DA konverzija

STAC. REG.

d_{n-1} Q_{n-1} MSB $R_{n-1} = R/2^{n-1}$ I_{n-1} R_f

d_2 Q_2 $R_2 = R/4$ I_2

d_1 Q_1 $R_1 = R/2$ I_1 LSB

d_O LOAD Q_O $R_O = R$ I_O

V_{REF} V_{iz}

$$V_{iz} = -R_f \cdot \left(\frac{V_{REF}}{R_0} \cdot Q_0 + \frac{V_{REF}}{R_1} \cdot Q_1 + \frac{V_{REF}}{R_2} \cdot Q_2 + \ldots + \frac{V_{REF}}{R_{n-1}} \cdot Q_{n-1} \right)$$

$$V_{iz} = -R_f \cdot V_{REF} \cdot \frac{1}{R} \cdot \left(2^0 \cdot Q_0 + 2^1 \cdot Q_1 + 2^2 \cdot Q_2 + \ldots + 2^{n-1} \cdot Q_{n-1} \right)$$

$$V_{iz} = K \cdot D \cdot V_{ref}$$
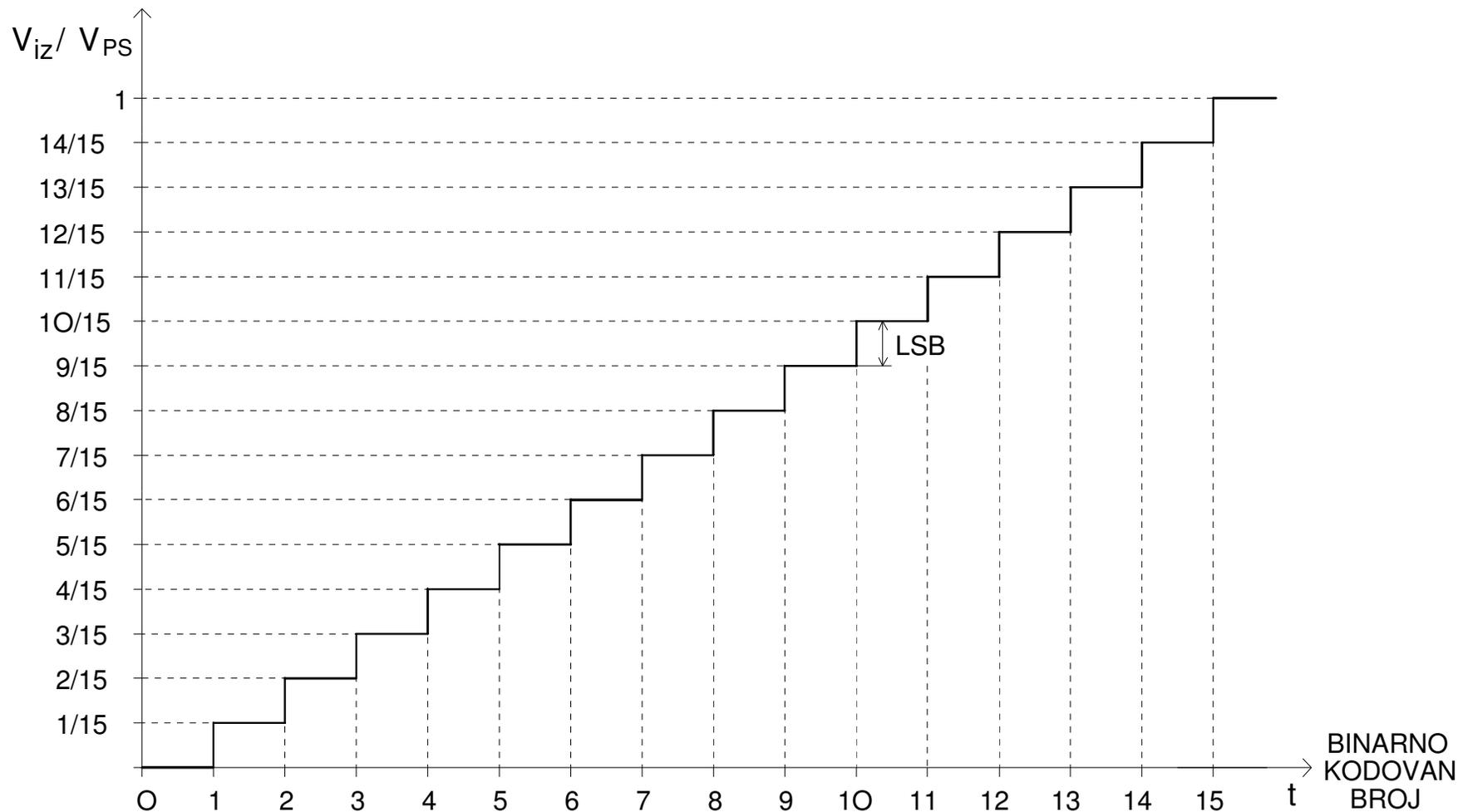
Idealna karakteristika prenosa D/A konvertora

$$q = V_{LSB} = \frac{V_{PS}}{2^n - 1} = \frac{R_f}{R} \cdot V_{REF}$$

Axis labels and values:

V_{iz}/V_{PS} (vertical axis), values: 1, 14/15, 13/15, 12/15, 11/15, 10/15, 9/15, 8/15, 7/15, 6/15, 5/15, 4/15, 3/15, 2/15, 1/15

