Lecture 3 ECE 615 Mixed-signal

BOISE STATE UNIVERSITY

Sept. 1, 2010

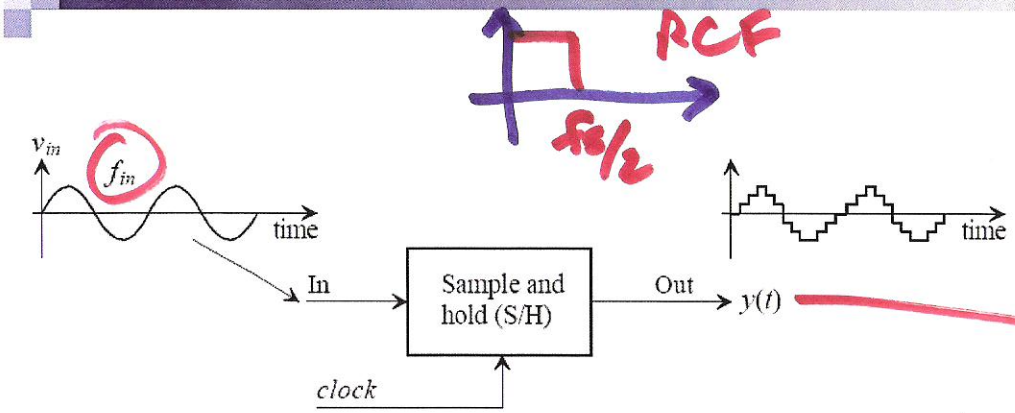


Figure 2.14 Sampling and holding an input sinewave.

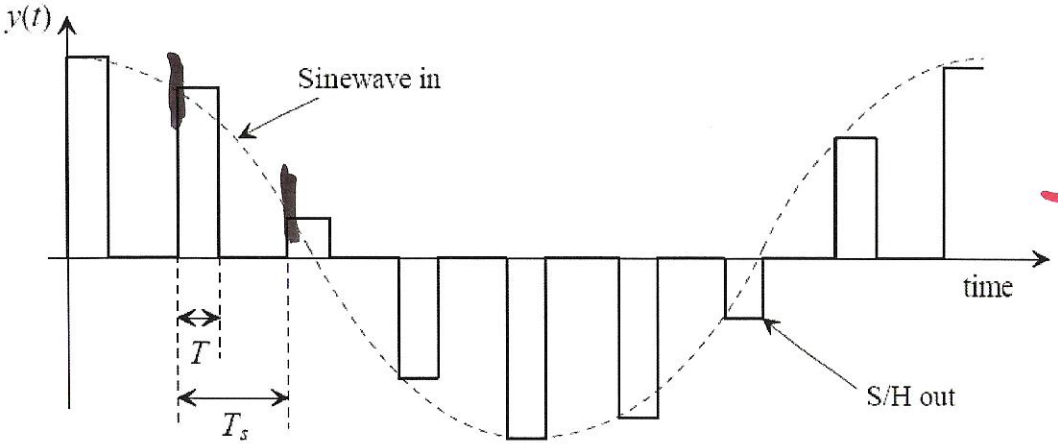
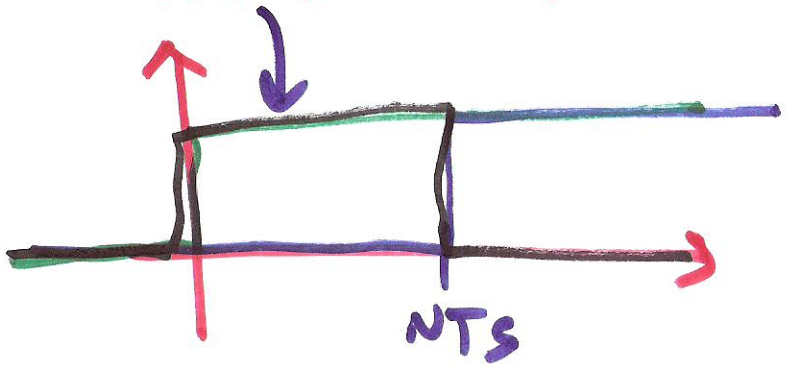


