Sisteme cu circuite integrate analogice

Proiect: GENERATOR

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Specificații

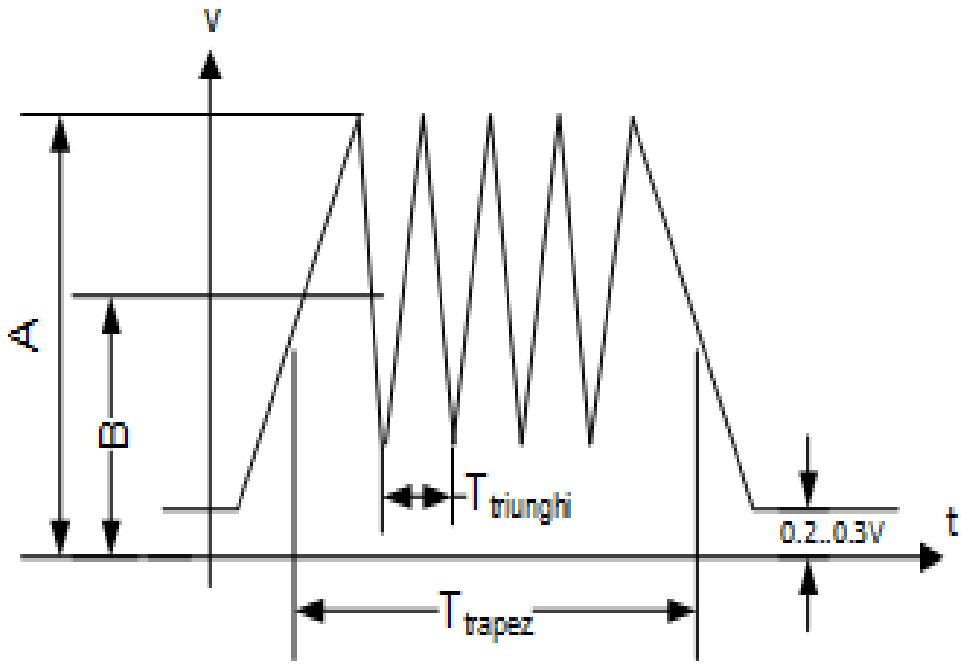
Trapezoidal: Timer 555 cu încărcarea condensatorului pe surse de curent constante

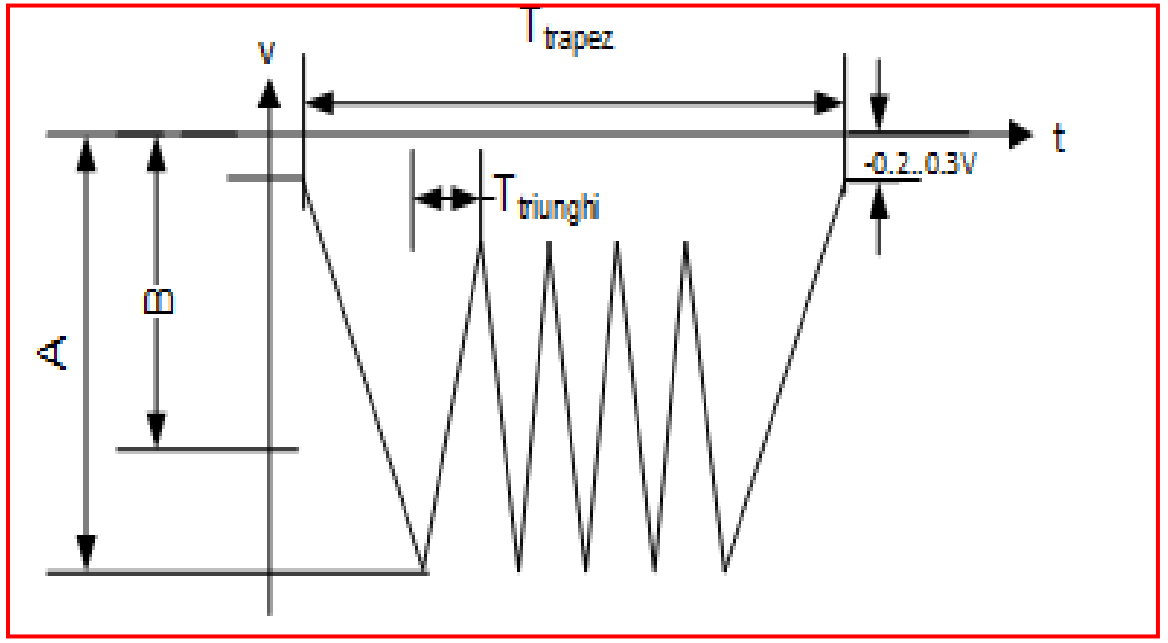
Triunghiular: Integrator AO + Trigger-Schmidt

