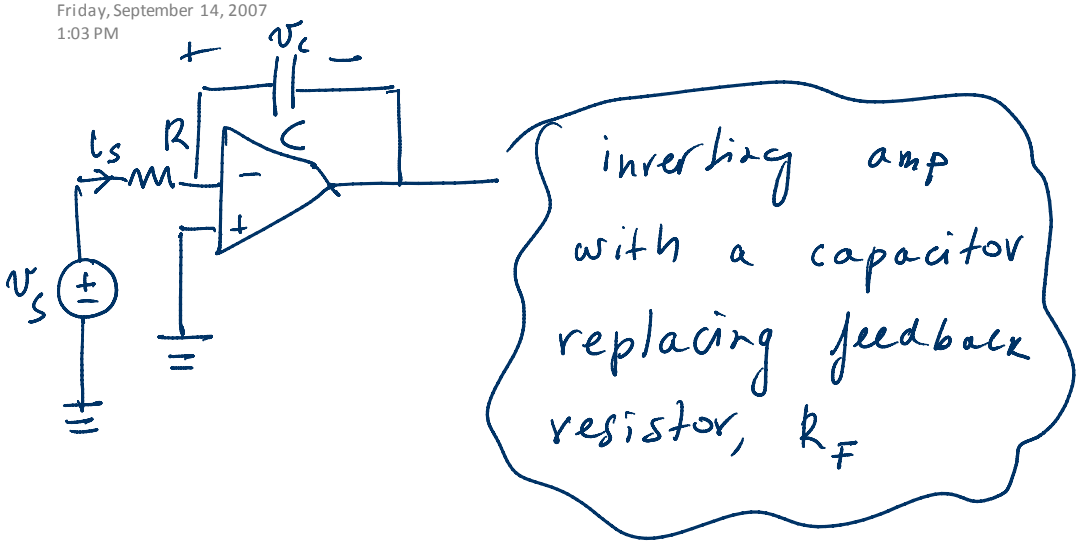
Integrator-Differentiator

Friday, September 14, 2007
1:03 PM



$$i_s = \frac{v_s}{R} \qquad (1)$$

$$i_c = -C\frac{dv_o}{dt} \qquad (2)$$

For an ideal amp:

$$i = 0 \Rightarrow i_c = i_s \qquad (3)$$

Equating (1) & (2) & integrating

$$\int dv_o = \int -\frac{1}{RC}\, v_s\, dt$$

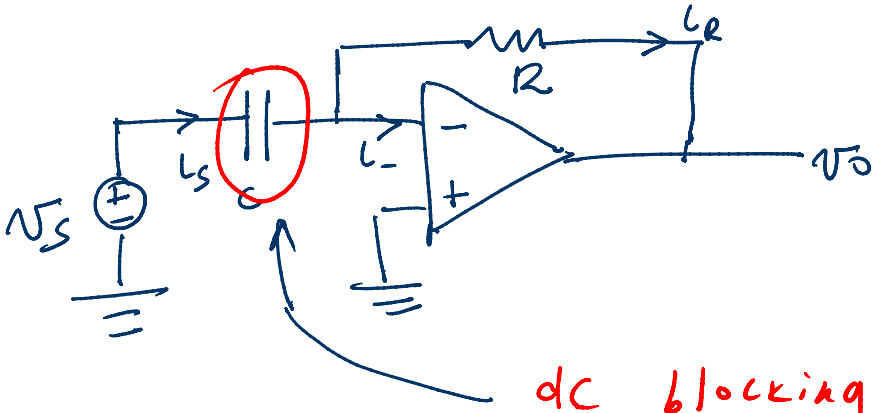
integral of input voltage

initial capacitor voltage

$$\text{or} \quad v_o = -\frac{1}{RC}\int v_s(\tau)\, d\tau + v_o(0)$$

in which $v_o(0)$ is determined by the voltage of the capacitor at $t = 0$: $v_o(0) = V_c(0)$

DIFFERENTIATOR



dc blocking capacitor ⇒ high frequency components of the signal are emphasized

$$i_s = C \frac{dv_s}{dt}$$

$$i_R = -\frac{v_o}{R}$$

Since $i_- = 0 \Rightarrow i_s = i_R$

$$\Rightarrow v_o = -RC \frac{dv_s}{dt}$$

⇒ Output voltage scaled derivative of the input voltage.