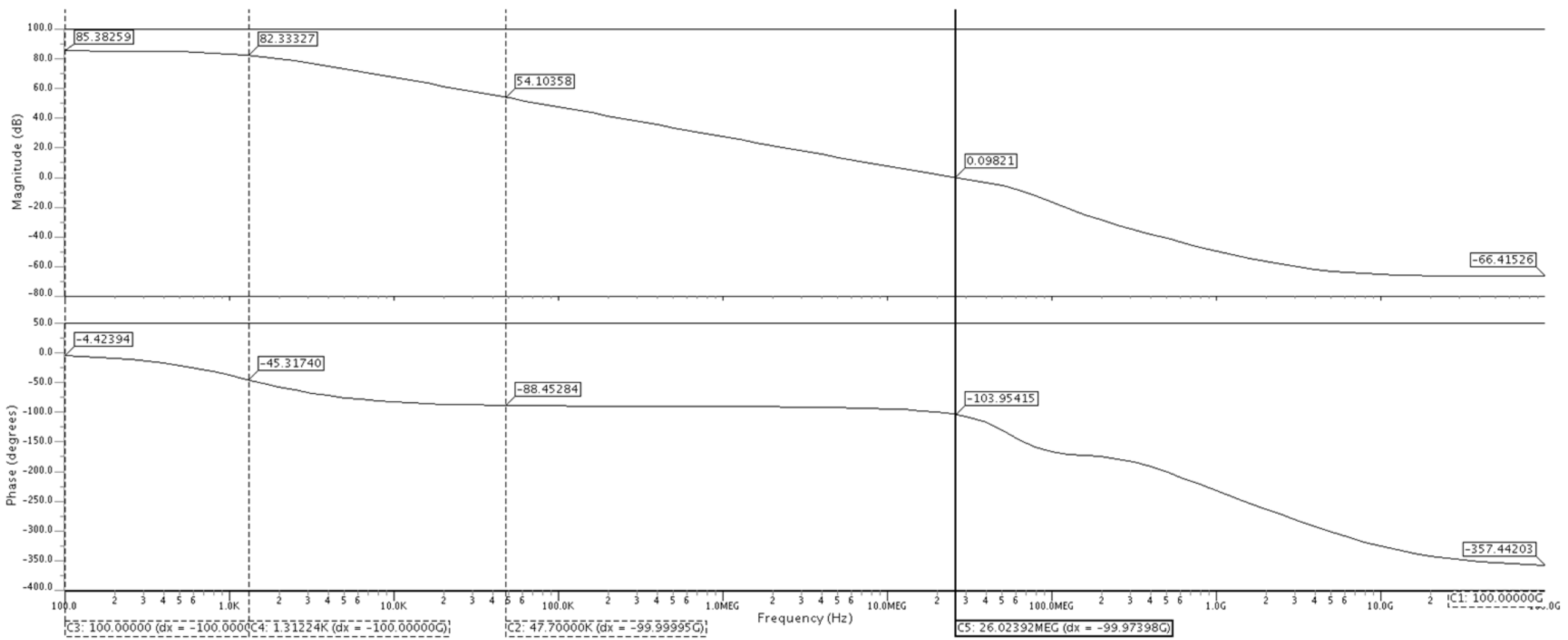
Requirements

Gain error (%)	Settling error (%)	$f_s(kHz)$
3	5	50

Calculated specifications

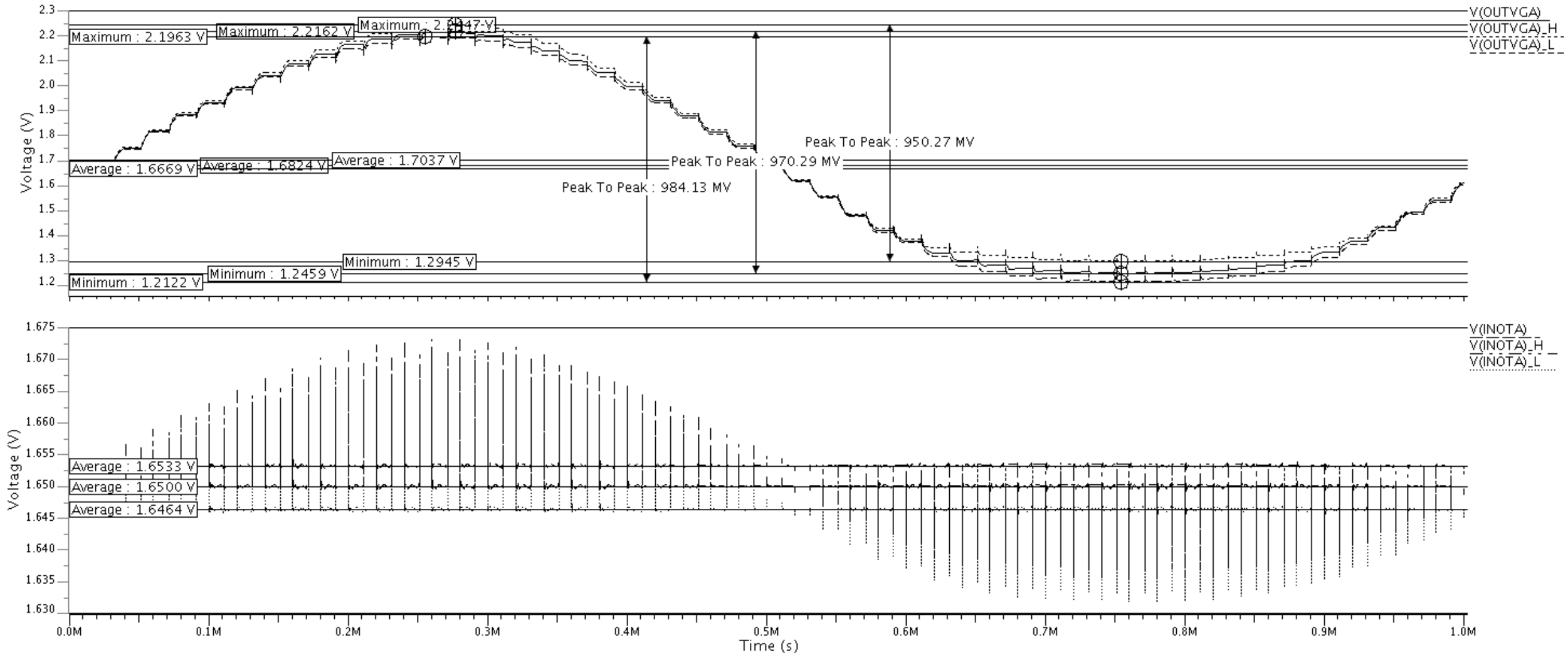
$BW_{CL}(kHz)$	$Gain_{CL,max}(/)$	GBW (MHz)
47.7	500	23.8
$BW_{OL}(kHz)$	$Gain_{OL}(dB)$	GBW (MHz)
1.47	84.2	23.8





$\mathrm{BW}_{OL}(kHz)$	$\mathrm{Gain}_{OL}(dB)$	GBW (MHz)
1.3	85.4	24.2
C_L (pF)	output swing (V)	Power (μW)
1.2	1.4	99

