



## SHEET 7

Q1. If a stepper motor rotates with 200 steps / rotation, what is the required delay between steps to achieve 24 RPM?

$$\rightarrow \text{RPM} = 1000 * 60 * \frac{1}{\text{no. of steps per rotation}} * \frac{1}{\text{delay between steps}}$$

delay in msec

$$\therefore 24 = 1000 * 60 * \frac{1}{200} * \frac{1}{\text{required delay}}$$
$$\therefore \text{Required delay} = 12.5 \text{ msec}$$

Q2. If a stepper motor rotates with 200 steps / rotation and the delay between steps is 20 milliseconds, what is the speed of the motor in RPM?

$$\rightarrow \text{RPM} = 1000 * 60 * \frac{1}{\text{no. of steps per rotation}} * \frac{1}{\text{delay between steps}}$$
$$\therefore \text{RPM} = 1000 * 60 * \frac{1}{200} * \frac{1}{20}$$
$$\therefore \text{RPM} = 15 \text{ rotation/min}$$

\* Another Solution

$$\begin{array}{lcl} 1 \text{ step} & \longrightarrow & 20 \text{ msec} \\ \boxed{?} & \longleftarrow & 1 \text{ min (60,000 msec)} \end{array}$$

$$\text{Steps} = \frac{60,000}{20} = 3000 \text{ steps per min}$$

$$200 \text{ steps} \longrightarrow 1 \text{ revolution}$$

$$3000 \text{ steps per min} \longrightarrow \boxed{?}$$

revolutions per min =  $\frac{3000}{200} = 15 \text{ rpm}$

$$\therefore \text{RPM} = 15 \text{ revolution per min.}$$

Q3. For a motor with 200 steps / rotation. Write a C program to implement a stepper motor controller that spins this motor at 6 RPM. Assume that you have an already implemented "systick\_wait\_10ms ()" function that provides a delay each 10ms.

$$\textcircled{1} \text{ delay} = 1000 * 60 * \frac{1}{\text{no. of steps per rotation}} * \frac{1}{\text{RPM}}$$

$$\therefore \text{delay} = 1000 * 60 * \frac{1}{200} * \frac{1}{6}$$

$$\therefore \text{delay} = 50 \text{ msec}$$

Steps  $\longrightarrow$  ① use the systick\_wait\_10ms() to generate the required delay  
 ② initialize the desired 4 pins to be digital Output  
 ③ insert the defined values to the pins

```
void delay(int time)
{
    int i;
    for (i=0; i<time; i++)
    {
        systick_wait_10ms();
    }
}
```

```
void stepper_motor_init()
{
    SYSCTL_RCGCGPIO_R |= 0x08;
    while ( (SYSCTL_PRGPIO_R & 0x08) == 0) {}
    GPIO_PORTD_AMSEL_R &= ~0x0F;
    GPIO_PORTD_PCTL_R &= ~0xFFFF;
    GPIO_PORTD_DIR_R |= 0x0F;
    GPIO_PORTD_AFSEL_R &= ~0x0F;
    GPIO_PORTD_DEN_R |= 0x0F;
}
```

```
int main()
{
    stepper_motor_init();
    while(1)
    {
        GPIO_PORTD_DATA_R = 5;
        delay(5);
        GPIO_PORTD_DATA_R = 6;
        delay(5);
        GPIO_PORTD_DATA_R = 10;
        delay(5);
        GPIO_PORTD_DATA_R = 9;
        delay(5);
    }
}
```

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