

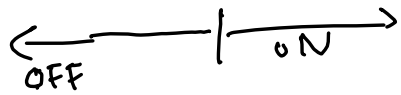
7.1 False. asynchronous = no clock.

7.2 Bit-serial: 1 bit sent at a time

Bit-parallel: multiple bits sent at the same time

13.4

ideal:



Switch debouncing



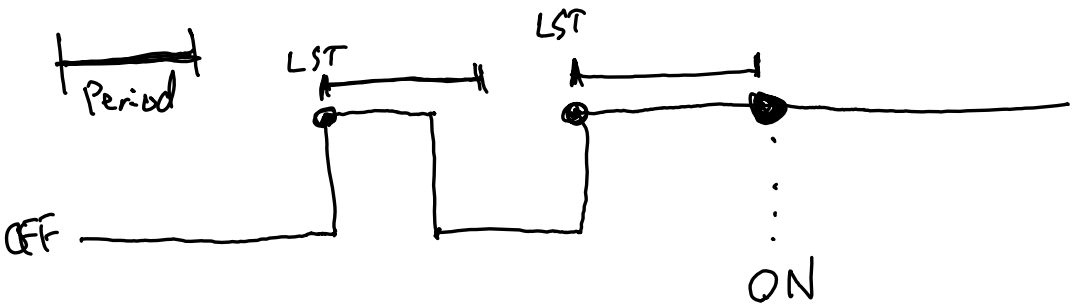
given current switch state (CSS)

if $CSS \neq \text{previous switch state (PSS)}$

set Last Switch Time (LST) to NOW

if $LST - \text{NOW} > \text{DEBOUNCE_PERIOD}$

set PSS to CSS



Period $\approx 50 \text{ ms}$ (acceptable reaction time)

13.10

hint:

non-inverting op amp:

$$V_{out} = V_{in} \cdot \left(1 + \frac{R_f}{R_i}\right)$$

inverting op-amp:

$$V_{out} = (V_{ref} - V_{in}) \cdot \left(\frac{R_f}{R_i}\right) + V_{ref}$$

$$\left(= -V_{in} \cdot \frac{R_f}{R_i} \text{ if } V_{ref} = 0 \right)$$

a) $R_i = 7.5k$, $R_{f_{low}} = 8k$, $R_{f_{high}} = 12k$, $V_{in} = 1V$

$$V_{out_{low}} = 1V \cdot \left(1 + \frac{8k}{7.5k}\right) = 2.067V$$

$$V_{out_{high}} = 1V \cdot \left(1 + \frac{12k}{7.5k}\right) = \underline{2.6V}$$

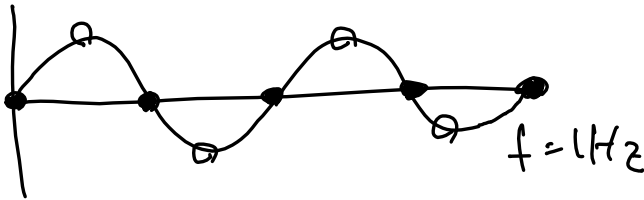
b) $V_{ref} = 2.287V$, $R_i = 1k\Omega$, $V_{in} =$, $R_f = 10k\Omega$

$$\begin{aligned} V_{out_{high}} &= (2.287V - 2.067V) \left(\frac{10k\Omega}{1k\Omega}\right) + 2.287V \\ &= 4.5V \end{aligned}$$

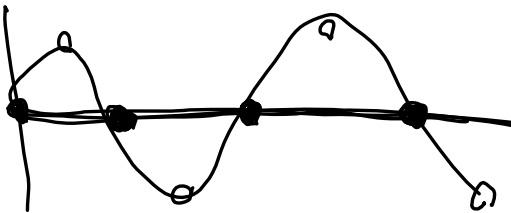
$$\begin{aligned} V_{out_{low}} &= (2.287V - 2.6V) \left(\frac{10k\Omega}{1k\Omega}\right) + 2.287V \\ &= -0.8V \end{aligned}$$

19.1 Nyquist sampling.

$$f_{\text{Nyq}} = 2 \cdot f_{\text{max}} = 2 \text{ kHz}$$



reconstruction:



- $f_{\text{sample}} = 2 \text{ Hz}$
- $f_{\text{sample}} = 4 \text{ Hz}$

19.3

$$V_{RL} = 0V, \quad V_{RH} = 5V$$

res = 8 bits, 10, 16, 24

find value of LSB

$$8 \text{ bits} : \frac{5V}{2^8} = 19.5 \mu V$$

$$10 \text{ bits} : \frac{5V}{2^{10}} = 4.88 \mu V$$

$$16 \text{ bits} : \frac{5V}{2^{16}} = 76.3 \mu V$$

$$24 \text{ bits} : \frac{5V}{2^{24}} = 298 \mu V$$