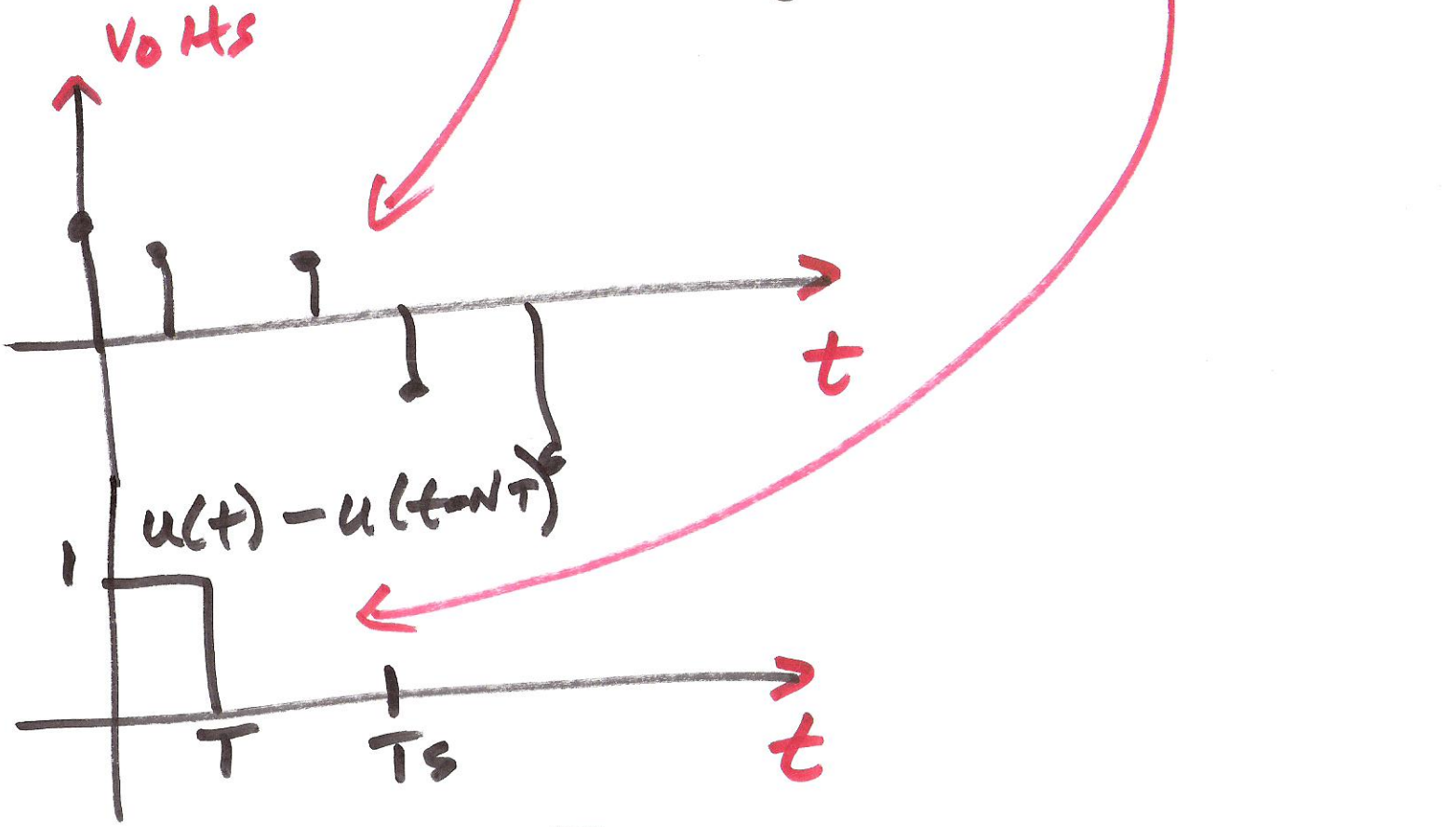
Figure 2.15 Sample-and-hold output with return to zero format.

