Montages de base avec un amplificateur opérationnel

Rappel : aop parfait

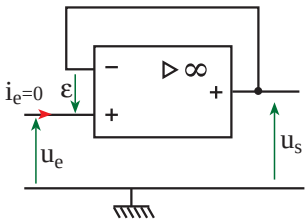
$i^+ = 0$

$i^- = 0$

$\varepsilon = 0$

Montage suiveur

$$u_s = u_e$$

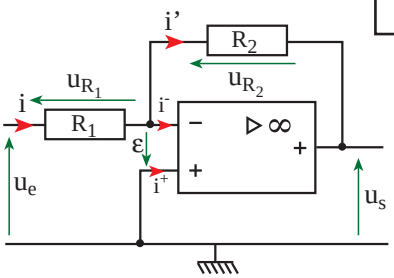


$u_s + \varepsilon - u_e = 0$

$\varepsilon = 0 \quad \Rightarrow \quad u_s = u_e$

Montage inverseur

$$u_s = -\frac{R_2}{R_1} u_e$$



$i = i' \quad car \quad i^- = 0$

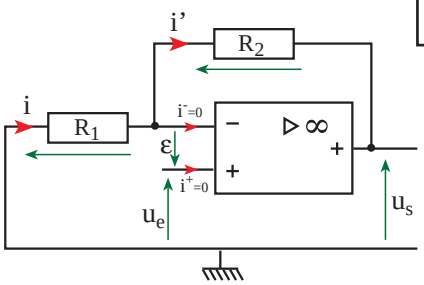
$u_s + R_2 i + \varepsilon = 0 \quad \Rightarrow \quad u_s = -R_2 i$

$u_e - R_1 i + \varepsilon = 0 \quad \Rightarrow \quad u_e = R_1 i$

$$\frac{u_s}{u_e} = \frac{-R_2 i}{R_1 i} = -\frac{R_2}{R_1}$$

Montage non inverseur

$$u_s = \frac{R_1 + R_2}{R_1} u_e$$



$i = i' \quad car \quad i^- = 0$

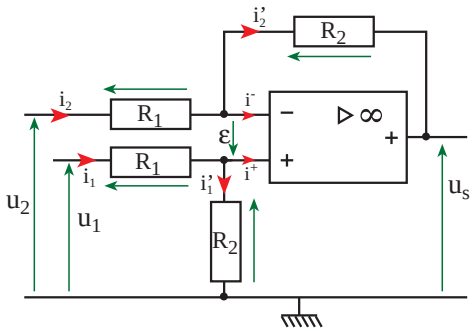
$u_s - R_2 i - R_1 i = 0 \quad \Rightarrow \quad u_s = (R_1 + R_2) i$

$u_e - \varepsilon - R_1 i = 0 \quad \Rightarrow \quad u_e = R_1 i$

$$\frac{u_s}{u_e} = \frac{(R_1 + R_2) i}{R_1 i} = \frac{R_1 + R_2}{R_1} = 1 + \frac{R_2}{R_1}$$

Montage soustracteur ou amplificateur de différence

$$u_s = \frac{R_2}{R_1}(u_1 - u_2)$$



$i_2 = i_2' \quad car \quad i^- = 0$

$i_1 = i_1' \quad car \quad i^+ = 0$

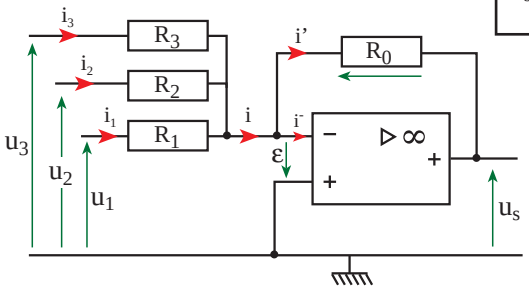
$u_2 - R_1 i_2 + \varepsilon + R_1 i_1 - u_1 = 0 \quad \Rightarrow \quad i_1 - i_2 = \frac{u_1 - u_2}{R_1}$

$u_s + R_2 i_2 + \varepsilon - R_2 i_1 = 0 \quad \Rightarrow \quad u_s = R_2 (i_1 - i_2)$

$$u_s = R_2 \frac{u_1 - u_2}{R_1}$$

Montage sommateur

$$u_s = -R_0 . (\frac{u_1}{R_1} + \frac{u_2}{R_2} + \frac{u_3}{R_3})$$



$i = i' \quad car \quad i^- = 0 \quad ; \quad i = i_1 + i_2 + i_3$

$u_s + R_0 i + \varepsilon = 0 \quad \Rightarrow \quad i = -\frac{u_s}{R_0}$

$u_1 - R_1 i_1 + \varepsilon = 0 \quad \Rightarrow \quad i_1 = \frac{u_1}{R_1}$ *de même* $i_2 = \frac{u_2}{R_2}$ *et* $i_3 = \frac{u_3}{R_3}$

