11/26

# Lecture 26

## ECG 722 Mixed-signal

.02 mV

7.5

$$v_{out}(z) = \frac{z^{-1}}{1+\frac{C_I}{C_F}\cdot\frac{1}{A_{OL}}}\cdot v_{in} + V_{QP}(\ \ )$$

EQ. 7.32

$$\varepsilon = \frac{C_I}{C_F}\cdot\frac{1}{A_{OL}}$$

EQ 7.33

$$A_{OL} = 10, \quad \frac{C_I}{C_F} = 1$$

$$\left|\frac{v_{in}\, z^{-1}}{1+.1}\right|$$

$$\frac{v_{in}}{1.1} \simeq .9\, v_{in}$$

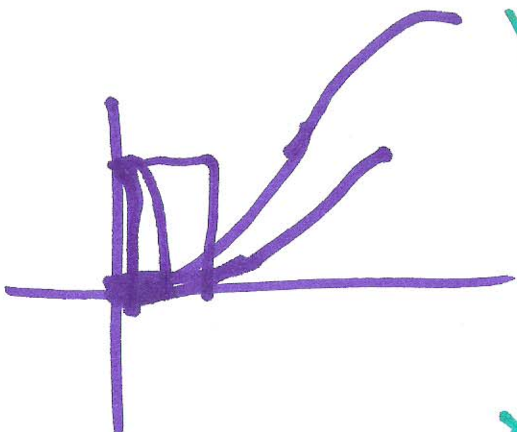
finite sense for DC signal ) start-up

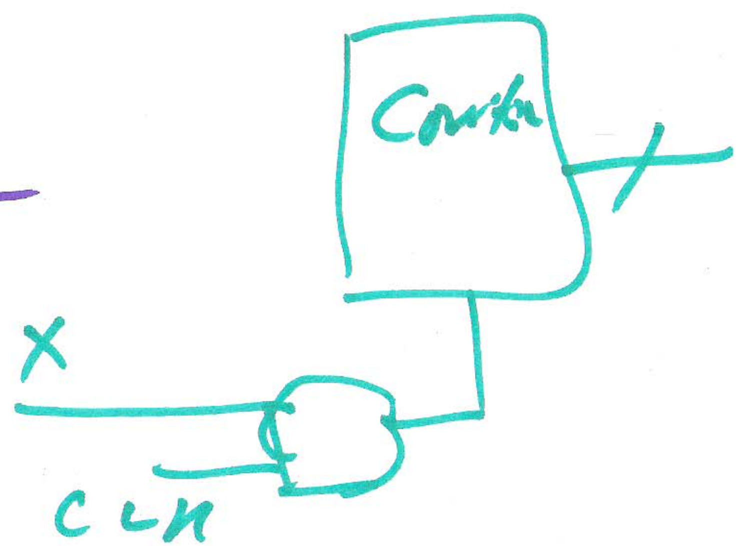
$$\sum \{x_1 + x_2 + \dots x_k\} = (1 + z^{-1} + z^{-2})X = Y$$

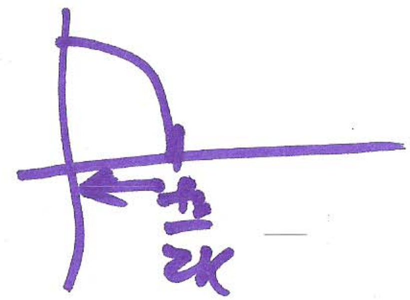
$$H = \frac{Y}{X} = \frac{1 - z^{-k}}{1 - z^{-1}}$$