Limitatorul pentru semnal trapezoidal: 2X TL431 sau similar în antifază

Sursa de curent: cu LT3092

Specificații



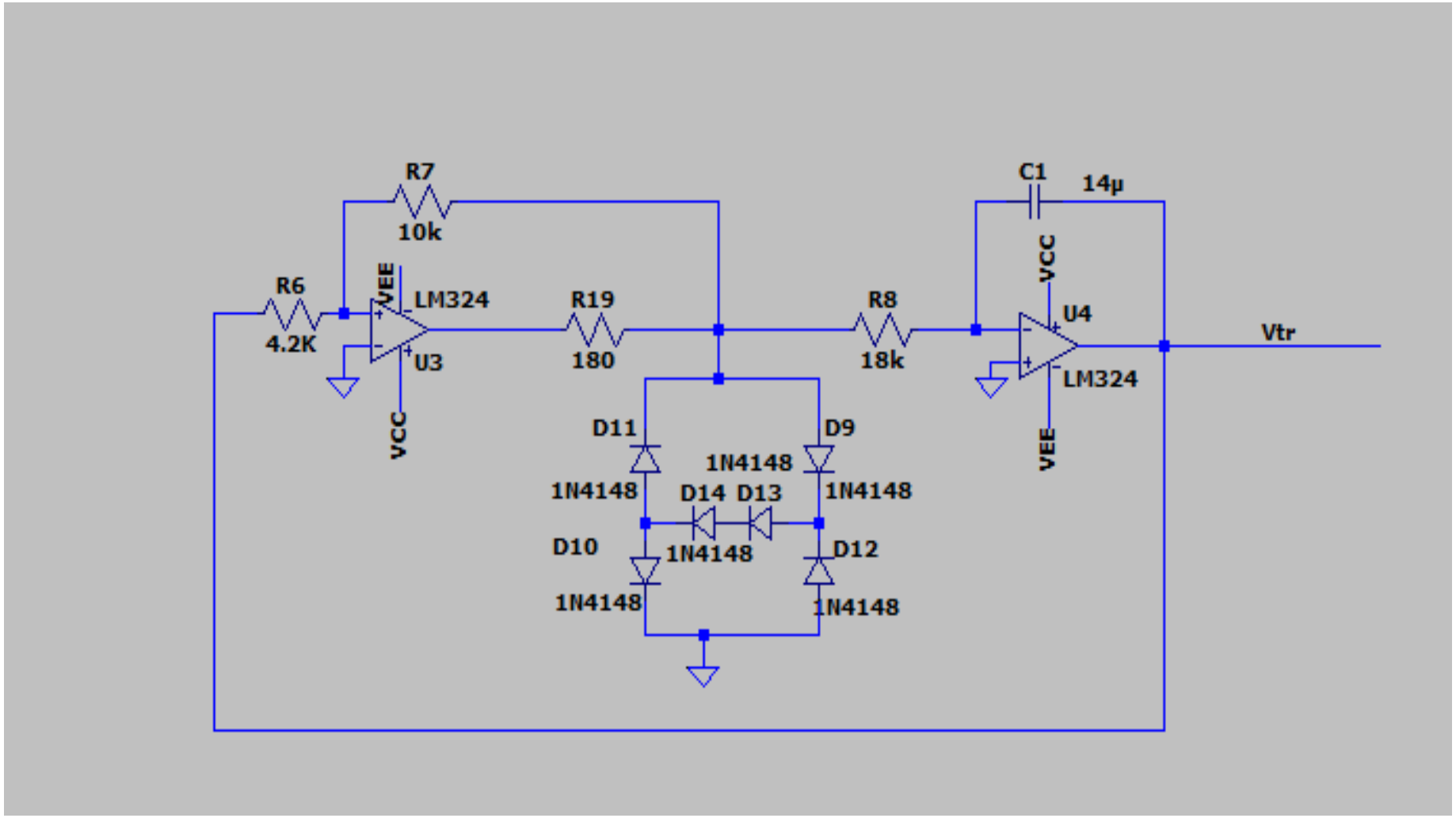


Gr1: A = 3.5V, B = 2.5V, T_{trapez} = 2.5s, $T_{triunghi}$ = 200ms

Gr2: A = 4V, B = 2.5V, T_{trapez} = 3s, $T_{triunghi}$ = 150ms

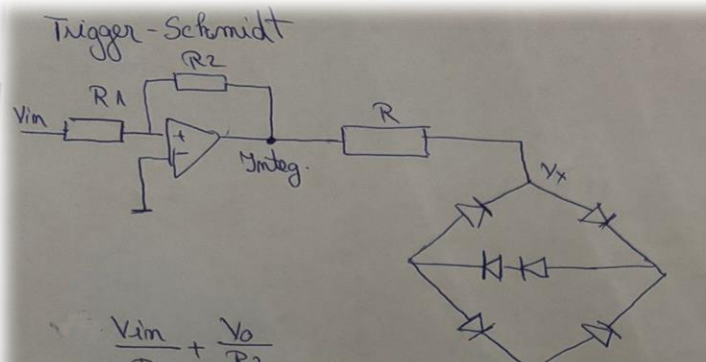
Gr3: A = 4.5V, B = 2.5V, T_{trapez} = 3.5s, $T_{triunghi}$ = 100ms

Schema elctrică :Integrator AO + Trigger-Schmidt



Calcule :Integrator AO + Trigger-Schmidt

Trigger - Schmidt



$$V^{\pm} = \frac{\frac{V_{in}}{R_1} + \frac{V_o}{R_2}}{\frac{1}{R_1} + \frac{1}{R_2}} = \frac{V_{in} \cdot R_2 + V_o \cdot R_1}{R_1 R_2} \cdot \frac{R_1 R_2}{R_1 + R_2}$$

$V^- = 0$

$V^+ = V^- \Rightarrow V_{in} R_2 + V_o \cdot R_1 = 0$

$V_{PS} = -\frac{R_1}{R_2} \cdot V_o = -\frac{R_1}{R_2} \cdot V_{OL} = \frac{R_1}{R_2} \cdot V_{OH}$

$V_{PJ} = -\frac{R_1}{R_2} \cdot V_o = -\frac{R_1}{R_2} \cdot V_{OH} = \frac{R_1}{R_2} \cdot V_{OL}$

Amplitudinea triunghiului de 1V $\Rightarrow$ praguile de la Trigger de $\pm 1V$

· pt un LM 324 : $V_{OH} = 3,5V$

$V_{OL} = -5V$

- am adaugat un circuit de simetrizare

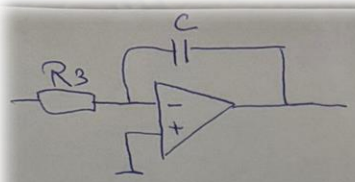
$$\Rightarrow R = \frac{\min(V_{OH}, |-V_{OL}|) - V_x}{I} = \frac{3,5V - 2,16V}{5 \cdot 10^{-3}} = \frac{0,9V}{5 \cdot 10^{-3}} = 0,18k = 180\Omega$$

$V_x = 4 \cdot 0,65 = 2,16V$

$$\left.\begin{aligned} V_{PH} &= -\frac{R_1}{R_2} \cdot V_{OL} \\ V_{PL} &= -\frac{R_1}{R_2} V_{OH} \end{aligned}\right\} \Rightarrow -\frac{R_1}{R_2} \cdot (-2,16) = 1V$$

$\frac{R_1}{R_2} = 0,33 \simeq 0,4 \Rightarrow \boxed{R_1 = 4K}$

pt $\boxed{R_2 = 10K}$



← Integrator

$$i_C = C \cdot \frac{dV_C}{dt} \Rightarrow v_C(t) = \frac{1}{C} \int i dt + v_C(0)$$

$$v_C(t) = \frac{I}{C} \cdot t + v_C(0)$$

$$I = \frac{E}{R}$$

$$\left.\begin{aligned} T_1: \; V_{out_1}(0) &= V_{PJ} = -\frac{R_1}{R_2} \cdot V_o \\ V_{out_1}(T_1) &= V_{PS} = \frac{R_1}{R_2} \cdot V_o \end{aligned}\right\} \Rightarrow T_1 = 2\frac{R_1}{R_2} \cdot R_3 C$$

$$\left.\begin{aligned} T_2: \; V_{out_1}(0) &= V_{PS} = \frac{R_1}{R_2} \cdot V_o \\ V_{out_1}(T_2) &= V_{PJ} = -\frac{R_1}{R_2} \cdot E \end{aligned}\right\} \Rightarrow T_2 = 2\frac{R_1}{R_2} \cdot R_3 C$$

$$\left.\begin{aligned} T &= 4\frac{R_1}{R_2} \cdot R_3 C \\ T_{triunghi} &= 200\,ms \end{aligned}\right\} \Rightarrow 4 \cdot 0,4 \cdot R_3 \cdot C = 200\,ms$$

