Question 1. Find the delay for a specific TCNT0 value,

a) Clock = 8 MHz, TCNT0 = 0x3E, TCCR0 = 1

b) Clock = 8 MHz, TCNT0 = 0x00, TCCR0 = 5

Answer:

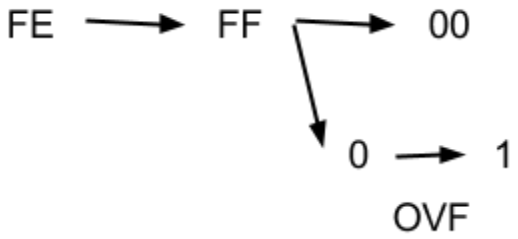
a) $f_{clk} = 8MHz$, so, $T_{clk} = \frac{1}{8MHz} = 0.125\mu s$

TCCR0 = 1 = 0b00000001, so clk with no prescaler will be used

Now, Timer0 will create $0.125\mu s$ delay for each count

given, TCNT0 = 0x3E, that means number of counts = (0xFF) - (0x3E) + (0x01) = 0xC2

the last 1 was added due to,



alternatively, we can get, number of counts = (0d256) - (0d62) = 0d194

we know, total delay = number of counts * delay for each count

= $194 * 0.125\mu s$

= $24.25\mu s$.

b) $f_{clk} = 8MHz$, so, $T_{clk} = \frac{1}{8MHz} = 0.125\mu s$

TCCR0 = 5 = 0b00000101, so clk with prescaler 1024 will be used, that means for every 1024 clock pulses Timer0 will get only 1 Count signal.

Now, Timer0 will create $1024 * 0.125\mu s$ delay for each count

given, TCNT0 = 0x00, that means number of counts = (0xFF) - (0x00) + (0x01) = 0x100

alternatively, we can get, number of counts = (0d256) - (0d00) = 0d256

we know, total delay = number of counts * delay for each count

= $256 * 1024 * 0.125\mu s$

= $32768\mu s$

= $32.768ms$.

Question 2. Find the value of TCNT0 for a specific delay,

a) Clock = 8 MHz, output signal frequency = 16 KHz

b) Clock = 8 MHz, output signal frequency = 125 Hz, with pre-scaler = 256

Answer:

c) $f_{clk} = 8MHz$, so, $T_{clk} = \frac{1}{8MHz} = 0.125\mu s$

$f_{Output\_Signal} = 16KHz$, so, $T_{Output\_Signal} = \frac{1}{16KHz} = 62.5\mu s$

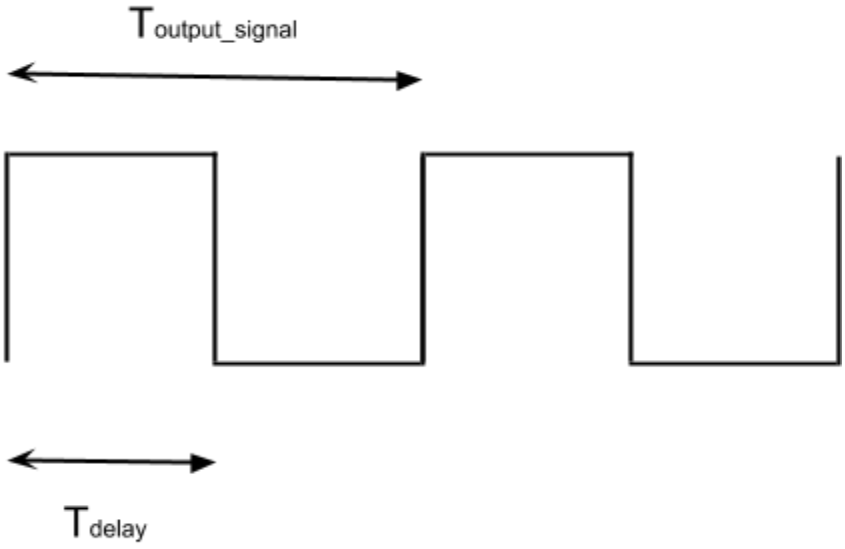
Let us use clk with no prescaler.

So, Timer0 will create $0.125\mu s$ delay for each count

Now, our code for generating output signal was like that,

```
while(1)
{
    delay();
    PORTB = PORTB ^ 0b00000001;
}
```

so,



that's why, delay = output_signal / 2 = $\frac{62.5\mu s}{2}$ = $31.25\mu s$

we know, total delay = number of counts * delay for each count

so, number of counts = total delay / delay for each count

$= \frac{31.25\mu s}{0.125\mu s}$

$= 250$

so, TCNT0 = (0d256) - (0d250) = 0d6 = 0x06.

d) $f_{clk} = 8MHz$, so, $T_{clk} = \frac{1}{8MHz} = 0.125\mu s$

$f_{Output\_Signal} = 125Hz$, so, $T_{Output\_Signal} = \frac{1}{125Hz} = 8ms = 8000\mu s$

Clk with prescaler 256 will be used, that means for every 256 clock pulses Timer0 will get only 1 Count signal.

So, Timer0 will create $256 * 0.125\mu s$ delay for each count

We know, delay = output_signal / 2 = $\frac{8000\mu s}{2} = 4000\mu s$

We also know, total delay = number of counts * delay for each count

so, number of counts = total delay / delay for each count

$= \frac{4000\mu s}{256 * 0.125\mu s}$

$= 125$

so, TCNT0 = (0d256) - (0d125) = 0d131 = 0x83.