Counter

$$x_1 + x_2 + x_3 + \dots x_k$$

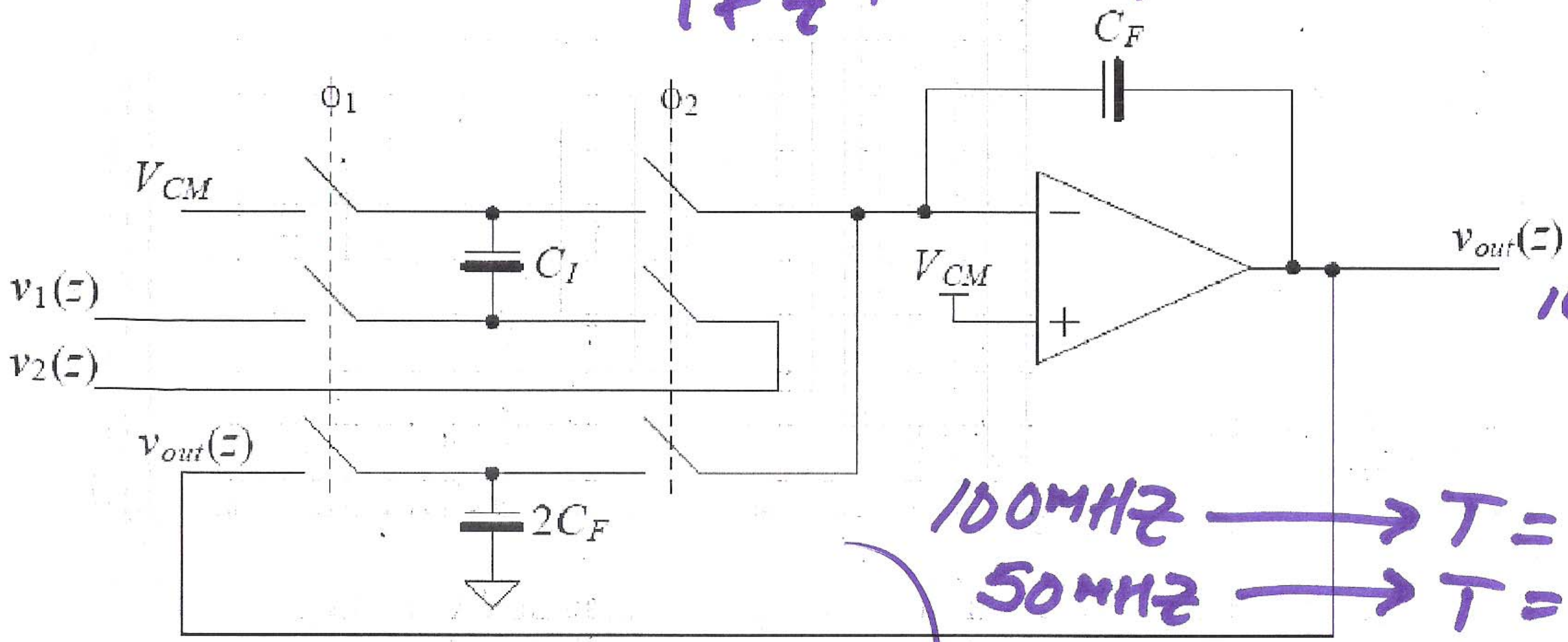





$K \to \infty$

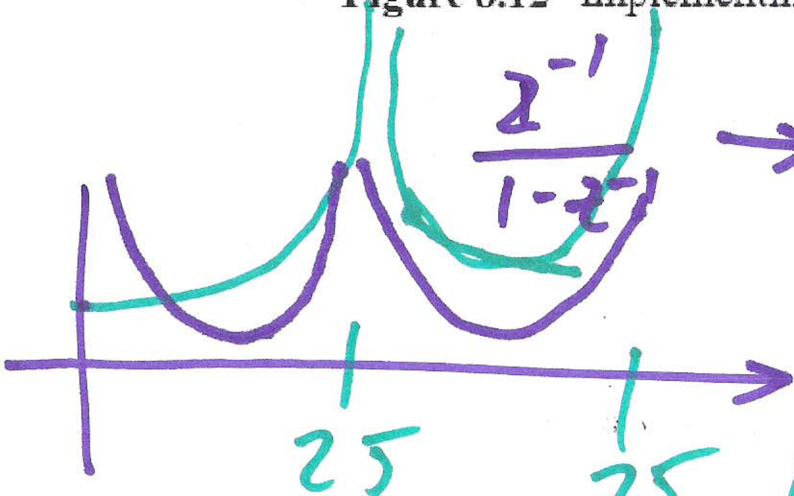
$$\frac{v_1(z)\cdot z^{-1/2} - v_2(z)}{1+z^{-1}} \qquad \frac{C_I}{C_F} = 2\omega_0 T$$




