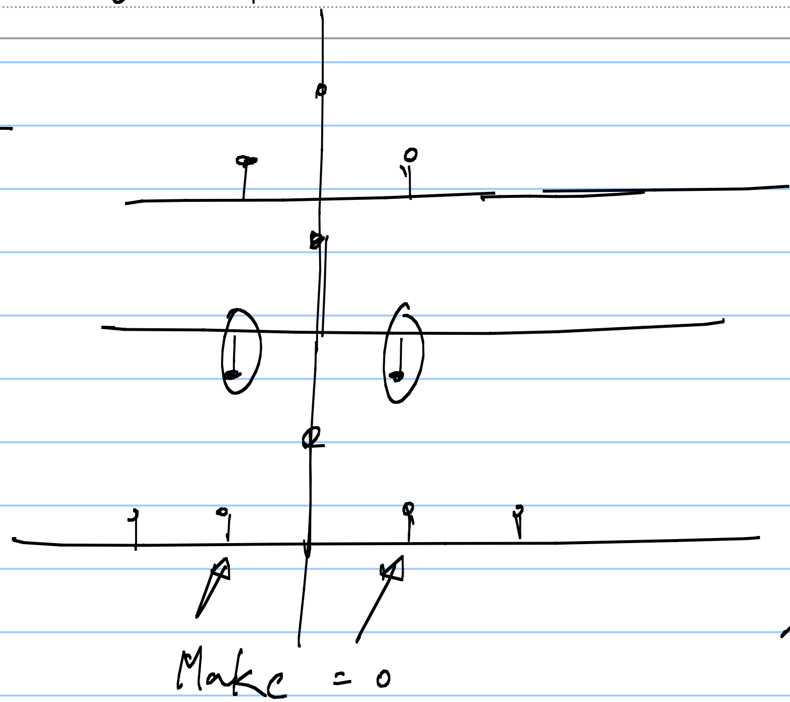
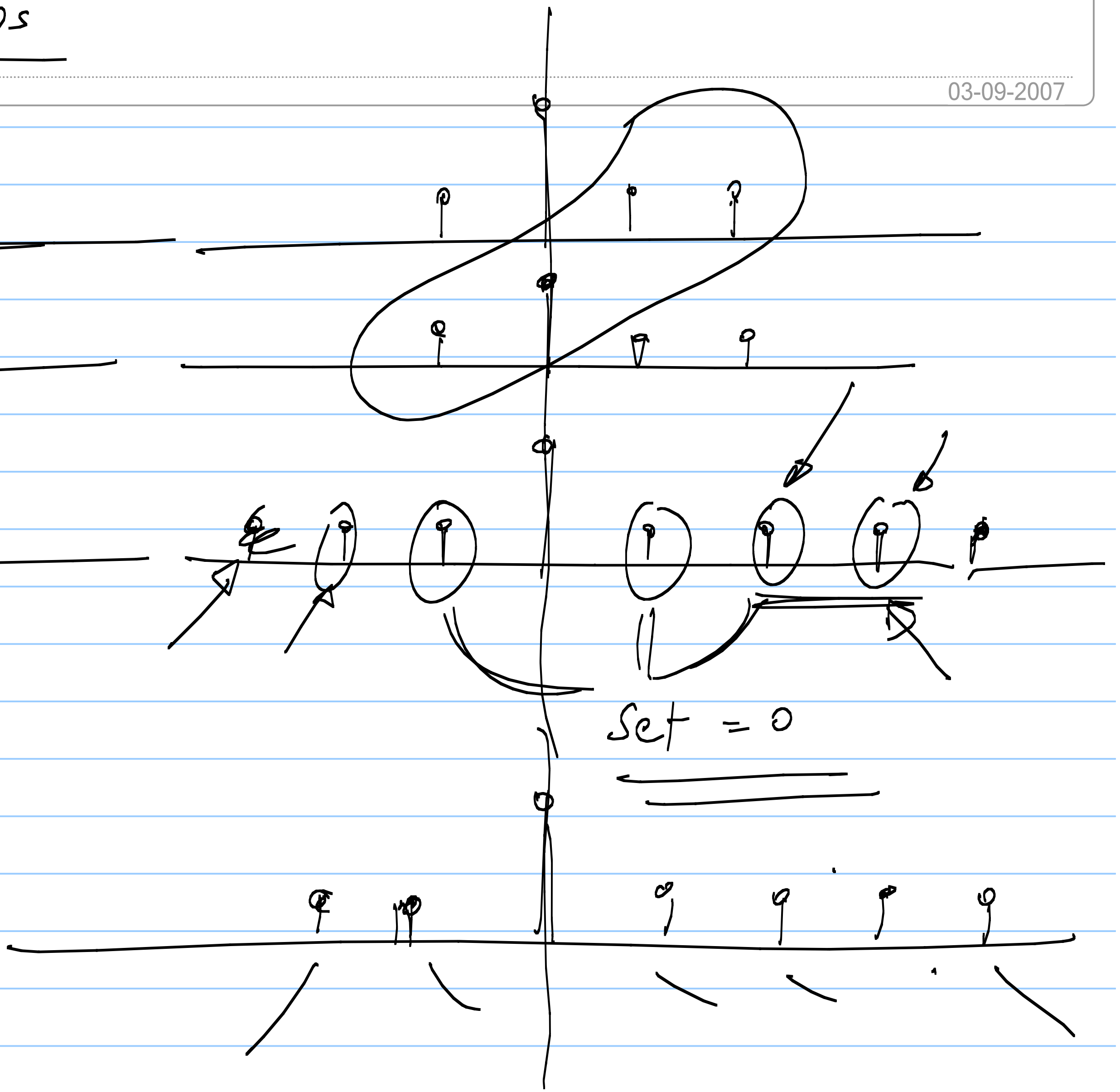
Choosing equalizer taps