LSB

Horizontal axis: O, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, t

BINARNO KODOVAN BROJ

Karakteristike

- ## Statičke
 - Linearnost
  - greška nule (ofsset)
  - greška pune skale
  - greška pojačanja
  - diferencijalna linearnost

  $$DL = \frac{\Delta V - V_{LSB}}{V_{LSB}}$$

- ## Dinamičke
  - vreme postavljanja
  - postojanje gličeva

V_{REF}

LOAD

STAC.
REG.

d_3 $\overline{Q}_3$

d_2 $\overline{Q}_2$

d_1 $\overline{Q}_1$

d_O $\overline{Q}_O$

R_C

T_3

R_C

T_2

R_C

T_1

R_C

T_O

$R_3 = R/8 - R_C$

$R_2 = R/4 - R_C$

$R_1 = R/2 - R_C$

$R_O = R - R_C$

R_C

$+V_L$

T_4

R_m

R_f

OFSET

V_{iz}

2R R R R 2R R_f P_P

2R 2R 2R 2R R_f^*

P_O P_1 P_2 P_3

I

-

+

V_{iz}

R_M

P_O

ANALOGNA MASA

V_{REF}

Q_O Q_1 Q_2 Q_3

V_{CC}

STACIONARNI REGISTAR

LOAD

d_O d_1 d_2 d_3

DIGITALNA MASA
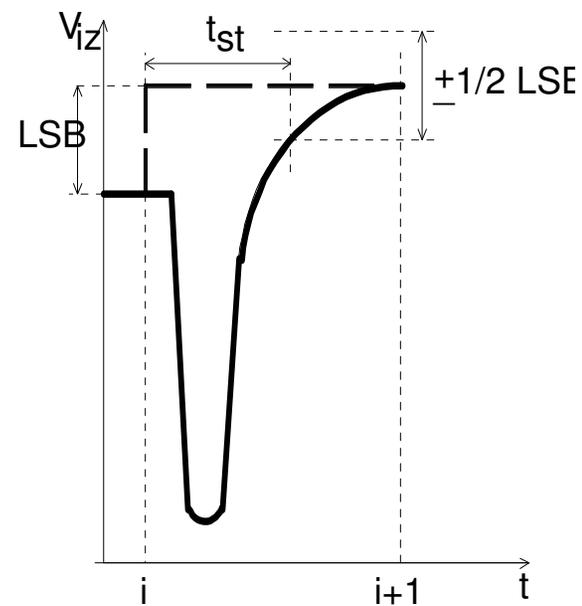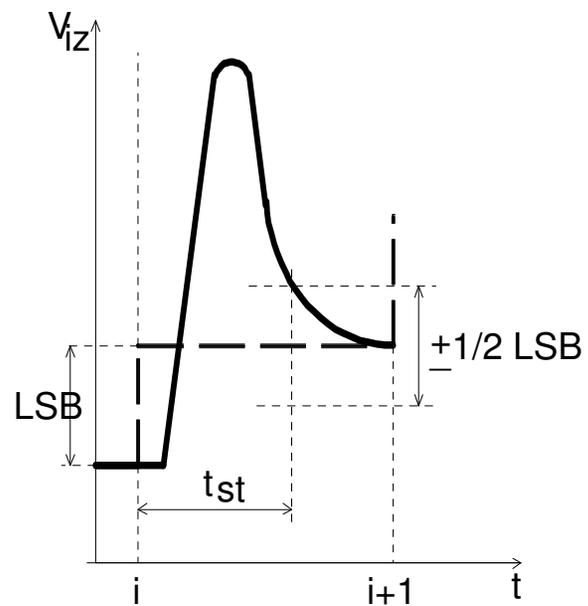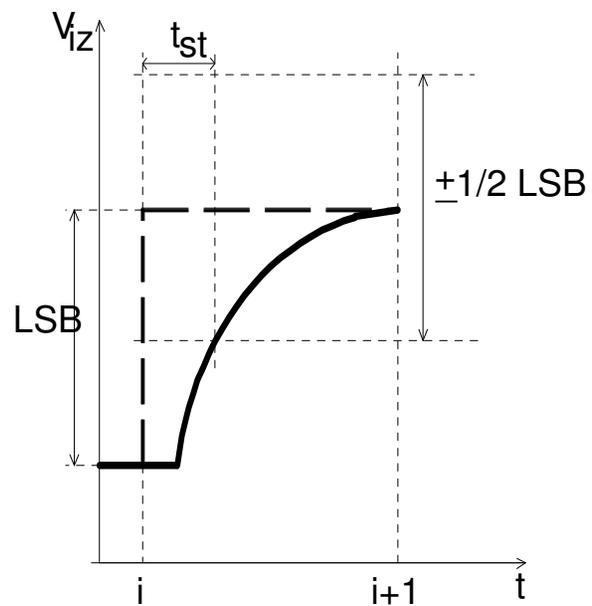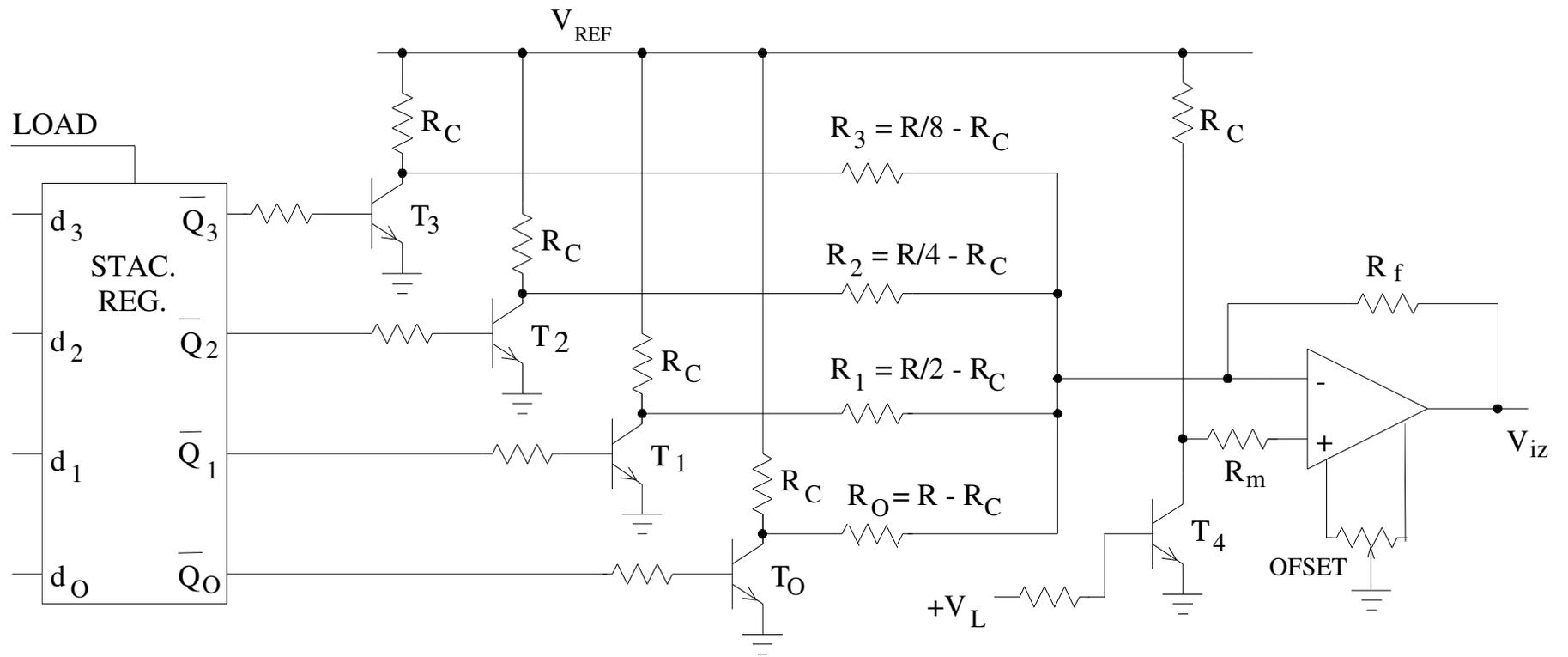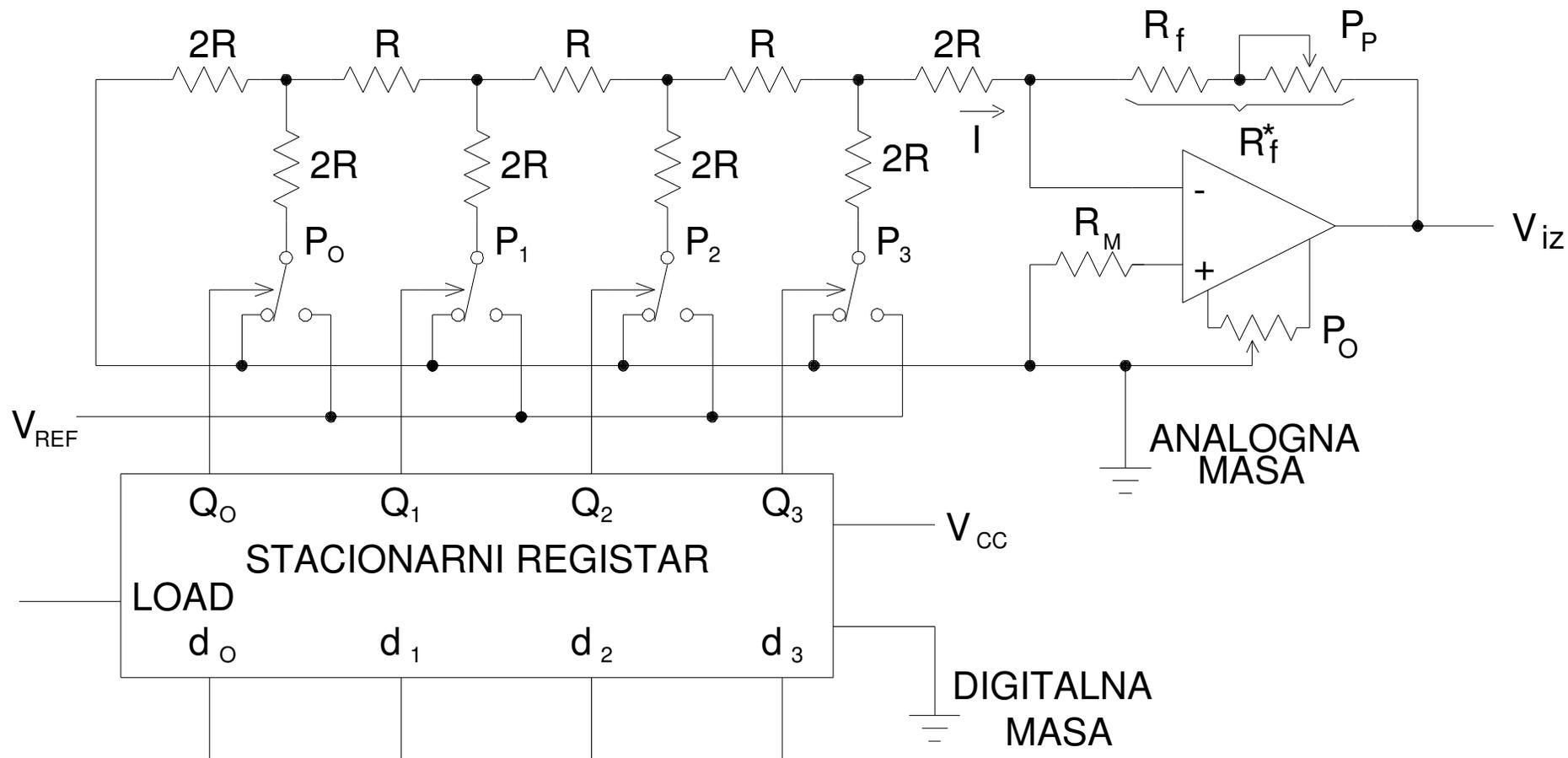
$$I = \frac{V_{REF}}{6R} \cdot \frac{1}{2^{n-1}} \cdot \left(2^{n-1} \cdot Q_{n-1} + 2^{n-2} \cdot Q_{n-2} + \ldots + 2^2 \cdot Q_2 + 2^1 \cdot Q_1 + 2^0 \cdot Q_0 \right)$$