Transient result switched-capacitor amplifier

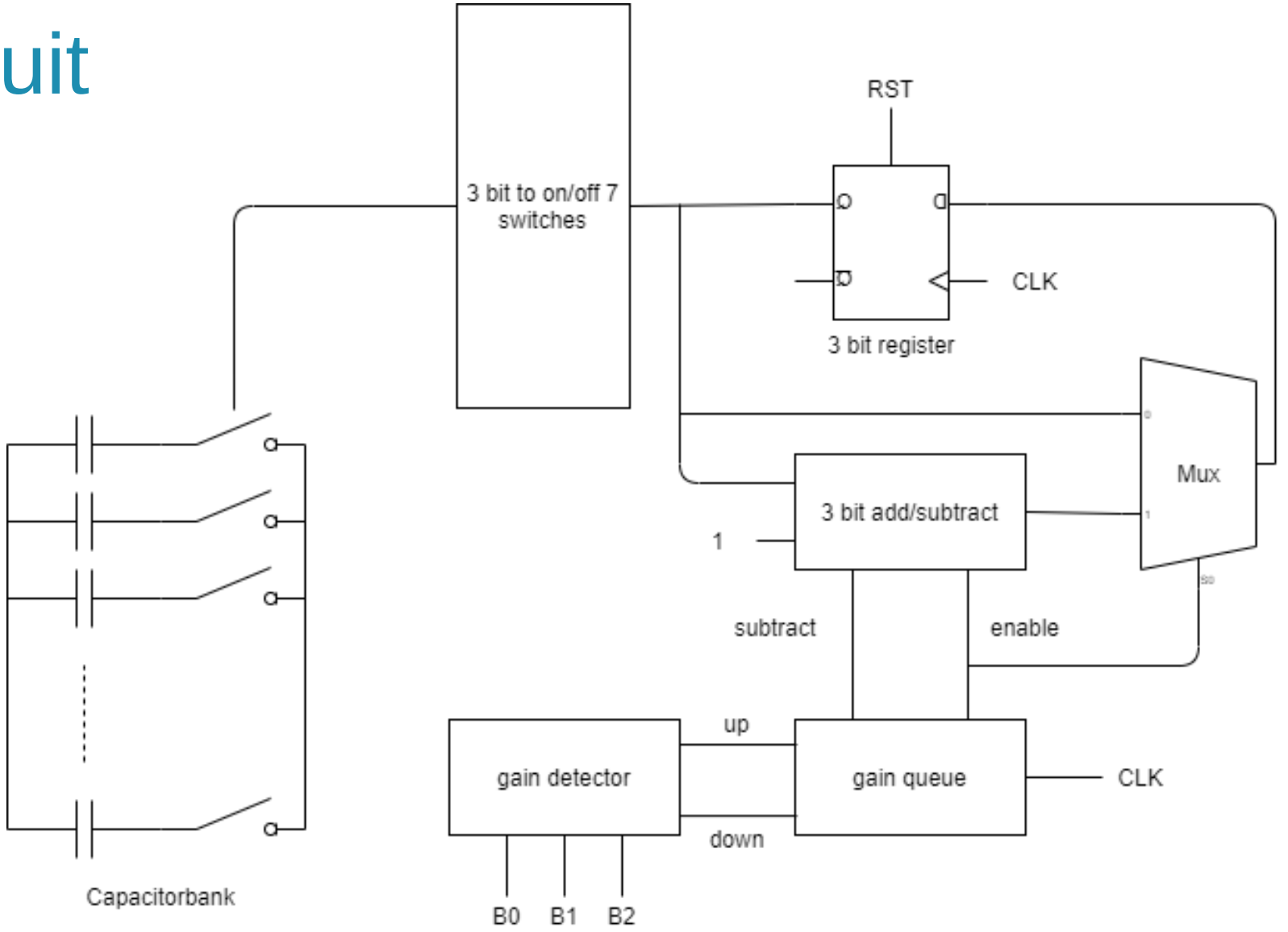


Variable gain circuit

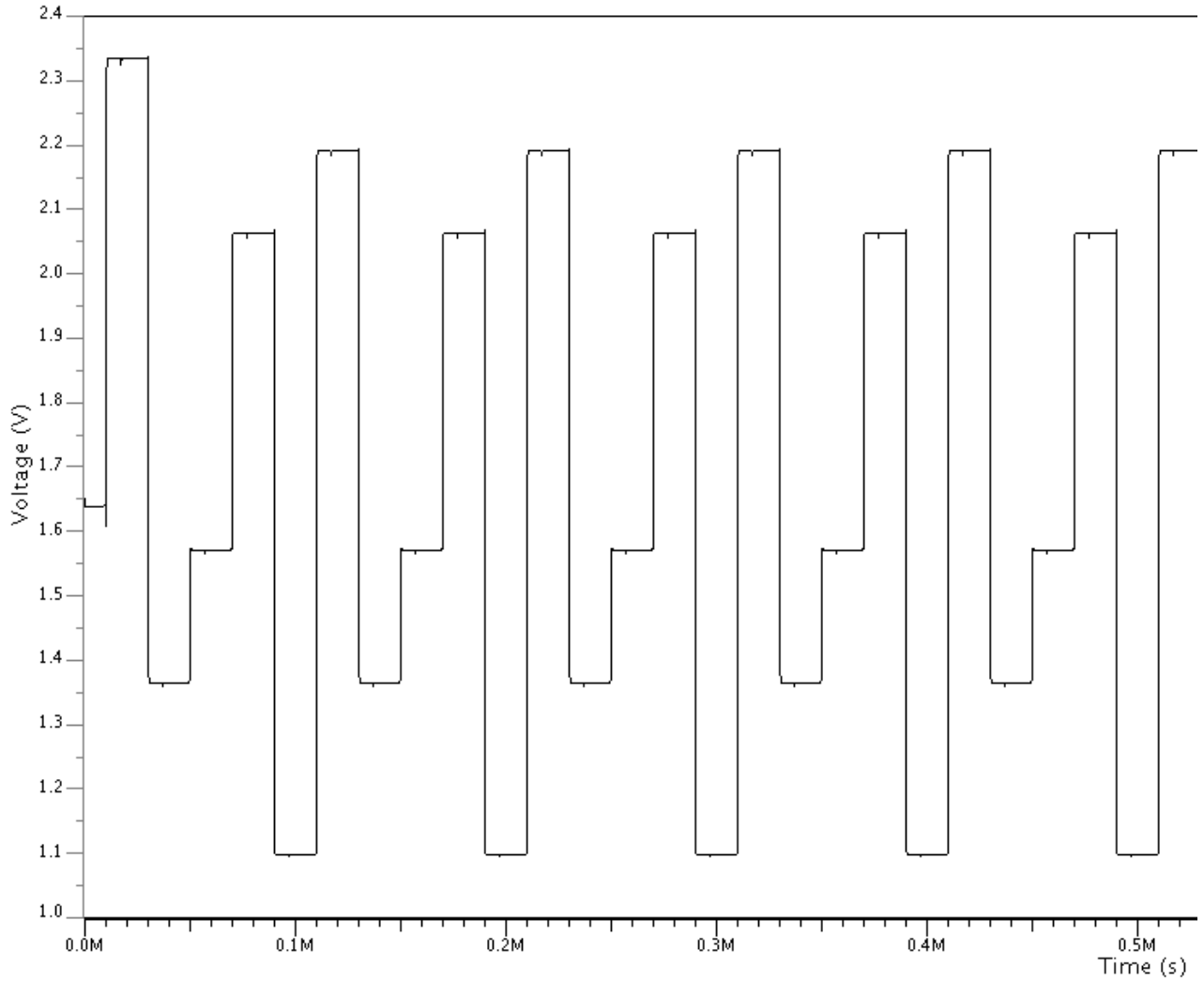