100MHZ → T = 10nS

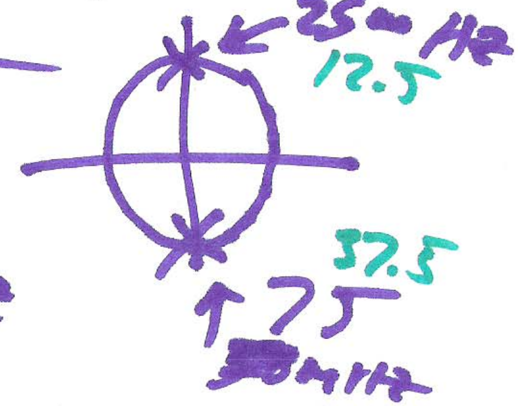
50MHZ → T = 20nS

**Figure 8.12** Implementing a resonator for use in a bandpass modulator.




$$\frac{z^{-1}}{1-z^{-1}} \rightarrow \frac{z^{-1}}{1+z^{-2}}$$

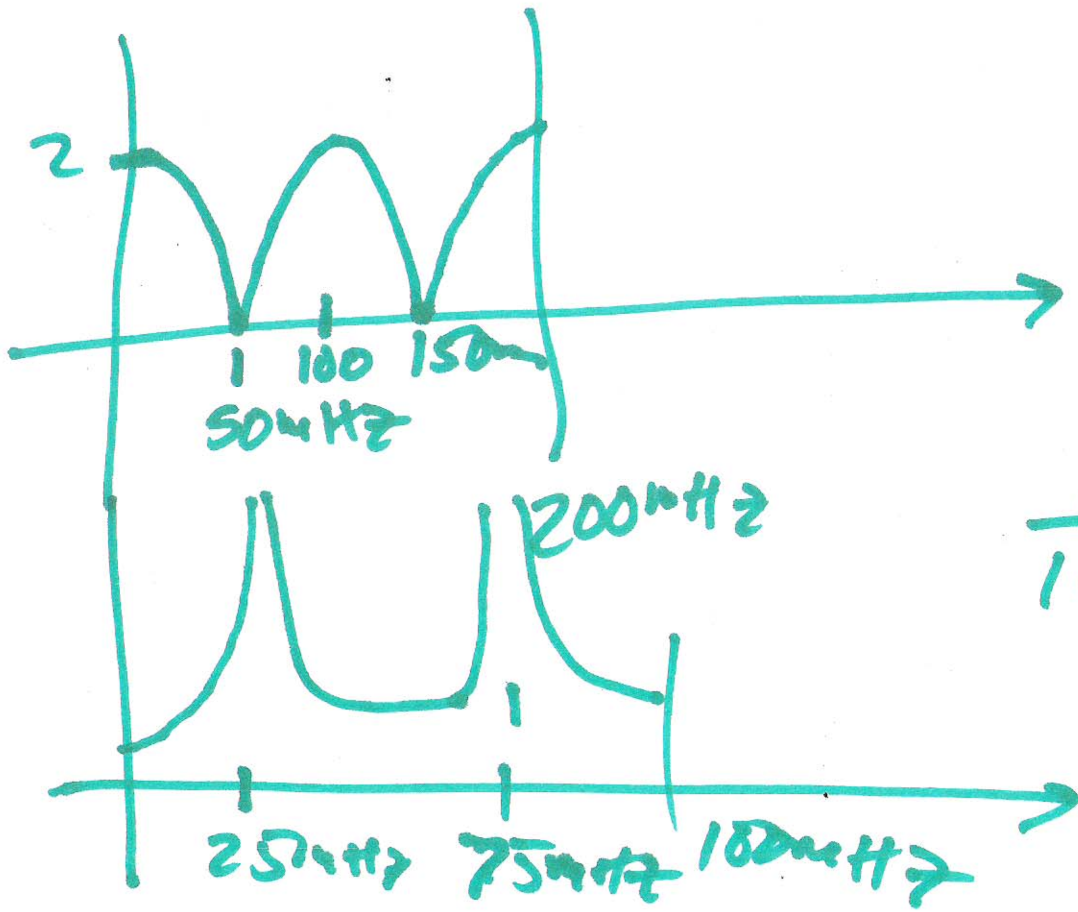
f = 100MHz






3)

