

Lab 5 - Digital Stopwatch

Lab 12:30 W 2:00 W 3:30 W
 Section 11:00 F 12:30 F

Task 1: Determine which modulus and prescalar to use to implement the necessary time delay.

Counter modulus for register OCR1A: _____

Prescalar value: 1 8 64 256 1024
 CS12,CS11,CS10 bits: 001 010 011 100 101

TCCR1B	7	6	5	4	3	2	1	0
	ICNC1	ICES1		WGM13	WGM12	CS12	CS11	CS10
	0	0	0	0	1			

TA/Instructor initials: _____

Item	Outcome	Score	Max.
Checkpoint <ul style="list-style-type: none"> Observed squarewave output from TIMER1 ISR on scope 	Yes/No		1
Stopwatch Operation <ul style="list-style-type: none"> Initialize count to 0.0 on startup, and at 59.9 the time rolls over to 0.0. “Start_Stop” button works correctly Time starts updating on the display at the start of the button press Display of time on the LCD and timing rate are correct “Lap” function operates correctly (displayed time holds, time increments internally, display updated on next button press) Time resets to 0.0 when timing is stopped and “Lap_Reset” is pressed 	Yes/No		1
	Yes/No		1
	Yes/No		1
	Yes/No		2
	Yes/No		1
	Yes/No		1
Review Questions (graded after submission) <ul style="list-style-type: none"> Questions below (put answers in Lab5_Answers.txt file and submit on Vocareum) 			4
Code Organization (Graded after submission) <ul style="list-style-type: none"> Code is indented properly and includes comments Timer initialization function is correct Chose an appropriate Timer prescalar and modulus count Used state machine to control display Time increment code is correct 	Yes/No		1
	Yes/No		2
	Yes/No		2
	Yes/No		2
	Yes/No		2
Total			21
Open ended comments:			

Review Problems

1. (2 points) Review the conceptual operation of a timer interrupt.
 1. For a 16-bit timer with clock frequency of 16MHz (like the Arduino) and prescalar of 64, how much time corresponds to a timer value of 2000?

 2. With a clock frequency of 16MHz and prescalar of 8, what is the longest amount of time we can track with an 8-bit hardware timer?

2. (2 points) The Timer modules we have used also have the ability to make an output pin turn ON (set), OFF (clear), or Toggle when the timer reaches the OCR1A or OCR1B values (i.e. the hardware can automatically control the output value of a pin). By searching the data sheet (ATmega328P datasheet is linked on our website from the Tools and Links page) answer the following questions:
 1. TIMER1 (the 16-bit timer) can control the pins that are associated with OC1A and OC1B signals. Find to what pins these signals are wired by looking at Figure 1.1 (“28 PDIP” package diagram) on page 12 of the data sheet, or alternatively, Tables 14-3, 14-6, or 14-9.

 2. In this lab we use TIMER1 in the “Clear Timer on Compare” or CTC mode. In this mode when the counter reaches the value in OCR1A register it generates an interrupt and starts counting again from zero. Using the information in section 16.11.1 and table 16-1, describe what the OC1A and OC1B pins would do when the timer reaches the OCR1A value if during initialization we used the statement `TCCR1A = 0x60;`