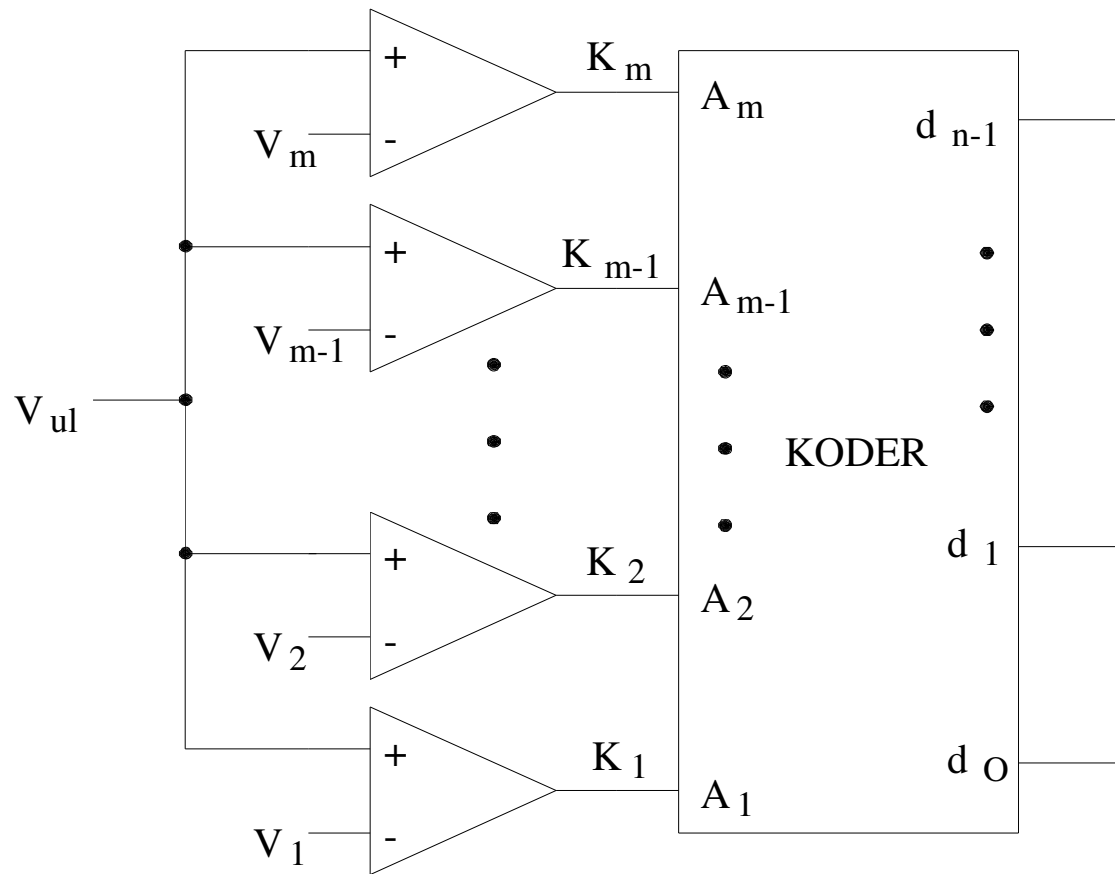
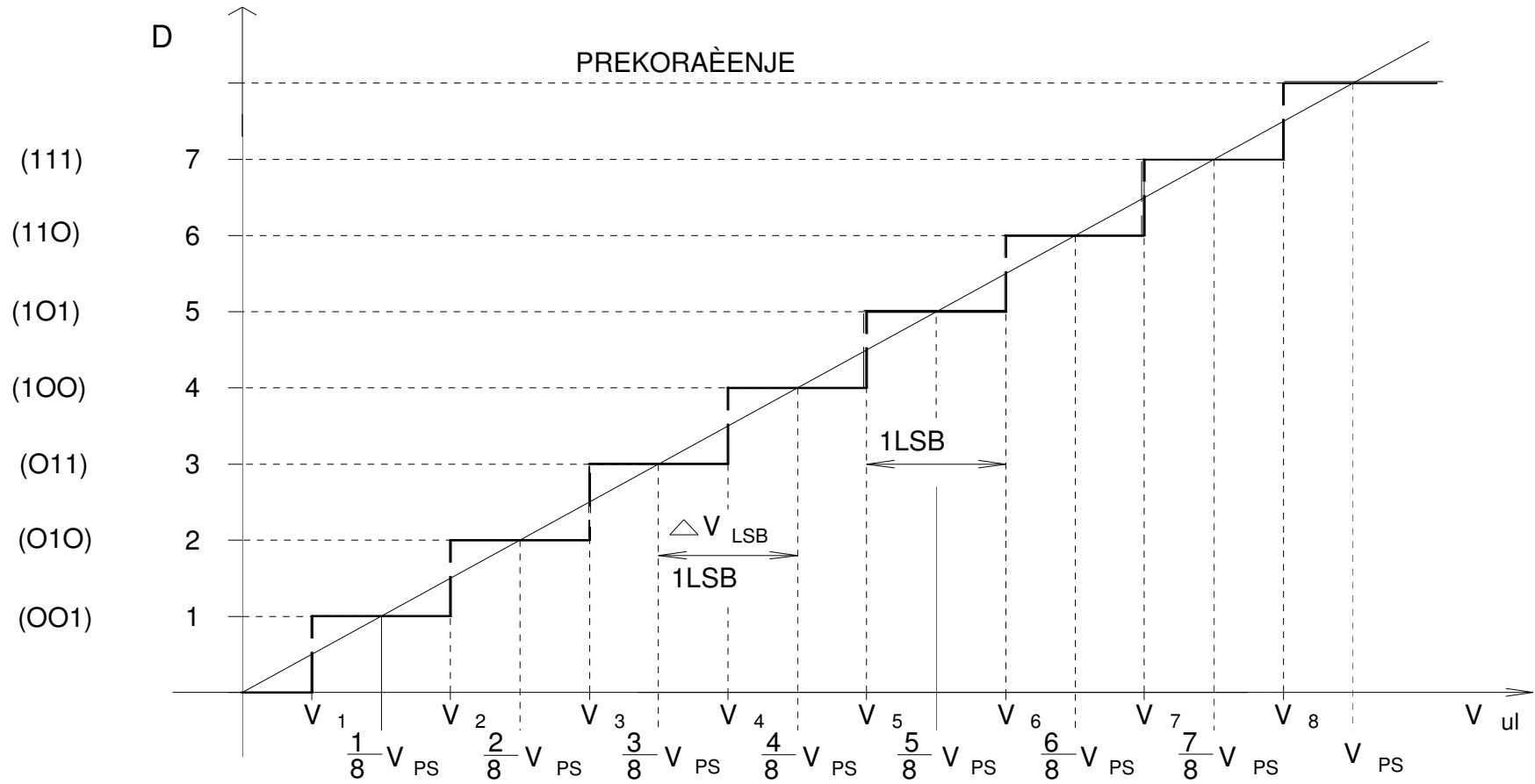


