NOVA SCHOOL OF
SCIENCE & TECHNOLOGY

MEEC/MIEEC

Signal Conversion

SAR ADC Exploiting Split-CDAC

Authors:

Martim Duarte Agostinho (70392) md.agostinho@campus.fct.unl.pt
Francisco Simões Coelho Sá da Costa (70386) fsc.costa@campus.fct.unl.pt
Sofia Margarida Mafra Dias Inácio (58079) sm.inacio@campus.fct.unl.pt

2024/2025 – 2nd Semester, DEEC

Contents

List of Figures

1 ARRANJAR TITULO

Para analisar o circuit primeiro dividir porque é diferencial. e analisar primeiro o DacCirc Explicar que o codigo]e dividido em dois codigos Falar dos split caps

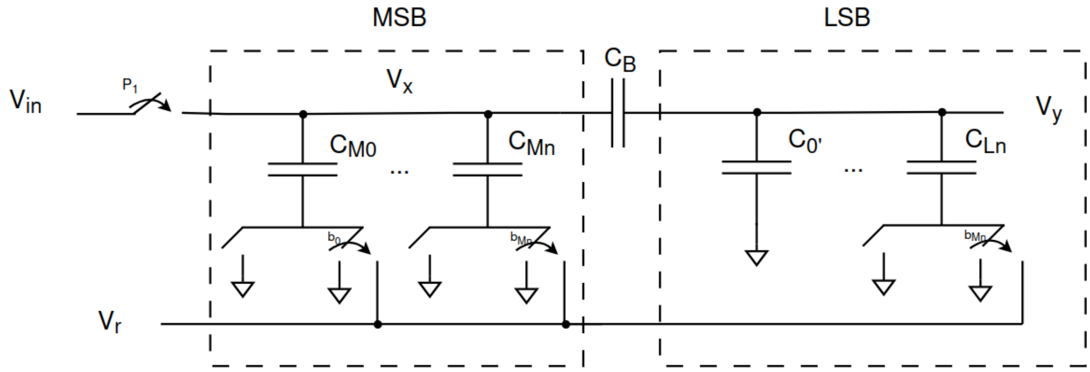

Figure 1: Simplified DAC circuit

explicar que para modelar o DAC só é preciso ver como mudar a fonte de um cap afeta o no.

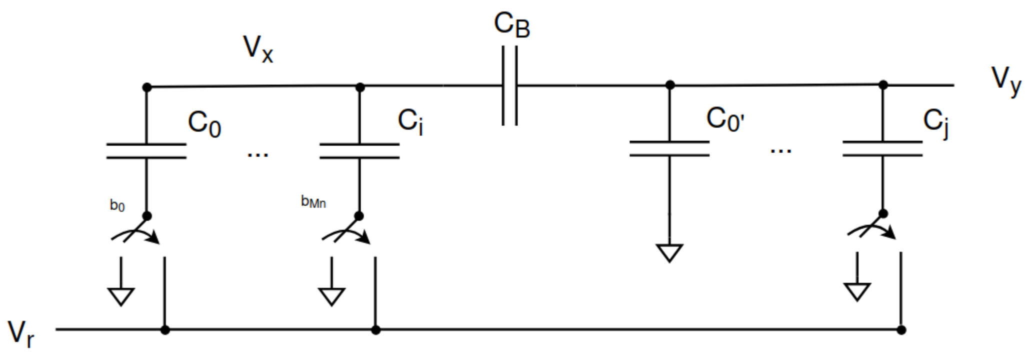

Figure 2: Circuit at phase ϕ_n

For phase ϕ_n the sum of charges at the node V_x is:

$$Q_{\phi_n} = (V_x^{\phi_n} - V_y^{\phi_n}) \cdot C_B + V_x^{\phi_n} \cdot \underbrace{\left(C_B + \sum_{i=0}^{I} C_i\right)}_{C_{MT}} - V_r \cdot \left(\sum_{i=0}^{I} C_i \cdot b_i\right)^{\phi_n} \tag{1}$$

Similarly for phase ϕ_{n+1}

$$Q_{\phi_{n+1}} = (V_x^{\phi_{n+1}} - V_y^{\phi_{n+1}}) \cdot C_B + V_x^{\phi_{n+1}} \cdot C_{MT} - V_r \cdot \left(\sum_{i=0}^{I} C_i \cdot b_i\right)^{\phi_{n+1}} \tag{2}$$

Therefore with $Q_{\phi_n} = Q_{\phi_{n+1}}$:

$$
\begin{aligned}
V_x^{\phi_{n+1}} &= V_x^{\phi_n} + \frac{V_r \overbrace{\sum_i \left[(C_i \cdot b_i)^{\phi_{n+1}} - (C_i \cdot b_i)^{\phi_n}\right]}^{\Delta C_i} + C_B \cdot \left(V_y^{\phi_{n+1}} - V_y^{\phi_n}\right)}{C_T} \\
V_x^{\phi_{n+1}} &= V_x^{\phi_n} + V_r \frac{V_r \Delta C_i + C_B \cdot \left(V_y^{\phi_{n+1}} - V_y^{\phi_n}\right)}{C_T}
\end{aligned}
\tag{3}
$$

explicar que como estou a subtrair os caps ligados aos desligados so conta os caps a fazer transicao +Ci de 0 pra vr e -ci vice versa.

Agora pra Vy

$$
Q_{\phi_n} = V_y^{\phi_n} \underbrace{\left(\sum_{j=0}^{J} C_j\right)}_{C_{LT}} + (V_y^{\phi_n} - V_x^{\phi_n}) C_B - V_r \cdot \left(\sum_{j=0}^{J} C_j \cdot b_j\right)^{\phi_n} \tag{4}
$$

$$
Q_{\phi_{n+1}} = V_y^{\phi_{n+1}} \underbrace{\left(\sum_{j=0}^{J} C_j\right)}_{C_{LT}} + (V_y^{\phi_{n+1}} - V_x^{\phi_{n+1}}) C_B - V_r \cdot \left(\sum_{j=0}^{J} C_j \cdot b_j\right)^{\phi_n + 1} \tag{5}
$$

$$
V_y^{\phi_{n+1}} - V_y^{\phi_{n+1}} = C_B \cdot (V_x^{\phi_{n+1}} - V_x^{\phi_n}) + V_r \Delta C_j \tag{6}
$$

$$
\boxed{V_x^{\phi_{n+1}} = V_x^{\phi_n} + V_r \frac{\Delta C_{Mi}(C_B + \sigma_{LC}) + C_B \Delta C_{Li}}{C_B\left(\sigma_{LC} + \sigma_{MC}\right) + \sigma_{LC}\sigma_{MC}}} \tag{7}
$$

provando que o valor atual depende apenas do valor anterior e dos caps que mudaram.

References