$$y(t) = \sum_{N=-\infty}^{\infty} \left(V_p \sin(2\pi f_{in} \cdot NT_s) \cdot (u(t-NT_s) - u(t-NT_s-T)) \right)$$

$$u(t) - u(t-NT_s)$$



$$y(t) = \sum_{N=-\infty}^{\infty} V_p \sin(2\pi f_m t) \cdot \delta(t - NT_s) \otimes \left(u(t) - u(t - NT)\right)$$



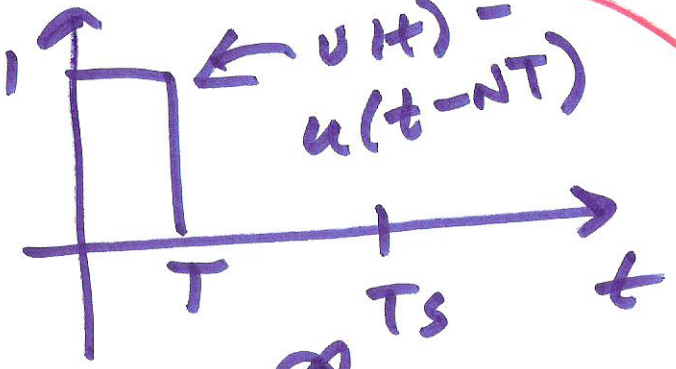
$T \leq T_s$

2)

$$\mathcal{F}\left(\sum_{N=-\infty} V_p \sin(2\pi f_N t)\cdot\delta(t-NT_s)\right)$$

$$= \frac{V_p}{2j}\sum_{K=-\infty}^{\infty}\left(\delta(f-f_N-Kf_s)\right.$$

$$\left.-\delta(f+f_N-Kf_s)\right)$$



$$\int_{-\infty}^{\infty}\left(u(t)-u(t-NT_s)\right)e^{-j2\pi f\cdot t}\cdot dt$$

$$= \int_0^T e^{-j2\pi ft}\cdot dt = \frac{1}{-j2\pi f}\,e^{-j2\pi ft}\Big|_0^T$$

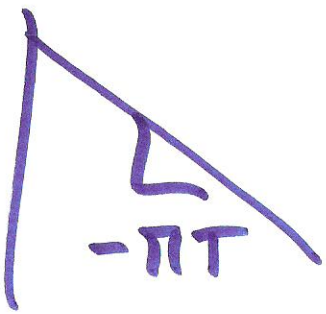
3)

$$\mathcal{F}\{u(t) - u(t-nT)\}$$

$$= \frac{e^{-j2\pi fT} - 1}{-j2\pi f}$$

$$\frac{\sin x}{x} = \operatorname{sinc} x$$

$$= e^{-j\pi fT} \cdot \frac{e^{+j\pi fT} - e^{-j\pi fT}}{j2\pi f}$$



$$= e^{-j\pi fT} \, T \, \frac{\sin \pi fT}{\pi fT}$$

$$= e^{-j\pi fT} \cdot T \operatorname{sinc} \pi fT$$

4)