odd:

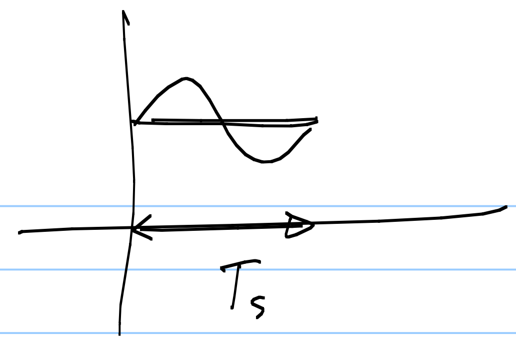


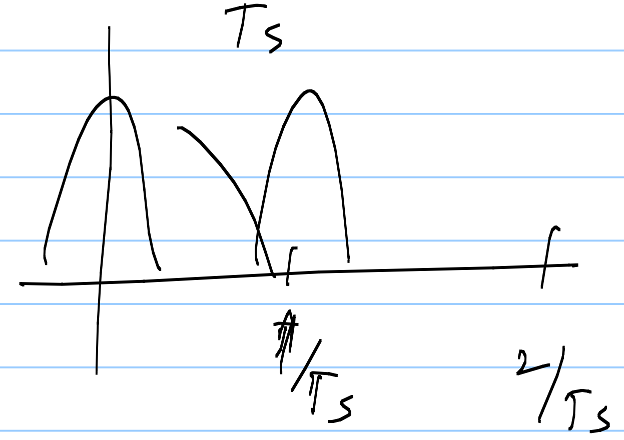


Linear equalizers:

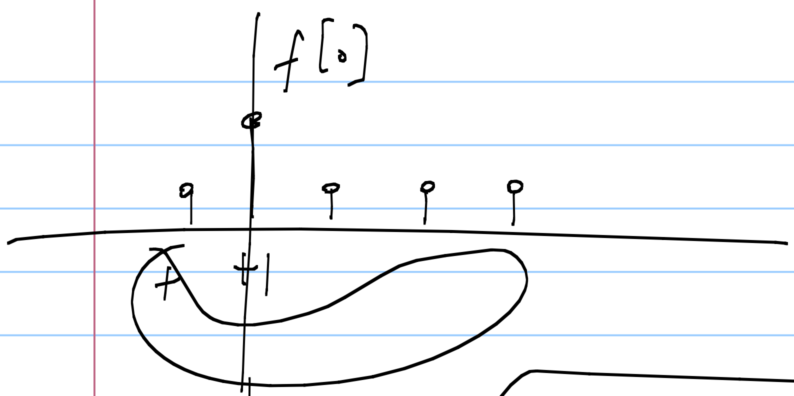
- $\{CT, DT\} \times \{R_x, T_x\}$
- More taps - better for ISI
- Zero forcing, MMSE