Gain detector

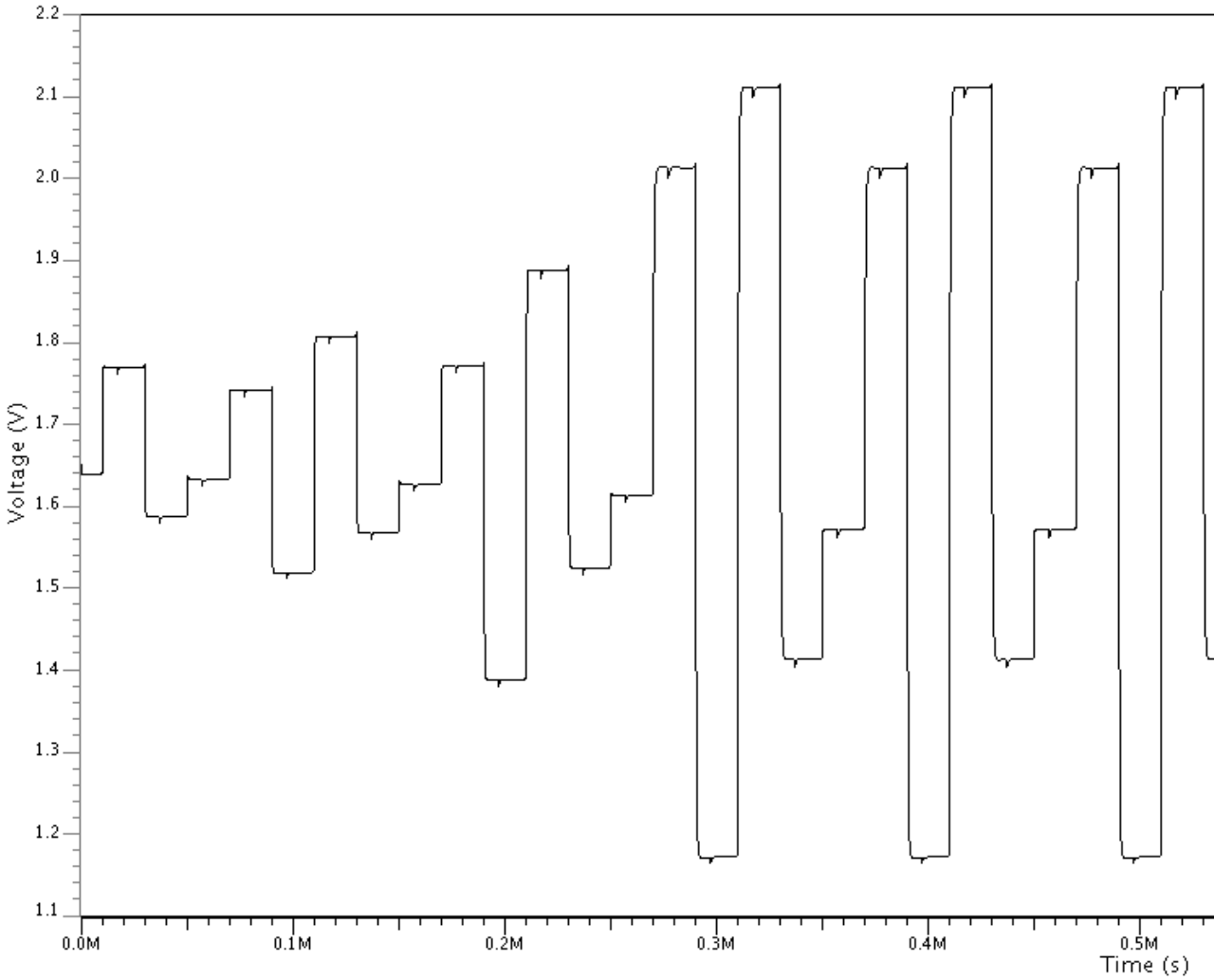
Gain queue

Gain regulator

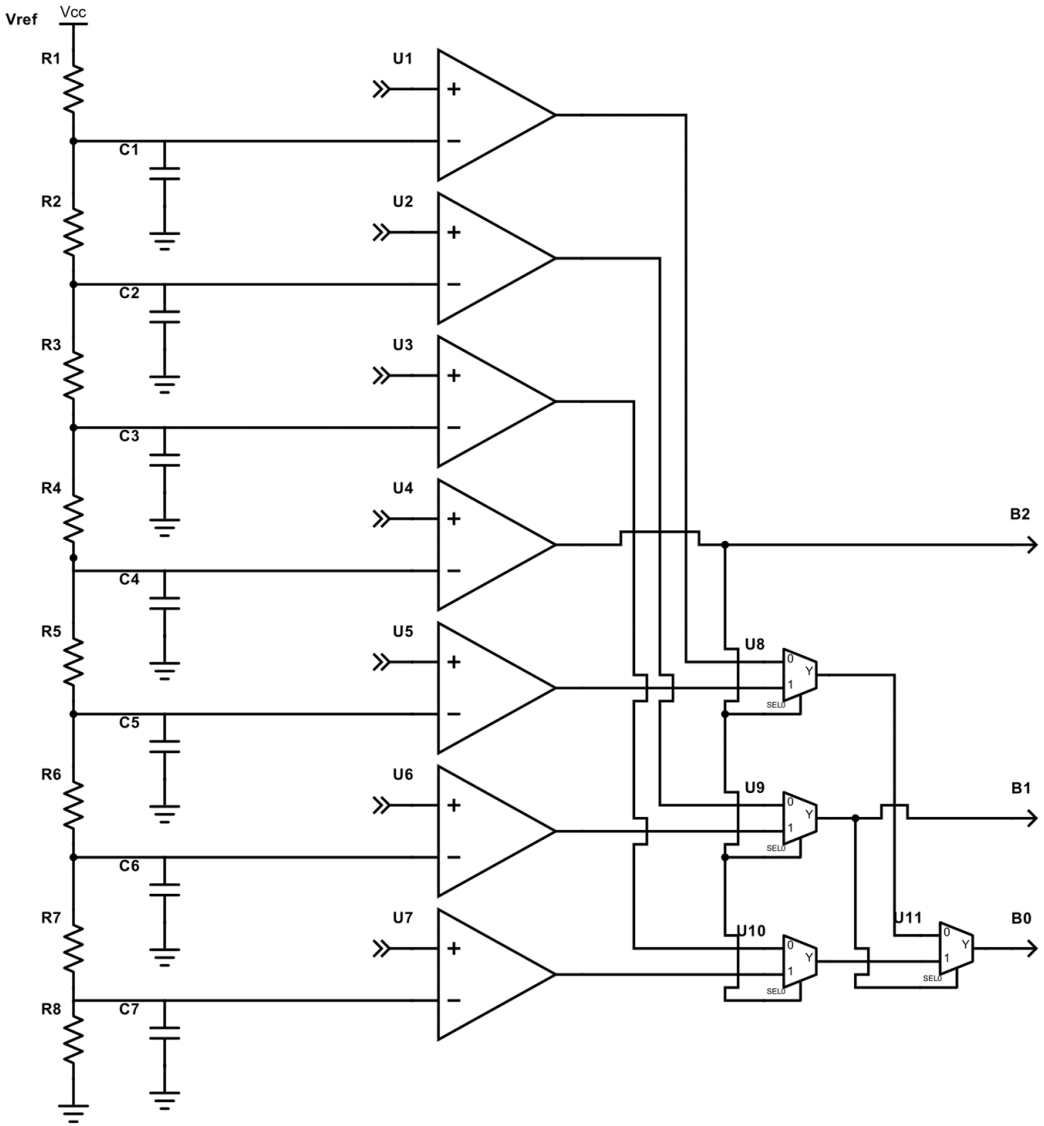