$1 + z^{-1}$  $f_s = 100\,\text{MHz}$




$$\frac{1}{1+z^{-2}} = \frac{z^2}{z^2+1}$$

$f_s = 50\text{mHz}$

$f = 100\text{m}$

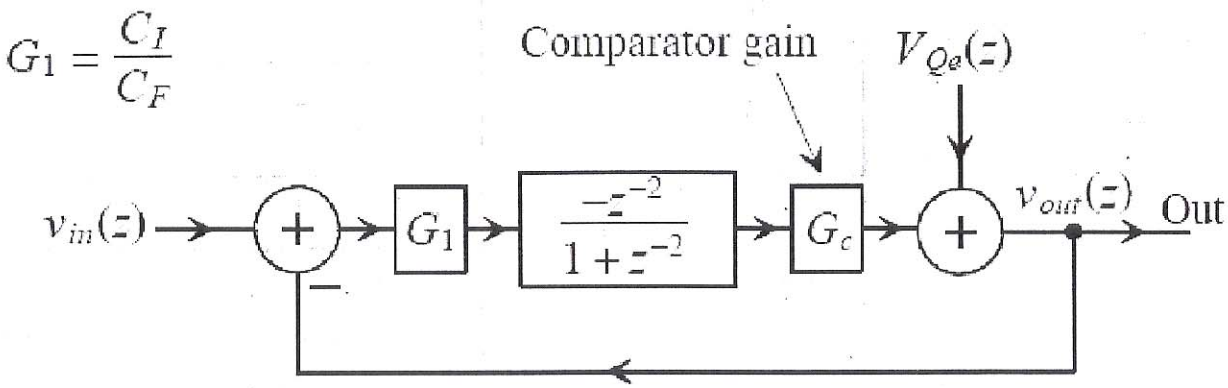
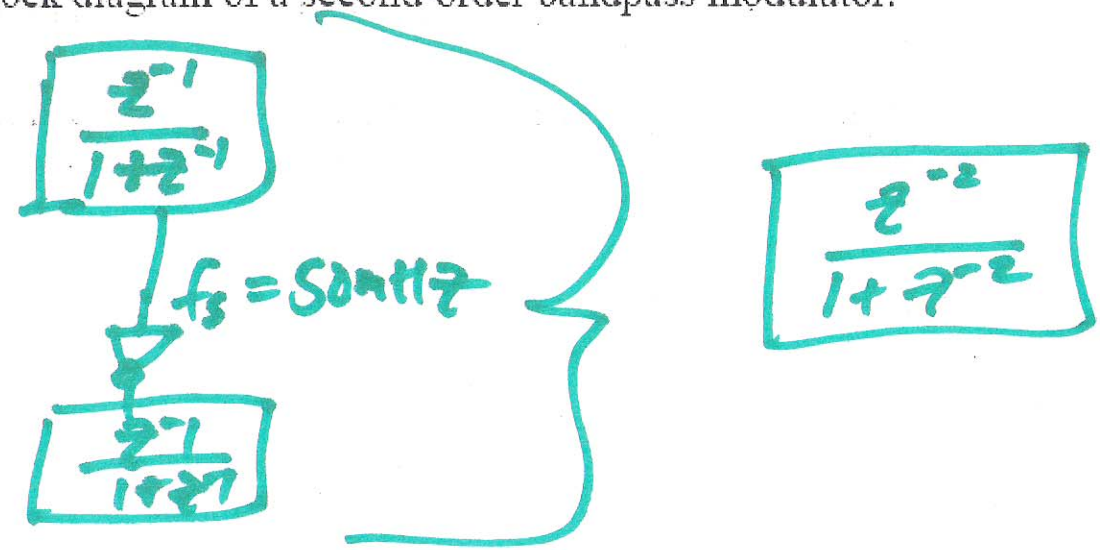