$$V_{iz} = -R_f^* \cdot I = -R_f^* \cdot \frac{V_{REF}}{6R} \cdot \frac{1}{2^3} \cdot \left(2^3 \cdot Q_3 + 2^2 \cdot Q_2 + 2^1 \cdot Q_1 + 2^0 \cdot Q_0 \right)$$

$2^O C$ $2^1 C$ $2^{n-2} C$ $2^{n-1} C$

V_{iz}

P_P

P_O P_1 P_{n-2} P_{n-1}

C

V_{REF}

Q_O Q_1 Q_{n-2} Q_{n-1}

LOAD STACIONARNI REGISTAR

d_O d_1 d_{n-2} d_{n-1}
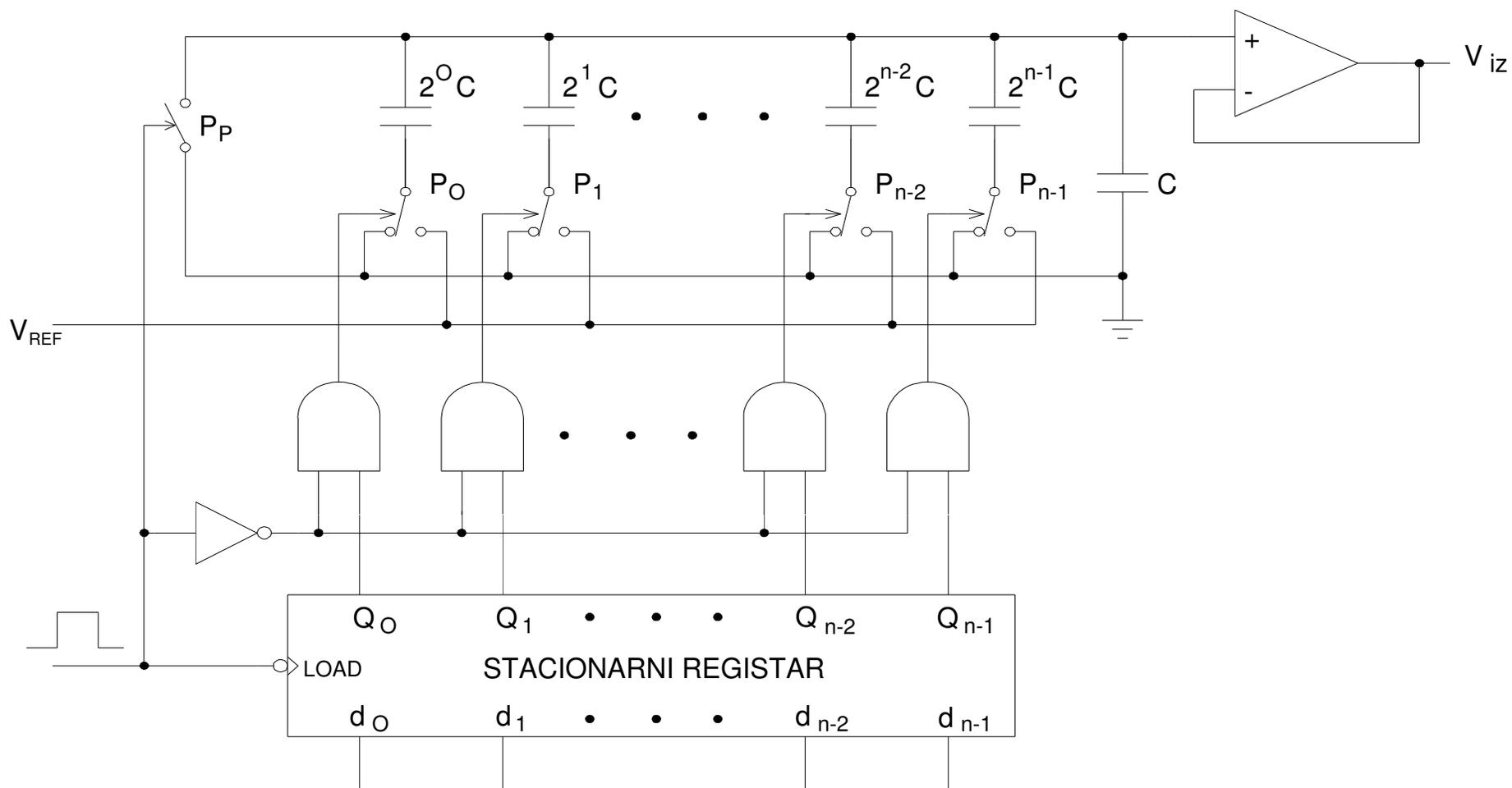
$$C_e = Q_{n-1} \cdot 2^{n-1} C + Q_{n-2} \cdot 2^{n-2} C + \ldots + Q_2 \cdot 2^2 C + Q_1 \cdot 2^1 C + Q_0 \cdot 2^0 C$$

$$V_{iz} = \frac{V_{REF}}{2^n} \cdot \left(Q_{n-1} \cdot 2^{n-1} + Q_{n-2} \cdot 2^{n-2} + \ldots + Q_2 \cdot 2^2 + Q_1 \cdot 2^1 + Q_0 \cdot 2^0 \right)$$

