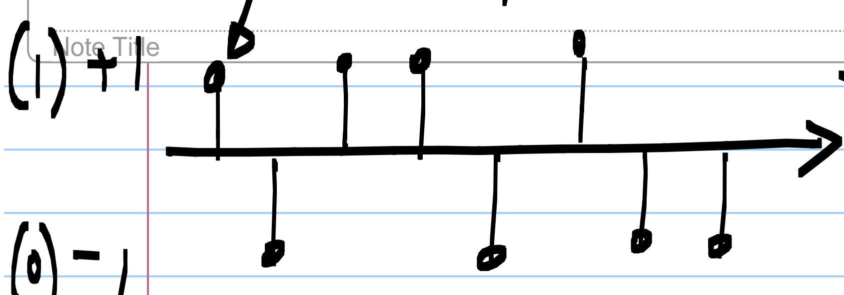
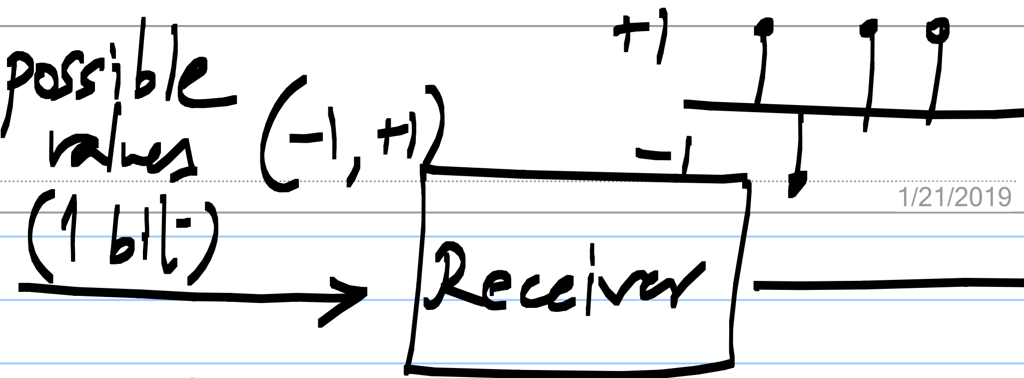
Note Title 1/21/2019

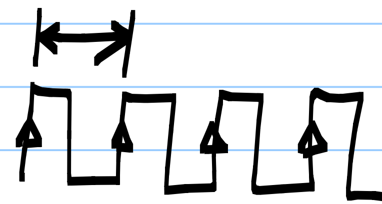
Each symbol has 2 possible values (−1, +1) (1 bit)



