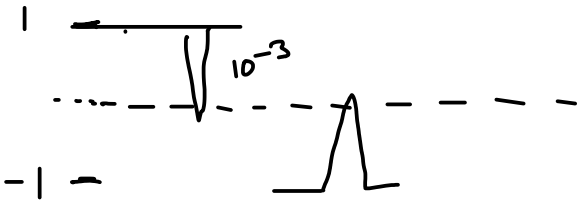
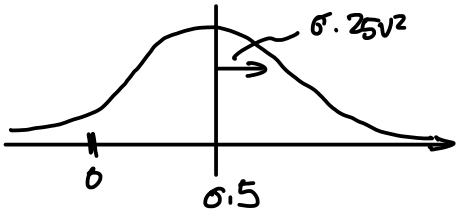
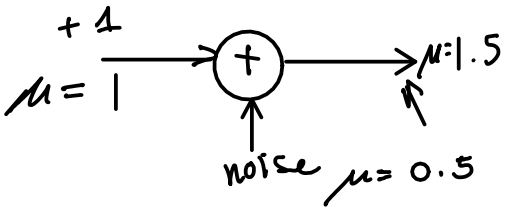
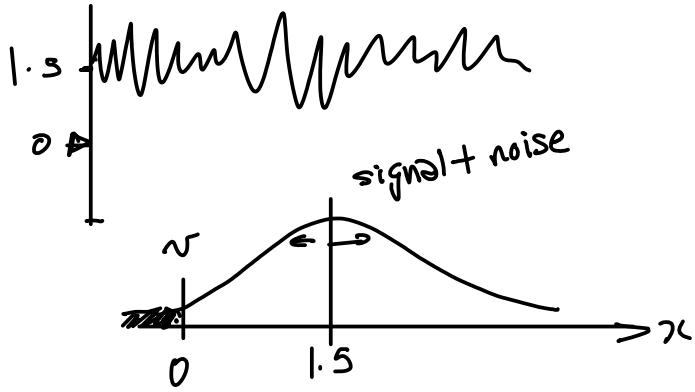
Exercise 1: Gaussian noise with a mean of 0.5 V and a variance of 0.25 V^2 is added to a bipolar signal with levels of ± 1 V. Assuming a decision threshold equally spaced between the two levels, what is the likelihoood of error if $+1$ is transmitted? If -1 is transmitted? What is the average error rate if $+1$ is transmitted 25% of the time?

$\mu = 0.5V$ variance $\sigma^2 = 0.25\ V^2 = \frac{1}{4}$ std deviation $\sigma = 0.5 = \frac{1}{2}$



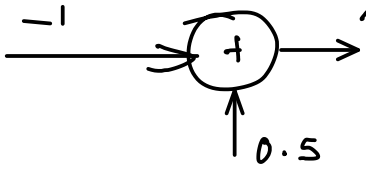






$\overline{a+b} = \overline{a} + \overline{b}$

$5 + 4 \qquad 4 + 5 = 7$



$\mu = -1 + 0.5 = -0.5$

$t = \frac{v - \mu}{\sigma} = \frac{0 - 1.5}{\frac{1}{2}} = -3$

$P(x < 0\ v) = \approx 10^{-3}$

$t = \frac{0 - (-0.5)}{\frac{1}{2}} = 1$

$P(\text{error}) = P(x > 0)$

$P(1) = 0.84$

$= 1 - P(x < 0)$

$= 1 - 0.84 = 0.16$

Exercise 2: What is the current flowing into a 1nF capacitor if it is being charged at a rate of 10V/μs?

$$i = \frac{\text{charge}}{\text{second}}$$

$$Q = CV$$

$$1A = \frac{1\,C}{s}$$

rate of change

$$\frac{Q}{T} = C\frac{V}{T}$$

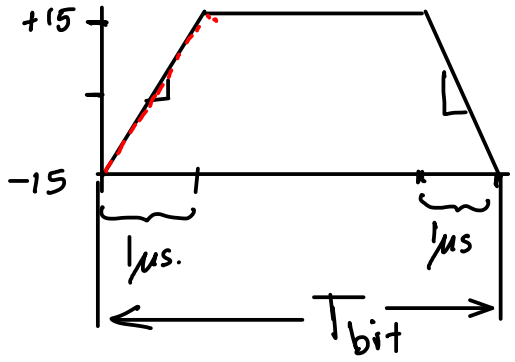
I

$$I = C\,\underbrace{\frac{dV}{dt}}_{\text{slew rate}}$$

$$I = 1\times10^{-9}(nF)\cdot\frac{10}{1\times10^{-6}}\left(\frac{V}{\mu s.}\right)$$

$$= 10^{-3}\cdot 10 = 10\ mA$$

Exercise 3: The RS-232 standard specifies a maximum slew rate of 30V/μs. Assuming a voltage swing of 30 volts, what is the maximum data rate for which two signal level transitions occupy 10% of the bit period?