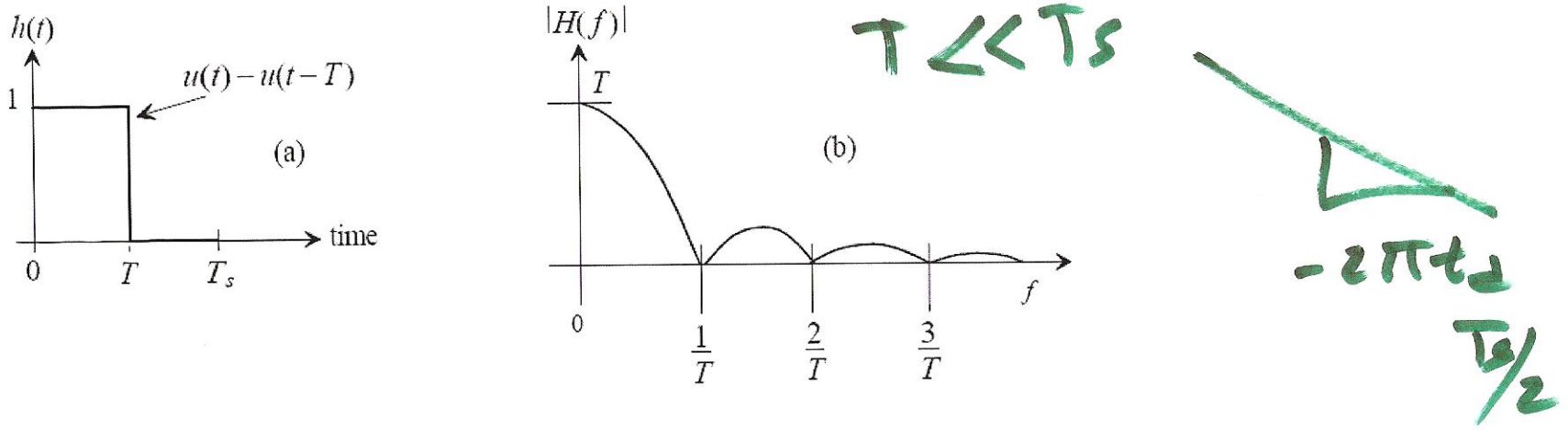
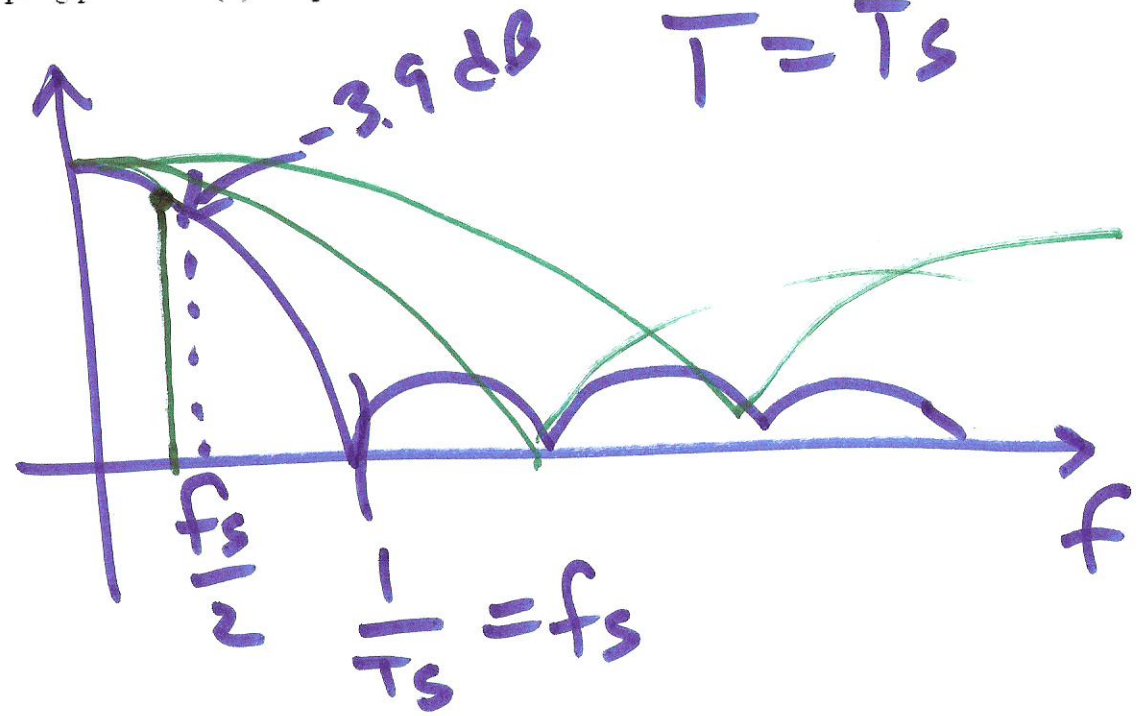


Figure 2.16 (a) Sampling pulse and (b) its spectrum.



