7.4.1 : Inverting Differentiator

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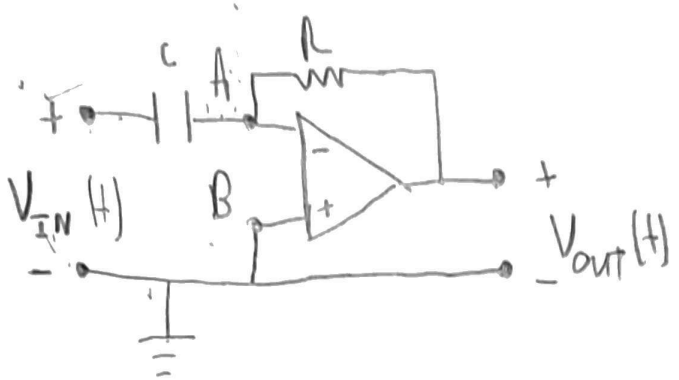

$R_{meas} = 1.47K$

$C = 100nF$

$A = 1V$

$f = 1kHz$

$\omega = 2\pi k$

$V_{IN}(t) = A\cos(\omega t)$ $\quad V = A - V_{IN}$ $\quad \dot{V} = \dot{A} - \dot{V}_{IN}$

$V = \frac{Q}{C} : \dot{V} = \frac{i}{C} \quad i = \dot{V}C$

$\frac{A - V_{out}}{R} + C(\dot{A} - \dot{V}_{IN}) = 0$ $\quad B = 0 \Rightarrow A = 0$

$\frac{-V_{out}}{R} + C(-\dot{V}_{IN}) = 0$

$V_{out} = -RC\,\dot{V}_{IN}$

$V_{out} = -RC\frac{d}{dt}(A\cos(\omega t))$

$\omega = 2\pi f$

$V_{out} = ARC\omega\sin(\omega t)$

$\uparrow\ \uparrow\ \uparrow$

$1 \quad 1.5k \quad 100nF$

$V_{out} = \underbrace{(1)(1.5k)(100nF)(2\pi k)}_{0.942sV}\sin(2\pi k t)$

1.97 peak to peak

$A_{measured} = 0.985$

$\frac{0.985 - 0.943}{0.943} \times 100 \approx 4.45\%$ error

$\frac{\pi}{2}$ phase shift.

Derivative is lagging by $\frac{\pi}{2}$.