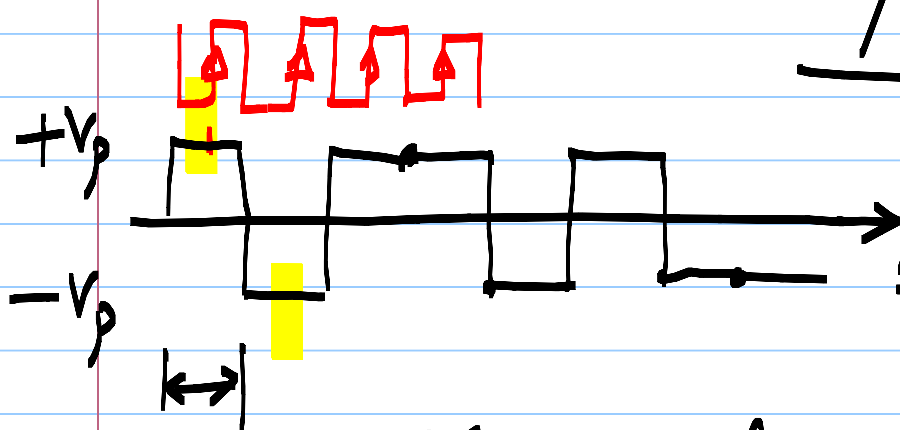


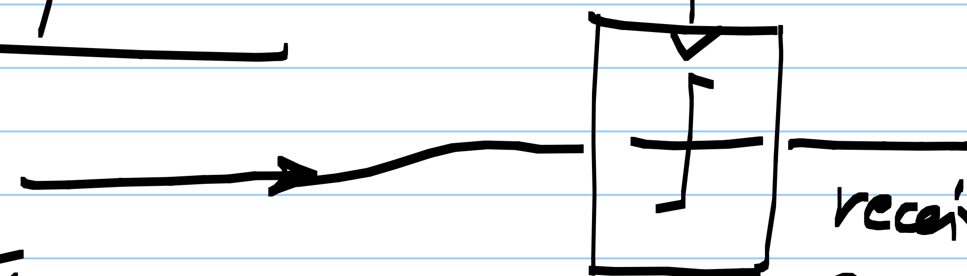
Digital data (binary)
(discrete)