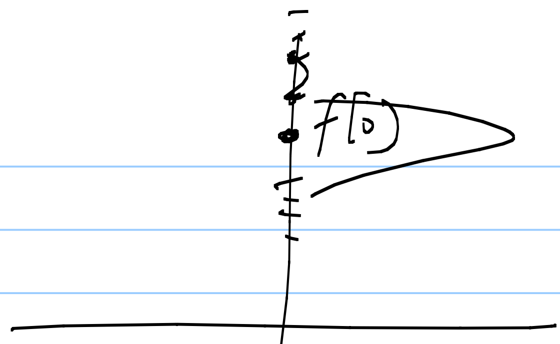
$$\sum_{n \neq \text{cursor}} h^2[n]$$





$$f[n] = h[n] * g[n]$$





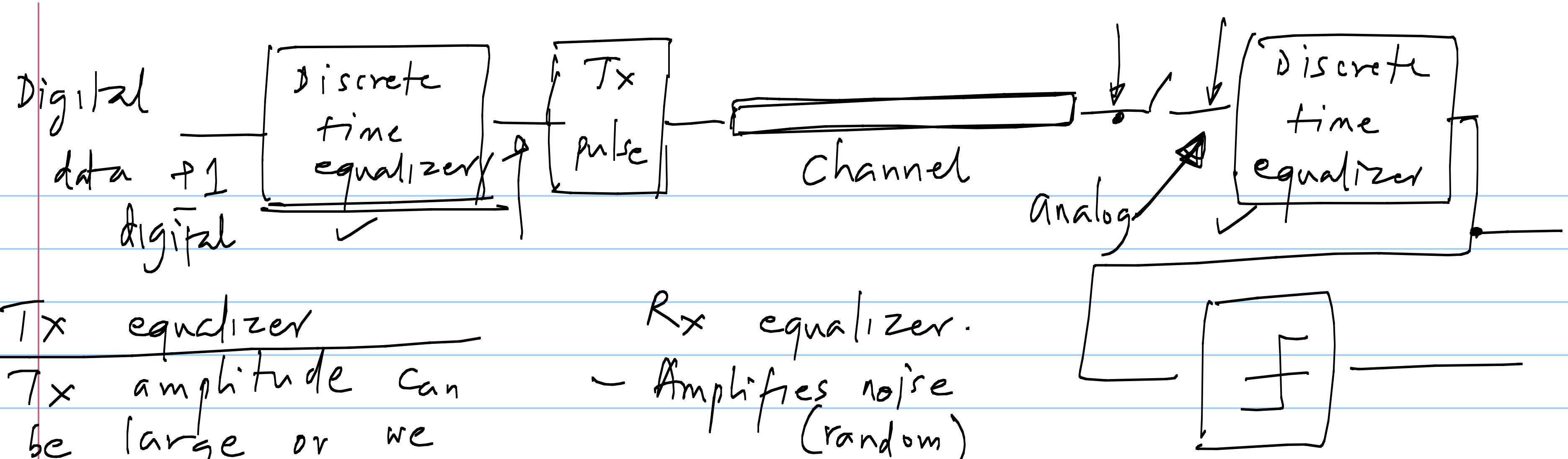
$$\left(-f[-1] - f[1] - f[2] - f[3]\right)^2 \qquad (a-b)^2$$

$$\left(-f[-1] - f[1] - f[2] + f[3]\right)^2 \qquad (a+b)^2$$

$$2(a^2+b^2)$$

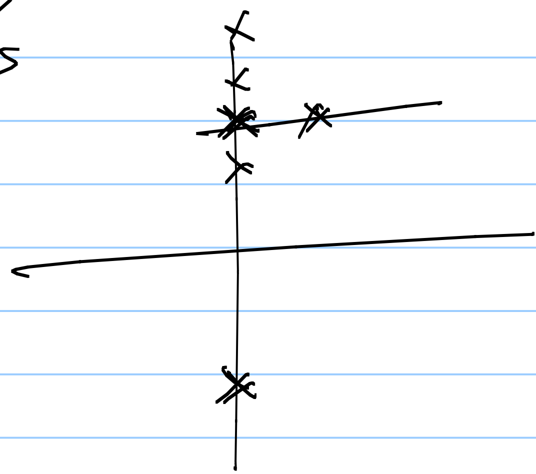
Cross terms cancel out in the expression for the mean sq. error

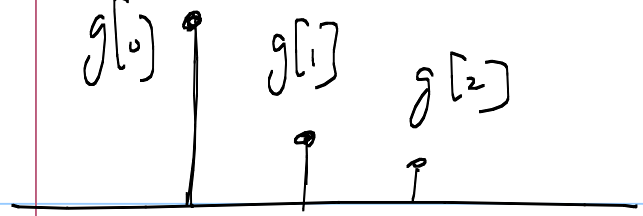
$$\left(f[-1]^2 + f[1]^2 + f[2]^2 + f[3]^2\right)$$



Tx equalizer
- Tx amplitude can be large or we need to scale down & receive a small signal
- Adaptation is more difficult. - (Back channel) for adaptation
  ↳ Data transmitted from Rx → Tx to adjust the eq.