AD konverzija

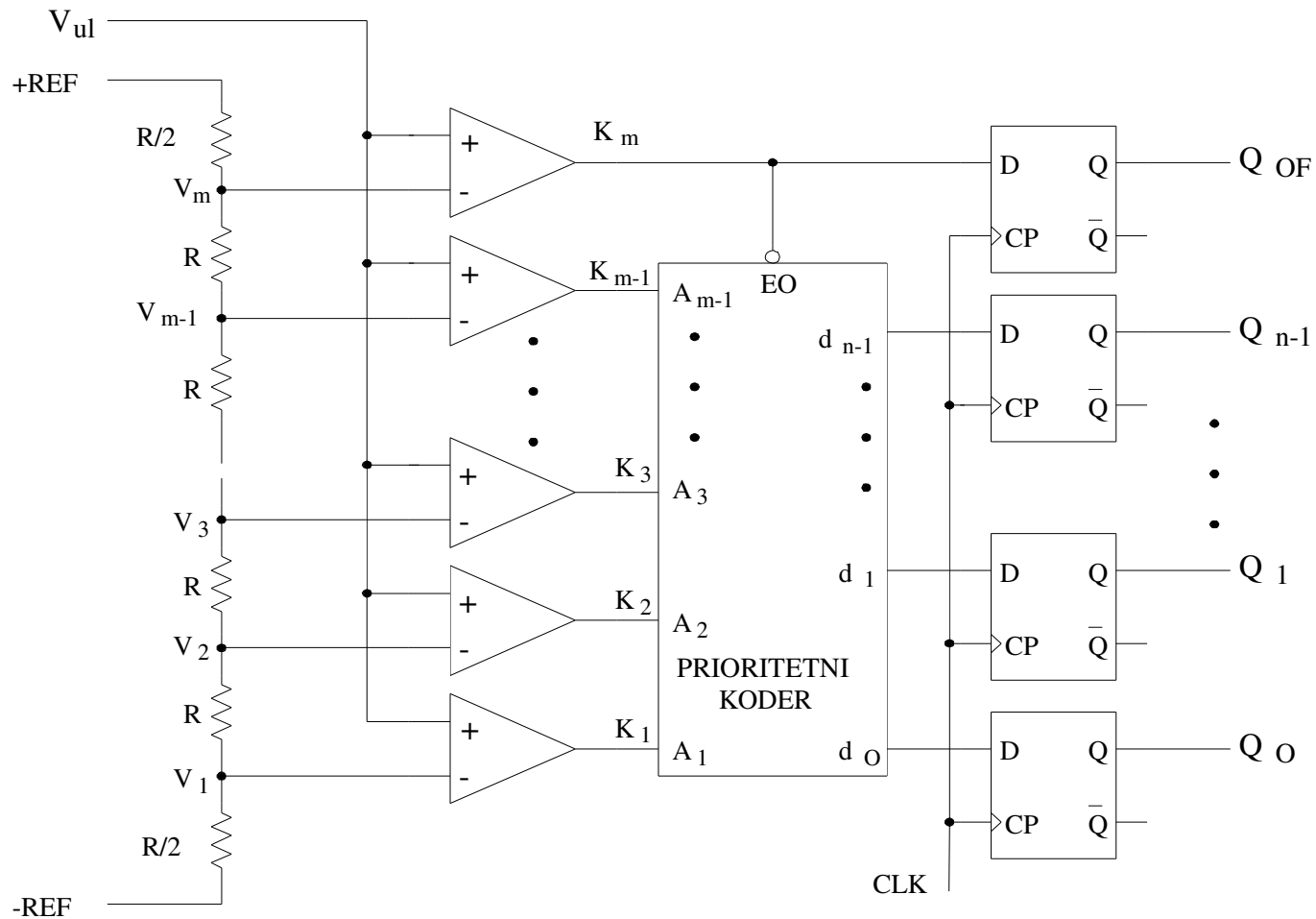


Principijelna šema A/D konvertora



Karakteristika prenosa idealnog A/D konvertora

$$D = k V_{ul}$$



A/D konvertor sa paralelnim komparatorima
(FLASH AD)

primena

- Na priključke $-REF$ i REF se priključuju referentni naponi V_{ref1} i V_{ref2}
- $-V_{ss} < V_{ref1}, V_{ref2} < V_{DD}$
- Najčešće se $-REF$ vezuje na masu a REF na izvor referentnog napona
- Pragovi komparacije:

$$V_k = \frac{V_{REF}}{R/2 + (m-1)R + R/2} \cdot ((k-1)R + R/2) = \frac{V_{REF}}{m} \cdot \left(k - \frac{1}{2}\right)$$

- Ako je rezultat konverzije broj D tada je napon na ulazu $V_{k=D} < V_U < V_{k=D+1}$
- usvaja se sredina intervala

$$\boxed{V_U} = \frac{V_{k=D} + V_{k=D+1}}{2}$$

$$\boxed{V_U} = \frac{V_{REF}}{m} \cdot D = \frac{V_{REF}}{2^n} \cdot D = V_Q \cdot D = V_{LSB} \cdot D$$

n – rezolucija AD konvertora, m – broj kvantizacionih nivoa

Greška konverzije:

$$V_e = \pm \frac{V_{REF}}{2^n} \cdot \frac{1}{2} = \pm \frac{V_{REF}}{2^{n+1}} = \pm \frac{1}{2} V_Q$$

Stvarni ulazni napon

$$V_U = \overset{\square}{V}_U + V_e$$

Poboljšanje rezolucije:

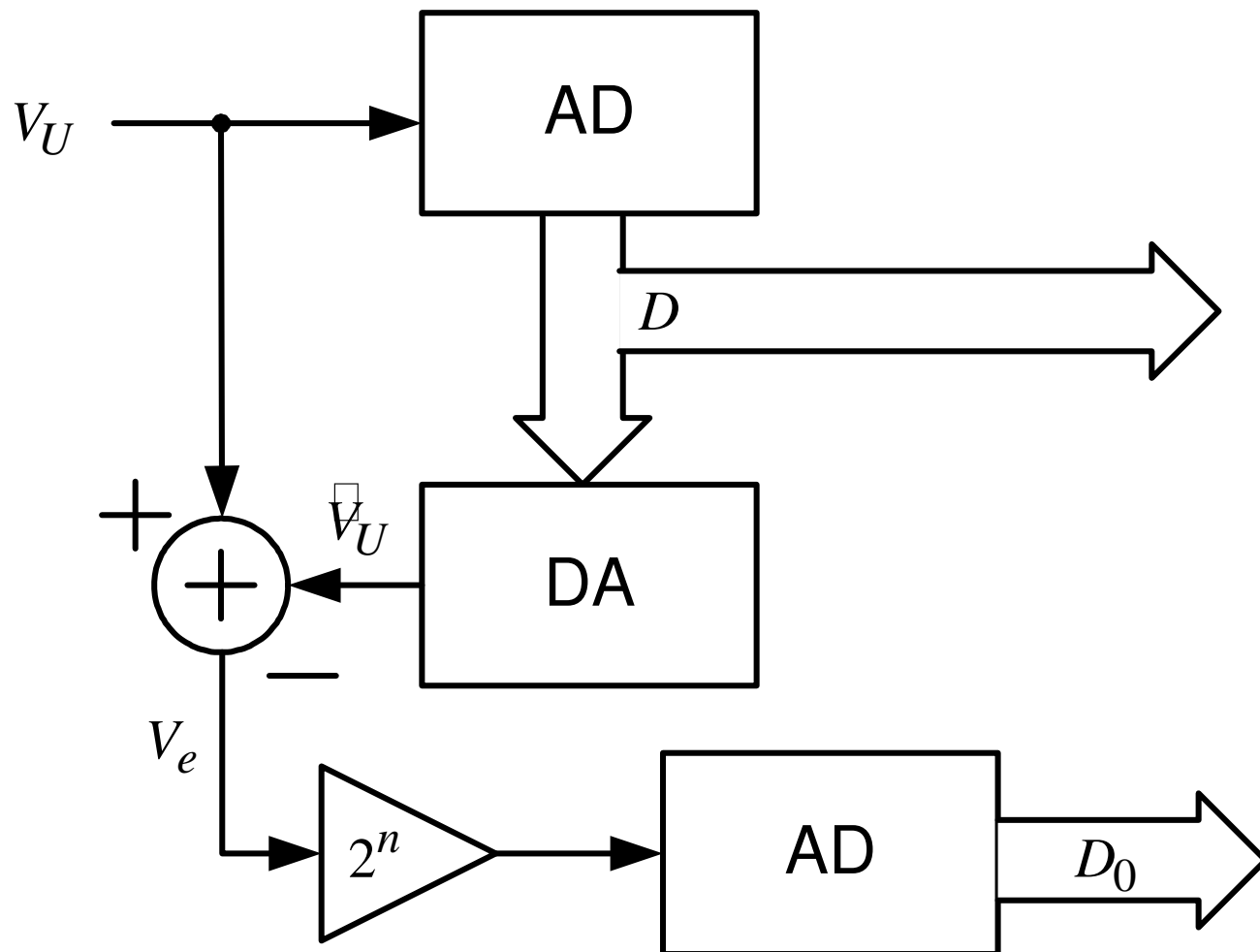
$$\overset{\square}{V}_U = V_Q \cdot D \Rightarrow D = \frac{\overset{\square}{V}_U}{V_Q} = \frac{\overset{\square}{V}_U}{V_{REF}} 2^n = \frac{V_U - V_e}{V_{REF}} 2^n$$