Symbol interval

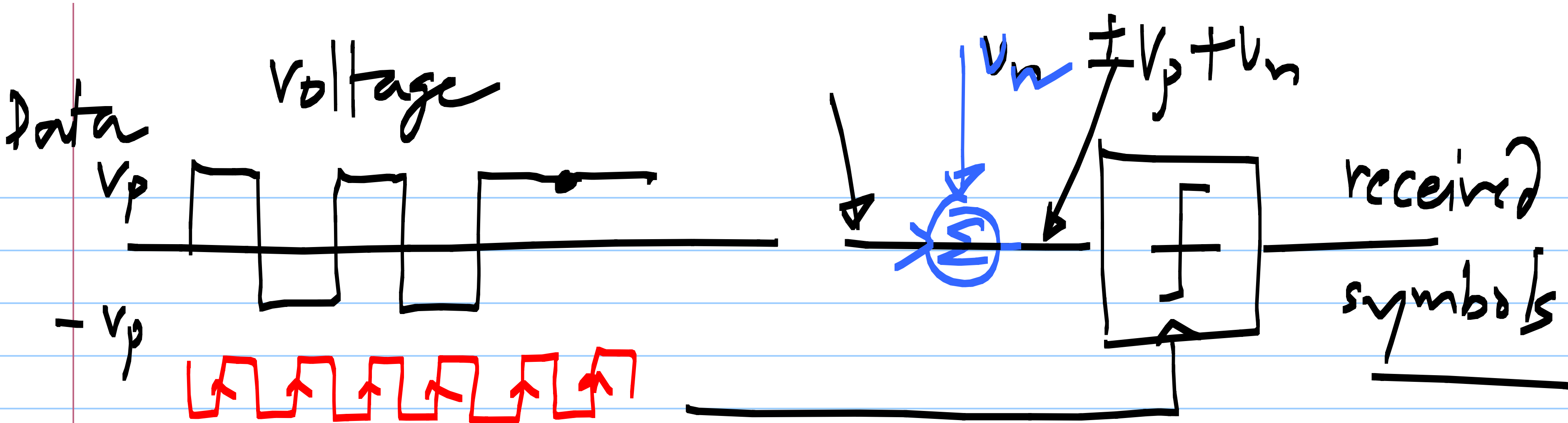


1 bit/symbol

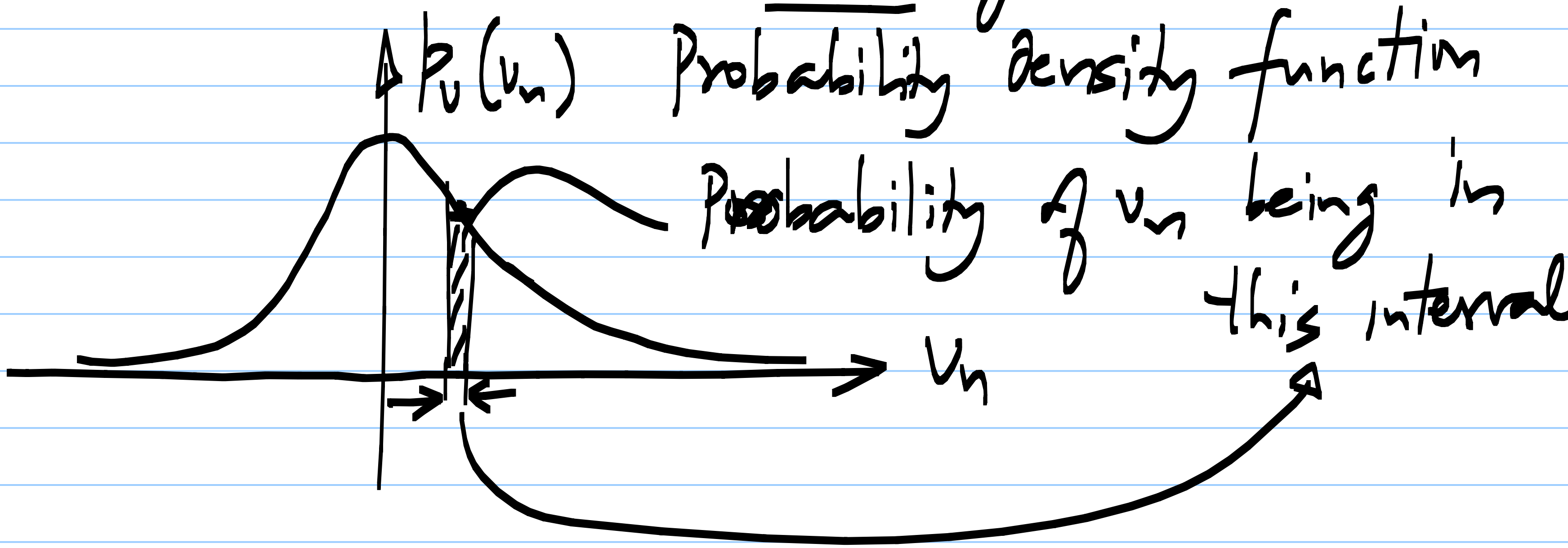


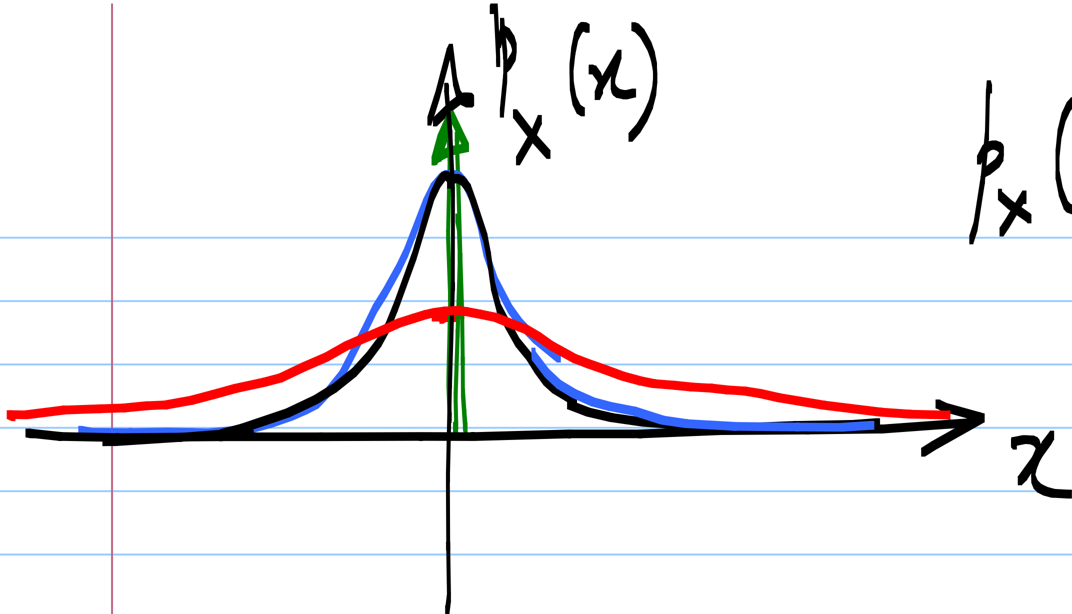


T_s = symbol interval ; $\frac{1}{T_s} = f_s$ = symbol rate