5)

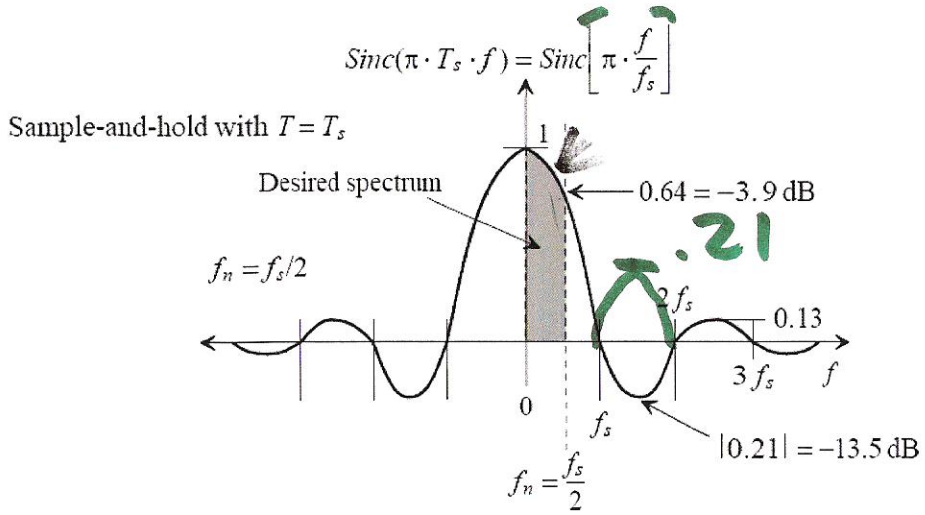
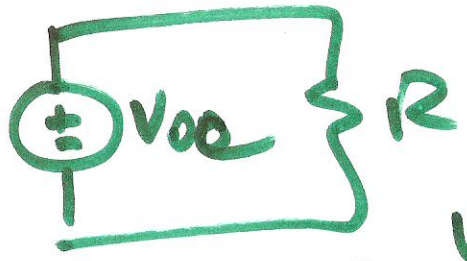


Figure 2.17 The frequency response of a S/H.

