

Name: _____ ID#: _____

Please read through the *entire* examination first! This exam was designed to be completed in 50 minutes. There are 3 problems for a total of 100 points. The point value of each problem is indicated in the table below. There will be generous partial credit so make sure to get to every problem.

Each problem is on a separate sheet of paper. Write your answer *neatly* in the space provided. Do not use any other paper to hand in your answers.

Good luck.

Problem	Max Score	Score
1	20	
2	50	
3	30	
TOTAL	100	

1. Timers

(20 points)

Define the following terms related to features of the timers in your Atmega16 microcontroller and provide an example of when each feature would be used. Relate your examples to the Ball Lightning project, if possible.

a) Overflow

b) Auto-reload

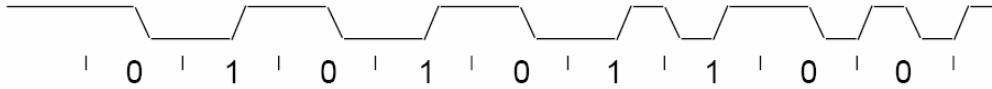
c) Input capture

d) Output compare

2. Decoding

(50 points)

Below is an example of a short packet of Manchester encoded data.



Note that each bit has two parts: a 0 is a high followed by a low, a 1 is a low followed by a high. Each bit within a packet is of the same duration but this duration may vary from packet to packet. The transition in the middle of a bit may jitter from bit to bit by at most 10% of the bit time. Show how you would write the code to decode such a signal using the timer features of the ATmega16 microcontroller. Do not be concerned with syntax. In fact, you can use English (e.g., “read timer value”). However, you must label interrupt routines so that it is clear what condition will cause them to be executed. Also, make sure to clearly show how timers are set.

- a) Describe how you would detect a starting bit (which is always a 0)?

- b) Describe how you would decode each bit. Do you need to have alternating bits at the start of the packet? Why or why not?

c) Describe how you would detect the end of the packet (when the line goes high)?

- d) Write some pseudo-code for decoding a packet one bit at a time. Call a function called “got_bit(bit_value, bit_type)”. The parameters are the value of the bit just decoded and a bit type which is one of START_BIT, PACKET_BIT, or STOP_BIT. For a START_BIT the value is assumed to be 0, for a STOP_BIT the value is assumed to be one.

- e) If you assume your timer has a clock at 10MHz, how fast can the packets be? That is, what is the shortest bit time for which you can still decode the signal correctly? Explain your conclusion and clearly state your assumptions.

3. Filtering

(30 points)

You have a pin on your ATmega16 microcontroller connected to a vibration sensor. It goes high and low with each oscillation. Write pseudo-code for a routine that can determine the frequency of the vibration and reports if it is within the range of 10-20Hz. It should set a variable when the vibration is present and clear when the vibration is at a frequency outside this range. This is called a band-pass detector – selecting only frequencies within a certain range and not those lower or higher. Your filter should make its decision within 1 sec. The vibration sensor is quite noisy and its period may vary by as much as a factor of 3 – that is, a period that should be 100ms may be as great as 300ms or as small as 33ms – but will be correct, on average, over 10 periods.