V_n : random noise - white Gaussian noise



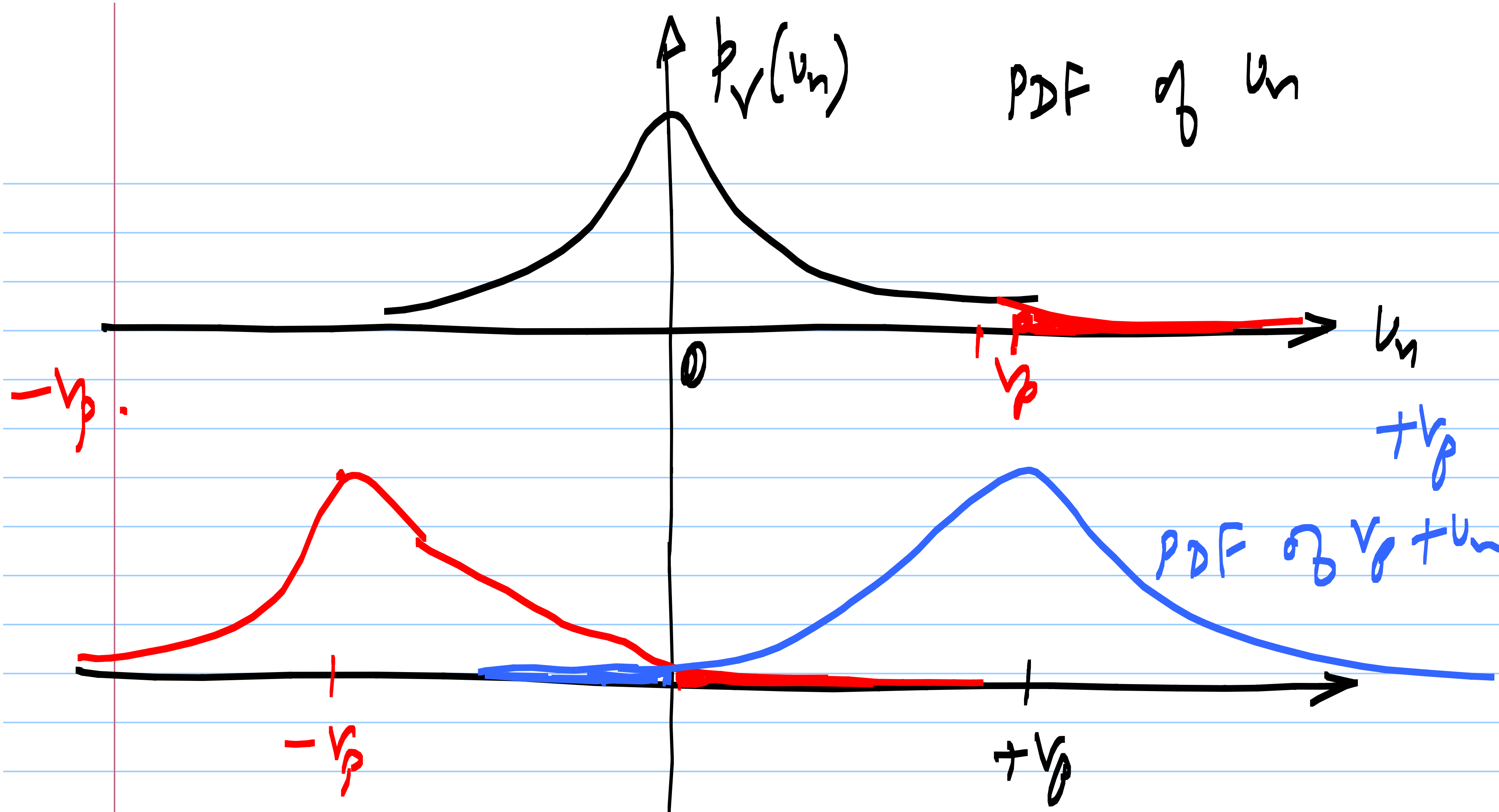


$$p_X(x) = \frac{1}{\sqrt{2\pi}\cdot\sigma}\exp\left(-\frac{x^2}{2\sigma^2}\right)$$