Results variable gain

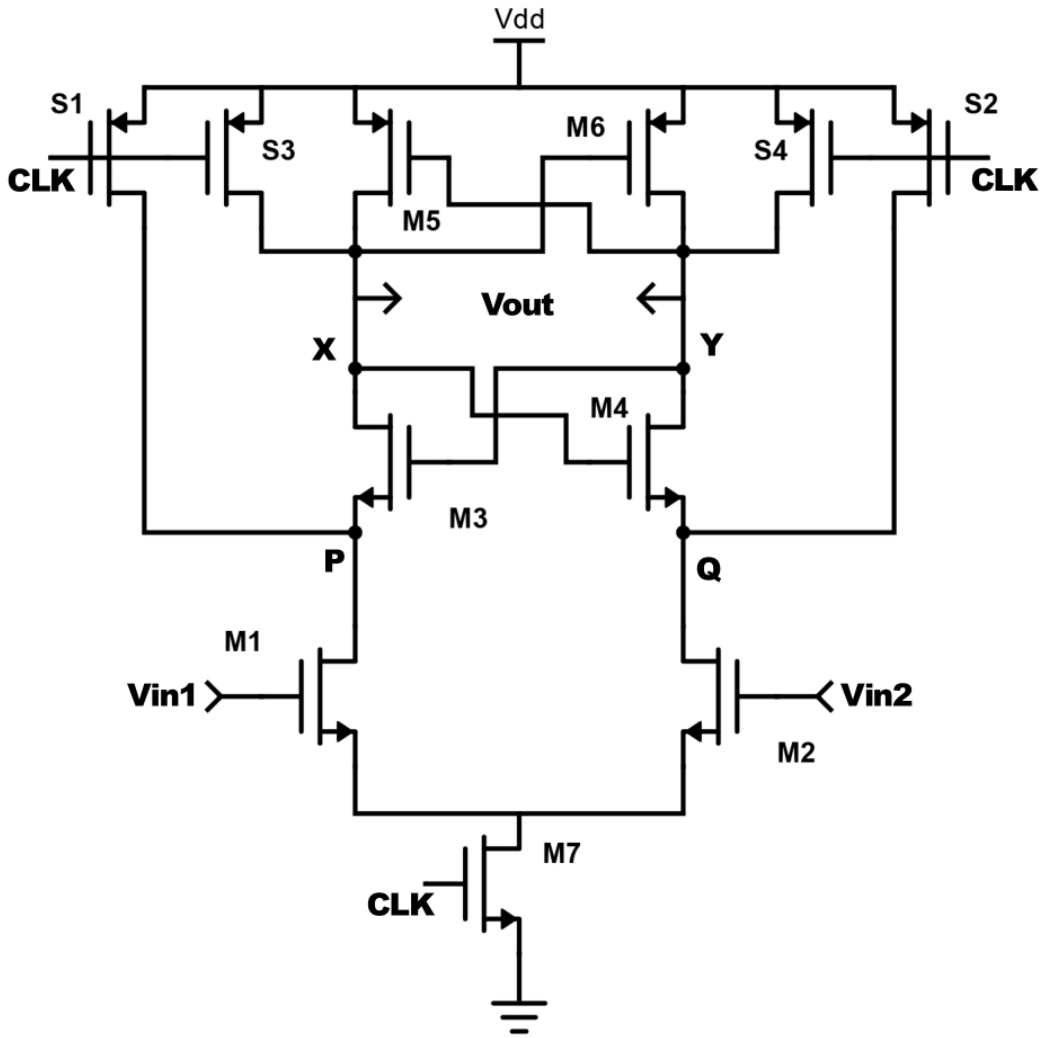




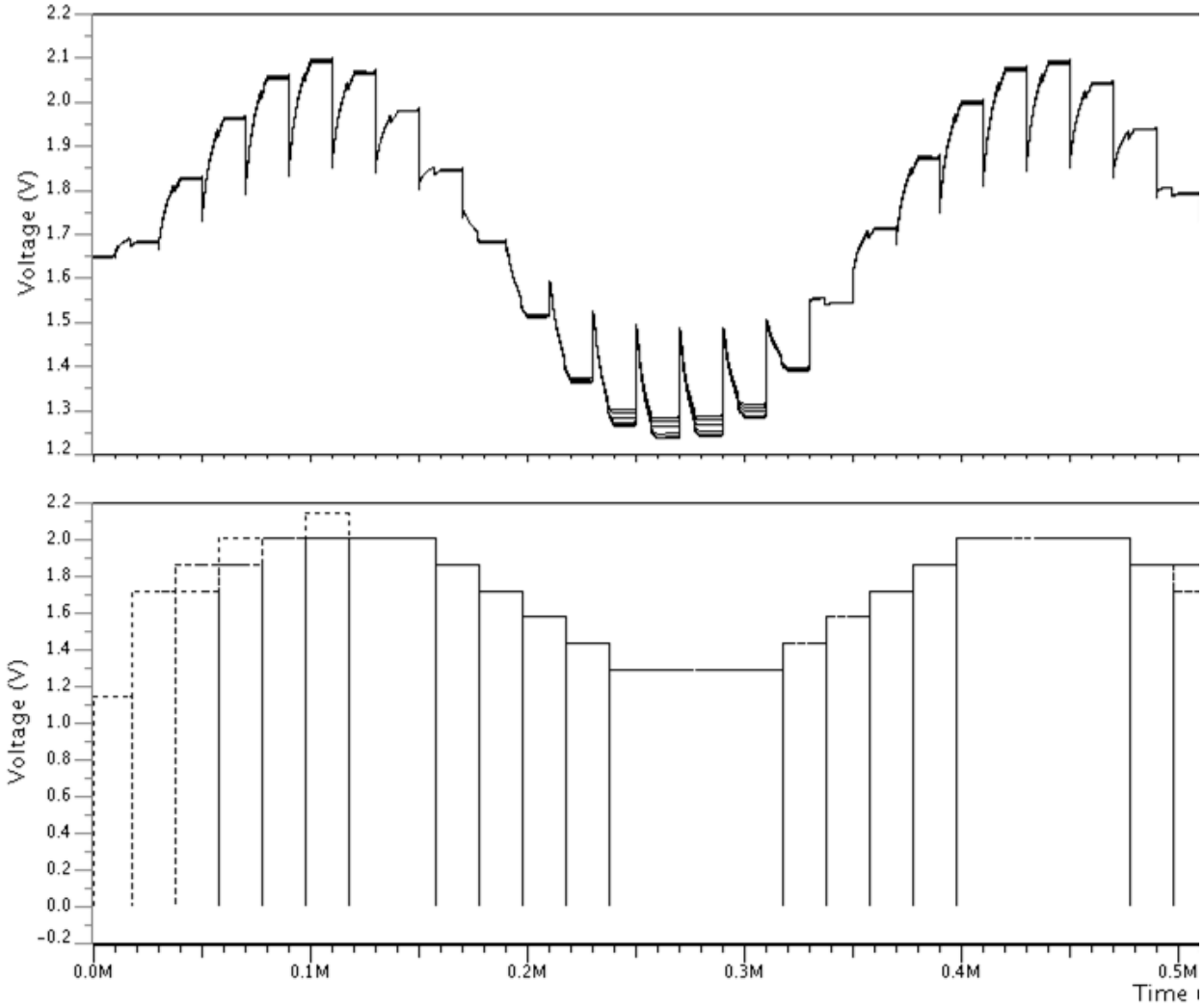
Flash ADC

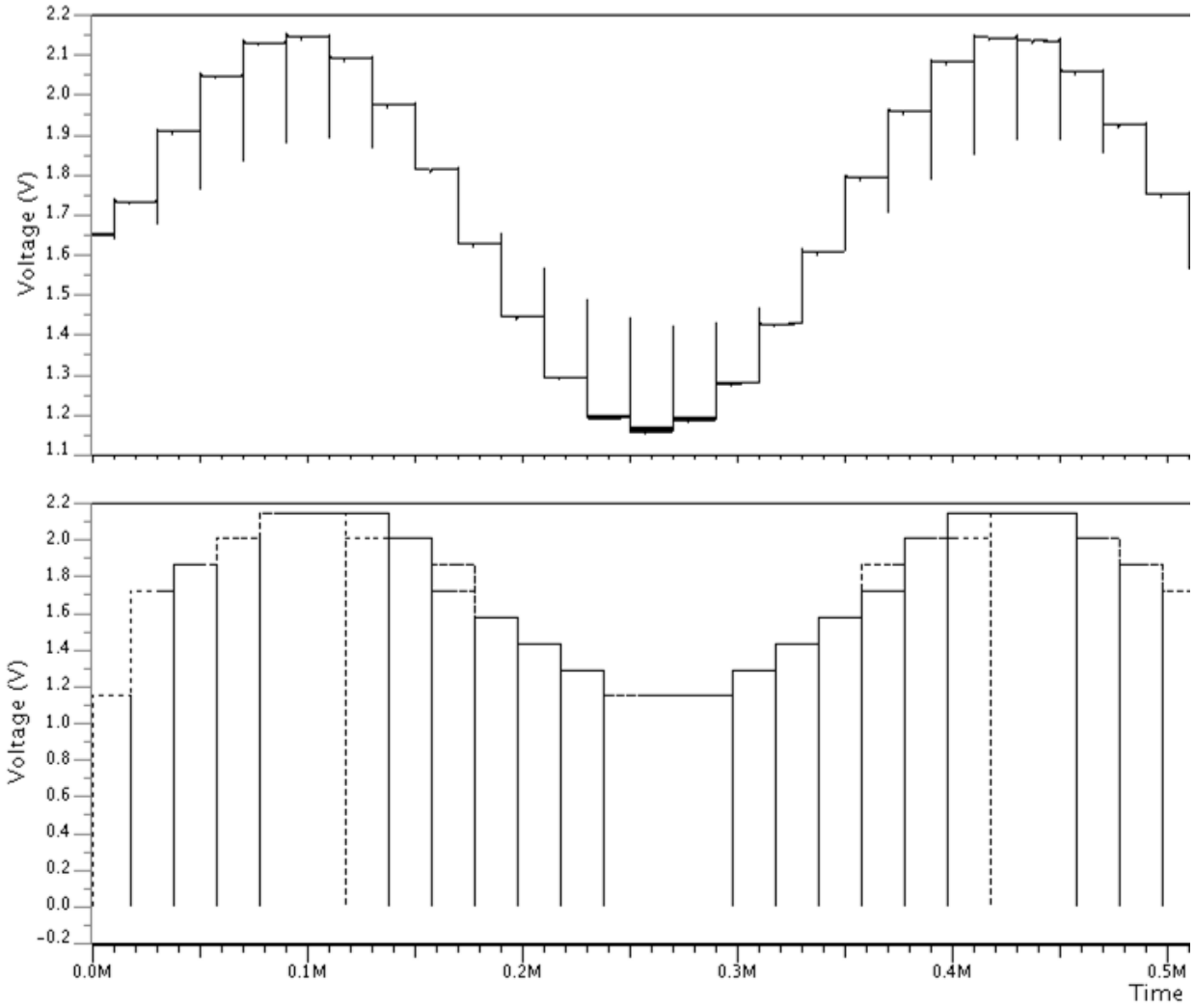