$1,6 \cdot 18K \cdot C = 200\,ms$

$C = \frac{200\,ms}{1,6 \cdot 18K}$

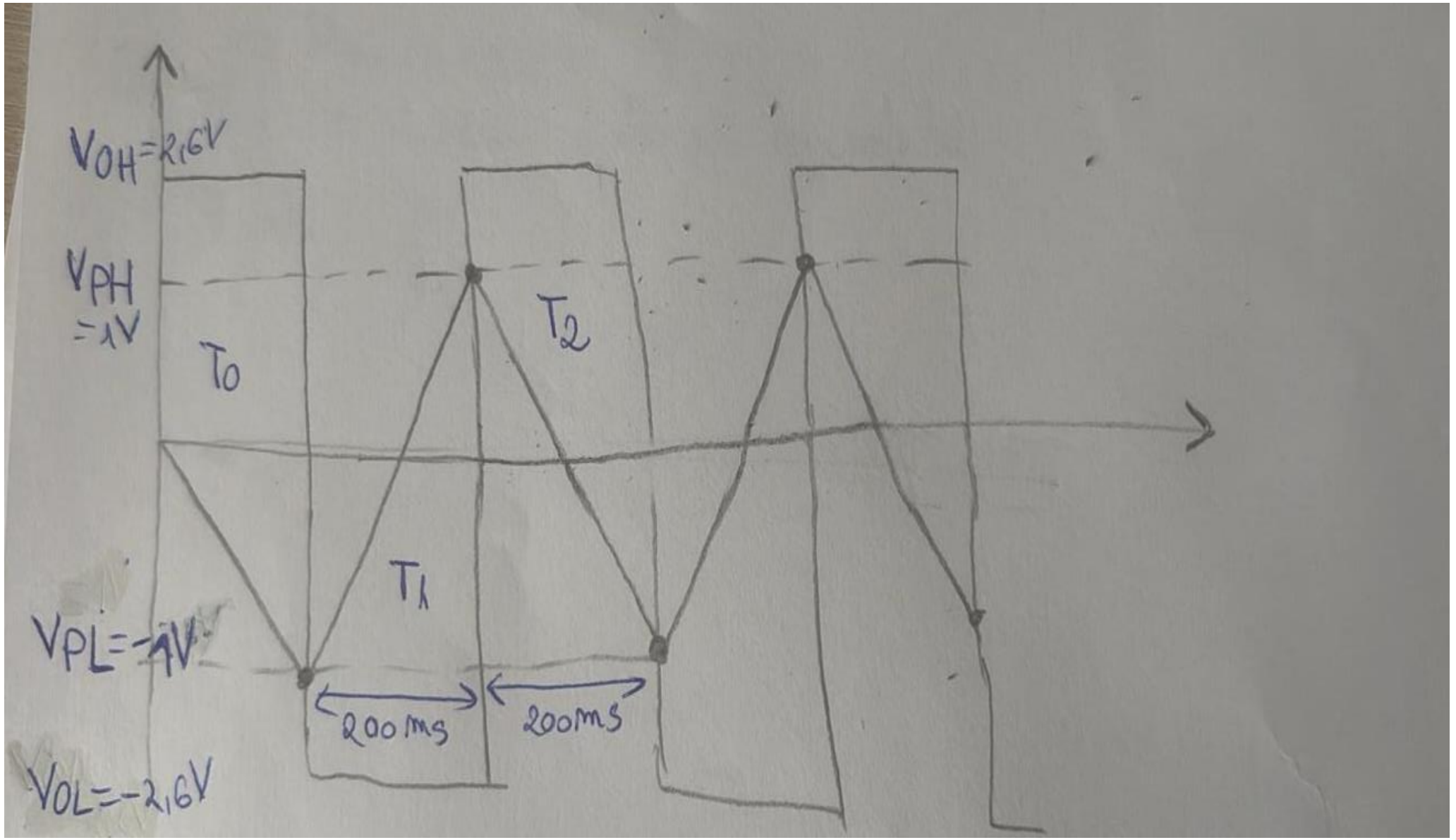
$C = \frac{200\,ms}{28,8}$

$C = 14\mu$

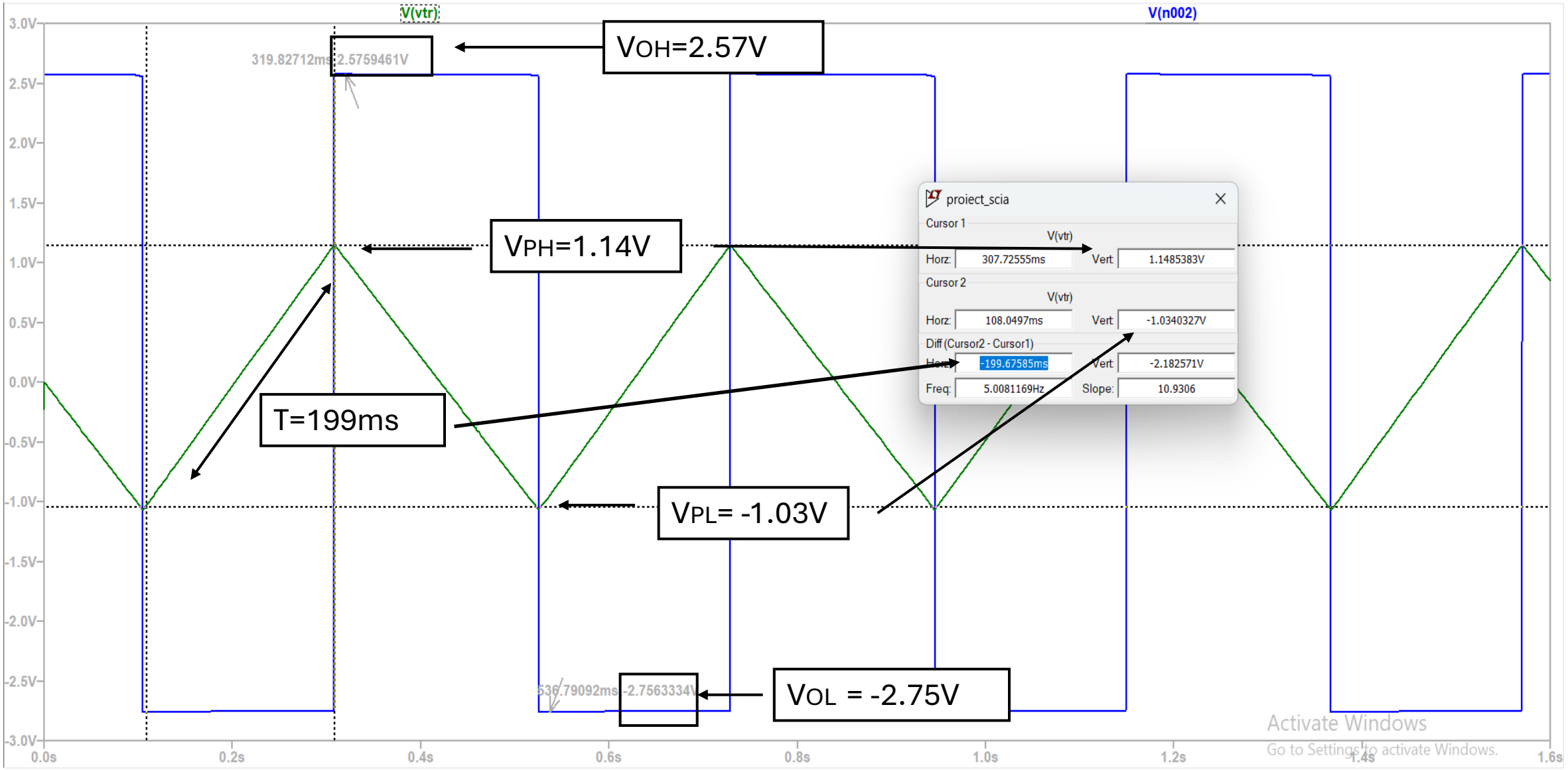
In specificatii: $T_{triunghi}$

$T_{triunghi} = 200 \Rightarrow$ /\ $= 400\,ms$

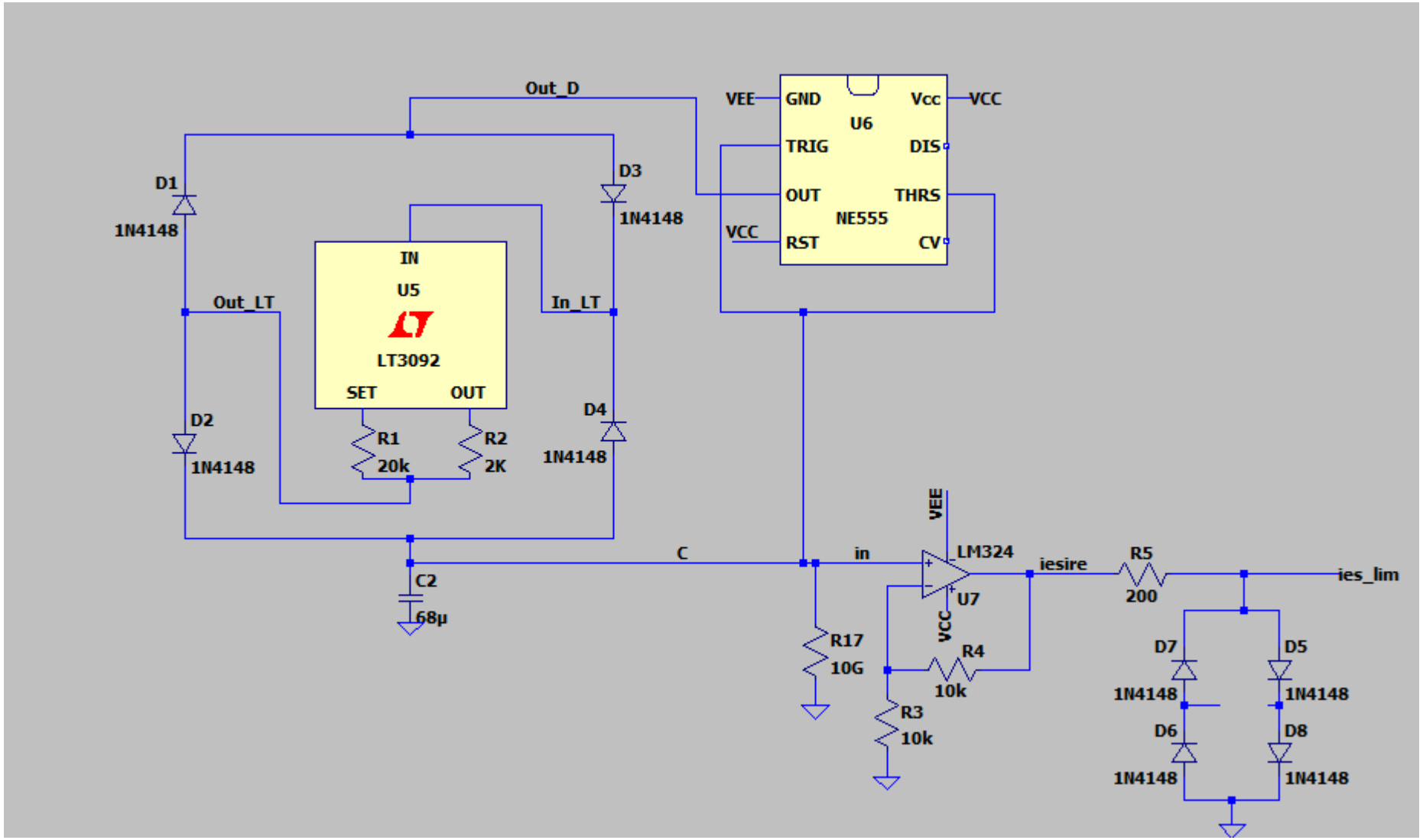
Diagrama de semnale :Integrator AO + Trigger-Schmidt



Rezultatele simulării trans :Integrator AO + Trigger-Schmidt



Schema:Timer 555 cu încărcarea condensatorului pe surse de curent constante ,sursa de curent LT3092