**Figure 8.13** Block diagram of a second-order bandpass modulator.




5)

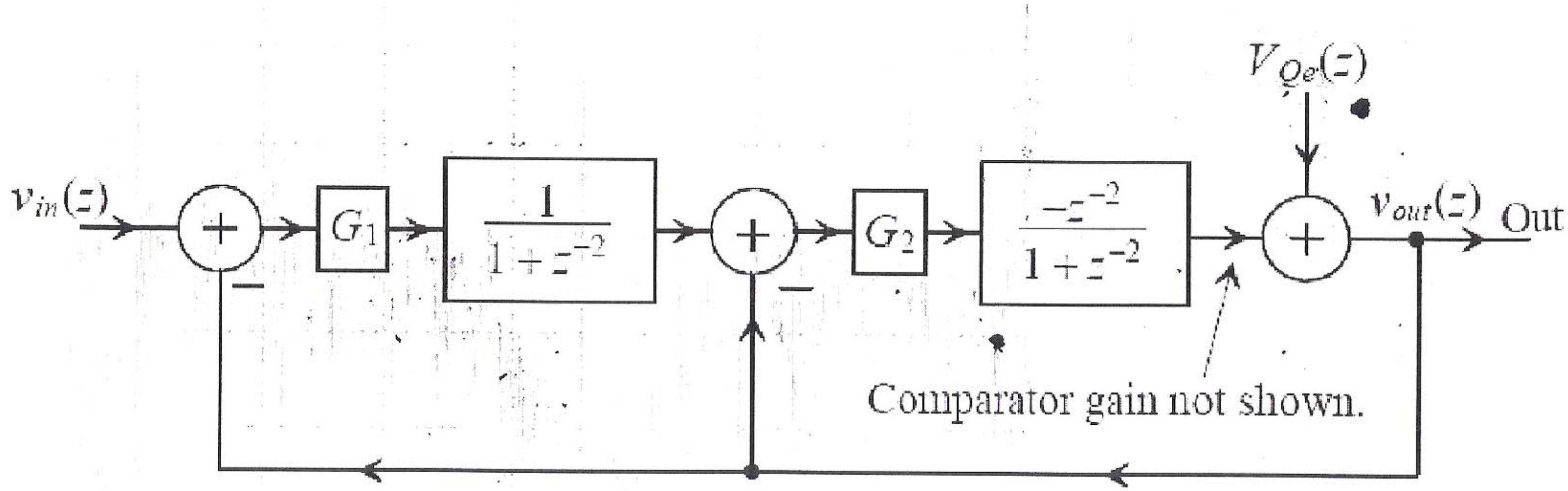



**Figure 8.15** A fourth-order bandpass modulator.

$$\left(\frac{(v_{in}-v_{out})G_1}{1+z^{-2}} - v_{out}\right)G_2\left(\frac{-z^{-2}}{1+z^{-2}}\right)+V_{Qe} = v_{out}$$

$$\left((v_{in}-v_{out})G_1 - v_{out}(1+z^{-2})\right)G_2\cdot(-z^{-2})+V_{Qe}(1+z^{-2}) = v_{out}(1+z^{-2})$$

b)

$$v_{in} G_1 G_2 (-z^{-2}) + v_{out} G_1 G_2 z^{-2} + v_{out} G_2 (1+z^{-2}) z^{-2}$$

$$+ V_{QE}(1+z^{-2})^2 = v_{out}(1+z^{-2})^2$$

$$-v_{in} \cdot G_1 G_2 z^{-2} + V_{QE}(1+z^{-2})^2 = v_{out}\Big((1+z^{-2})^2 - G_1 G_2 z^{-2}$$

$$1 + 2z^{-2} + z^{-4} - z^{-2} - z^{-2} - z^{-4} \quad - G_2(1+z^{-2})z^{-2}\Big)$$

$$v_{out} = -v_{in} z^{-2} + V_{QE}(1+z^{-2})^2$$

7)