.21

$T = T_s$



$P = \frac{V_{DC}^2}{R}$

RCF (ideal) for impulse sampling

S/H $T = T_s$

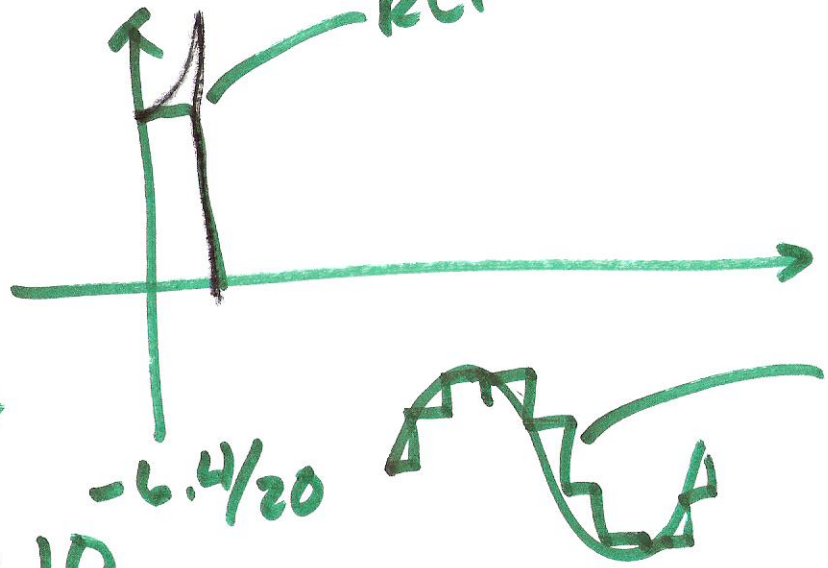
6.4

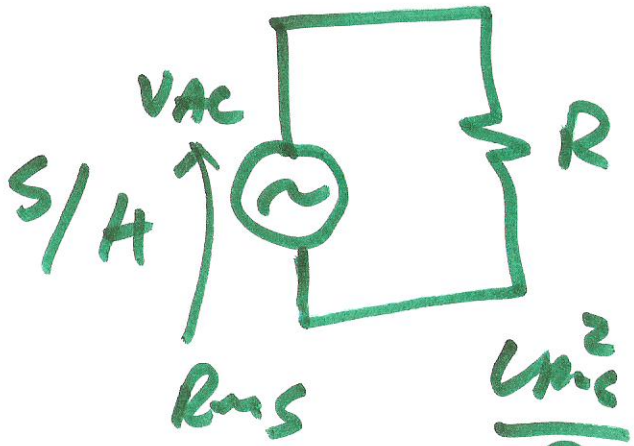
$-6.4 =$

$20 \log V_{DC}$

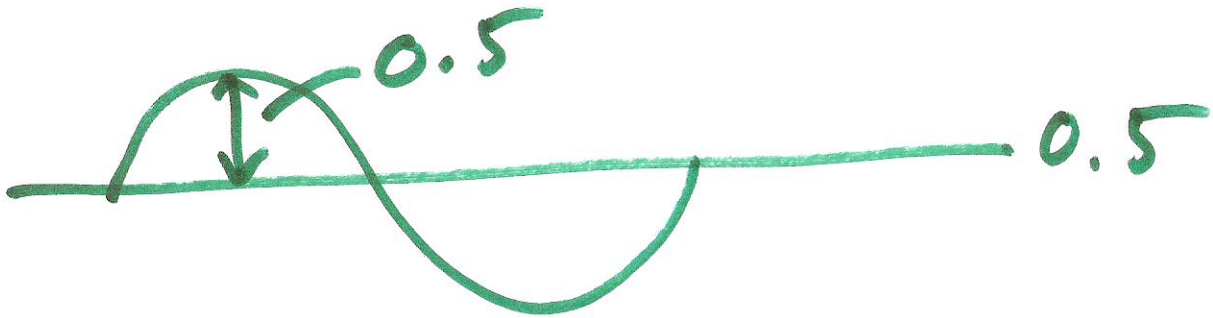
$-6.4/20$

$V_{DC} = 10$





6)



$V_{rms} = 0.5/\sqrt{2}$

$20 \log V_{rms}$

$= -9\,dB$

7)