Calcule:Timer 555 cu încărcarea condensatorului pe surse de curent constante ,sursa de curent LT3092

$$Q = C \cdot V$$

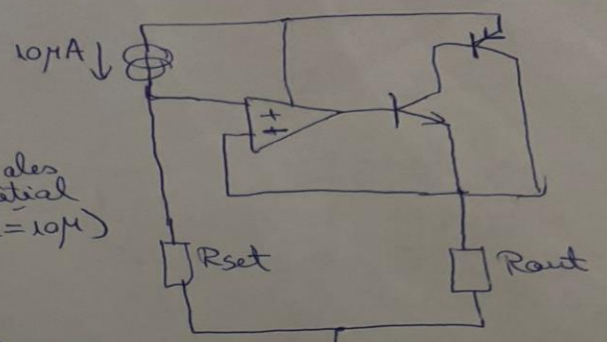
$$\frac{\Delta Q}{\Delta t} = C \cdot \frac{\Delta V}{\Delta t}$$

$$\Delta t = \frac{C \cdot \Delta V}{I}$$

$$1{,}5\,s = \frac{10\mu \cdot 3{,}3V}{I}$$ (am ales inițial R = 10µ)

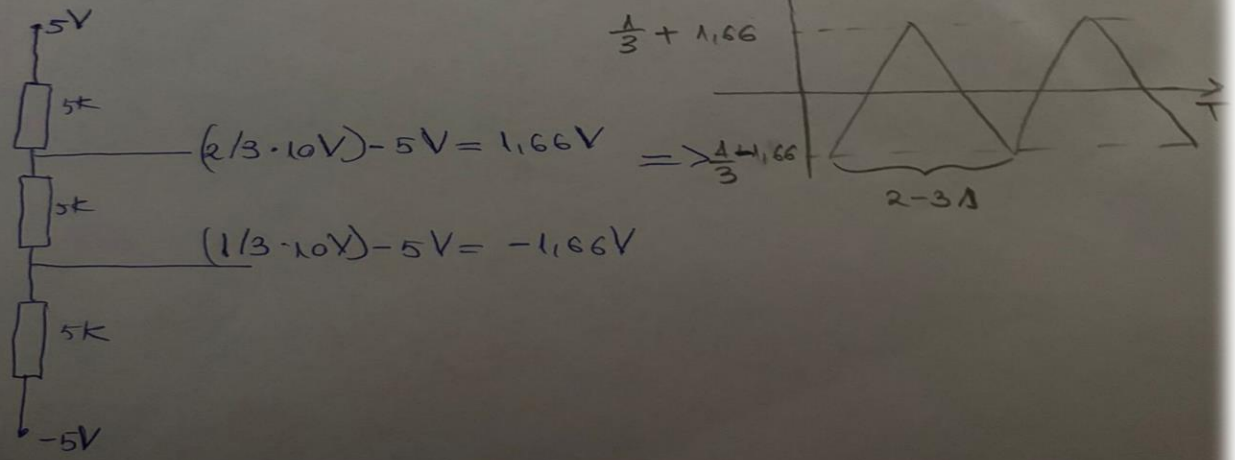
$$I = \frac{33\,\mu}{1{,}5\,s}$$

$$I = 22\mu A$$



$$I_{sursa} = 10\mu A \cdot \frac{R_5}{R_{out}}$$ - formulă luată din foaia de catalog

$$\frac{R_5}{R_{out}} = \frac{22\mu}{10\mu} = 2{,}2 \Rightarrow R_5 = 20k,\ R_{out} = 9k$$