StrongArm Comparator

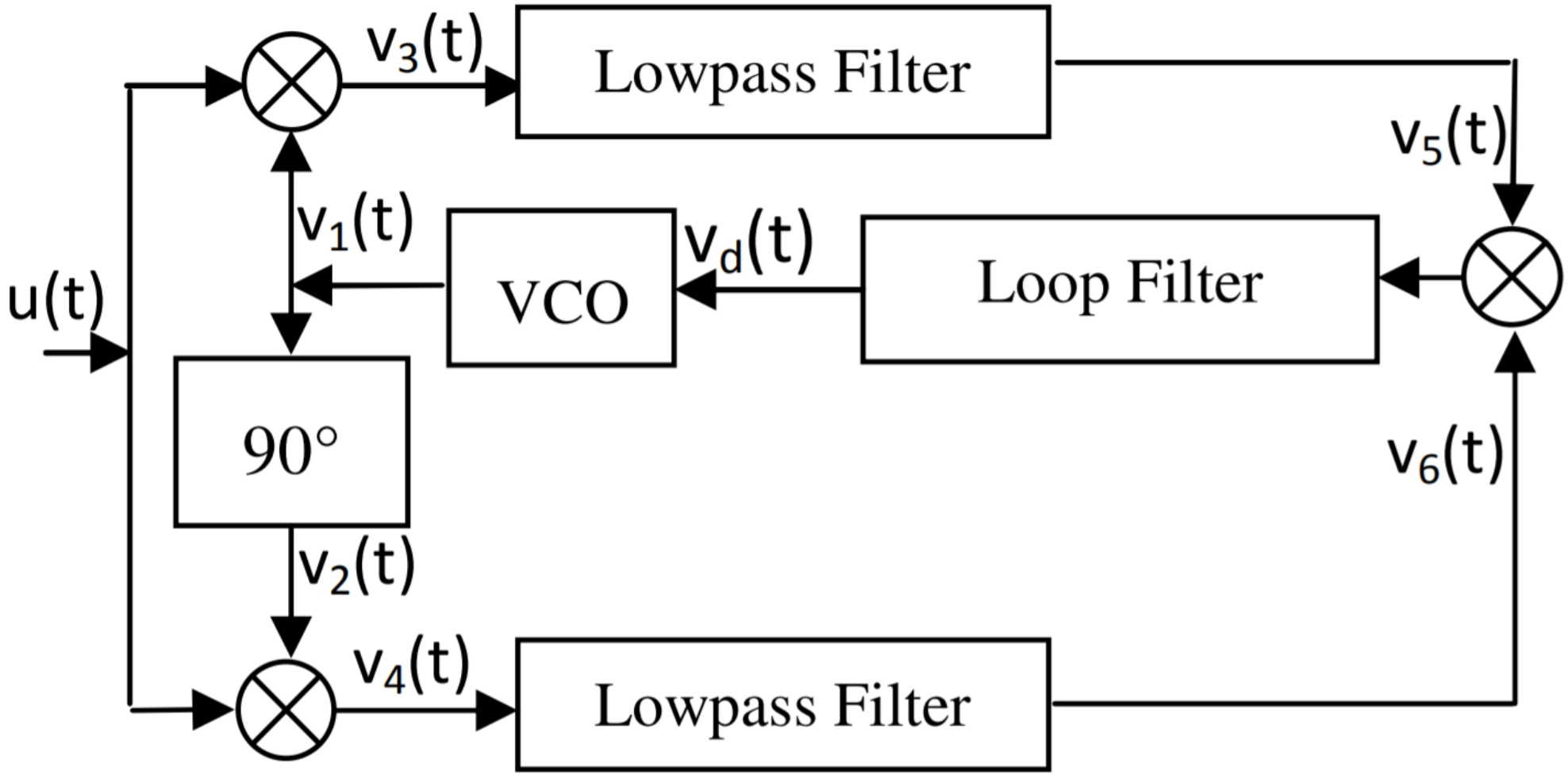


Results Analog Front-end

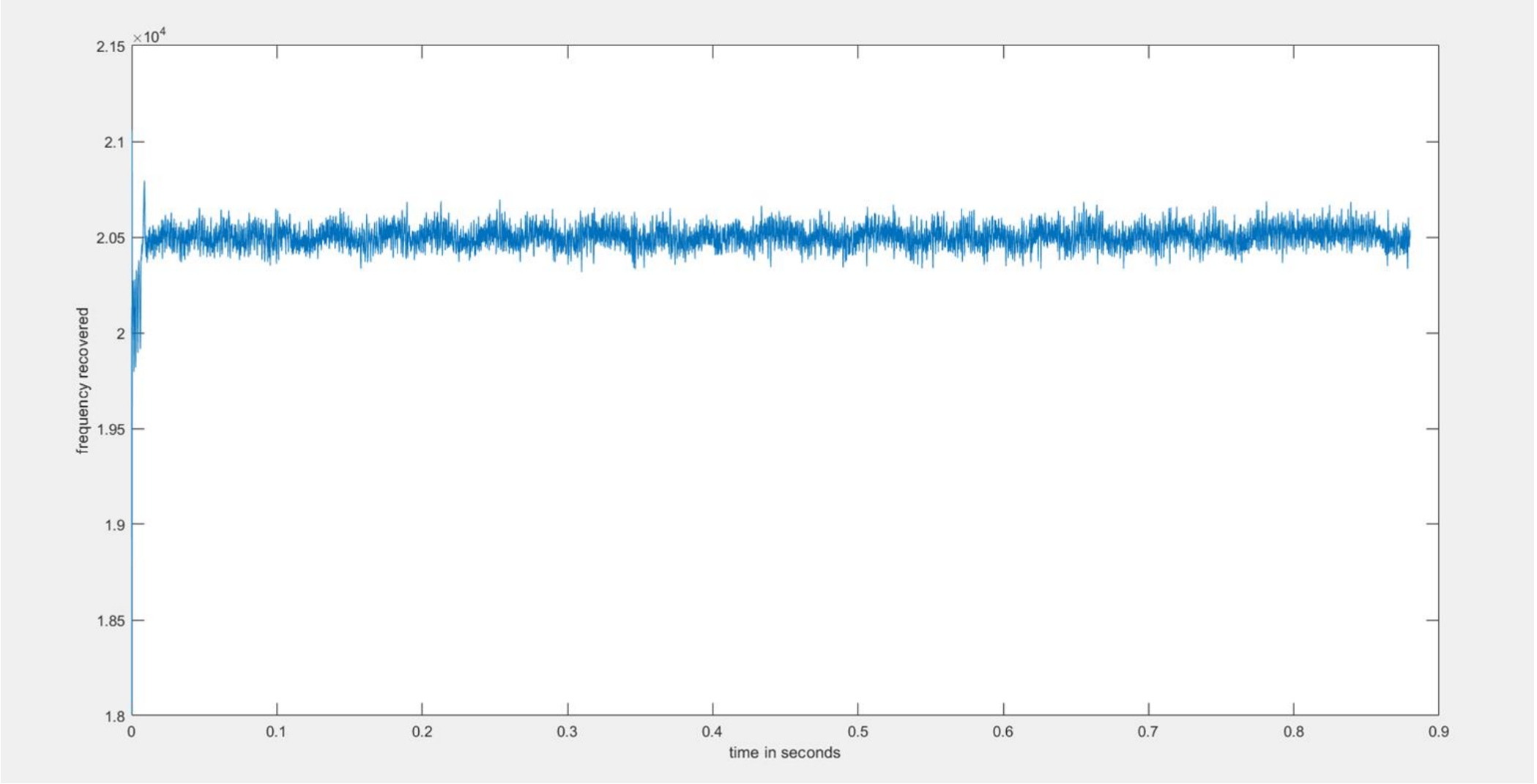