Rx equalizer.
- Amplifies noise (random)
- Adaptation is easier





Tx equalizer: digital inputs

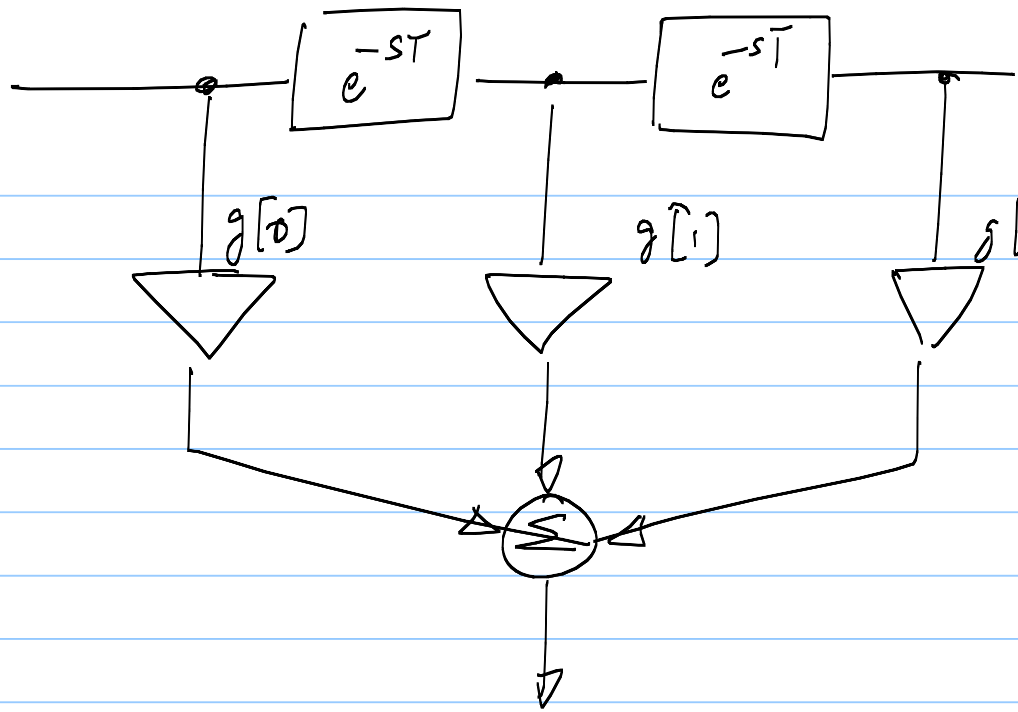
Rx equalizer: Analog inputs

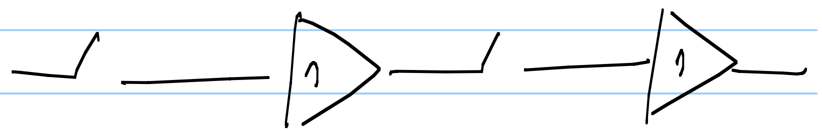
Digital data can be delayed using Flip flops

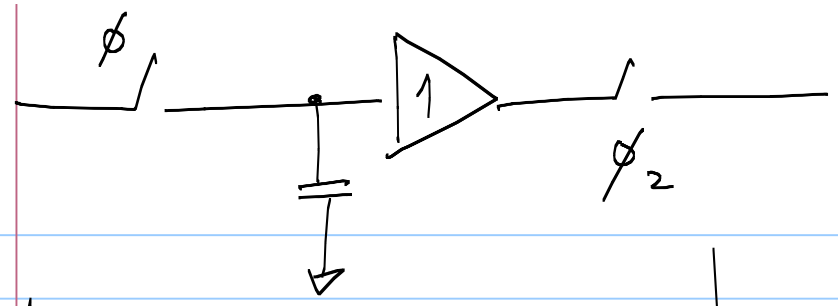
Analog data can be delayed using - Transmission lines / Filters

- Sample & Hold.