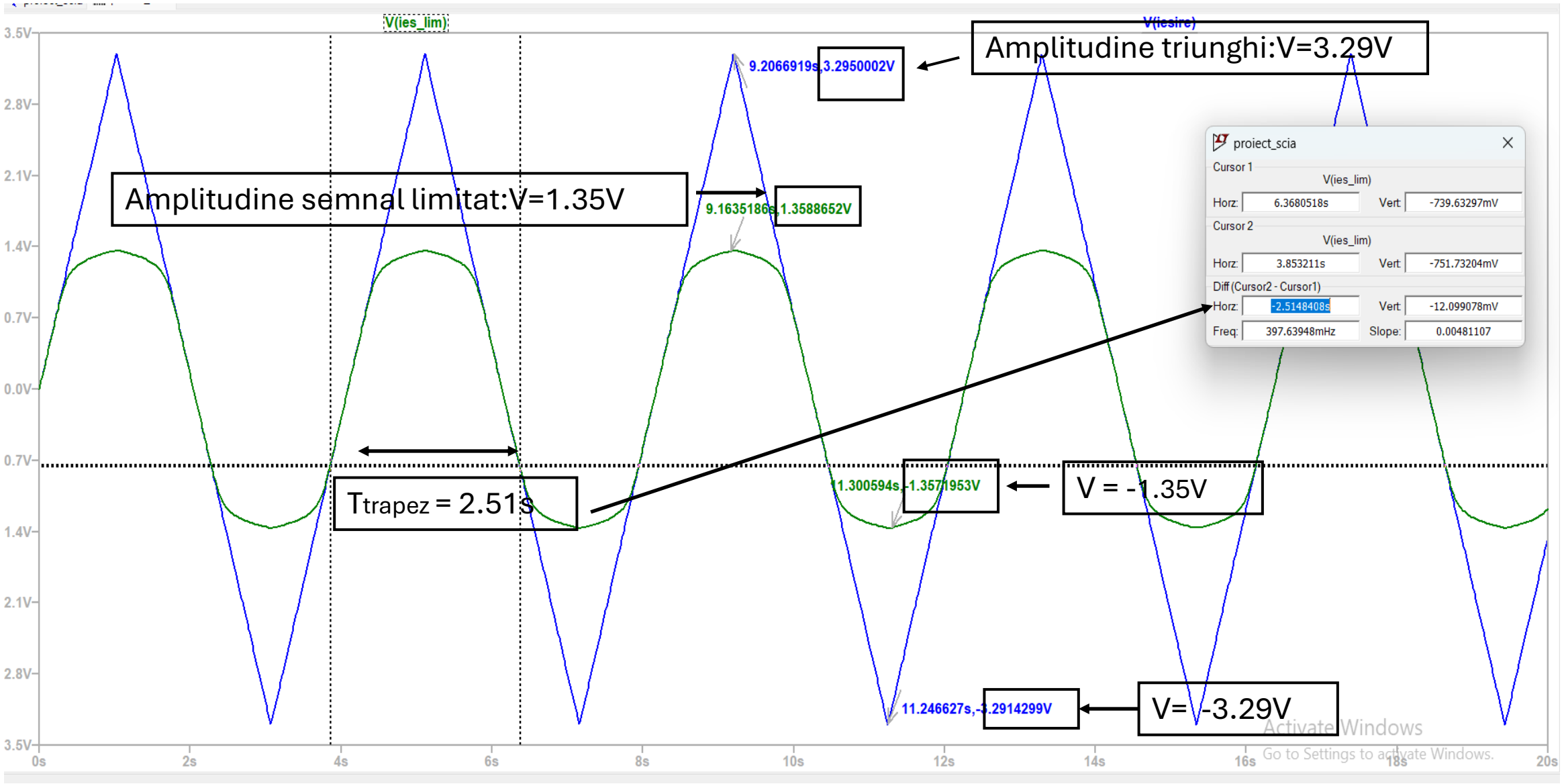


$$1 + \frac{R_4}{R_3} = 2 \Rightarrow \frac{R_4}{R_3} = 1V \Rightarrow R_3 = 10k,\ R_4 = 10k$$

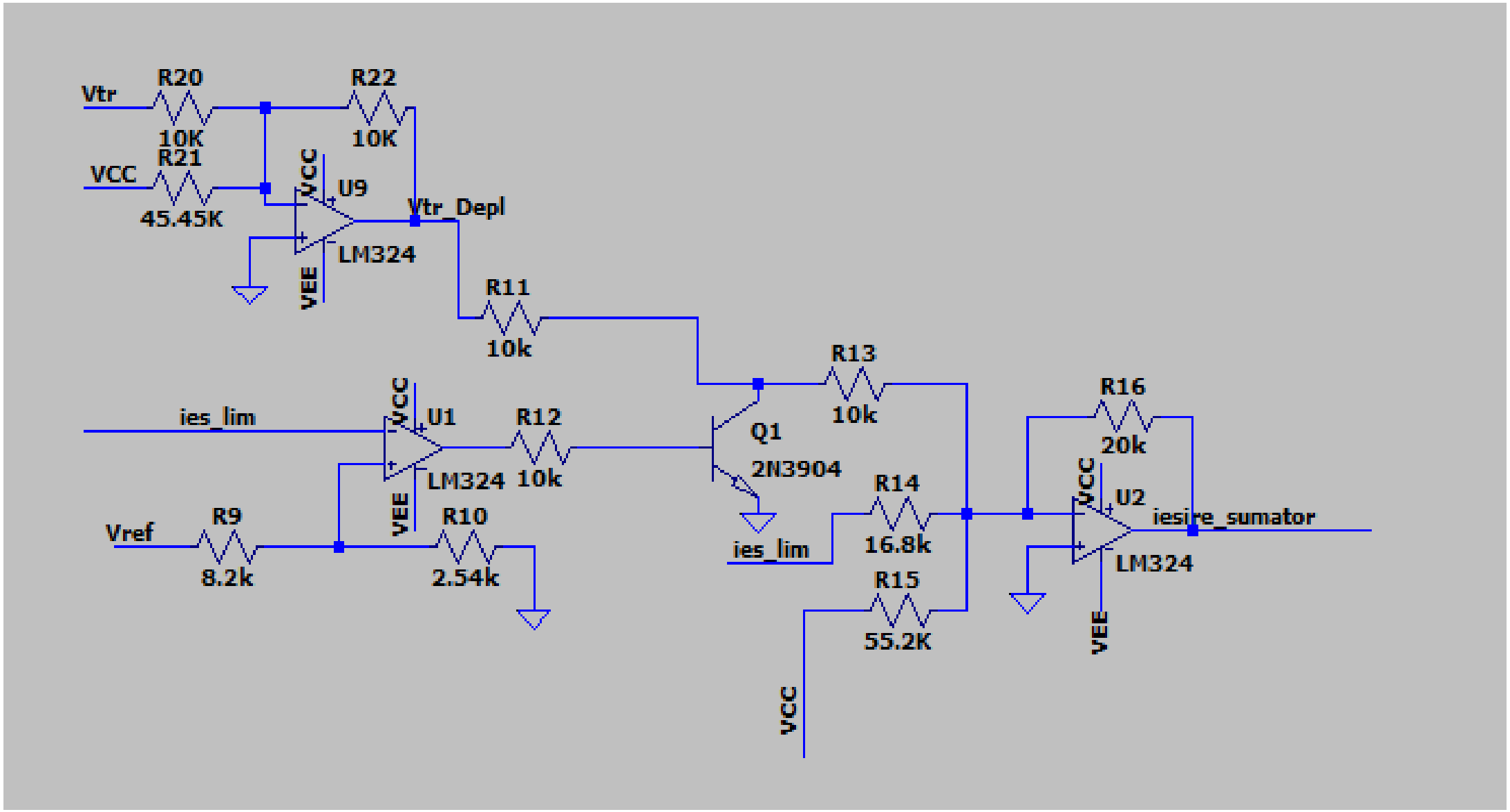
Am amplificat semnalul până aproape de excursia tensiunii de ieșire.

