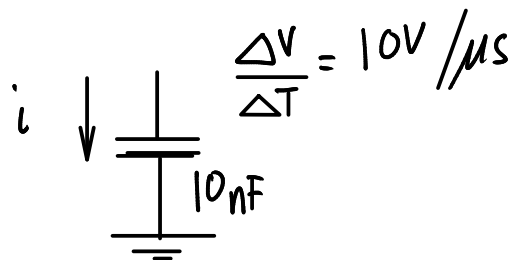# Lecture 6 - Baseband Transmitters and Receivers

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

$$Q = CV$$

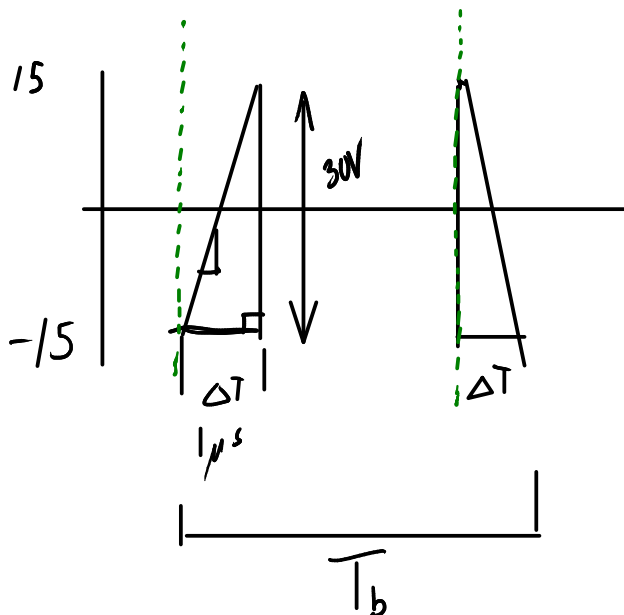$$\frac{\Delta V}{\Delta T} = 10V/\mu s$$

$$i = \frac{\Delta Q}{\Delta T}$$

$$i = C\frac{\Delta V}{\Delta T} = C\frac{dV}{dt}$$

$$i = 1 \times 10^{-9} \cdot \frac{10\,V}{10 \times 10^{-6}} = 1 \cdot 10 \cdot 10^{-3} = 10mA$$

Exercise 2: 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?

$$\text{Slew rate} = 30V/\mu s = \text{slope} = \frac{\Delta V}{\Delta T}$$

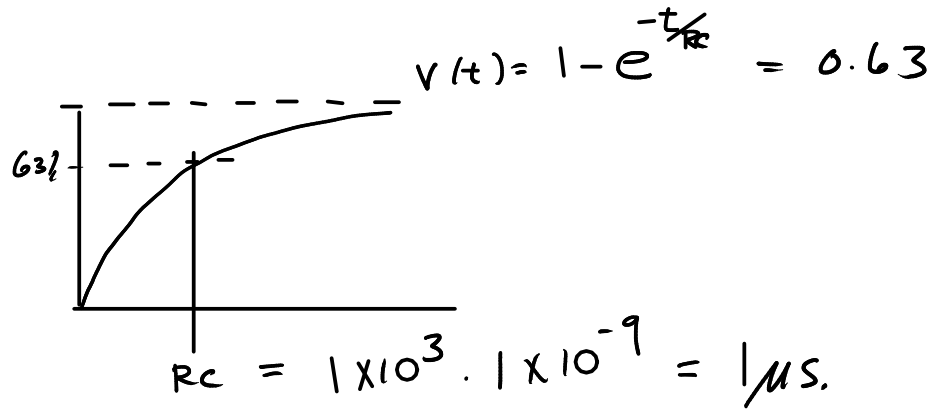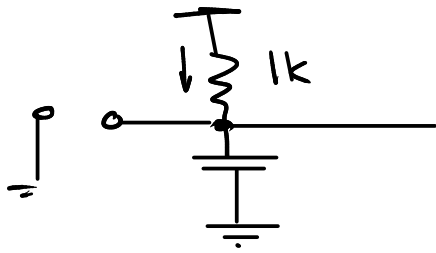$$\Delta T = \frac{\Delta V}{\text{slope}} = \frac{30v}{30V/\mu s} = 1\mu s$$

$$2\Delta T = 10\% \, T_b = \frac{0.1}{f_b}$$

$$f_b = \frac{0.1}{2\Delta T} = \frac{0.1}{2\mu s}$$

$$= 50\,kb/s$$

Exercise 3: If the capacitance of the transmission line joining several OC drivers is 1nF and the pull-up resistor is 1kΩ, how long will it take for the pull-up to pull the line from 0V to 63% of the logic high voltage?