STACIONARNI REGISTAR

d_O d_1 $\bullet$ $\bullet$ $\bullet$ d_{n-2} d_{n-1}

LOAD

Q_O Q_1 $\bullet$ $\bullet$ $\bullet$ Q_{n-2} Q_{n-1}

LSB

ZNAK

PREKIDAÈI I OTPORNA MREŽA

$-V_{REF}$

R_f

R_f

R_f

SUM. TAÈKA

A_1

A_2

V_{da}

$-V_{da}$

V_{iz}

P_Z

d_O d_1 • • • d_{n-2} d_{n-1}

LOAD STACIONARNI REGISTAR

Q_O Q_1 • • • Q_{n-2} Q_{n-1}

LSB ZNAK

R_f

R_f

$-V_{REF}$

$+V_{REF}$ P_Z

V_{REF}

UNIPOLARNI

D/A KONVERTOR

V_{iz}
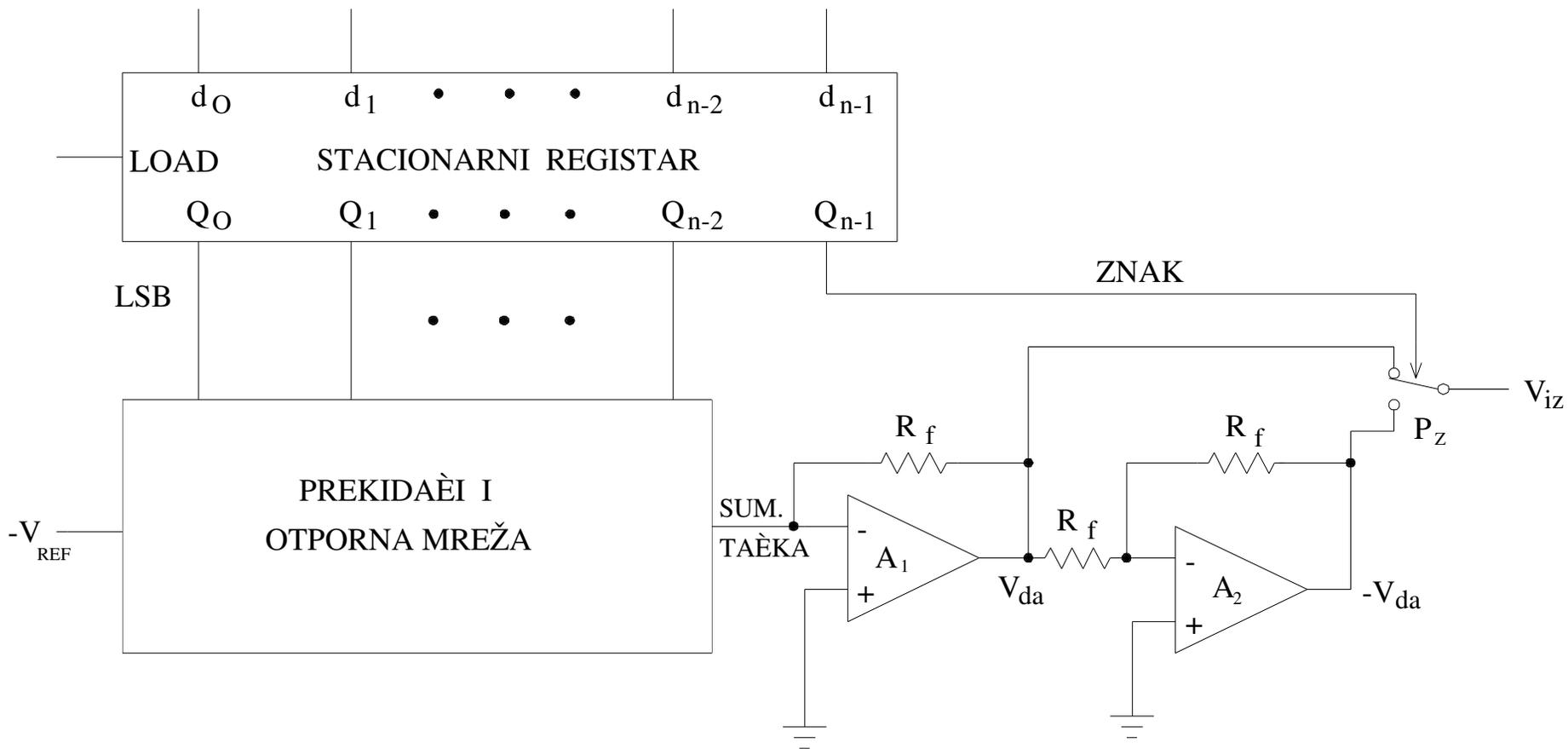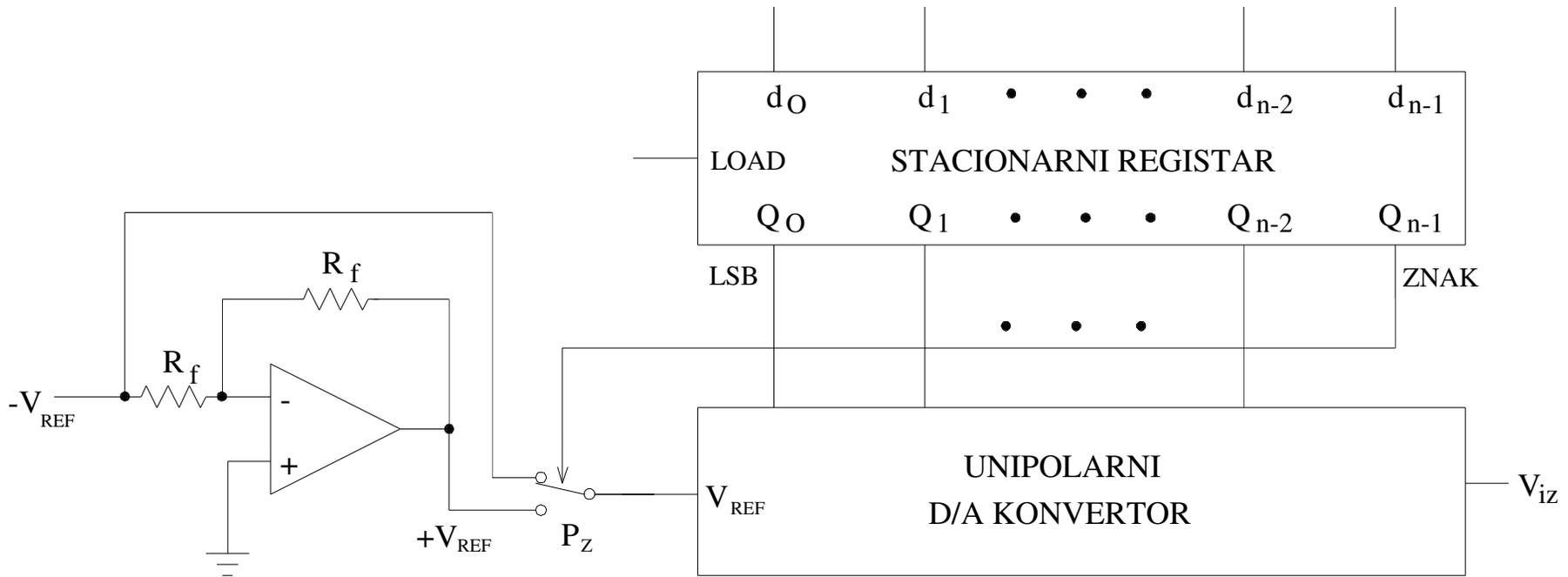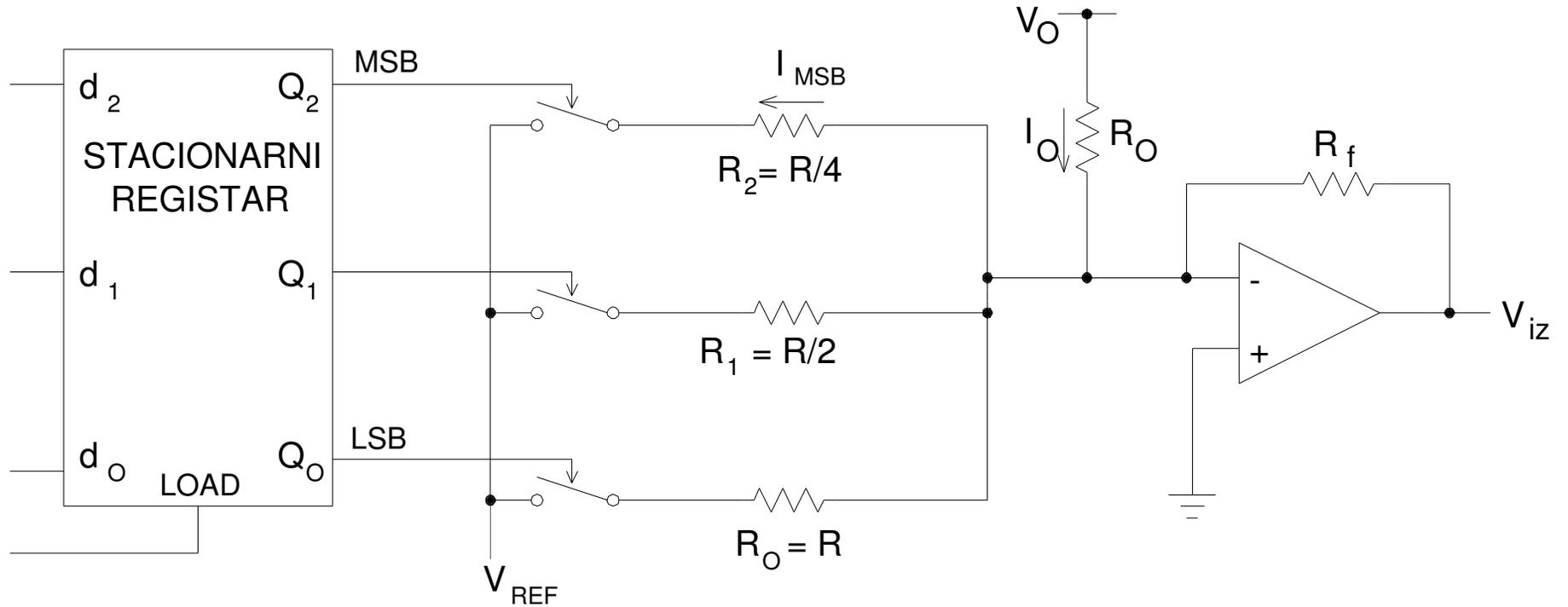
$$V_{iz} = -\frac{R_f}{R} \cdot \left(4Q_2 + 2Q_1 + Q_0\right) \cdot V_{REF} - \frac{R_f}{R_o} \cdot V_o$$