Ako se D dovede na DA konvertor:

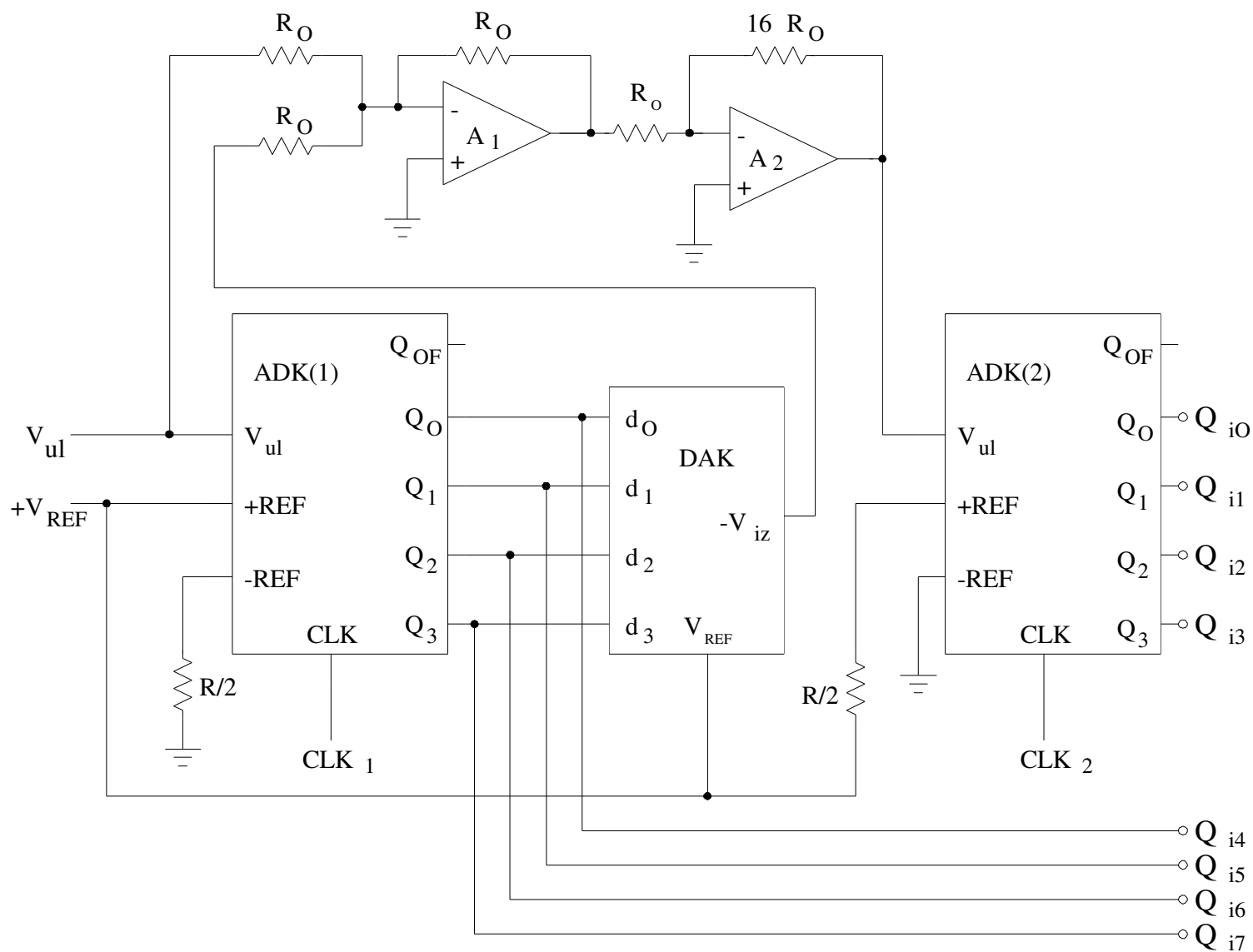
$$V_a = kD = \frac{V_{REF}}{2^n} \cdot D = \frac{V_{REF}}{2^n} \frac{V_U - V_e}{V_{REF}} 2^n = V_U - V_e$$