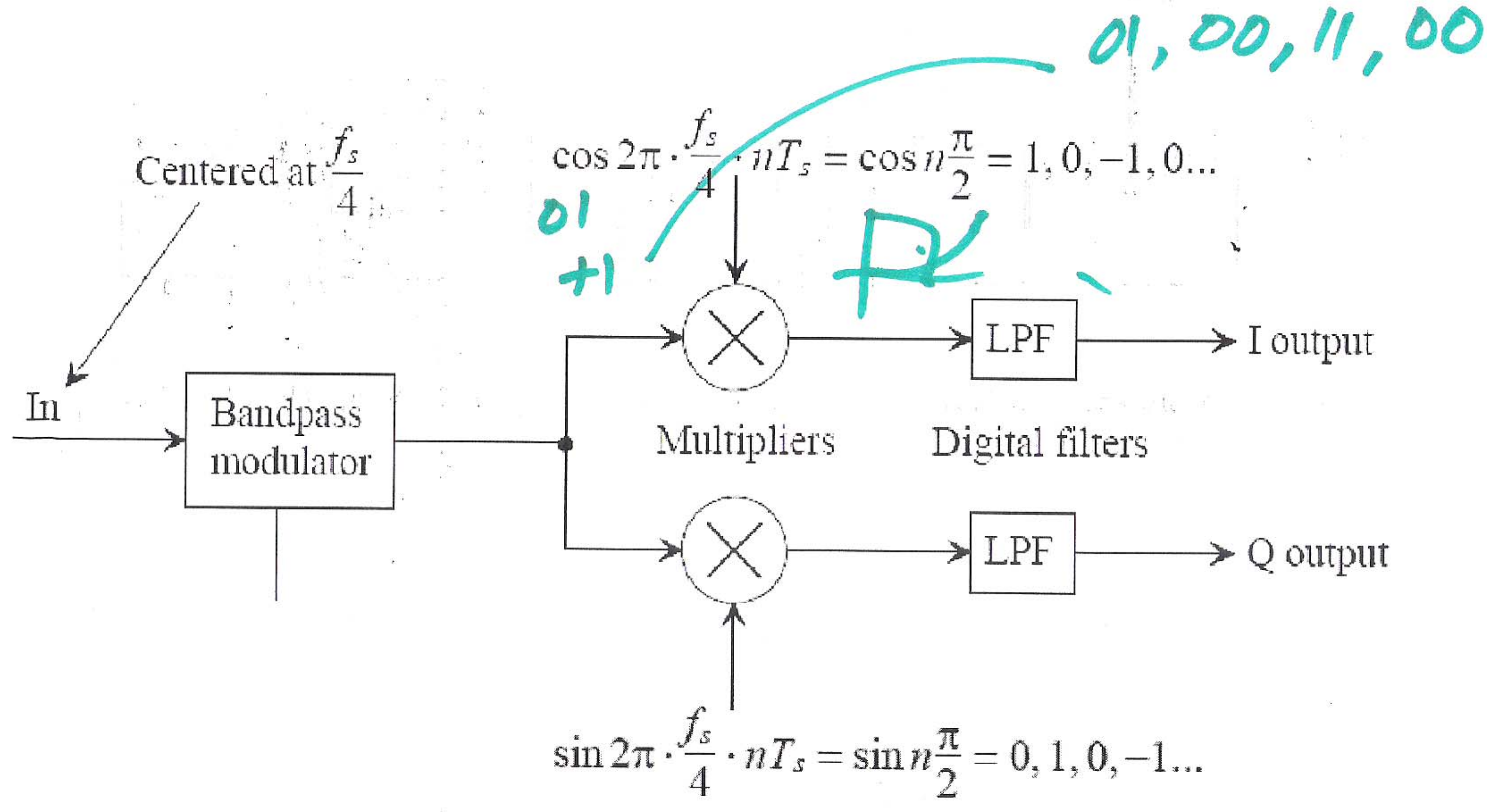



**Figure 8.18** Digital I/Q demodulation.

8)