$$V_{iz} = -\frac{R_f}{R} \cdot \left(2^{n-1} \cdot Q_{n-1} + \ldots + 2^2 \cdot Q_2 + 2^1 \cdot Q_1 + 2^0 \cdot Q_0 - 2^{n-1}\right) \cdot V_{REF}$$

Left graph — vertical axis V_{iz} with values 7, 6, 5, 4, 3, 2, 1. Horizontal axis labels: OO1, O1O, O11, 1OO, 1O1, 11O, 111.

Right graph — vertical axis V_{iz} with values +3, +2, +1, O, -1, -2, -3, -4. Horizontal axis labels: OO1, O1O, O11, 1OO, 1O1, 11O, 111.
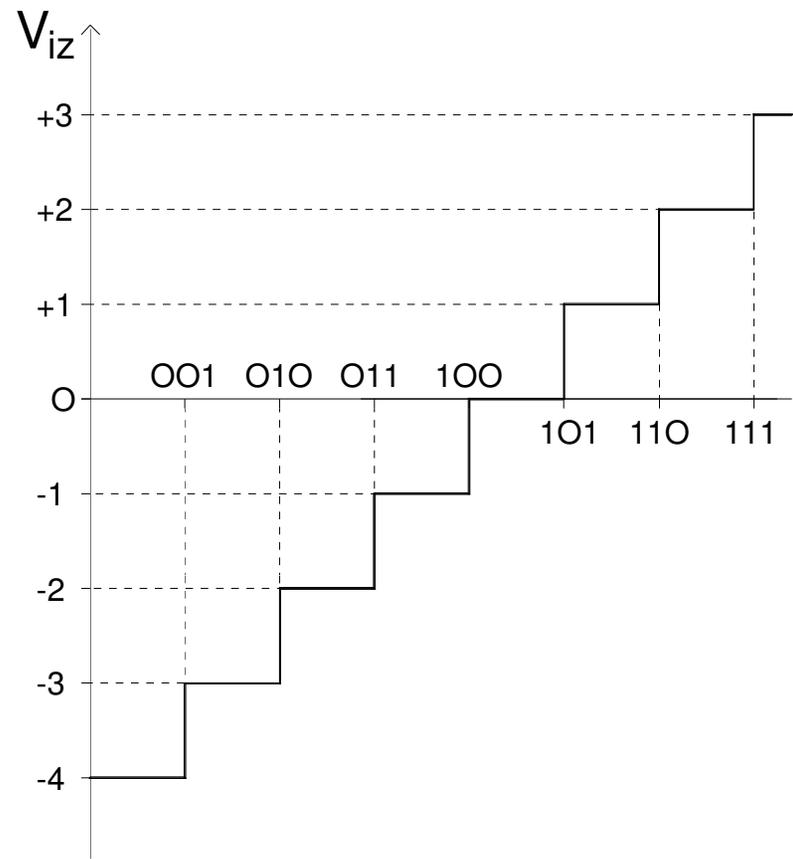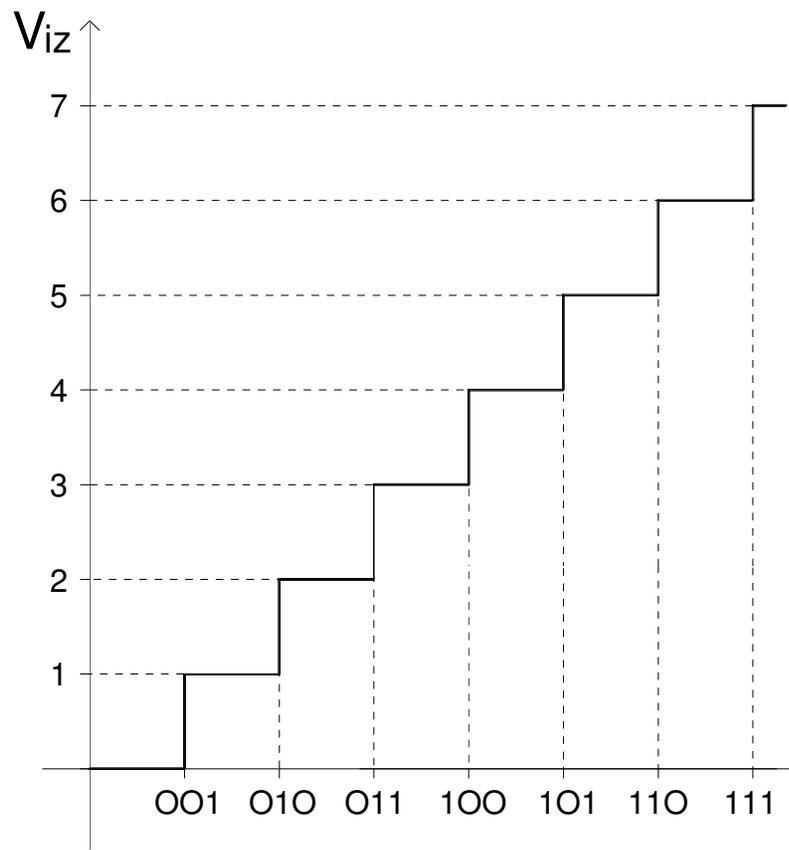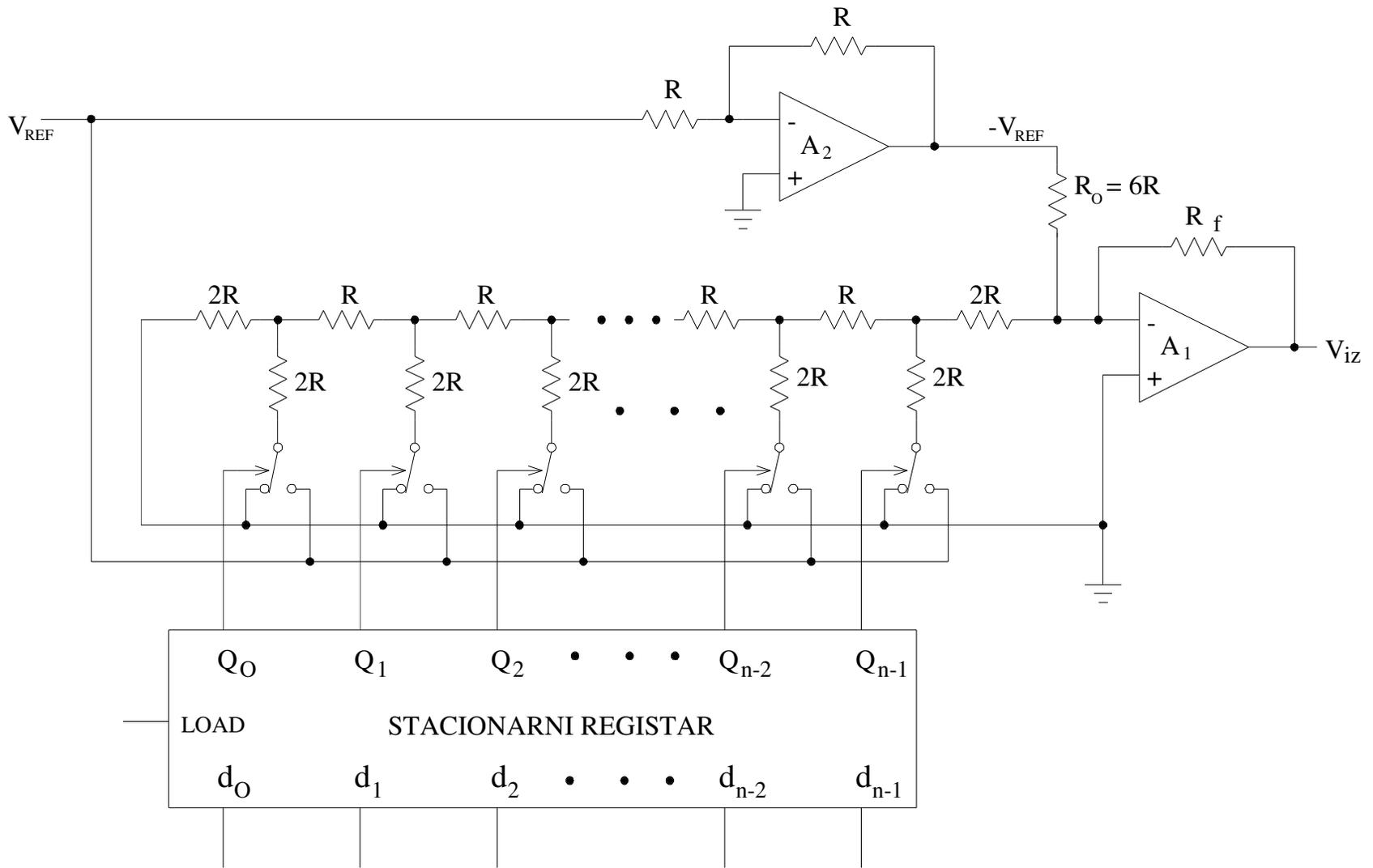
Dec. ekviv.	Binarni ofset				Kompl. do 2			
	d_3	d_2	d_1	d_0	d_3	d_2	d_1	d_0