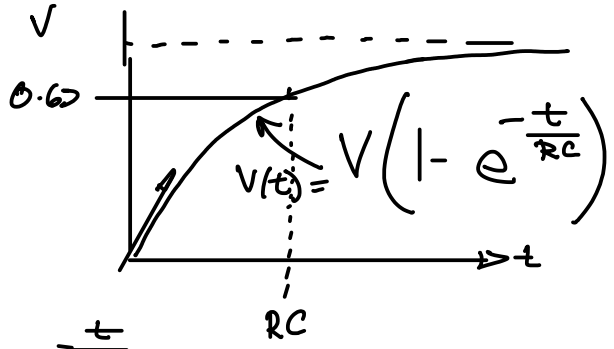


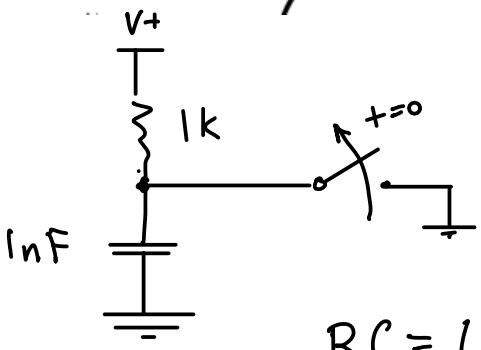
$10\% \cdot T_{bit} = 2\mu s.$

$$T_{bit} = \frac{2}{0.1}\mu s = 20\mu s.$$

$f_{bit} = 50\,kHz$ (kb/s).

Exercise 4: If the capacitance of the transmission line joining several OC drivers is 1 nF and the pull-up resistor is 1 kΩ, how long will it take for the pull-up to pull the line from 0V to 63% of the logic high voltage?





$1 - e^{-\frac{t}{RC}} = 0.63$

$0.37 = e^{-\frac{t}{1ms}}$

$RC = 1 \times 10^{-9} \cdot 1 \times 10^{3} = 1 \times 10^{-6} = 1\mu s.$

$-0.9\,\mu s$

$1\mu s.$

$1 - e^{-\frac{t}{RC}} = 0.63$

$1 - 0.63 = e^{-\frac{t}{RC}}$

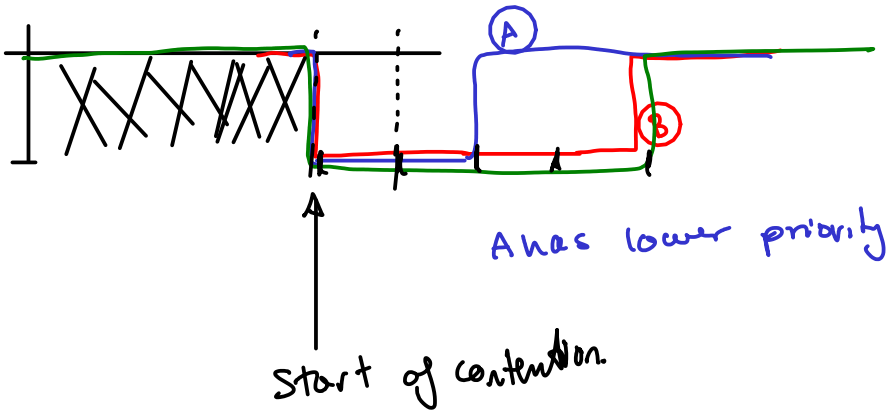
$\ln(1 - 0.63) = -\frac{t}{RC}$

$-RC \cdot \ln(1 - 0.63) = t$

$= 1\mu s.$

Exercise 5: What are the consequences of increasing the delay between polls? What other factor might determine the maximum delay before slave gets access to the bus in a system using polling?

- polling increases maximum latency to polling period.
- other factors: — utilization of the bus.
  — number of devices.



Exercise 6: Consider a communication bus in a car that connects an airbag activation controller with a collision detector, a passenger-seat occupancy sensor and an airbag-disabling switch. Would it be more appropriate to use a polling- or contention-based bus arbitration protocol? Would it be appropriate for the arbitration protocol to allow different priorities for bus access? If so, what priorities might be assigned the different sensors?

- for minimum latency use a contention protocol
- priorities would be good
- highest to collision sensor.