Exame de Recurso 20.7.2009

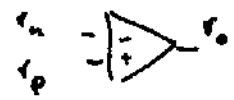
1)

R = resistência

S = sensor

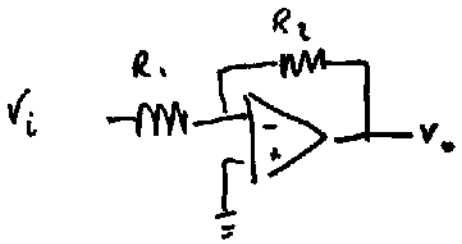
para translate signal para 0 V

2)



- ganho infinito
- $r_{in} = \infty$
- $r_{out} = 0$
- $V_o = A(V_p - V_n)$

→ $V_p = V_n$ quando não há saturação



$I_i = \frac{V_i}{R_1}$, $V_p = 0 \Rightarrow V_n = 0$

$V_o = V_n - I_i \cdot R_2$

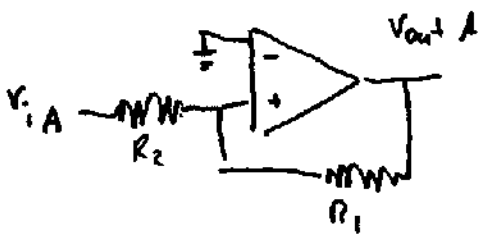
$= -V_i \frac{R_2}{R_1}$

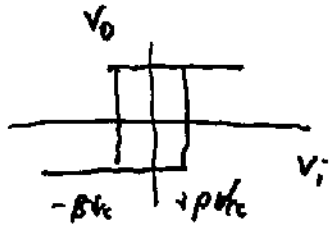
$= -100 \Rightarrow R_2 = 10\ k\Omega$, $R_1 = 100\ \Omega$

3) B é um integrador

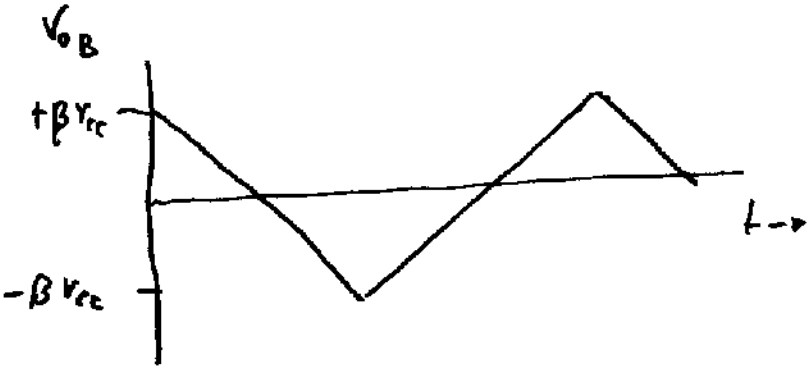
$V_{out\,B} = -\frac{V_{in}\,B}{RC}\,t + V_{out\,0}$ $(V_{in} = 0)$

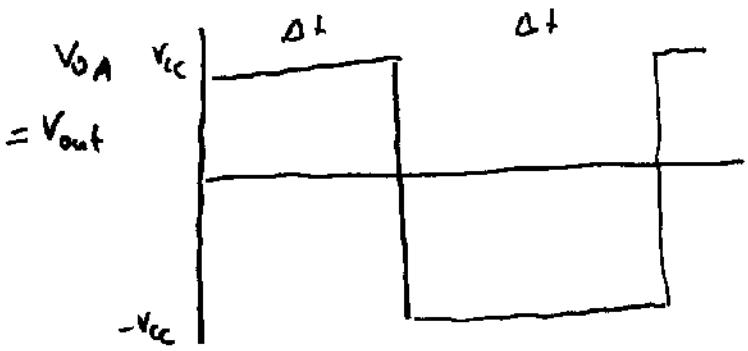
A é um comparador com histerese





$\beta = \frac{R_2}{R_1 + R_2}$





$$\Delta t \cdot \frac{V_{in\,B}}{RC} = 2\beta V_{cc}$$

$$\Delta t = \frac{2RC\,\beta V_{cc}}{V_{cc}}$$

$$= 2\beta RC$$

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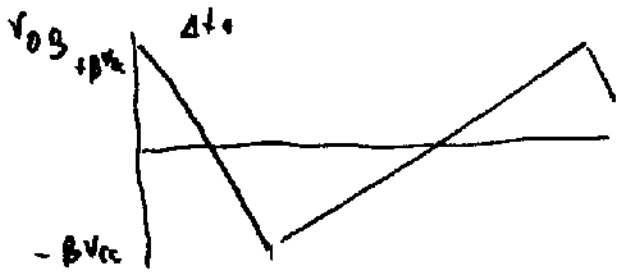
com $V_{in} \neq 0$:

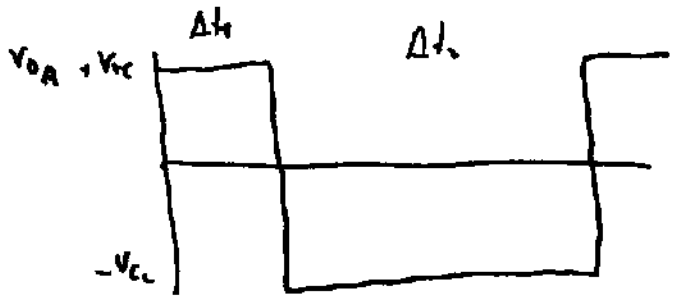
$$V_{out\,B} = -\frac{V_{out\,A} + V_{in}}{RC} t$$

$$V_{out\,A} = \pm V_{cc}$$



$$\Delta t_1 \cdot \frac{V_{in} + V_{cc}}{RC} = 2\beta V_{cc}$$

$$\Delta t_1 = 2\beta RC \cdot \frac{V_{cc}}{V_{in} + V_{cc}}$$



$$\Delta t_2 \cdot \frac{V_{cc} - V_{in}}{RC} = 2\beta V_{cc}$$

$$\Delta t_2 = 2\beta RC \frac{V_{cc}}{V_{cc} - V_{in}}$$

duty cycle : $\dfrac{\Delta t_1}{\Delta t_1 + \Delta t_2} = \dfrac{V_{cc} / V_{in} + V_{cc}}{V_{cc} / V_{cc} - V_{in}}$

$$= \frac{V_{cc} - V_{in}}{V_{cc} + V_{in}}$$

Período : $\Delta t_a + \Delta t_b = 2\beta RC\, V_{cc} \left(\frac{1}{V_{in}+V_{cc}} + \frac{1}{V_{cc}-V_{in}} \right)$

b) duty cycle 20%

$$\frac{V_{cc}-V_{in}}{V_{cc}+V_{in}} = 0.2 \Rightarrow \frac{10-V_i}{10+V_i} = 0.2$$

$$10 - V_i = 2 + 0.2\,V$$

$$1.2\,V_i = 8 \Rightarrow V_i = 6.7\ V$$

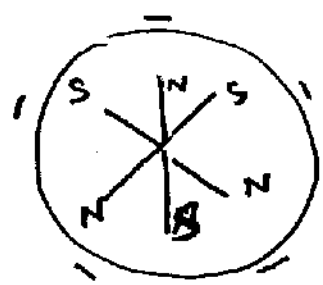
$$\Delta t = 2\beta RC \cdot V_{cc} \left(\frac{1}{V_{in}+V_{cc}} + \frac{1}{V_{cc}-V_{in}} \right)$$

$$\Delta t = 2\beta RC \cdot 10 \left(\frac{1}{16.7} + \frac{1}{3.3} \right)$$

$$\Rightarrow \beta RC = \frac{1\ ms}{20 \left(\frac{1}{16.7} + \frac{1}{3.3} \right)}$$

4) a) reja sebenta

b)

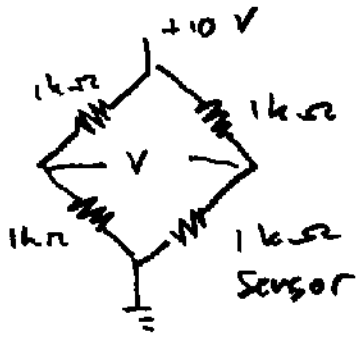


$a = 72°$
$b = 60°$
$\Delta\alpha = 12°$

$360°/12° = 30$ passos

5) veja abaixo

6) a)



$$V = 10 \times \frac{R_s}{R_s + 1k\Omega} - 5$$

traduz $\Delta R \rightarrow V$

tira offset do sensor $V = 0$ em ponto de calibração

b) $$\frac{dV}{dR} = 10 \times \frac{1000}{(R+1000)^2} \quad \left(\frac{V}{\Omega}\right)$$

$$= 10 \times \frac{1000}{(1000+1000)^2} = \frac{10}{4000}\frac{V}{\Omega} = 2.5 \frac{mV}{\Omega}$$

$$\frac{dR}{dB} = \frac{\Delta R}{\Delta B} = \frac{0.8 \cdot 1k\Omega}{2T} = 400\ \Omega/T$$

$$\frac{dV}{dB} = \frac{dV}{dR} \cdot \frac{dR}{dB} = 2.5 \frac{mV}{\Omega} \cdot 400 \frac{\Omega}{T} = 1\ V/T$$

resolução do sistema $\Delta B = \frac{\Delta V}{dV/dB} = \frac{0.2\ \mu V}{1\ V/T}$

$$= 0.2\ \mu T = 2 \times 10^{-7}\ T =$$

$$2 \times 10^{-3}\ G \ll 5\ \text{gauss}$$

c) $10nm \times 10nm = 1\ G = 10^{-16}\ m^2$

$2 \times 10^{-3}\ G = 2 \times 10^{-19}\ m^2$

disco area: $\pi \times (0.1)^2 = 3.14\ 10^{-2}\ m^2$

$$= \frac{3.14\ 10^{-2}\ m^2}{2 \cdot 10^{-19}\ m^2} = 1.57\ 10^{17}\ bits \sim 2\ 10^{16}\ bytes = 20000\ TB$$