$$V_e = V_U - V_a, \quad -V_Q/2 < V_e < V_Q/2$$

Principijelni blok dijagram

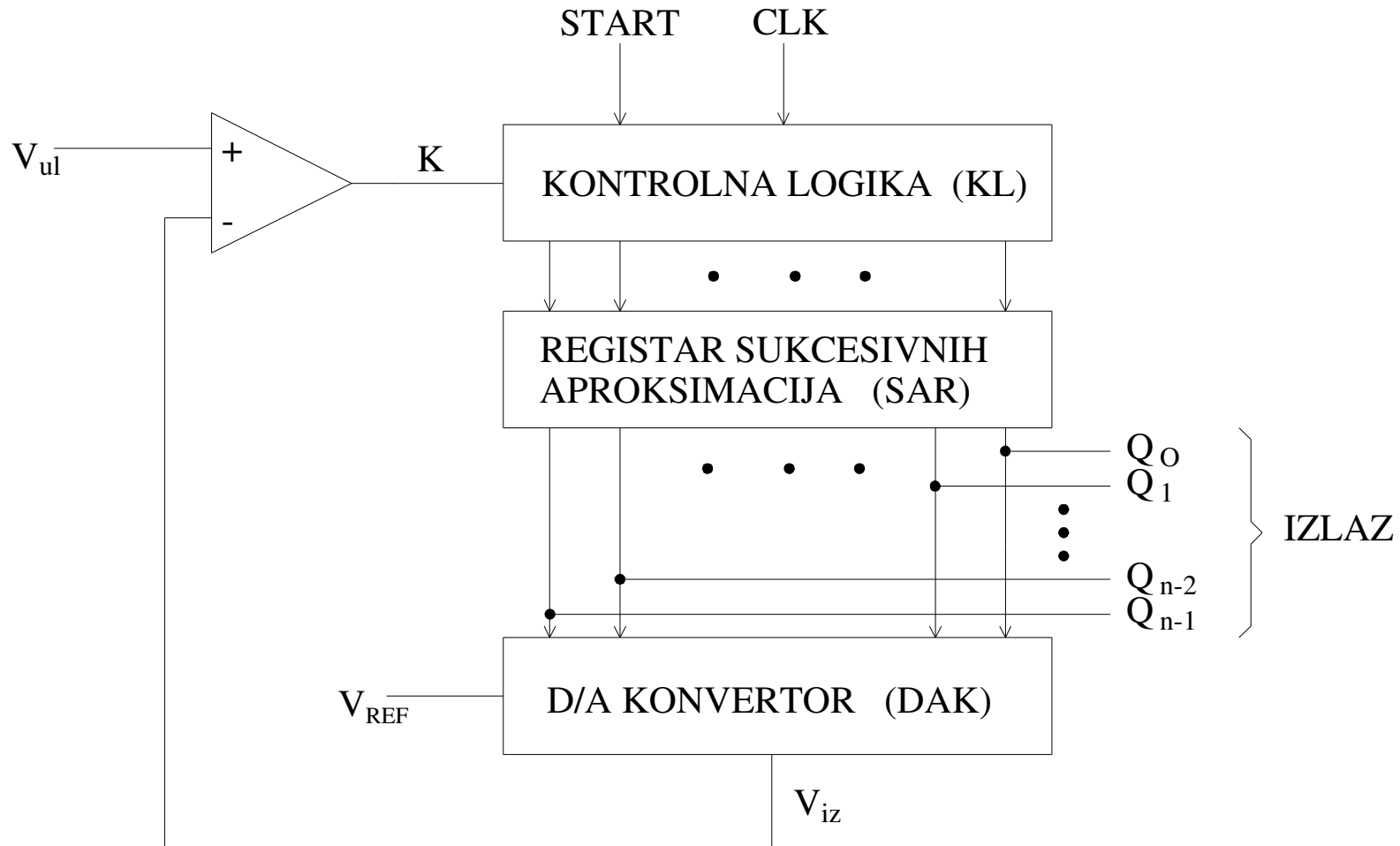


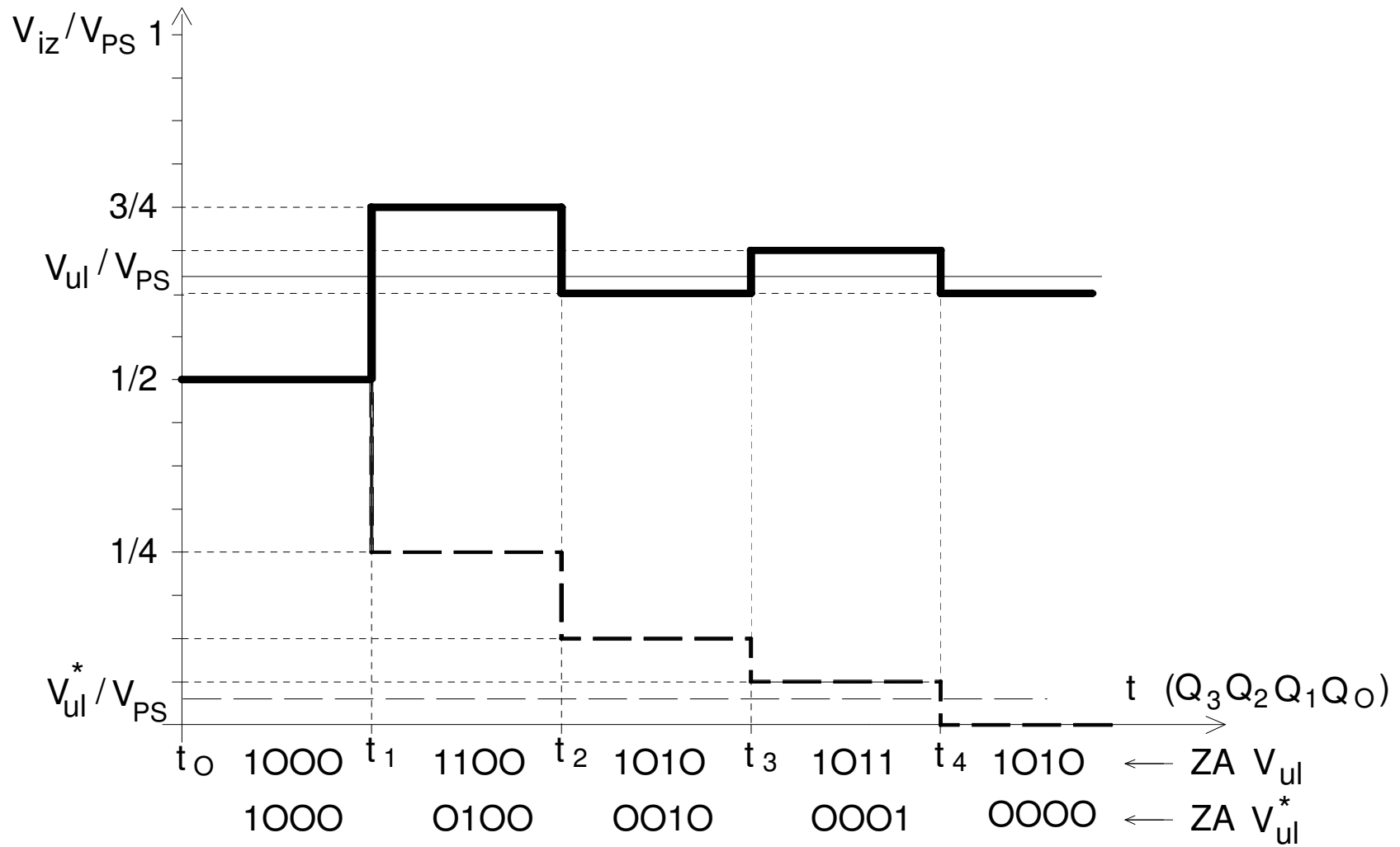
Praktična realizacija – kaskadni FLASH AD



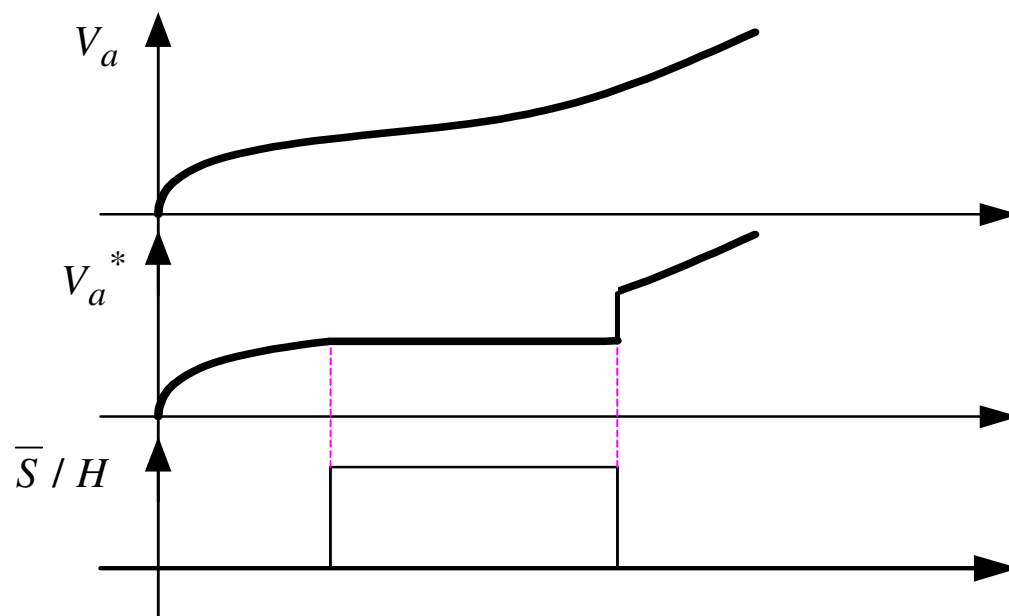
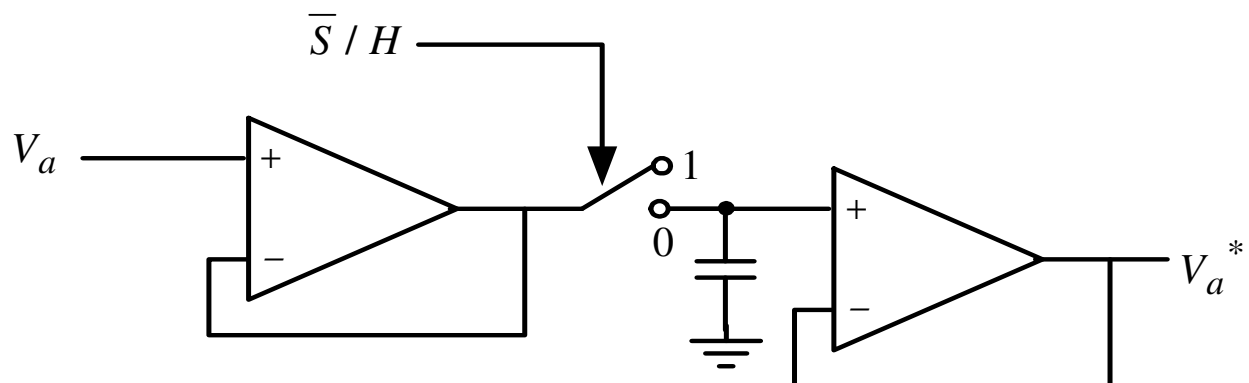
- Prvi AD ima dodati $R/2$ prema masi tako da je greška kvantizacije prvog AD uvek pozitivna
$$0 < V_e < V_Q$$
- drugi AD ima dodati $R/2$ prema REF tako da su struje kroz otporne lance jednake a time nagib karakteristike oba AD
- Prvi AD daje gornja 4 bita, a drugi donja 4 bita rezultata