−8	0	0	0	0	1	0	0	0
−7	0	0	0	1	1	0	0	1
−6	0	0	1	0	1	0	1	0
−5	0	0	1	1	1	0	1	1
−4	0	1	0	0	1	1	0	0
−3	0	1	0	1	1	1	0	1
−2	0	1	1	0	1	1	1	0
−1	0	1	1	1	1	1	1	1
0	1	0	0	0	0	0	0	0
1	1	0	0	1	0	0	0	1
2	1	0	1	0	0	0	1	0
3	1	0	1	1	0	0	1	1
4	1	1	0	0	0	1	0	0
5	1	1	0	1	0	1	0	1
6	1	1	1	0	0	1	1	0
7	1	1	1	1	0	1	1	1

D

PREKORAÈENJE

(111) 7

(11O) 6

(1O1) 5

(1OO) 4

(O11) 3

(O1O) 2

(OO1) 1

1LSB

$\triangle V_{LSB}$

1LSB

V_1 V_2 V_3 V_4 V_5 V_6 V_7 V_8 V_{ul}

$\frac{1}{8}V_{PS}$ $\frac{2}{8}V_{PS}$ $\frac{3}{8}V_{PS}$ $\frac{4}{8}V_{PS}$ $\frac{5}{8}V_{PS}$ $\frac{6}{8}V_{PS}$ $\frac{7}{8}V_{PS}$ V_{PS}