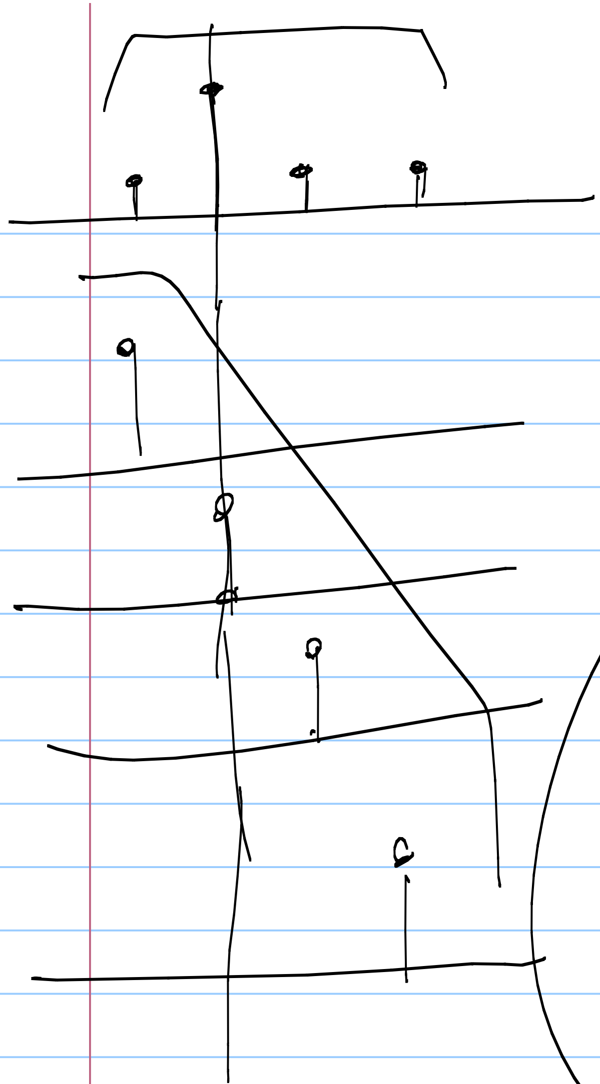
- A/D converter & use digital delays.