A/D konvertori sa sukcesivnim aproksimacijama

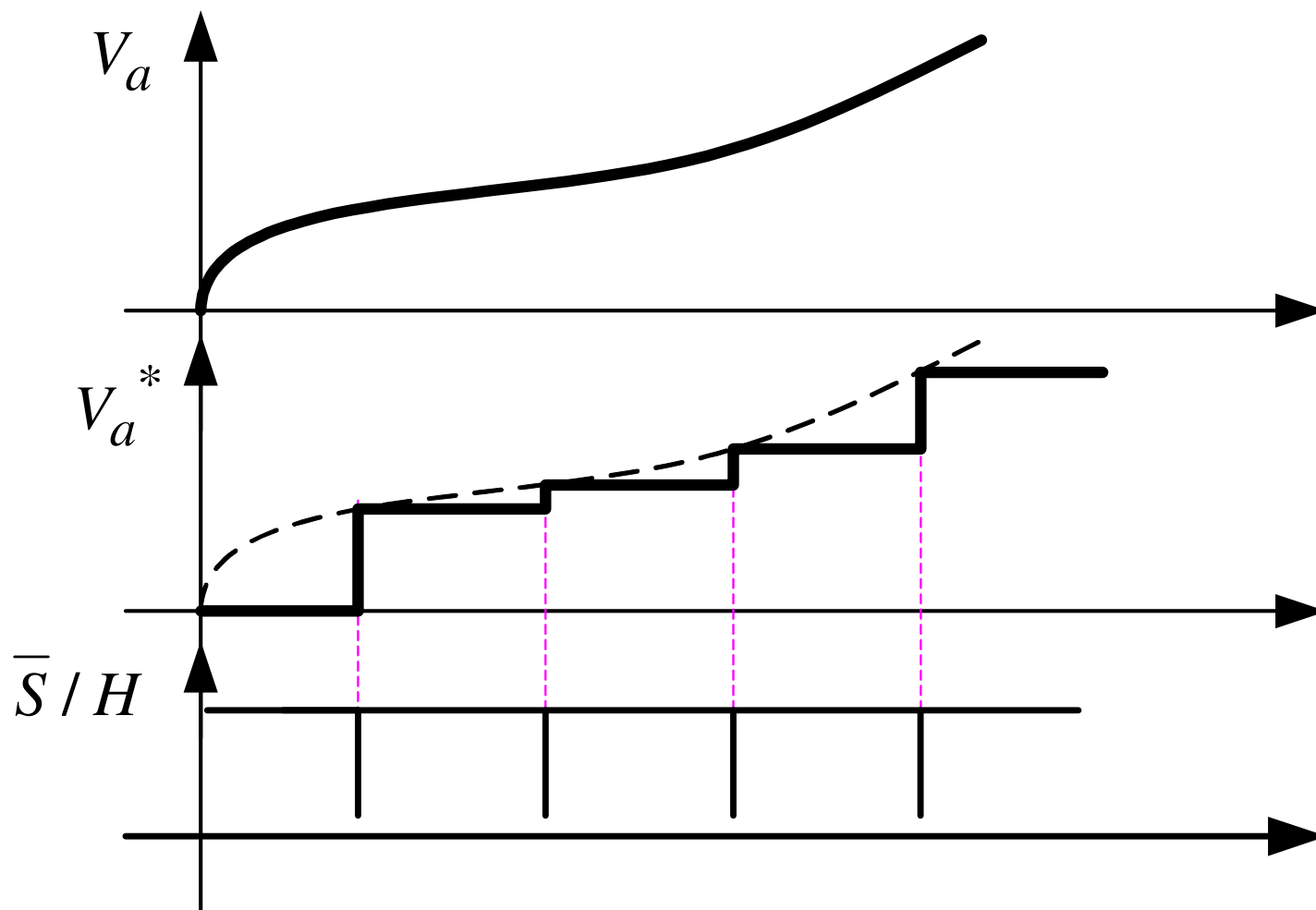


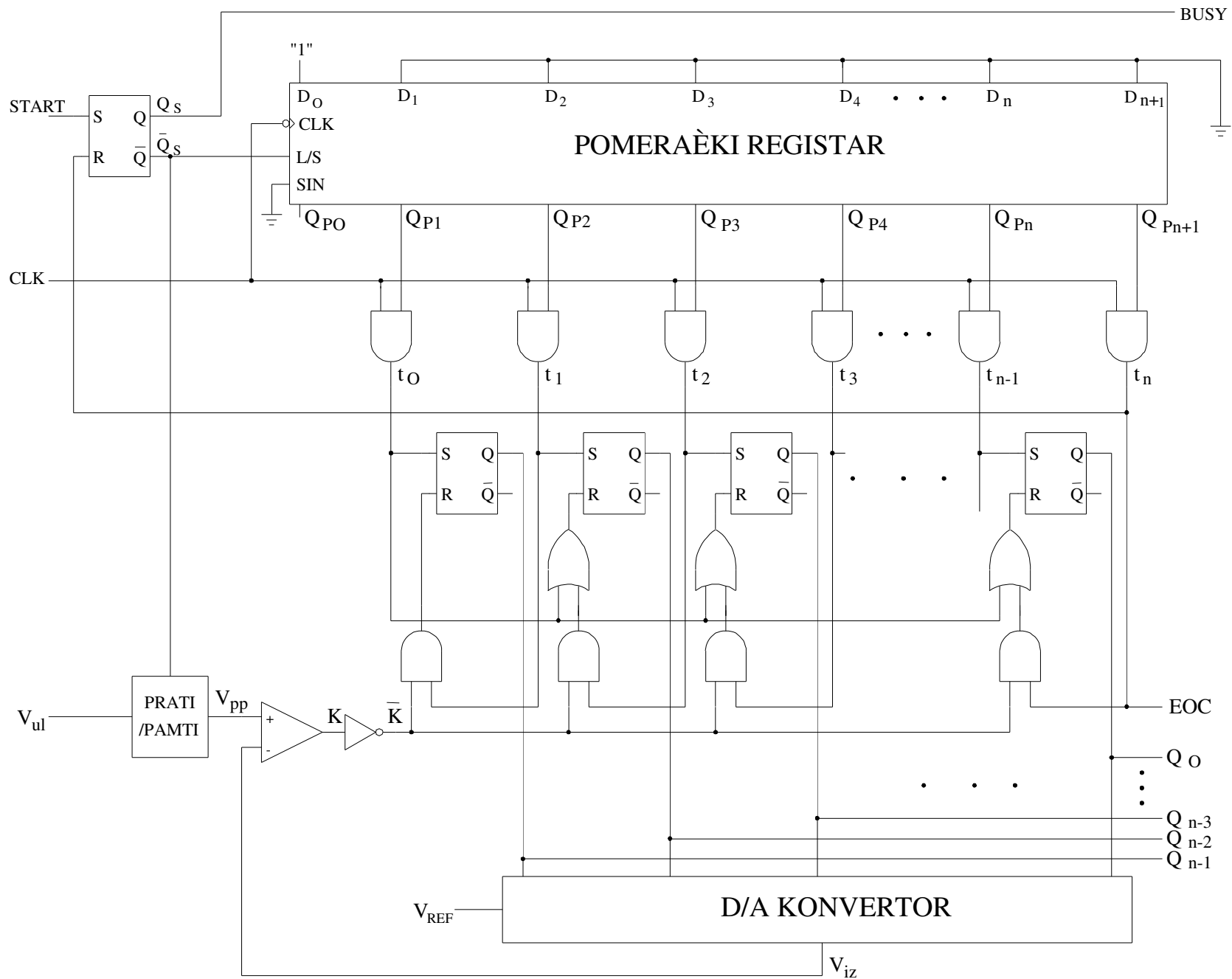


Prati/pamti kolo (track&hold circuit)