$$R_5 = \frac{V_{ieșire} - V_{ies\_lim}}{I_5} = \frac{3{,}3 - 1{,}3}{10 \cdot 10^{-3}} = 200\Omega$$

Rezultatul simularii trans.Semnalul trapezoizal obtinut dintr-un limitator si un semnal triunghiular

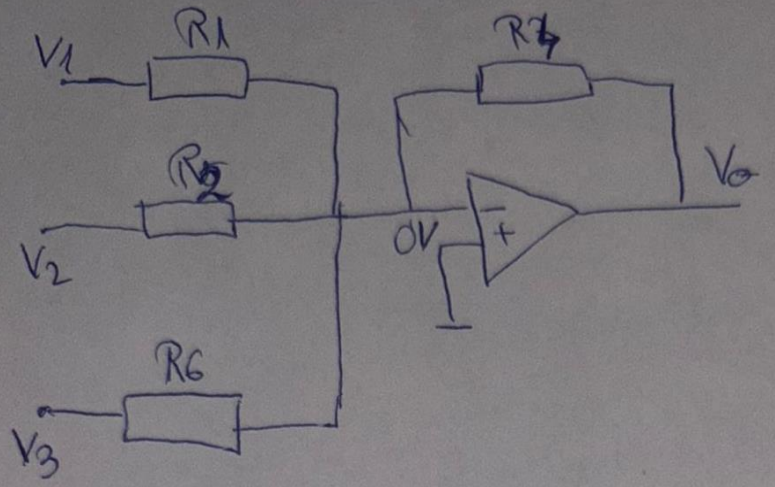


Schema electrică a sumatorului



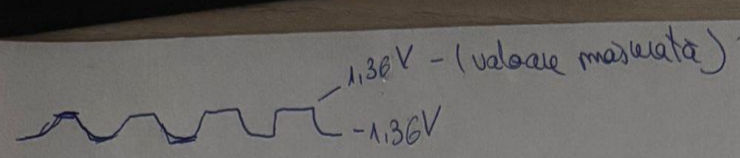
Calcule și demonstrații sumator

Sumatorul



$$\frac{V_1}{R_1} + \frac{V_2}{R_2} + \frac{V_3}{R_3} + \frac{V_0}{R_4} = 0$$

$$V_0 = -\frac{R_4}{R_1} \cdot V_1 - \frac{R_4}{R_2} V_2 - \frac{R_4}{R_3} V_3$$



Scădem 0,25 pentru că semnalul trapezoidal trebuie să se prezească de la valori cuprinse în intervalul 0,2 - 0,3 V

3,5 − 0,25 = 3,25

3,25 : 2,72 = 1,19 (câștig)

$R_{14} = \frac{R_{16}}{1,19}$ } ⇒ $R_{14} = 16,8K$

pt $R_{16} = 20K$

1,56 + 0,25 = 1,81 V

1,81 V : VCC = 1,81 : 5 = 0,362 V

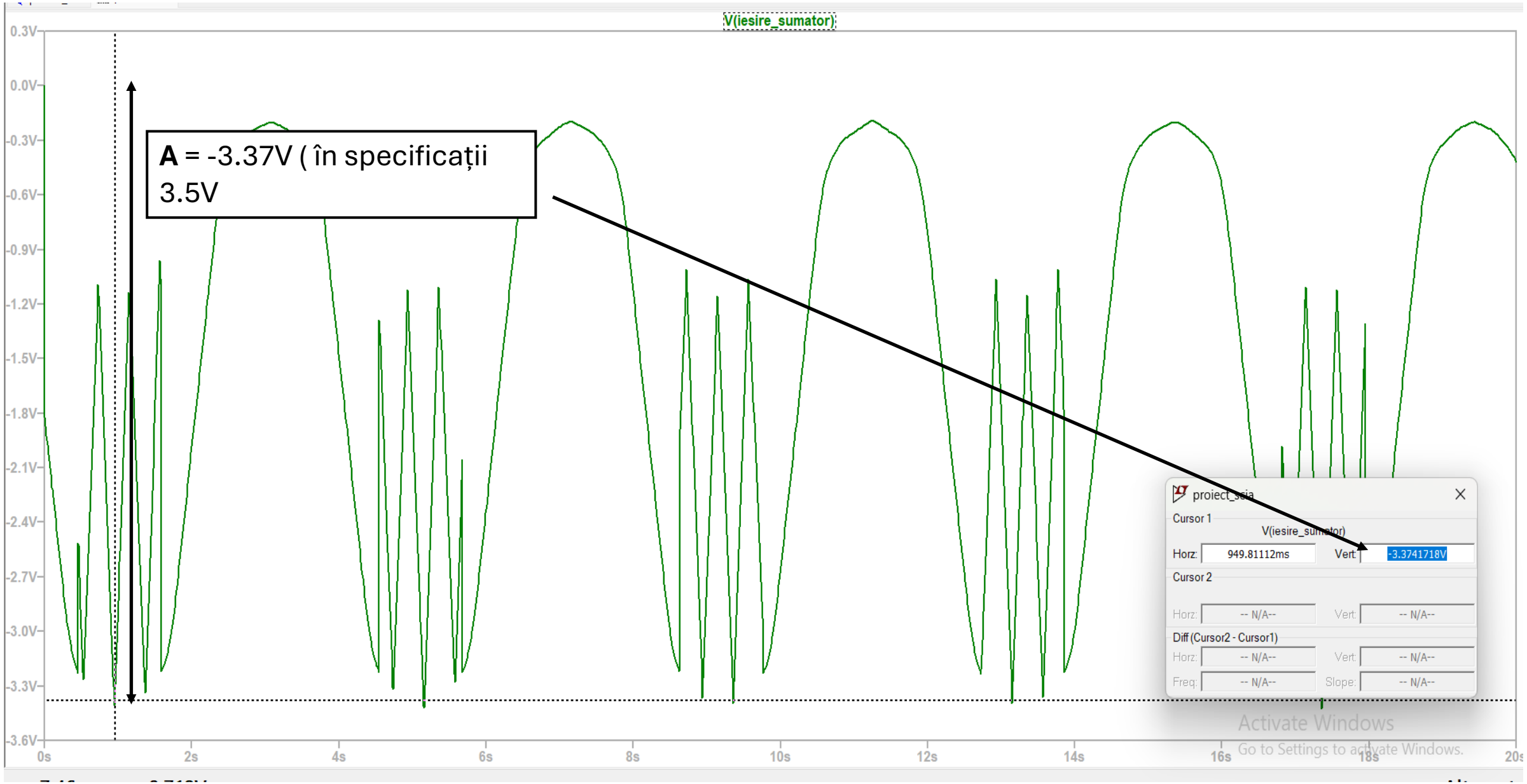
$\frac{1}{0,362} \cdot 20 = 55,24$ k (R15)