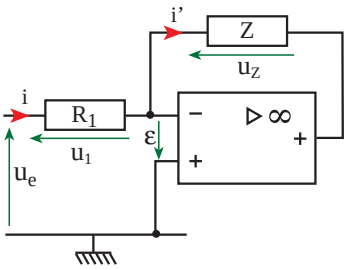
$i = i_1 + i_2 + i_3 \quad \Rightarrow \quad -\frac{u_s}{R_0} = \frac{u_1}{R_1} + \frac{u_2}{R_2} + \frac{u_3}{R_3}$

$u_s = -R_0 (\frac{u_1}{R_1} + \frac{u_2}{R_2} + \frac{u_3}{R_3})$ *et si* $R_1 = R_2 = R_3$ *alors* $u_s = -\frac{R_1}{R_0}(u_1 + u_2 + u_3)$

Autres montages de base avec un amplificateur opérationnel

Conversion tension-courant

$$i = \frac{u_e}{R_1}$$



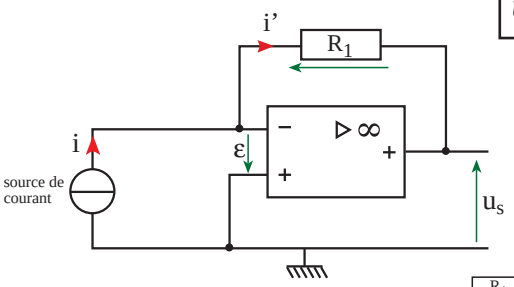
$i = i_1 \quad car \quad i^- = 0$

$u_e - R_1 i_1 + \varepsilon = 0 \quad \Rightarrow \quad i = i_1 = \frac{u_e}{R_1}$

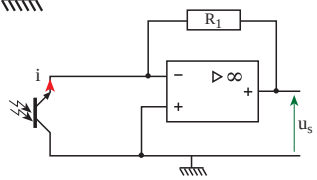
Le courant *i* dans la charge ne dépend pas de celle-ci, mais de la tension de commande u_e.

Conversion courant-tension

$$u_s = R_1.i$$



Exemple d'application : le phototransistor produit un courant proportionnel à l'éclairement.



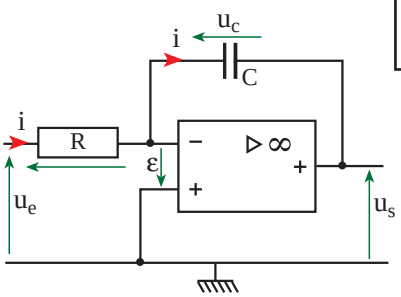
$i_1 = i \quad car \quad i^- = 0$

$u_s + R_1 i_1 + \varepsilon = 0 \quad \Rightarrow \quad u_s = R_1 i$

La tension de sortie u_s est proportionnelle au courant d'entrée *i*.

Montage intégrateur

$$u_s = -\frac{1}{RC}\int u_e dt$$



$u_e - Ri + \varepsilon = 0 \quad \Rightarrow \quad i = \frac{u_e}{R}$

$u_s + u_c + \varepsilon = 0 \quad \Rightarrow \quad u_s = -u_c$

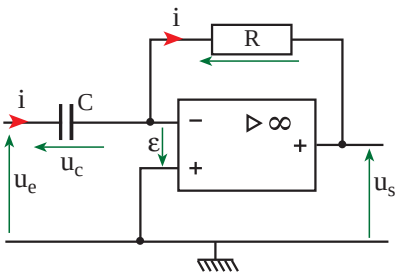
et $i = C\frac{du_c}{dt}$ *donc* $i = -C\frac{du_s}{dt}$

finalement $-C\frac{du_s}{dt} = \frac{u_e}{R}$ *soit* $\frac{du_s}{dt} = -\frac{1}{RC}u_e$

en intégrant, on obtient $u_s = \int -\frac{1}{RC}u_e.dt$

Montage dérivateur

$$u_s = -RC\frac{du_e}{dt}$$



$u_e - u_c + \varepsilon = 0 \quad \Rightarrow \quad u_e = u_c$

$u_s + Ri + \varepsilon = 0 \quad \Rightarrow \quad u_s = -Ri$

$i = C\frac{du_c}{dt} \quad \Rightarrow \quad u_s = -RC\frac{du_c}{dt} = -RC\frac{du_e}{dt}$