Blink LED through AVR-Assembly

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Contents

***Abstract*—This manual shows how to use the Atmega328p timer to blink the builtin led with a delay.**

1 Components

Component	Value	Quantity
Arduino	UNO	1

2 Blink

1) Connect the Arduino to the computer and execute the following code

```
wget https://raw.githubusercontent.com/
    gadepall/arduino/master/assembly/timer/
    codes/timer.asm
```

2) Explain the following instruction

```
sbi DDRB, 5
```

3) What do the following instructions do?

```
ldi r16, 0b00000101
out TCCR0B, r16
```

Solution: The system clock (SYSCLK) frequency of the Atmega328p is 16 MHz. TCCR0B is the Timer Counter Control Register. When

$$TCCR0B = 0b101 \tag{2.1}$$

$$\implies CLK = \frac{SYSCLK}{1024} \tag{2.2}$$

$$= \frac{16M}{1K} = 16kHz. \tag{2.3}$$

4) Explain the PAUSE routine.

```
ldi r19, 0b01000000 ;times to run the loop =
    64 for 1 second delay
PAUSE: ;this is delay (function)
lp2: ;loop runs 64 times
                IN r16, TIFR0 ;tifr is timer
                    interupt flag (8 bit timer
                    runs 256 times)
                ldi r17, 0b00000010
                AND r16, r17 ;need second
                    bit
                BREQ PAUSE
                OUT TIFR0, r17 ;set tifr
                    flag high
        dec r19
        brne lp2
        ret
```

Solution: TIFR0 is the timer interrupt flag and TIFR0=0bxxxxxx10 after every 256 cycles. PAUSE routine waits till TIFR0=0bxxxxxx10, this checking is done by the AND and BREQ instructions above.

5) Explain the lp2 routine.
Solution: R19 = 64 and is used as a count for lp2. The lp2 routine returns after 64 PAUSE rutines.

6) What is the blinking delay?

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Solution: The blinking delay is given by

$$delay = \frac{CLK}{lp2 \times PAUSE} seconds \quad (2.4)$$

$$= \frac{16 \times 1024}{64 \times 256} seconds = 1 second \quad (2.5)$$

3 Blink through Cycle Delays

1) Connect pin 8 of the Arduino to an led and execute the following code

```
wget https://raw.githubusercontent.com/
    gadepall/arduino/master/assembly/timer/
    codes/cycle_delay.asm
```

2) Explain how the delay is obained

```
    ldi r16,0x50
    ldi r17,0x00
    ldi r18,0x00

w0:
    dec r18
    brne w0
    dec r17
    brne w0
    dec r16
    brne w0
    pop r18
    pop r17
    pop r16
    ret
```

Solution: The w0 loop is executed using the counts in R16=$2^6 + 2^4 = 80$, R17=R18=$2^8 = 256$. Thus

$$delay \approx 80 \times 256 \times 256 cycles \quad (3.1)$$

$$= \frac{80 \times 256 \times 256}{2^4 \times 2^20} seconds \quad (3.2)$$

$$= 0.3125 seconds \quad (3.3)$$

The actual time is slightly more since each instruction takes a few cycles to execute.

3) Should you use timer delay or cycle delay?
Solution: Timer delay is an accurate method for giving delays. Cycle delay is a crude method and should be avoided.