standard deviation

<u>Error:</u> $T_X: +1$; $R_X = -1$

$T_X: -1$; $R_X = +1$



$P(1) \cdot P(\text{Error when 1 is sent})$

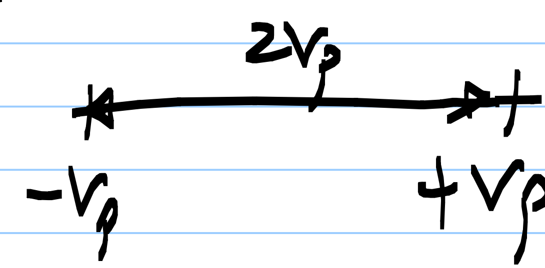
$+ P(0) \cdot P(\text{Error when 0 is sent})$

$$p_v(v_n) = \frac{1}{\sqrt{2\pi}\,\sigma} \exp\left(-\frac{v_n^2}{2\sigma^2}\right).$$

Probability of Error: $$\int_{v_p}^{\infty} p_v(v_n)\cdot dv_n$$

$$= \frac{1}{\sqrt{2\pi}\,\sigma} \int_{v_p}^{\infty} \exp\left(-\frac{v_n^2}{2\sigma^2}\right) dv_n$$

$$= \underline{Q\left(v_p/\sigma\right)}$$



"Standard" Gaussian with $\sigma = 1$

$$p_X(x) = \frac{1}{\sqrt{2\pi}} \exp\left(-\frac{x^2}{2}\right).$$

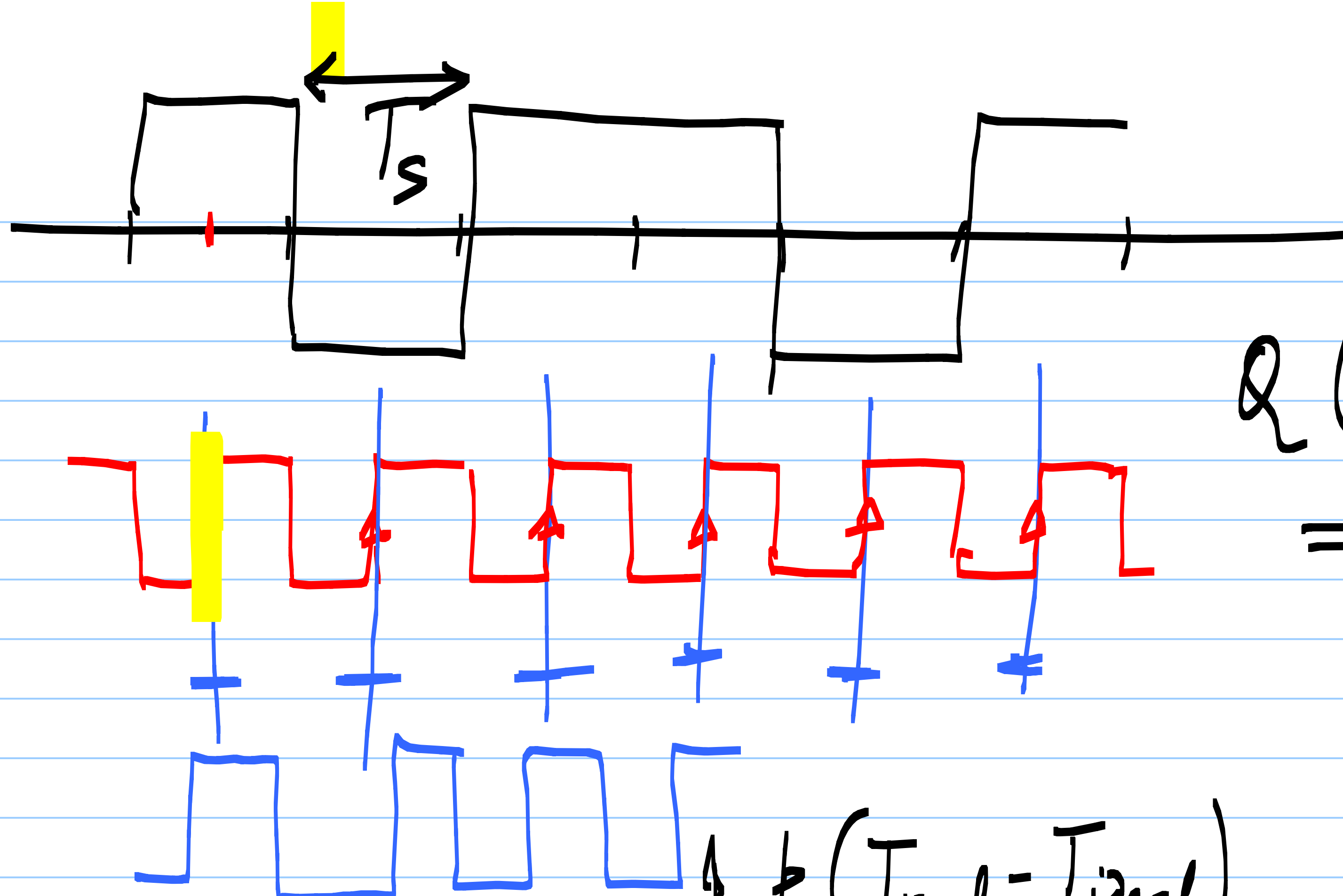
$$Q(y) = \int_y^{\infty} \overbrace{p_X(x)} \cdot dx$$

