

LAB 2-1

USE TIMER TO GENERATE DELAY AND PULSES

OBJECTIVE:

- Understanding the operating modes of a timer:
- Understanding how to use a timer for creating delays and generating pulses.

REFERENCES:

- Lab manual Chapter 4, 5
- Atmel-2505-Setup-and-Use-of-AVR-Timers_ApplicationNote_AVR130.pdf

EXPERIMENT 1:

- a) Write a delay subroutine of 1 ms using Timer 0. Use this subroutine to generate a 500 Hz pulse on pin PA0.
- b) Simulate and modify the program to achieve accurate pulse generation.
- c) Connect pin PA0 to an oscilloscope to verify.

EXPERIMENT 2:

- a) Write a program to generate a 64 us square wave using Timer 0 in Normal mode. Use pin OC0 as the output.
- b) Write a program to generate a 64 us square wave using Timer 1 in CTC mode. Use pin OC0 as the output.
- c) Connect pin OC0 to an oscilloscope and observe.

EXPERIMENT 3:

- a) Given the program for generating two PWM pulses on OC0A and OC0B, connect pins OC0A and OC0B to two oscilloscope channels, measure and record the waveform, and explain the obtained waveform.

```
.org    00  
  
call    initTimer0
```

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```
start:

    rjmp start

initTimer0:

    // Set OC0A (PB3) and OC0B (PB4) pins as outputs

    ldi    r16, (1 << PB3) | (1 << PB4);

    out    DDRB,r16

    ldi    r16, (1 << COM0B1)|(1 << COM0A1) |  (1 << WGM00)|(1 << WGM01)

    out    TCCR0A,r16                // setup TCCR0A

    ldi    r16, (1 << CS01)

    out    TCCR0B,r16                // setup TCCR0B

    ldi    r16, 100

    out    OCR0A,r16                //OCRA = 100

    ldi    r16, 75

    out    OCR0B,r16                //OCRB = 75

    ret
```

EXPERIMENT 4:

- a) Modify the program for different combinations of TCCR0A and TCCR0B registers as described in the table:

	TCCR0A								TCCR0B							
	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
1	COM0A1	COM0A0	COM0B1	COM0B0			WGM01	WGM00	FOC0A	FOC0B			WGM02	CS02	CS01	CS00
2	1	0	1	0			1	1					0	0	1	0
3	1	0	1	0			1	1					1	0	1	0
4	1	0	1	0			0	1					0	0	1	0

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- b) Connect pins OC0A and OC0B to two oscilloscope channels, measure and record the waveforms, and explain the obtained results.

EXPERIMENT 5:

- a) Write a program to generate a 1 kHz square wave with a duty cycle of 25% on pin OC0B.
- b) Connect to an oscilloscope and measure the output waveform.
- c) Connect OC0B to the R channel of an RGB LED. Write a program to increase the duty cycle on OC0B from 0% to 100% and then decrease it back to 0% over 10 ms, with a 1% increment.

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Class group:

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EXPERIMENT 1:

1. Answer the following questions:
 - a. What is the maximum delay achievable using Timer 0 with an 8 MHz frequency?
Explain the calculation.
 - b. What is the maximum delay achievable using Timer 1 with an 8 MHz frequency?
Explain the calculation.
 - c. Explain how to calculate the prescaler values and the values loaded into Timer0 registers for this experiment.
 - d. Source code for the program with comments.

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EXPERIMENT 2:

1. Answer the following questions:
 - a. In Normal mode, when is the TOVx bit set to 1?
 - b. In CTC mode, when is the OCFx bit set to 1?
 - c. Provide the register configurations for Timer 0 for both cases.
 - d. Source code for the programs in both cases.

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EXPERIMENT 3:

1. Answer the following questions:
 - a. Describe the waveform on the oscilloscope (capture and insert it).
 - b. Explain the reasons for the observed waveform (frequency, duty cycle, phase).

EXPERIMENT 4:

1. Answer the following questions:
 - a. Identify the working modes of Timer 0 corresponding to the values in the table.

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2. Capture images of the waveforms corresponding to the different working modes and explain the results.

EXPERIMENT 5:

1. Answer the following questions:
 - a. In which mode is Timer 0 operating?
 - b. What values are loaded into Timer 0 registers, and why?
2. Present the source code with comments.

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