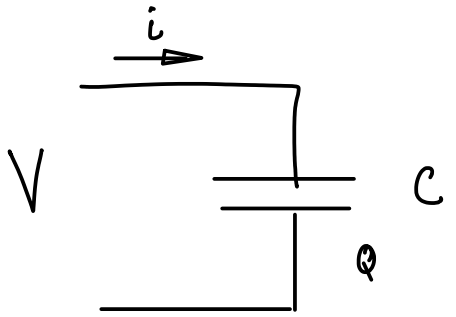
Lecture 5 - Baseband Transmitters and Receivers

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



$Q = CV$

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

$Q_0 = CV_0$

$Q_1 = CV_1$

$Q_1 - Q = C(V_1 - V_0)$

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

$i = C\frac{\Delta V}{\Delta T} = 1\times10^{-9}\ \frac{10}{1\times10^{-6}}$

$= 10^{-9}\cdot 10^{6}\cdot 10^{1}$

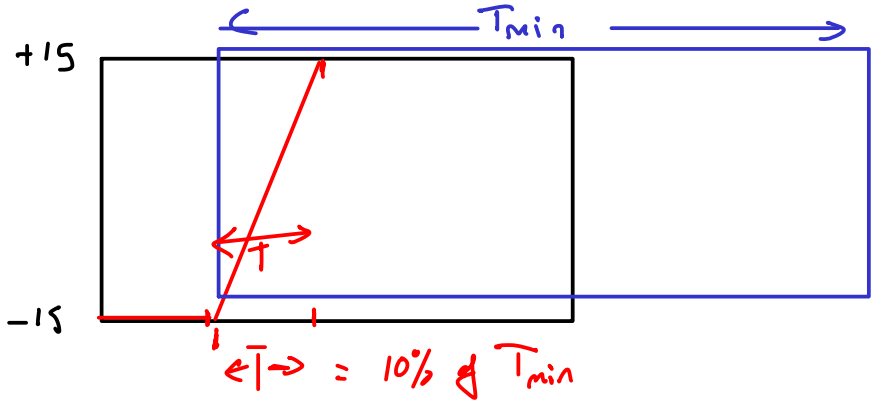
$= 10^{-2}$

$10\times10^{-2} = 100\,mA$

$1\times10^{-2} = 10\,mA$

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?



slew rate $= \frac{\Delta V}{\Delta T} = \frac{15-(-15)}{T} = \frac{30\,V}{0.1\,T_{min}} = 30\,V/\mu s$

$T_{min} = \frac{30\,V}{0.1\cdot 30\,V/\mu s} = 10\,\mu s$

data rate $= \frac{1}{10\,\mu s} = 100\,kHz$

Exercise 3: 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?

$R = 10^3$

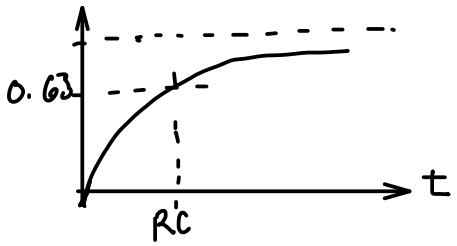
$C = 1 \times 10^{-9}$

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

$e^{-1} = 0.37$

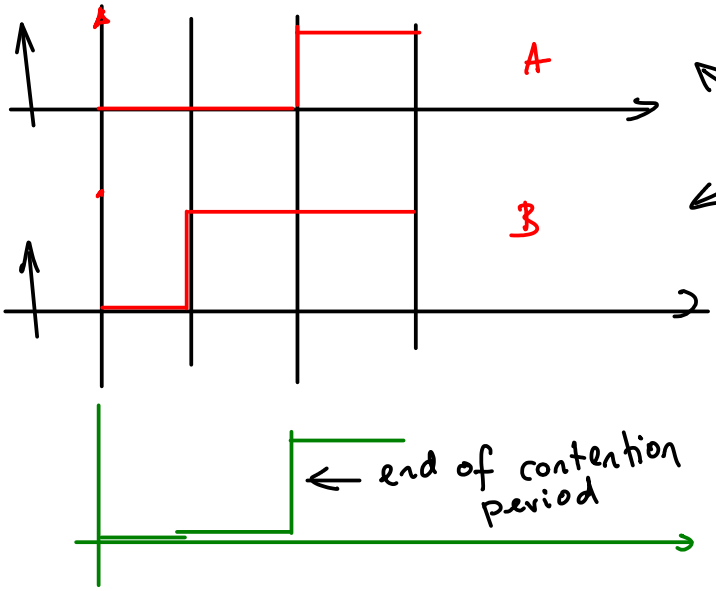
$t = RC$

$= 10^{-6} = 1\mu s.$



Exercise 4: 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?

- increasing delay ⇒ increases response time (delay)
- # slaves.
- length of each transmission



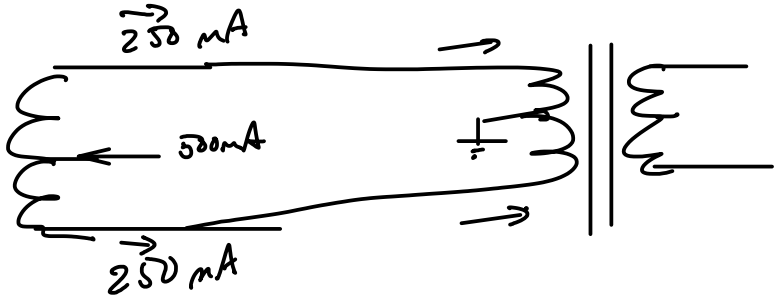
two devices contend for the bus. who wins?

- device that holds down bus longest "wins" (has highest priority)

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 to minimize delay
- yes:
  priorities — highest - collision sensor
  - lower - switch
  - sensor.

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

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.