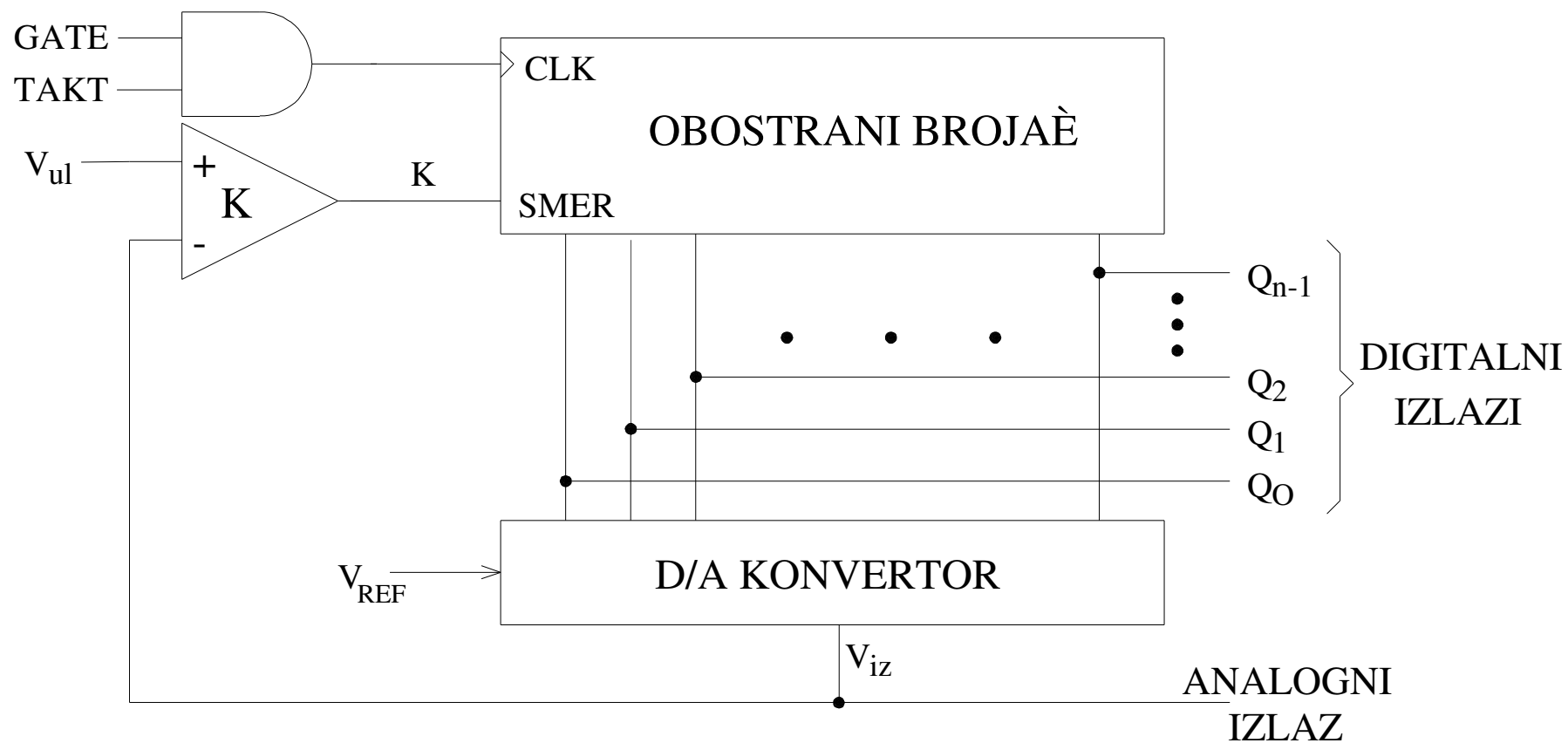
Odabiranje signala kratkotrajnim impulsima