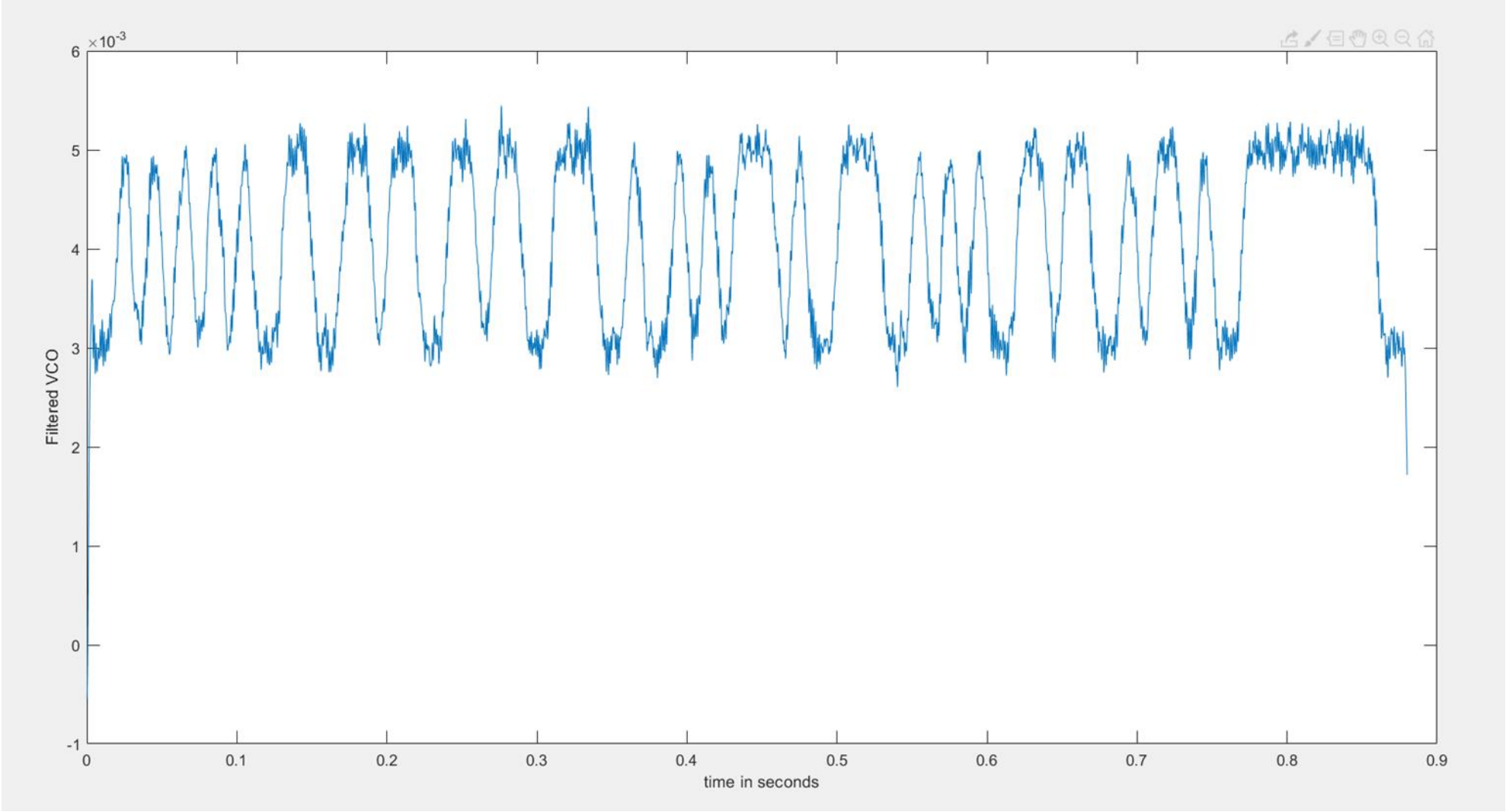
Digital: costas



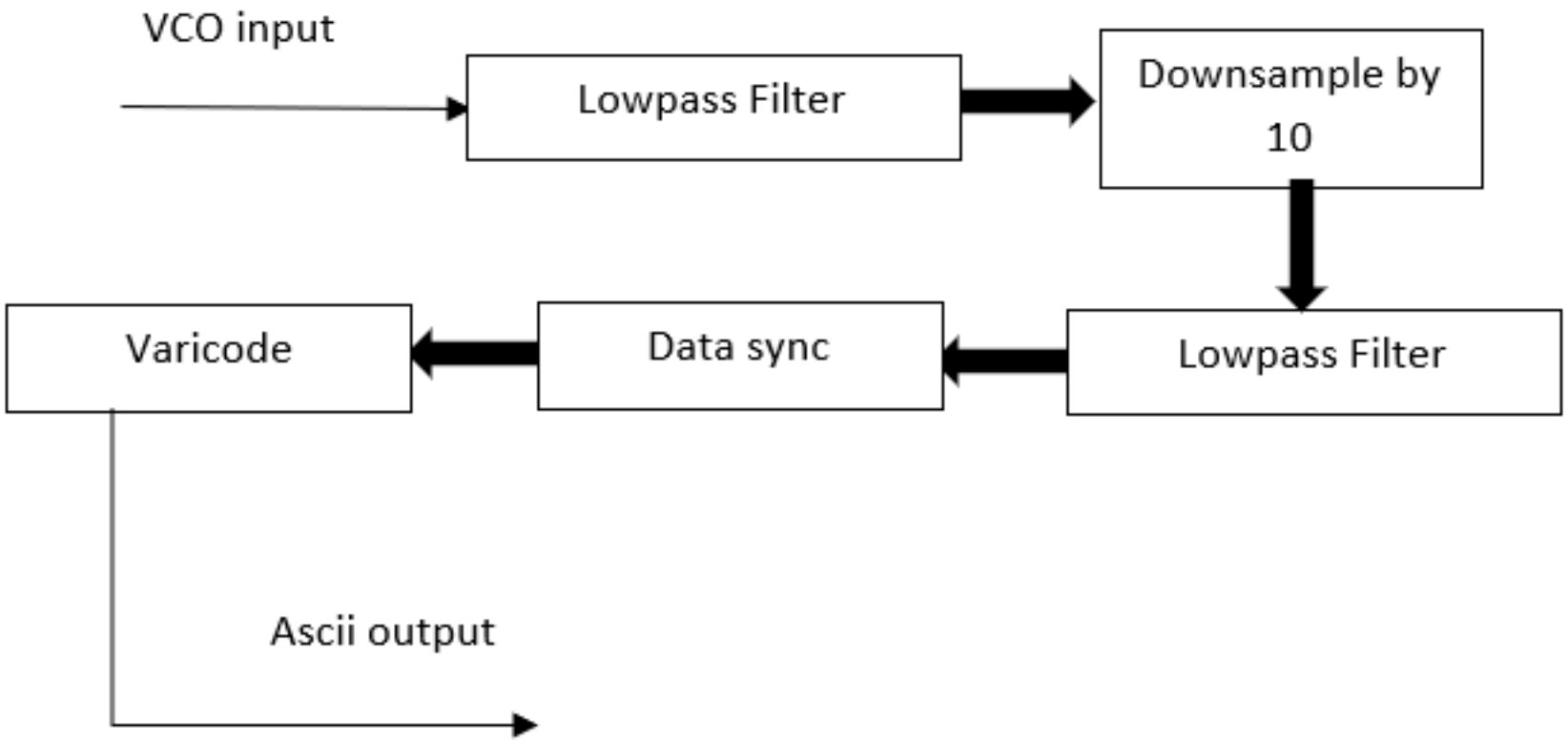
Frequency recovered from the costas loop