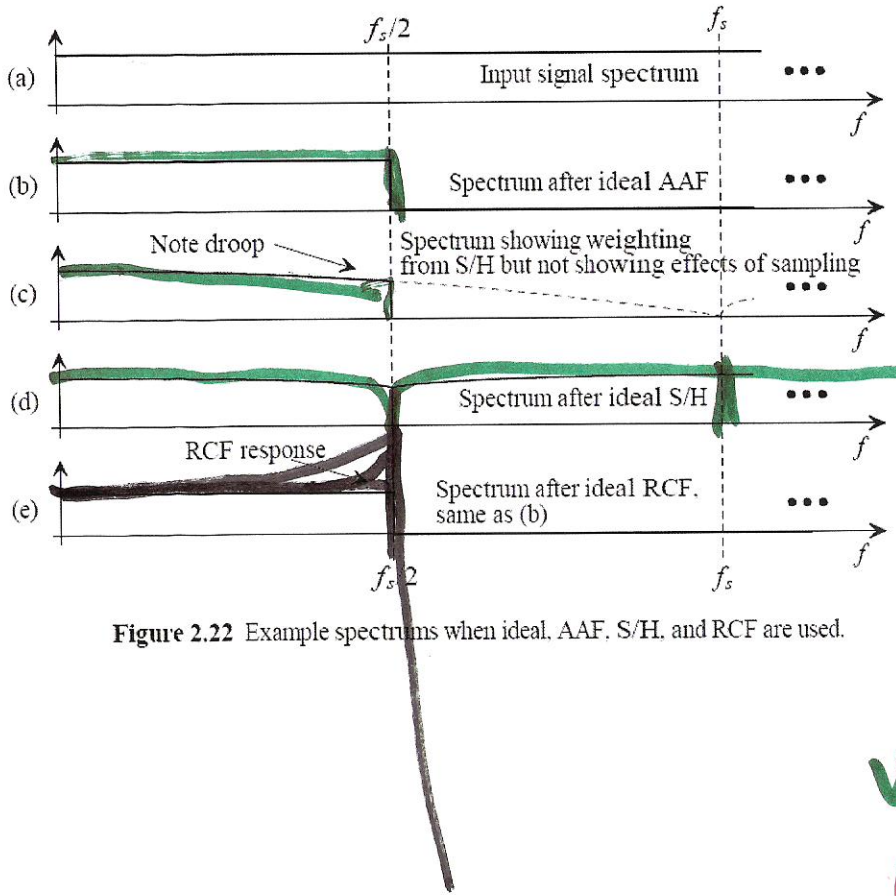
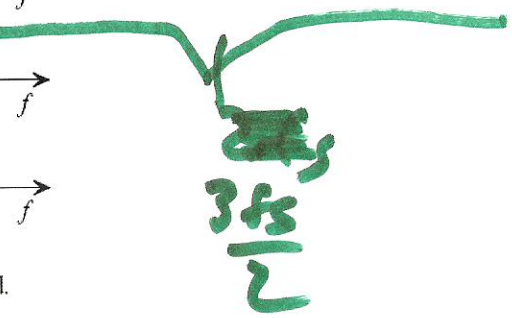
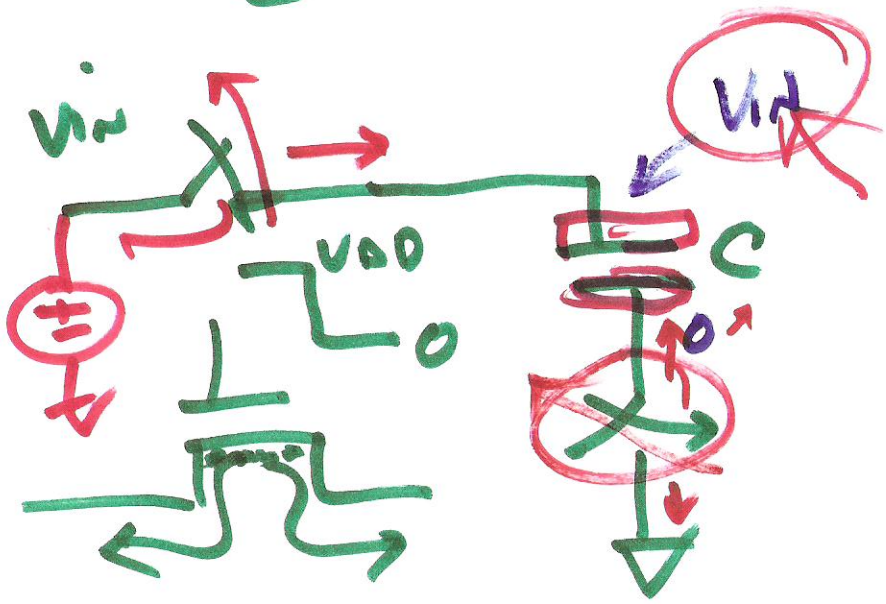