3,25 + 2,2 = 5,45

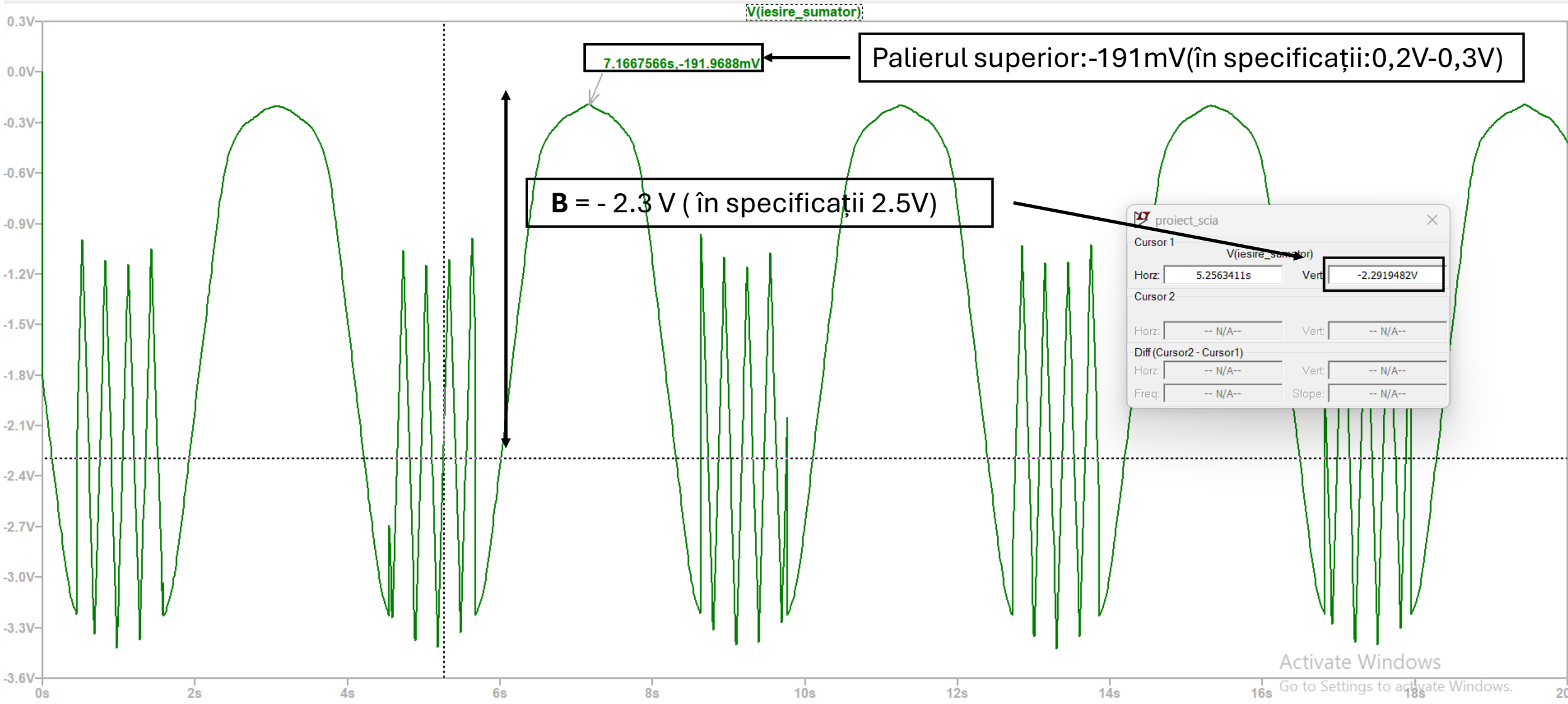
5,45 : 2 = 2,7 (centrarea semnalului)

$\frac{20K}{2,7} = 7,4K$ ⇒ pt R11 și R13 am luat 10K

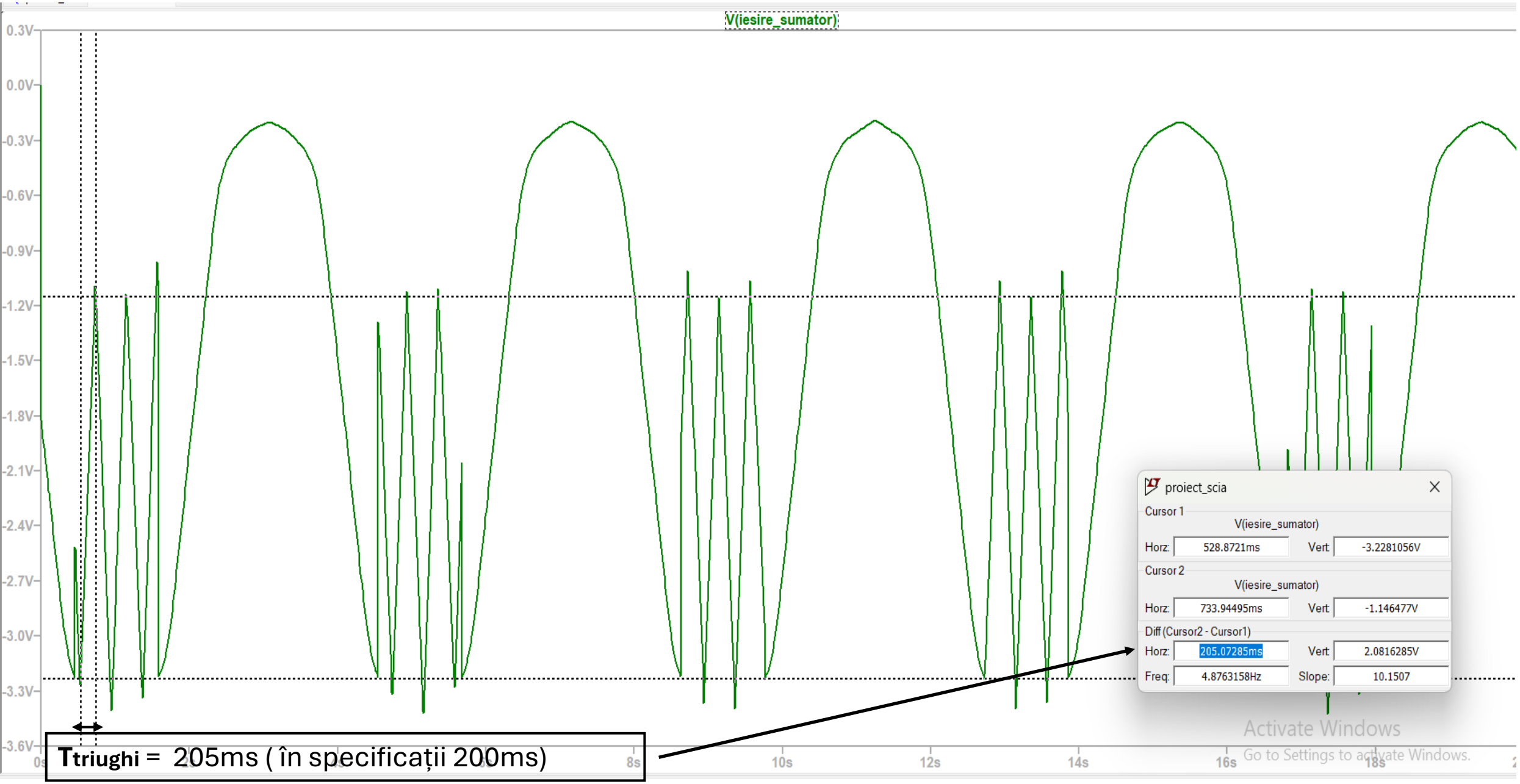
Rezultatul simularii trans. Semnalul de la iesirea sumatorului



