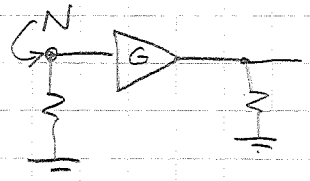
Lec. 3

Ex. 2

$$T_s = \frac{1}{300}\ s \doteq 3.3\,ms$$

$$10\%\ \text{of}\ T_s = 0.33\,ms$$

Ex. 5



$$N = -174 + 10\log(B) + 10\log F \quad dB_m$$

$$= -174 + 10\log((1002\text{-}54)\times 10^6) + 3$$

$$\approx -174 + 90 + 3$$

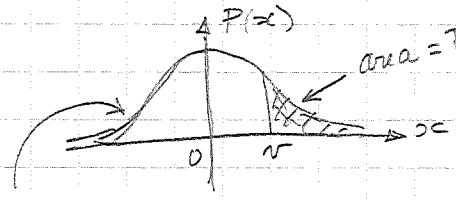
$$= -81\,dB_m$$

$$P_{OUT} = G \cdot N$$

$$= 30dB + -81dBm$$

$$= -51\,dB_m$$

Ex. 6



$P = 20\,mW$

$R = 100\,\Omega$

Gaussian distribution with zero mean & σ (std. dev.) $= \sqrt{2}$ Volts

$$P = \frac{V^2}{R} \Rightarrow V = \sqrt{PR}$$

$$V = \sqrt{0.02 \cdot 100} = \sqrt{2}\ V_{rms}$$

$$= \sigma$$

$$P(x > v) = \frac{1}{2}\,erfc\left(\frac{v}{\sigma\sqrt{2}}\right)$$

$$= \frac{1}{2}\,erfc\left(\frac{0.3}{\sqrt{2}\cdot\sqrt{2}}\right) = \frac{1}{2}\,erfc\left(\frac{0.3}{2}\right) = \frac{1}{2}\,erfc(0.15)$$

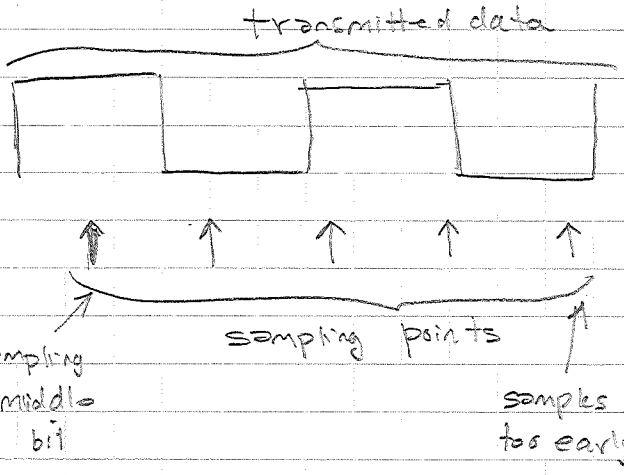
We can look this up in a table: $erfc(0.15) = 0.83$

$= 1 - erf(0.15)$

$P(x > 300mV) = 042$

Lec 4 (3 & 4)

Ex 3



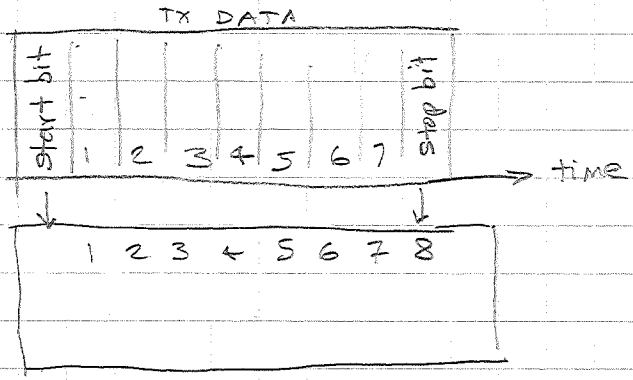
EXAMPLE

Tx clock period = 3

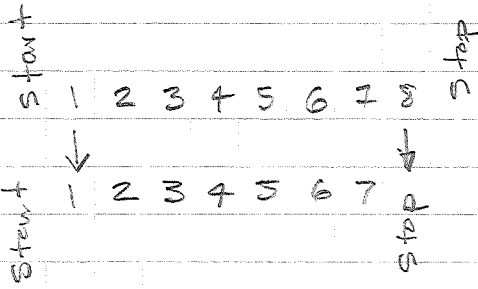
Rx clock period = 2,5

If receiver clock is at the wrong frequency, the sampling points will shift in time relative to the transmitted data

Ex. 4



- if Rx expecting 8 bits, (i) the stop bit (always a '1') will be treated as a data bit & (ii) the stop bit will (may) be lost.



- in this case the 8th data bit is seen instead of a stop bit
- the receiver will probably detect a "framing error" if the value of the 8th data bit is not a '1'

Lec. 8

Ex 1

$$53 \text{ bytes} \times 8 \text{ bits/byte} = 424 \text{ bits}$$

$$\frac{424 \text{ bits}}{1.5 \text{ Mb/s}} = 283 \, \mu s$$

$$\frac{424 \text{ bits}}{1 \text{ Gb/s}} = 424 \text{ ns} = 0.424 \, \mu s.$$

minimum delay = 10 x transmission time (or 11x)

= 2.8 ms or 4.2 μs.

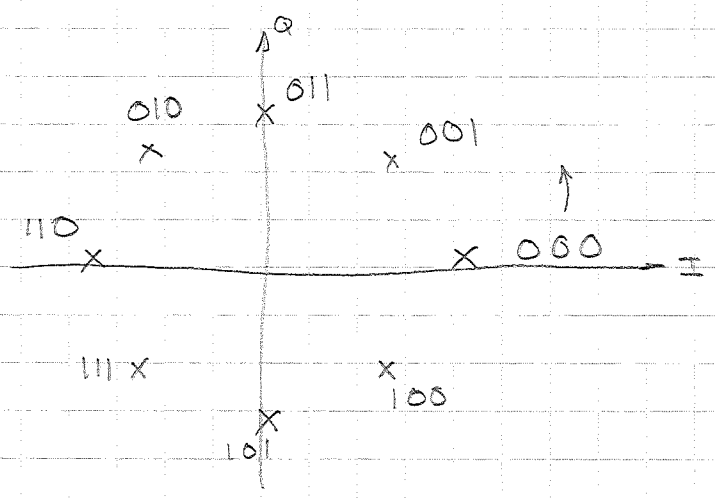
$$\text{prop. delay} = \frac{6000 \text{ km}}{0.66 \times 3 \times 10^8 \text{ m/s}} = 3 \times 10^{-2} \text{ s} = 30 \text{ ms}$$

Lecture 9

Ex. 5

- for symbol rate of 2 MHz minimum bandwidth = 1 MHz (typically is higher)
- the bandwidth of the RF signal is 2 MHz
- spectral efficiency is $\frac{2\ \text{MHz}}{2\ \text{MHz}} = 1\ \frac{\text{symbol/second}}{\text{Hz}}$

Ex 6



(this is one possible example)

3-bit gray-code sequence:

000
001
011
010
110
111
101
100