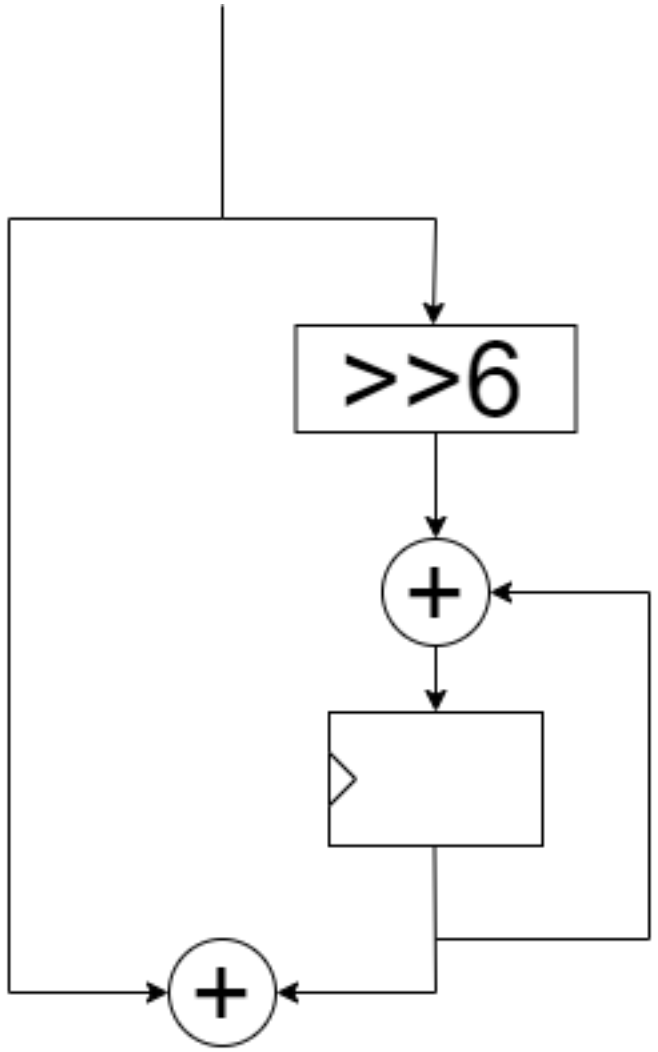
Filtered VCO



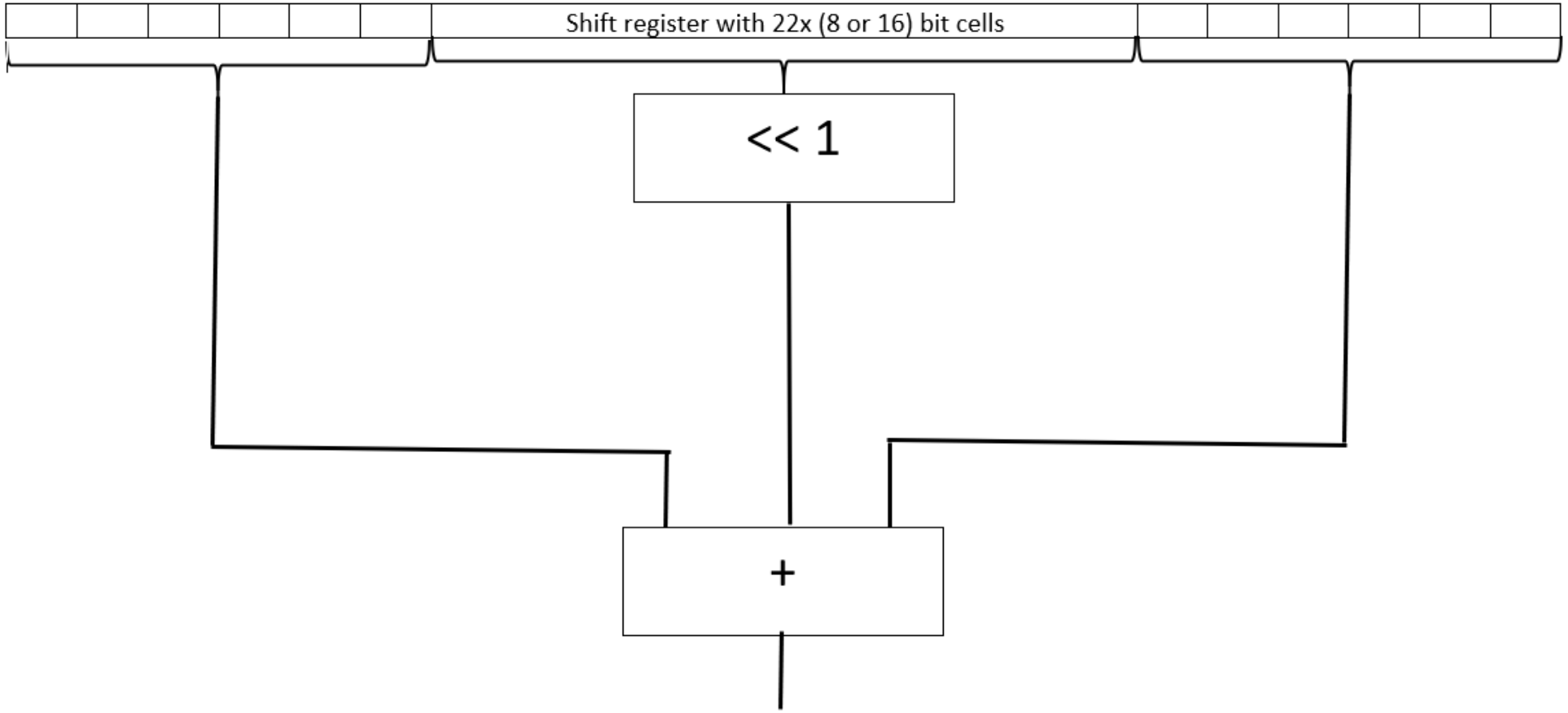
Filtering and ascii recovery



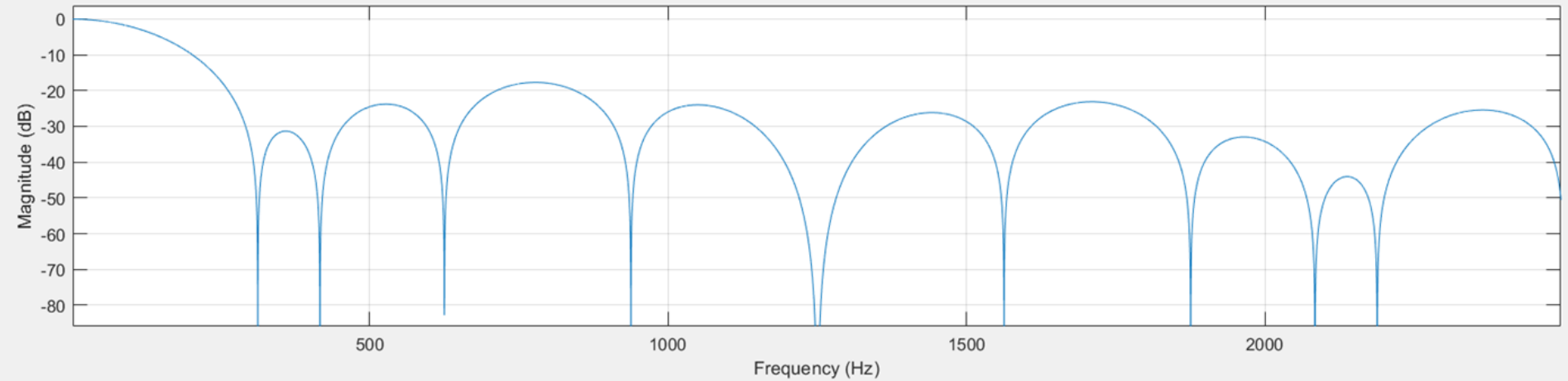
Loop filter

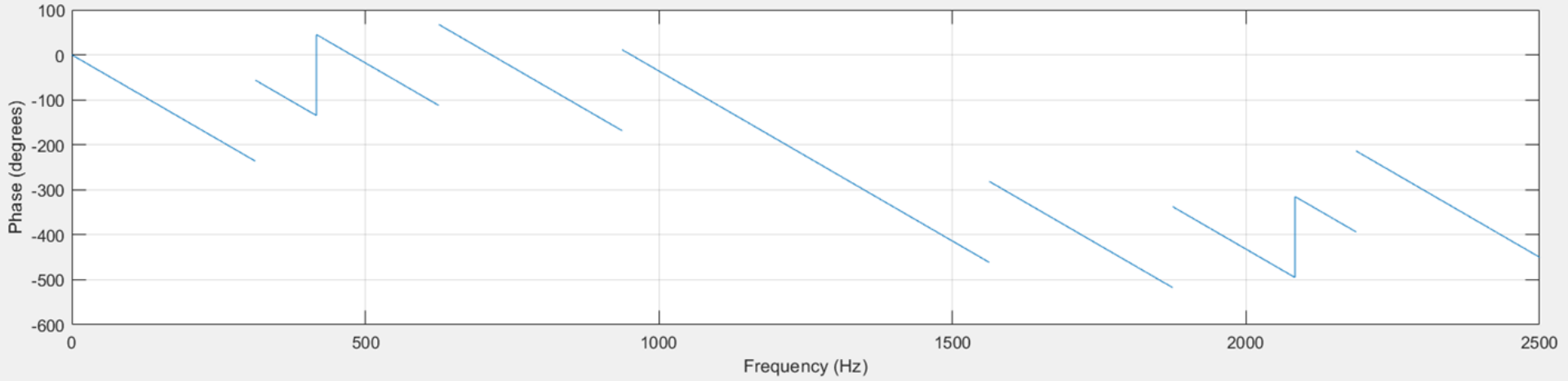


Hardware implementation of our filter



Frequency spectrum of filter



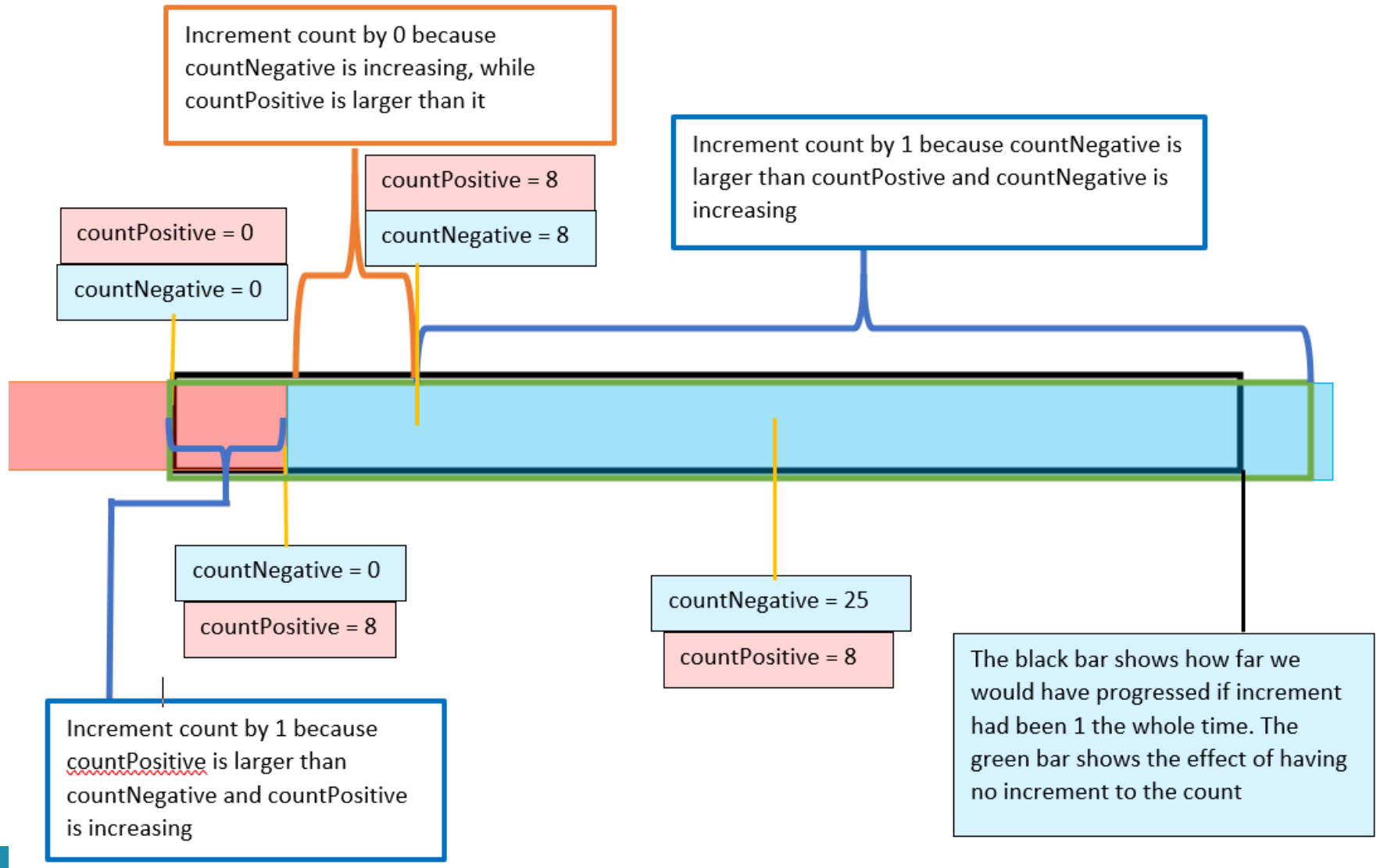


Cordic Matrix for single iteration

$$\begin{bmatrix} x_{(n+1)} \\ y_{(n+1)} \end{bmatrix} = \cos(\theta_n) \begin{bmatrix} 1 & -S_n tan(\theta_n) \\ S_n tan(\theta_n) & 1 \end{bmatrix} \begin{bmatrix} x_n \\ y_n \end{bmatrix}$$

Hardware-efficient iterative method
Multiply by tan(θn) can be achieved by a bitwise shift

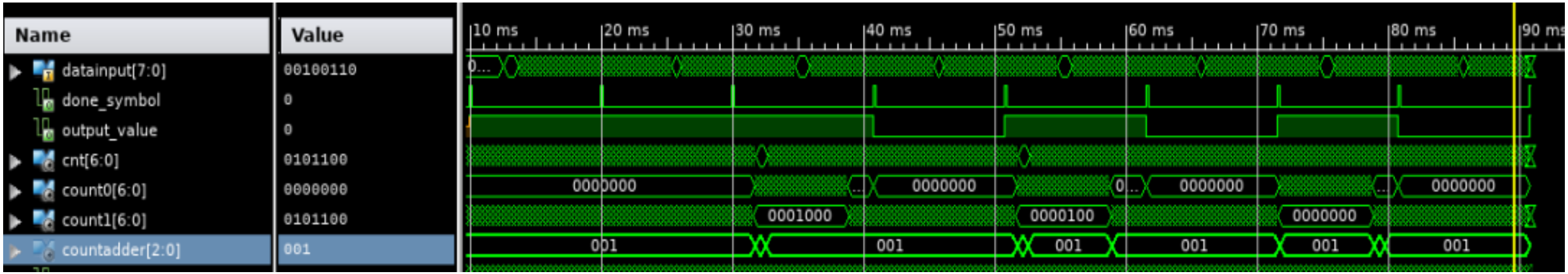
Data synchronization



Slow down the total count when running ahead

Speed up the count when running behind

Data synchronization



Cnt : increments by counterassder on every new value
Count0 : increments on a positive value
Count1 : increments on a negative value
Countadder : slow down when “000” and speed up when ”010”

Result and resources

Logic	Used	Available	Utilization
Slice Register	2570	4896	52 %
Total 4 input LUT’s	3661	4896	74 %
RAMB 16’s	1	12	8 %
MULT18X18SIOs	3	12	24 %

Result digital message & conclusion

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Terminal
File  Edit  View  Search  Terminal  Help
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LEEVEL: 2
SECRET: NpaaKKZllYYY3DdmIrnytTddzbww8vAv33zLCkw


"The aim of science is to make difficult things understandable in a simpler wayy; the aim of poetry is to state simple things in an incomprehensible way. The two are incompatible.."
- Paul Dirac

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LEEVEL: 2
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