Rezultatul simulării trans. Semnalul de la ieșirea sumatorului

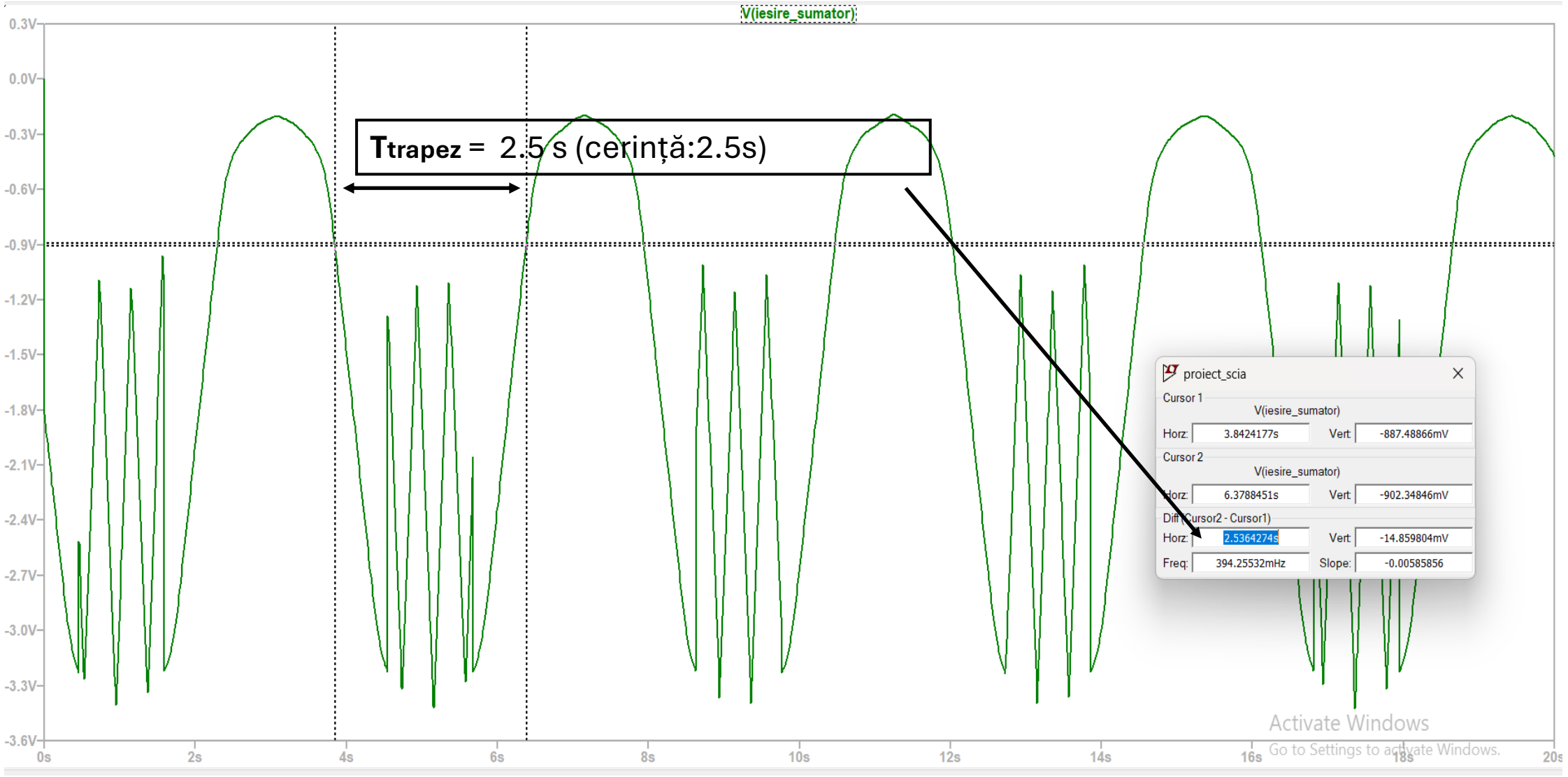


Rezultatul simulării trans. Semnalul de la ieșirea sumatorului

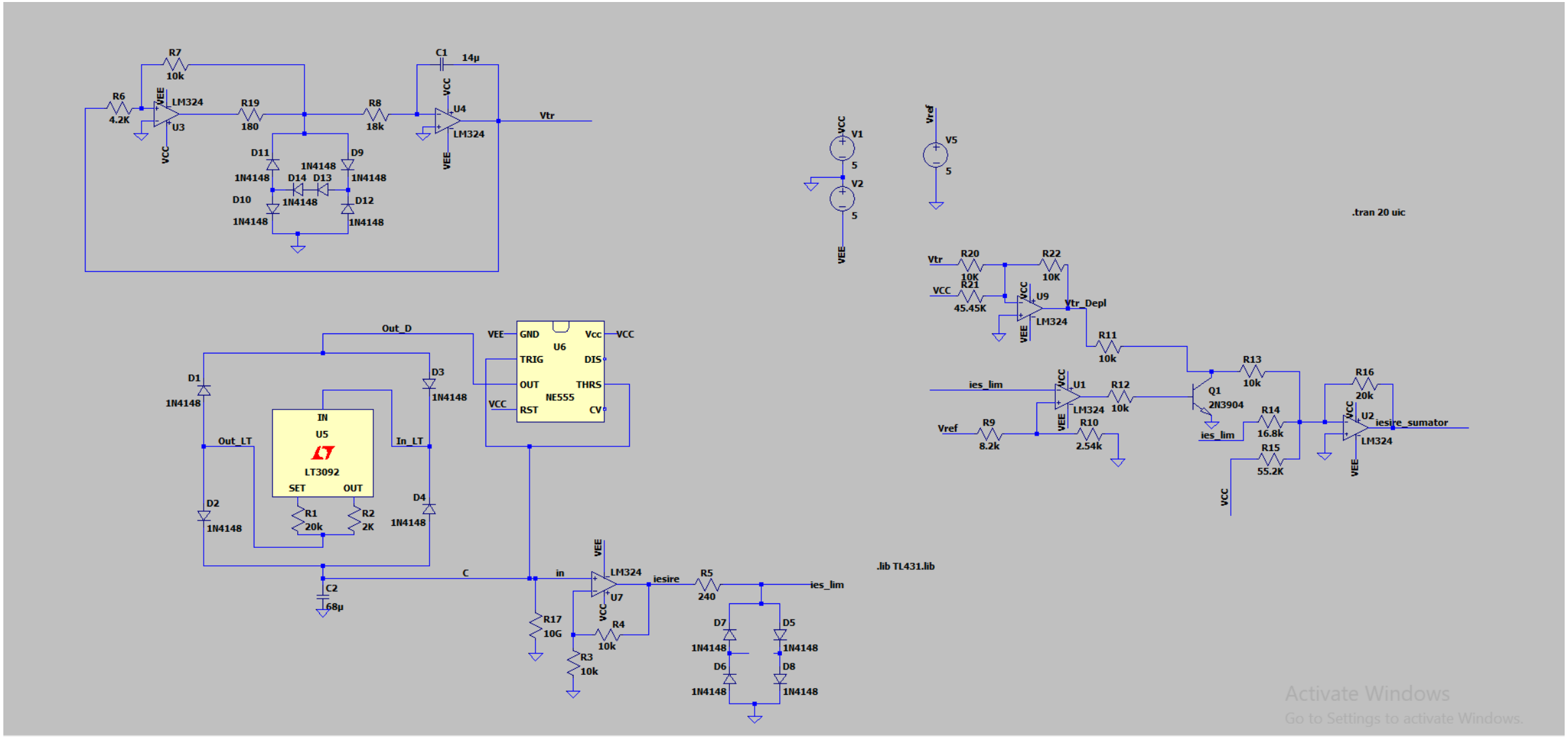


Ttriughi = 205ms (în specificații 200ms)

Rezultatul simulării trans. Semnalul de la ieșirea sumatorului



Schema finală a circuitului



Alterna