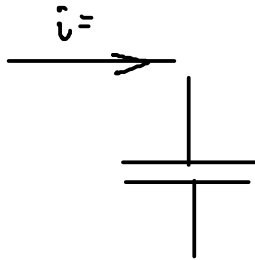


# Lecture 6 - Baseband Transmitters and Receivers

**Exercise 1:** What is the current flowing into a 1nF capacitor if it is being charged at a rate of 10V/ $\mu$ s?



$$1\text{nF} = 10^{-9}\text{F}$$

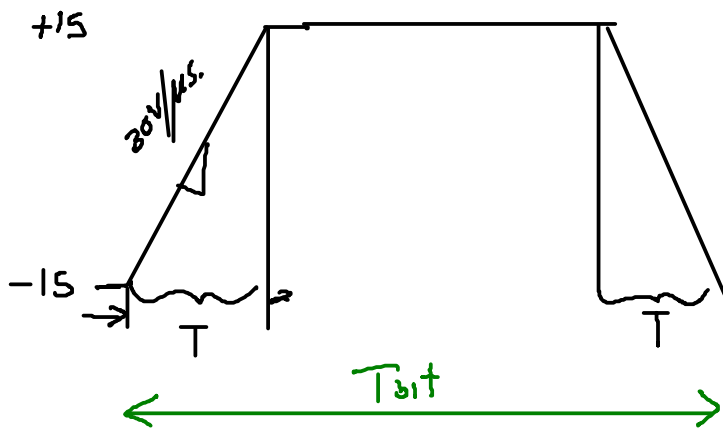
$$i = C \frac{\Delta V}{\Delta t}$$

$$= 10^{-9} \frac{10}{10^{-6}} = 10 \times 10^{-3}$$

$$= 10\text{mA}$$

**Exercise 2:** The RS-232 standard specifies a maximum slew rate of 30V/ $\mu$ s. 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?

50kHz?



$$2T = 0.1 \cdot T_{\text{bit}}$$

$$\text{Slew rate} = \frac{\Delta V}{\Delta T}$$

$$= 30 \frac{\text{V}}{\mu\text{s}}$$

$$\Delta T = \frac{\Delta V}{\text{slew rate}} = \frac{15 - (-15)}{30 \times 10^6}$$

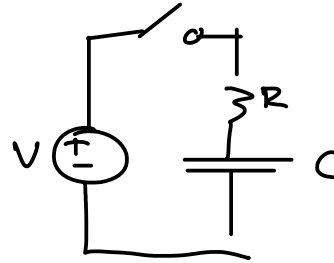
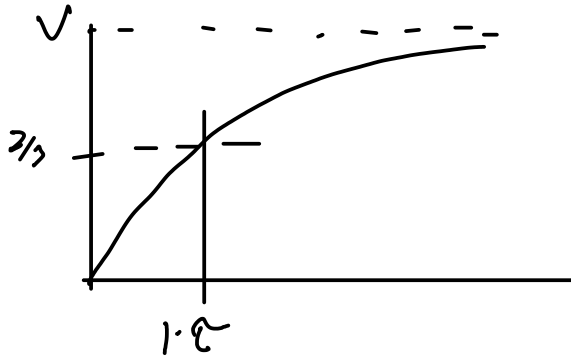
$$= 1\mu\text{s}$$

$$2T = 0.1 T_{\text{bit}}$$

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

$$f_{\text{bit}} = 50\text{kHz}$$

**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?



$$\begin{aligned} \tau &= RC \\ &= 1k \cdot 1nF \\ &= 10^3 \cdot 10^{-9} \\ &= 10^{-6} \end{aligned}$$

**Exercise 4:** When the input to the optocoupler is high, will the output be high or low? Assume a pull-up is connected to the output.

a high input turns on the LED,  
this turns on the output transistor,  
this pulls the output low.

**Exercise 5:** What is the active termination supply voltage for bipolar signalling?

assuming equally likely H and L levels, a supply voltage of zero will minimize power consumption.