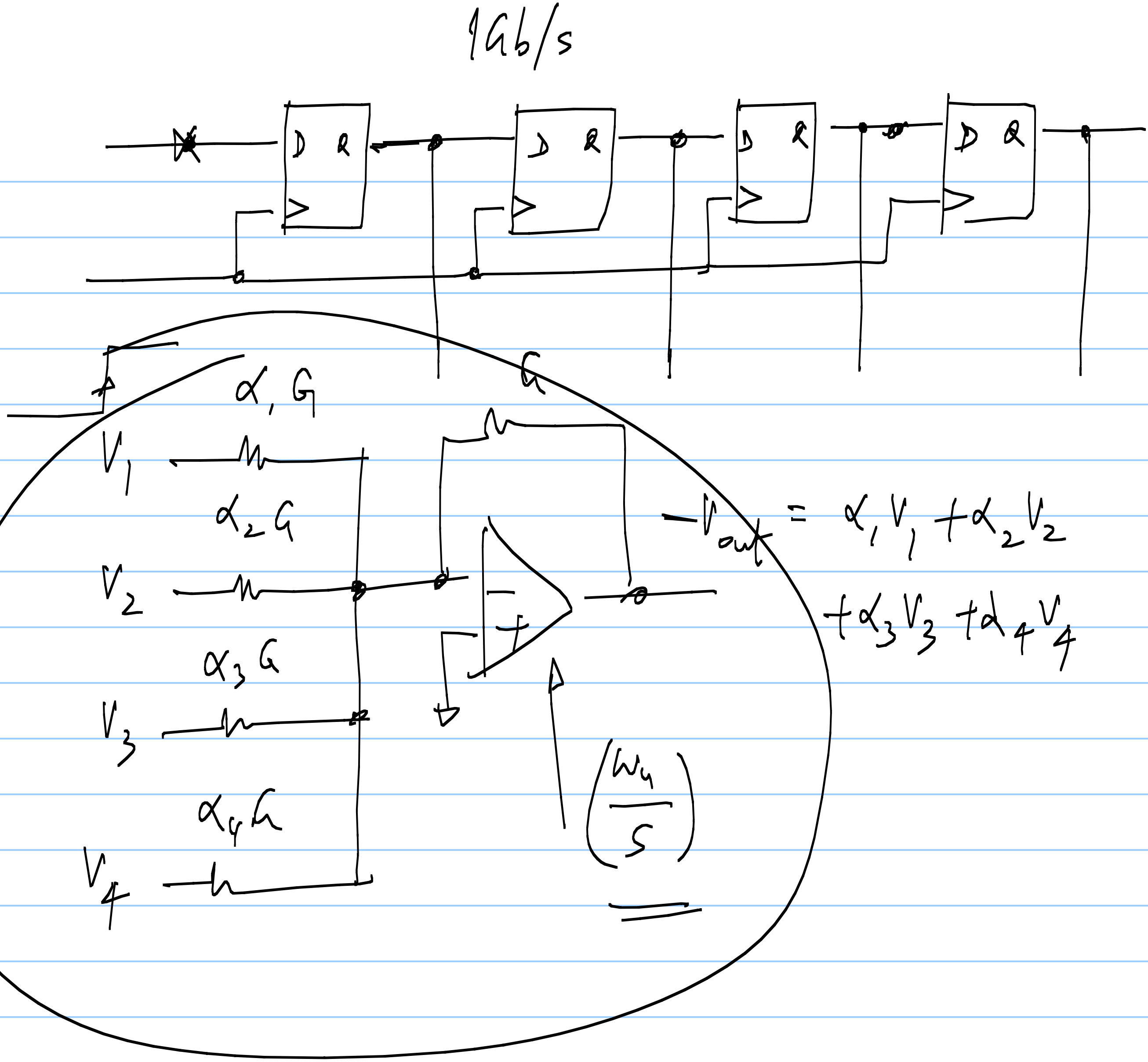




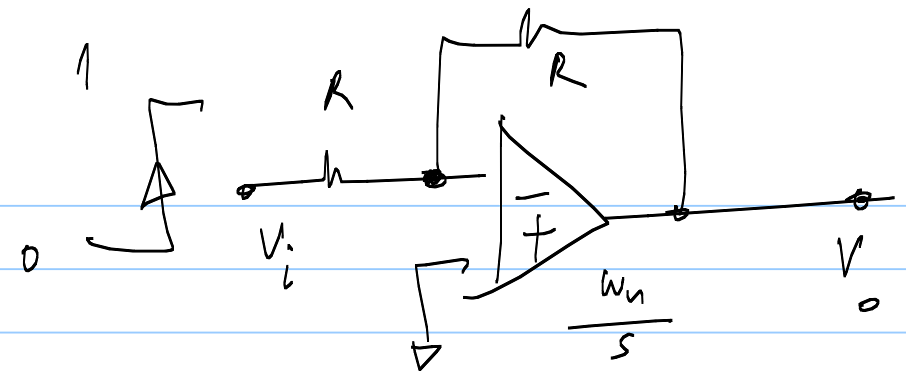


Easier to implement the equalizer in the transmitter





$$-V_{out} = \alpha_1 V_1 + \alpha_2 V_2 + \alpha_3 V_3 + \alpha_4 V_4$$

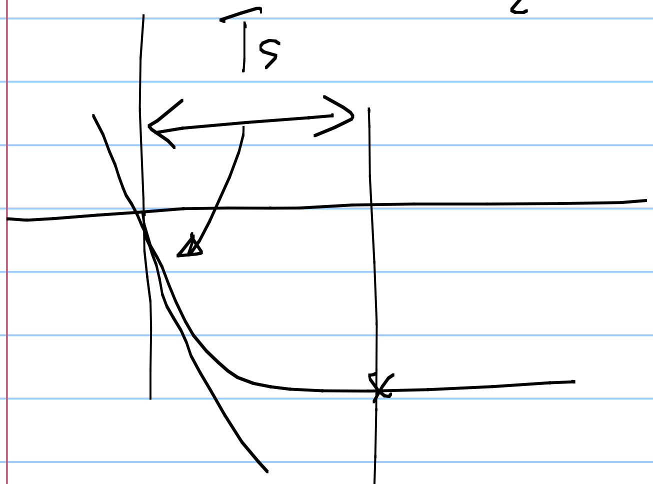


$$\frac{A_0}{1 + \frac{s}{\omega_d}} \qquad \frac{(A_0 \omega_d)}{s}$$

$$\frac{V_o(s)}{V_i(s)} = -\frac{\omega_u/2}{s + \frac{\omega_u}{2}} = -\frac{1}{1 + \frac{s}{(\omega_u/2)}}$$

95% in T_s

1Gb/s



Find out ω_u

$\alpha_1 = -0.25$, $\alpha_2 = 1$

$\alpha_3 = -0.5$, $\alpha_4 = 0.25$