

Michael Feneley HW4

1.a)  $D=8$ ,  $P=9999$ ,  $f_{\text{BCLK}} = 10 \text{ MHz}$

$$f_{\text{rollover}} = \left( \frac{f_{\text{BCLK}}}{D} \right) \cdot \frac{1}{(P+1)} = \frac{10 \text{ MHz}}{8} \cdot \frac{1}{(9999+1)} = \boxed{1.25 \text{ Hz}}$$

1.b)  $12.5 \text{ Hz} = \frac{10 \text{ MHz}}{4} \cdot \frac{1}{(P+1)}$ ,  $P = \frac{10 \text{ MHz}}{12.5 \text{ Hz} \cdot 4} - 1 = \boxed{19999}$

1.c)  $D=1$  requires  $P = \frac{10 \text{ MHz}}{12.5 \text{ Hz}} - 1 = 79999$ .

A 16 bit register can only hold  $P = 2^{16} - 1 = 65536$ .

So using  $D=1$  may be a bad idea for this frequency because we would have to use an extra 16 bit register to make a 32 bit register.

2.a)  $1 \text{ Hz} = \frac{10 \text{ MHz}}{256} \cdot \frac{1}{(1+P)}$   $D_{\text{max}} = 256$

$$P = \frac{10 \text{ MHz}}{256 \text{ Hz}} - 1 = 39062$$

$\boxed{D=256}$   
 $\boxed{P=39062}$   
 $\text{Error} = -\frac{1}{2} \left( \frac{10 \text{ MHz}}{256} \cdot \frac{1}{(1+39062)} \right) = \boxed{-1.25 \cdot 10^{-5} \text{ Hz}}$

2.b)  $50 \text{ Hz} = \frac{10 \text{ MHz}}{256} \cdot \frac{1}{(1+P)}$   $D_{\text{max}} = 256$

$$P = \frac{10 \text{ MHz}}{50 \text{ Hz} \cdot 256} - 1 = 780.3 \approx 780$$

$\boxed{D=256}$   
 $\boxed{P=780}$   
 $\text{Error} = \left( \frac{10 \text{ MHz}}{256} \cdot \frac{1}{780+1} \right) - 50 \text{ Hz} = \boxed{16 \cdot 10^{-3} \text{ Hz}}$

2.c Pick  $D = 64$

$$P = \frac{10 \text{ MHz}}{64 \cdot 1000 \text{ Hz}} - 1 = 155.3 \approx 155$$

$$\boxed{D=64, P=155} \quad \text{Error} = \frac{10 \text{ MHz}}{64} \cdot \frac{1}{155+1} - 1000 \text{ Hz} = \boxed{1.603 \text{ Hz}}$$

2.d) Pick  $D = 4$

$$P = \frac{10 \text{ MHz}}{20000 \text{ Hz} \cdot \frac{4}{64}} - 1 = 124$$

$$\boxed{D=4, P=124} \quad \text{Error} = \frac{10 \text{ MHz}}{4} \cdot \frac{1}{124+1} - 20000 = \boxed{0 \text{ Hz}}$$

3.a) Assume  $f_{PBCLK} = 10 \text{ MHz}$

$$F_{\text{rollover}} = \frac{10 \text{ MHz}}{D} \cdot \frac{1}{(1+P)}, \text{ Pick } D=1, P=0$$

$$\boxed{F_{\text{rollover}} = 10 \text{ MHz}} \text{ for A and B}$$

3.b) →

3.c) Pick  $D = D_{\text{max}} = 256$

$$P = P_{\text{max}} = 2^{16} - 1, \quad F_{\text{rollover}} = \frac{10 \text{ MHz}}{256} \cdot \frac{1}{2^{16}} \approx 5.96 \cdot 10^{-6}$$

$$\text{Period} = \frac{1}{F_{\text{rollover}}} = \frac{1}{5.96 \cdot 10^{-6}} = 1.68 \text{ seconds}$$

3.d)  $D_{\text{max}} = 256$   
 $P_{\text{max}} = 2^{32} - 1$

$$F_{\text{rollover}} = \frac{10 \text{ MHz}}{256} \cdot \frac{1}{2^{32}} = 7.075 \cdot 10^{-12} \text{ MHz}$$

$$\text{Period} = \frac{1}{7.075 \cdot 10^{-12} \text{ MHz}} = \boxed{109951 \text{ Ks}}$$