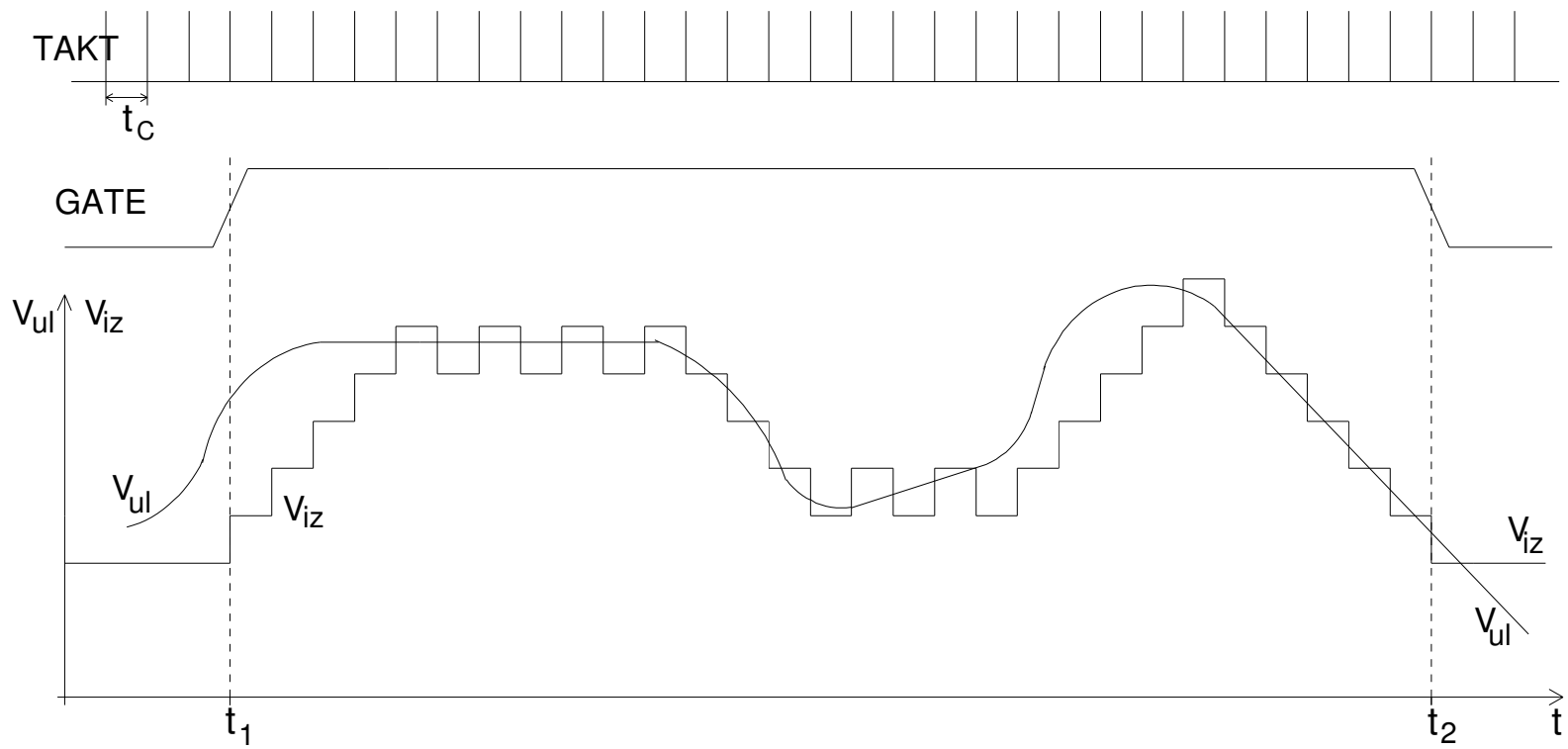




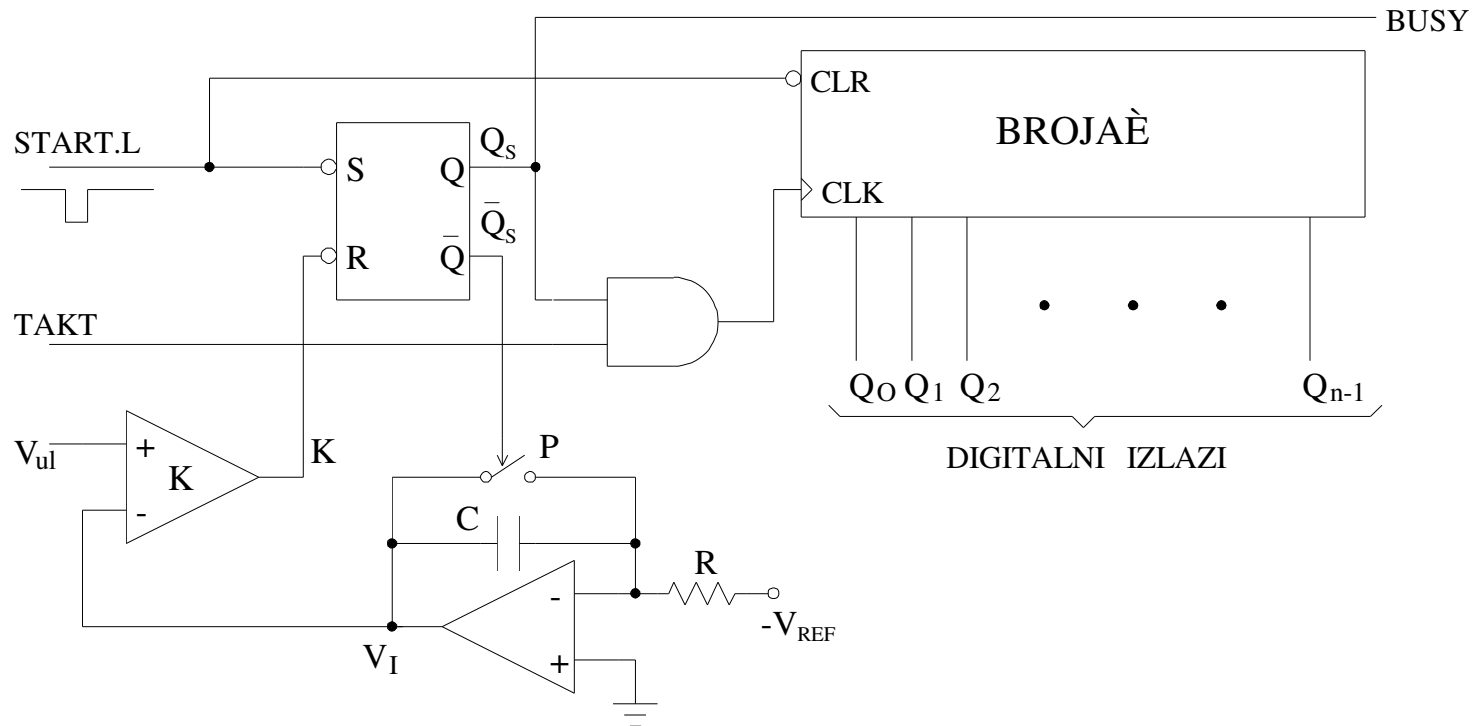
$$t_{ADK} = (n + 1) \cdot t_C$$

Slika 16.42 Prateći A/D konvertor



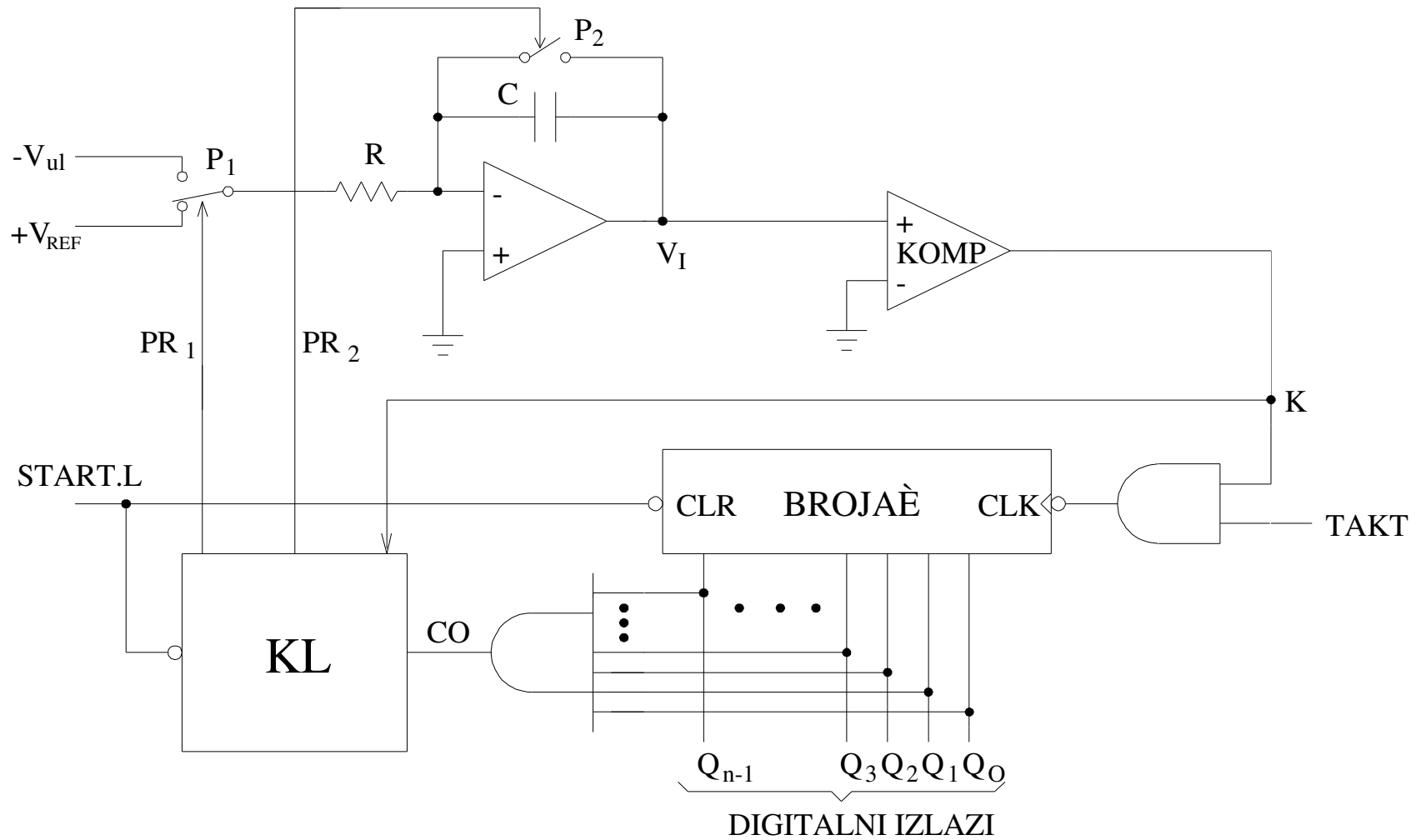


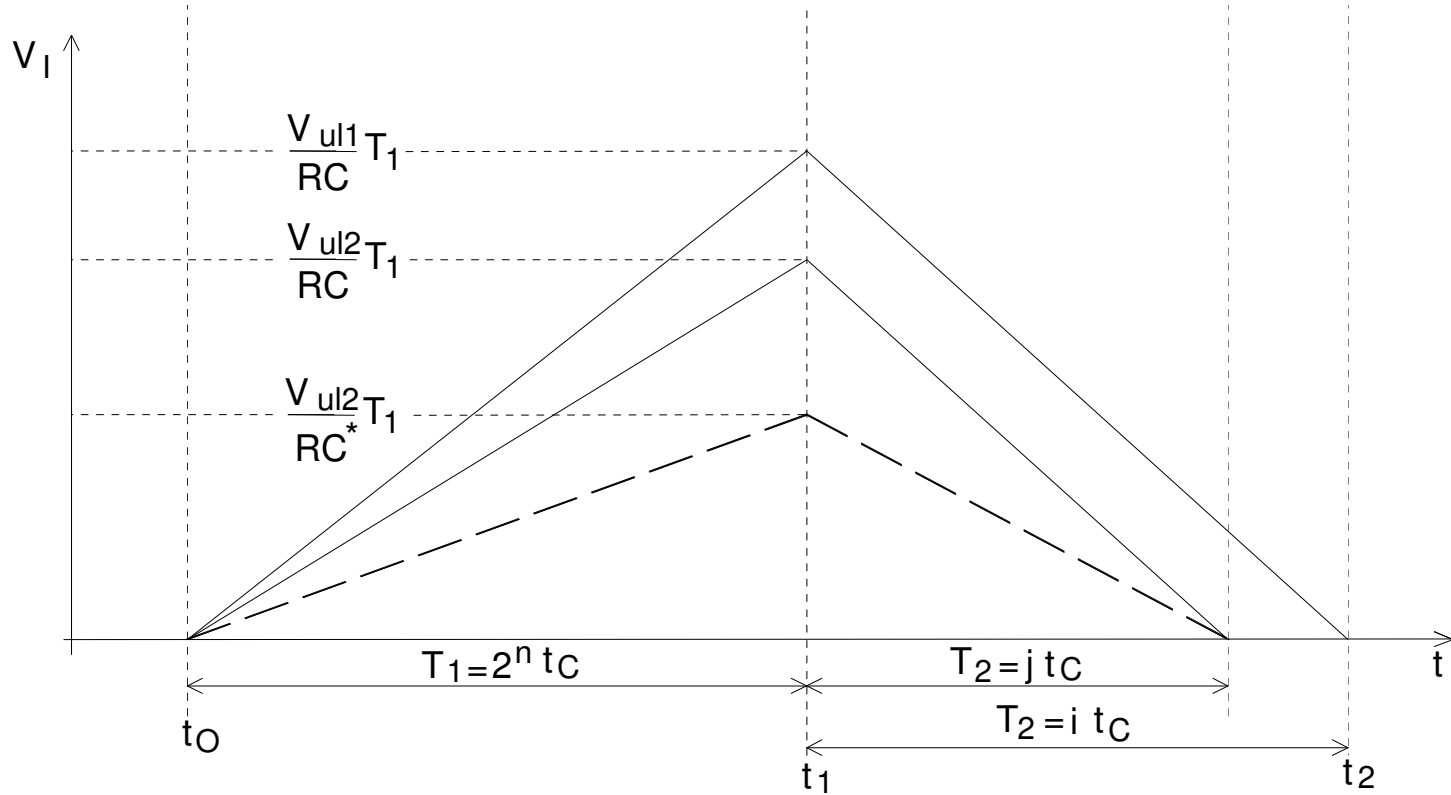
A/D konvertor sa generatorom rampe



$$V_I(t) = \frac{V_{REF}}{RC} \cdot t$$

A/D konvertori sa dvojnim nagibom



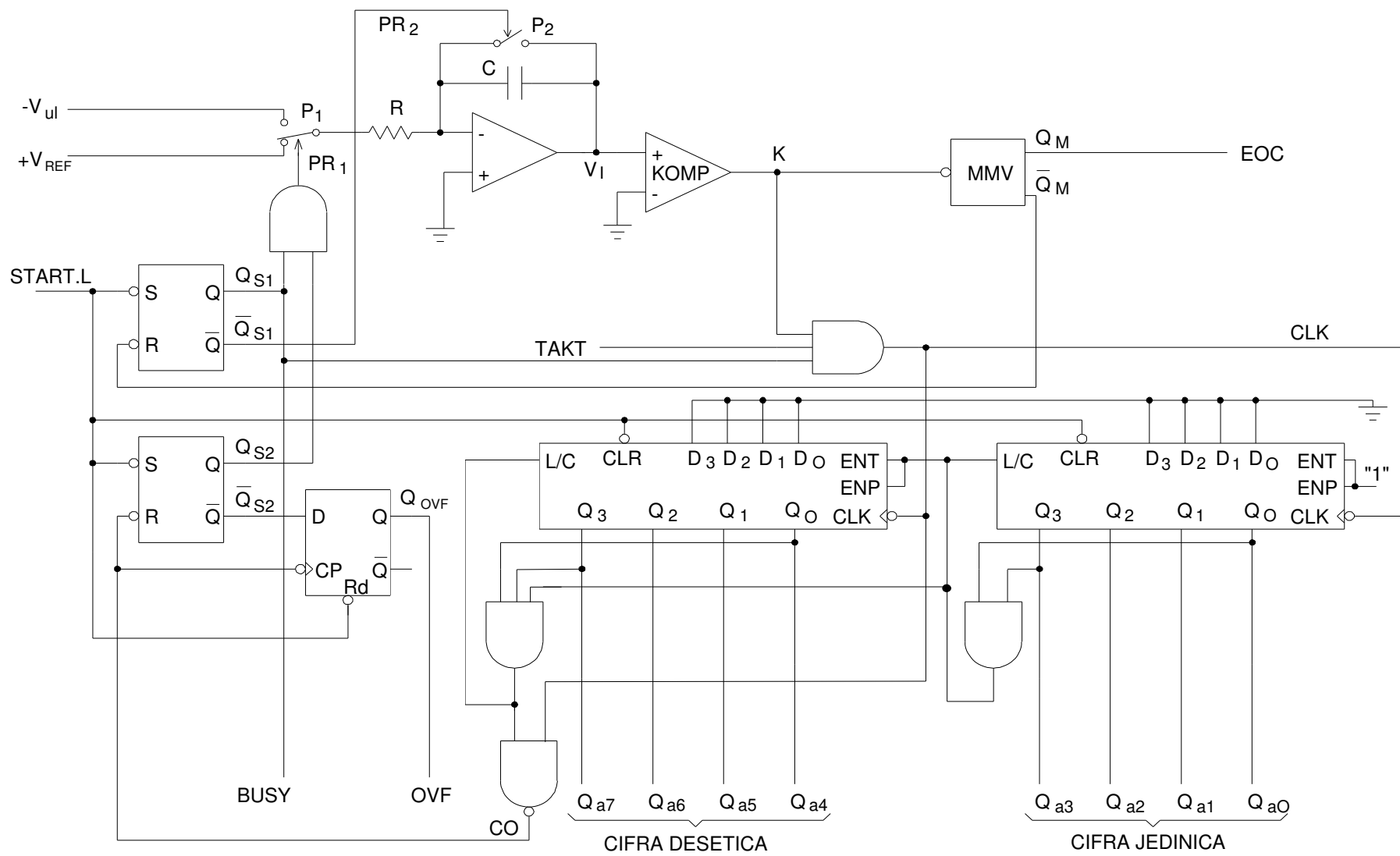


$$V_I(t_1) = V_I(t_0) + \frac{1}{RC} \cdot \int_0^{T_1} V_{ul} dt = \frac{V_{ul}}{RC} \cdot T_1 = \frac{V_{ul}}{RC} \cdot 2^n t_{clk}$$

$$V_I(t_2) = V_I(t_1) - \frac{1}{RC} \cdot \int_0^{T_2} V_{ref} dt = V_I(t_1) - \frac{V_{ref}}{RC} \cdot T_2 = 0 \Rightarrow \frac{V_{ul}}{RC} \cdot 2^n t_{clk} = \frac{V_{ref}}{RC} \cdot D \cdot t_{clk}$$

$$D = \frac{V_{ul}}{V_{ref}} \cdot 2^n$$

- Dužina konverzije zavisi od nivoa napona koji se meri*
- Beskonačno potiskivanje komponenti ulaznog napona periode T_1/M
- Zaštićen ulaz



Dvocifreni BCD A/D konvertor sa dvojnim nagibom