$$v(t) = 1 - e^{-t/RC} = 0.63$$

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

Exercise 4: What are the consequences of increasing the delay between polls? (number of devices.) What other factor might determine the maximum delay before slave gets access to the bus in a system using polling?

increase
- delay between polls $\begin{cases} \text{latency increases} \\ \text{throughput reduced} \end{cases}$

- as utilization increases latency increases

CAN   Priority Arbitration
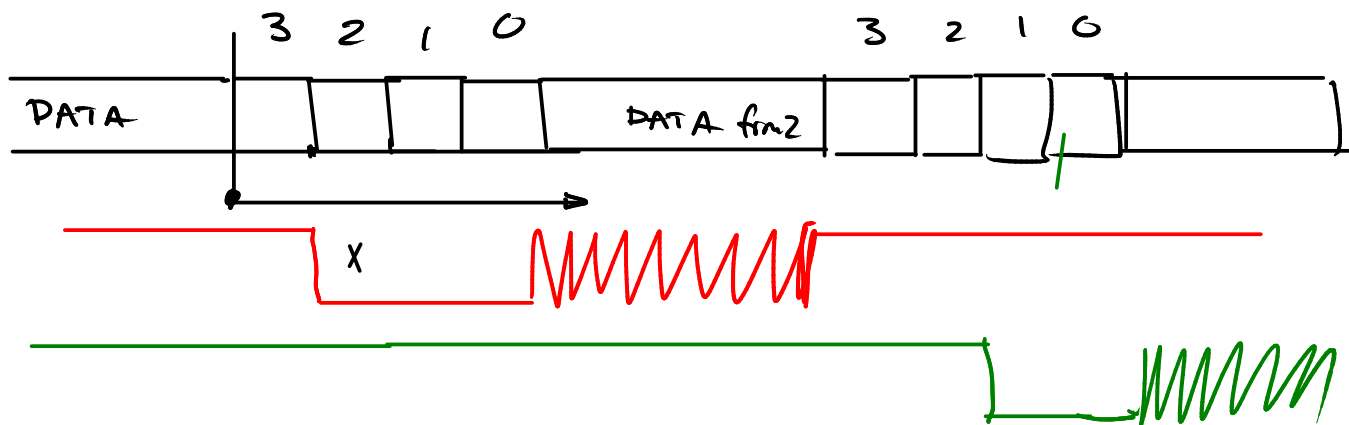
Exercise 5: Consider a communication bus in a car that connects an airbag activation controller with a collision detector, a passenger-seat occupancy sensor and an airbag-disabling switch. Would it be more appropriate to use a polling- or contention-based bus arbitration protocol? Would it be appropriate for the arbitration protocol to allow different priorities for bus access? If so, what priorities might be assigned the different sensors?

- contention-based more appropriate
- priorities are probably good.

- HI   — collision sensor
  _
-       _
  Low   — passenger detector
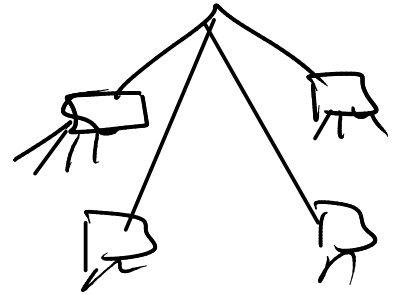
Exercise 6: If the common-mode circuit is used to carry 500mA, how much current flows through each half of the transformer secondary? What is the net effect on the flux in the transformer core? no net effect.

$$\rightarrow I/2$$

$$\leftarrow I$$

$$\rightarrow I/2$$
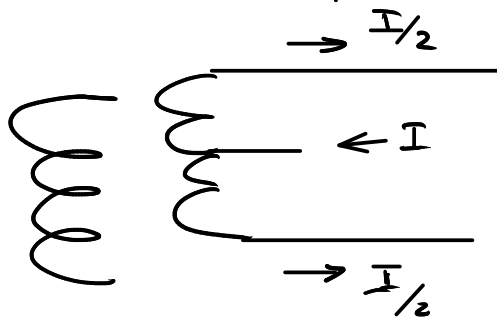
Exercise 7: When the input to the optocoupler is high, will the output be high or low? Assume a pull-up is connected to the output.

+5

Low