$Q\left(\frac{V_p}{\sigma}\right).$

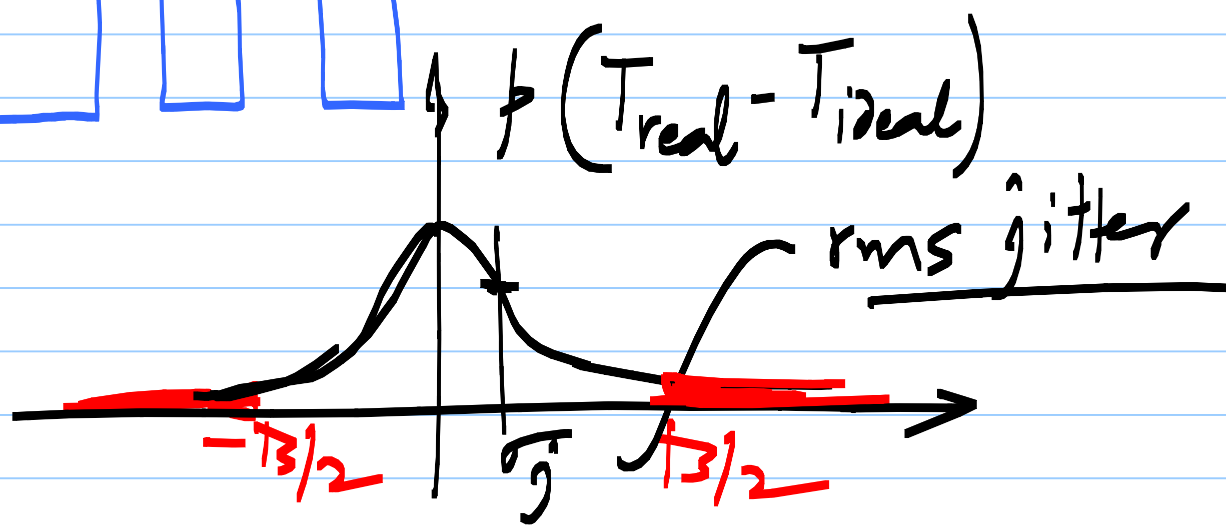
$V_p/\sigma = 6 . \quad Q\left(\frac{V_p}{\sigma}\right) \simeq 10^{-9}$

