

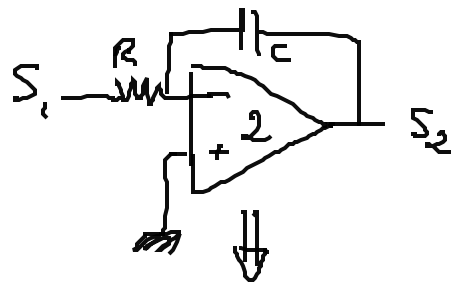
$$S_1 = f(R, e, S_2, S_3)$$

$$v^+ = \frac{e/R + S_2/R}{1/R + 1/R} = \frac{e + S_2}{2}$$

$$v^- = \frac{S_3/R + S_1/R}{1/R + 1/R} = \frac{S_3 + S_1}{2}$$

$$v^+ = v^- \Rightarrow e + S_2 = S_3 + S_1 \Rightarrow \textcircled{a} \boxed{S_1 = e + S_2 - S_3}$$

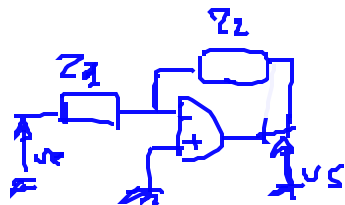
Ampli 2 et 3 idem



$$\Rightarrow \left. \begin{aligned} v^+ &= 0 \\ v^- &= \frac{S_1/R + Y_C S_2}{1/R + Y_C} \end{aligned} \right\} \Rightarrow \frac{S_1}{R} + Y_C S_2 = 0$$

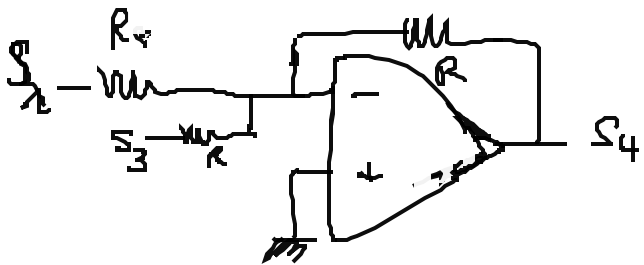
ampli inverseur

$$\frac{v_s}{v_e} = -\frac{Z_2}{Z_1}$$



$$\frac{S_1}{R} + j\omega C S_2 = 0 \Rightarrow \boxed{S_2 = -\frac{S_1}{jRC\omega}}$$

$$\boxed{S_3 = -\frac{S_2}{jRC\omega}}$$



$$\left. \begin{aligned} v^+ &= 0 \\ v^- &= \frac{S_4/R + S_1/R + S_2/R}{3/R} \end{aligned} \right\} \Rightarrow S_4 = -\boxed{S_1 + S_2 + S_3}$$