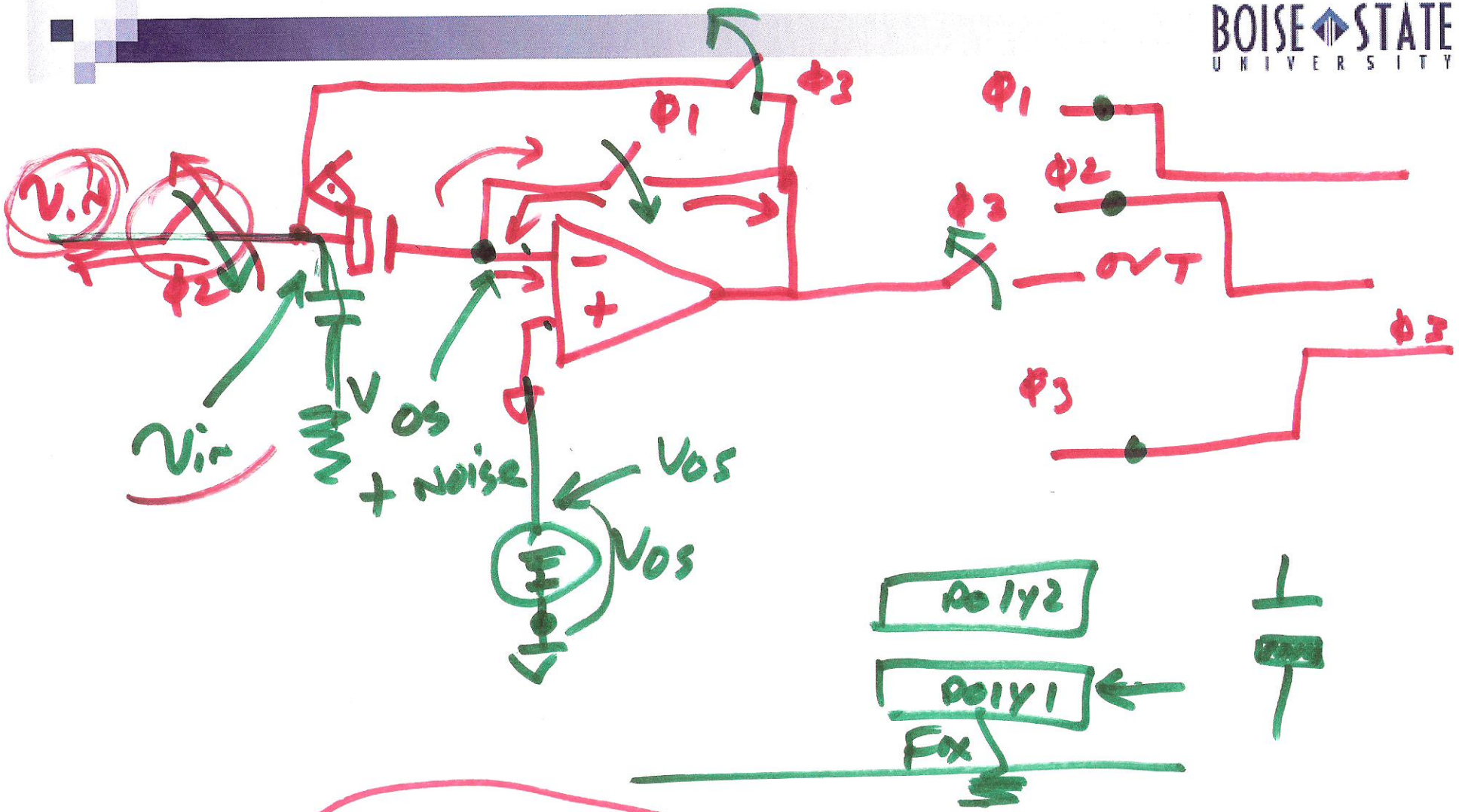
Figure 2.22 Example spectrums when ideal, AAF, S/H, and RCF are used.



Bottom plate sampling



8)



CDS

→ Autozero followed by S/H

9)

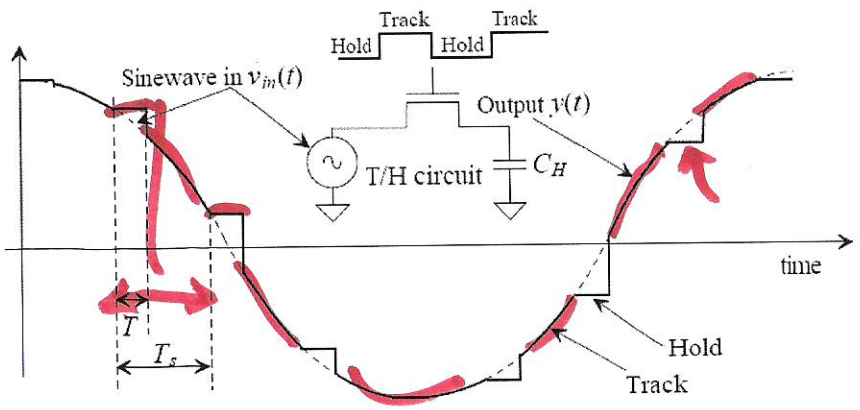


Figure 2.23 Track-and-hold output.

$T_s \to T$

$$\frac{(T_s - T)}{(T_s - T)} \cdot \frac{\sin \pi k f_s (T_s - T)}{\pi k f_s (T_s - T)}$$

$$|Y_{TH}| \sum_{k=-\infty}^{\infty} (T_s - T) \operatorname{sinc} \pi k f_s (T_s - T) \cdot (\text{impulse sampler})$$

Eq. 2.24

10)