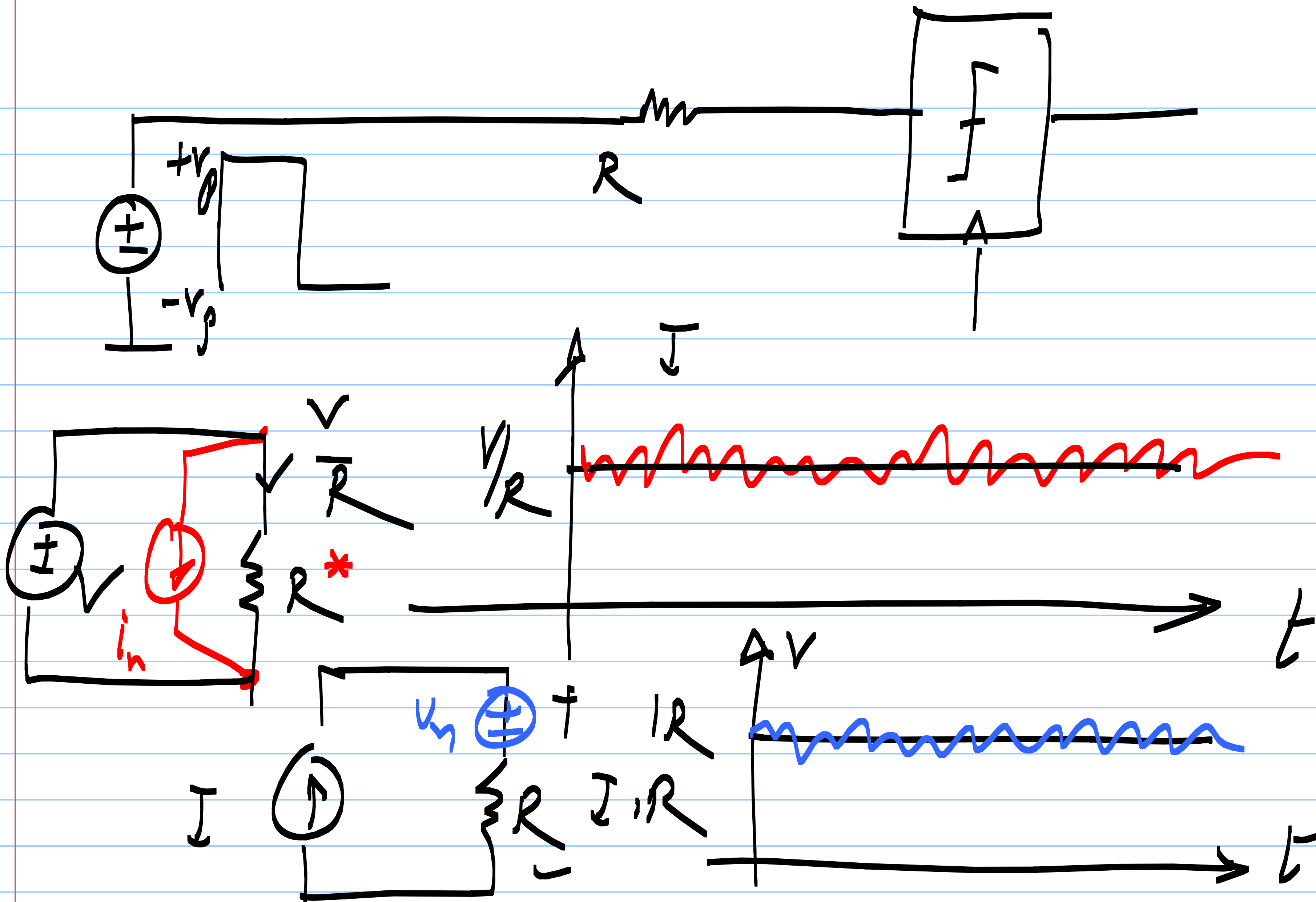
$7 \qquad \simeq 10^{-12}$

$8 \qquad \simeq 10^{-15}$

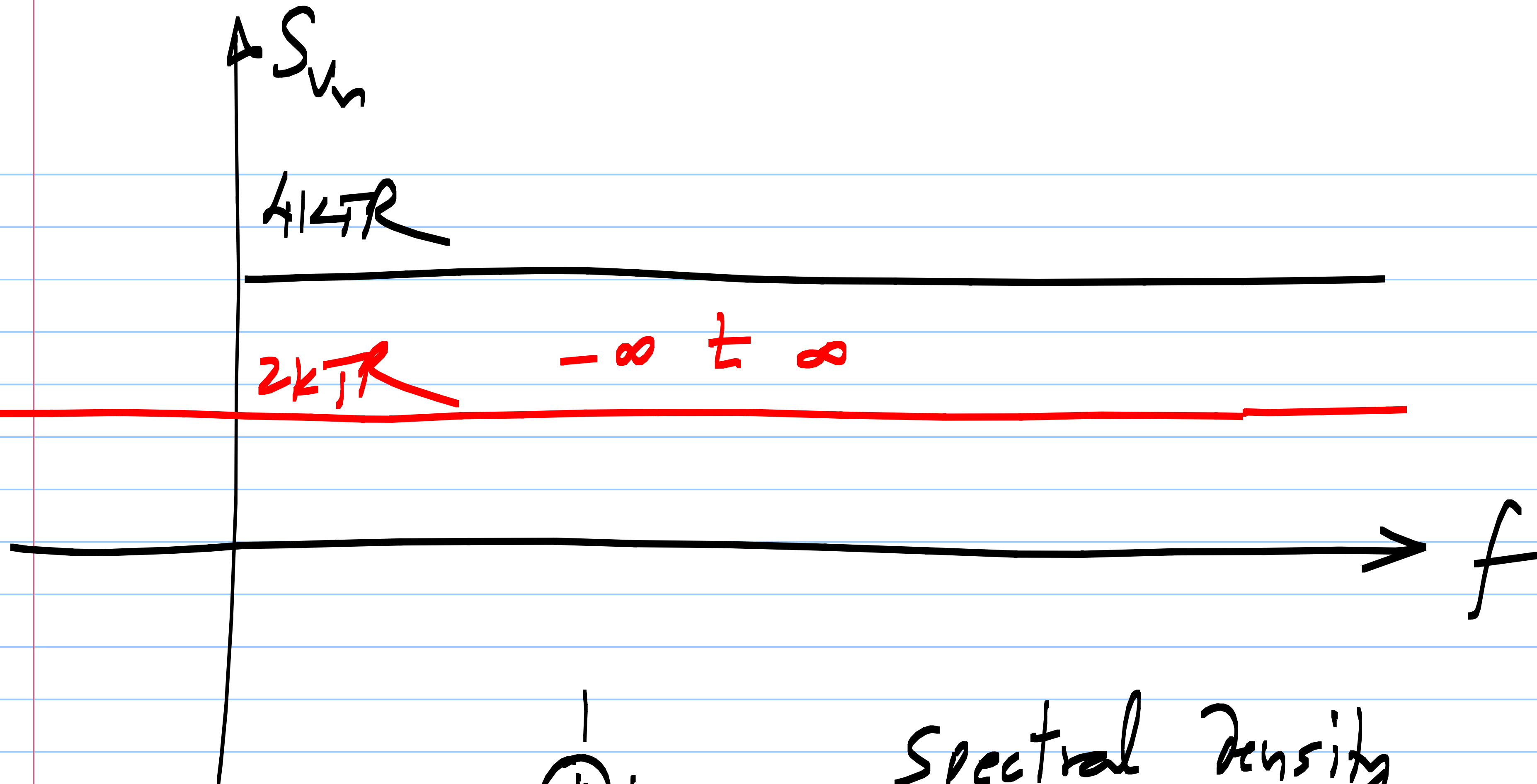


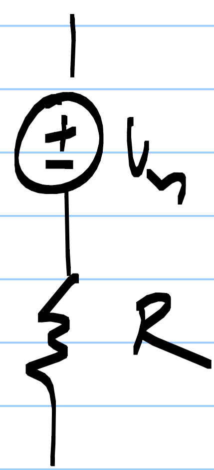
$$Q\left(\frac{T_s}{2\sigma_j}\right)$$





+v_p
-v_p
R
f
I
V/R
V
R
R*
i_n
t
V
v_n
I
R
IR
I, R
t





— Spectral density is $4kTR$

$f: 0$ to ∞