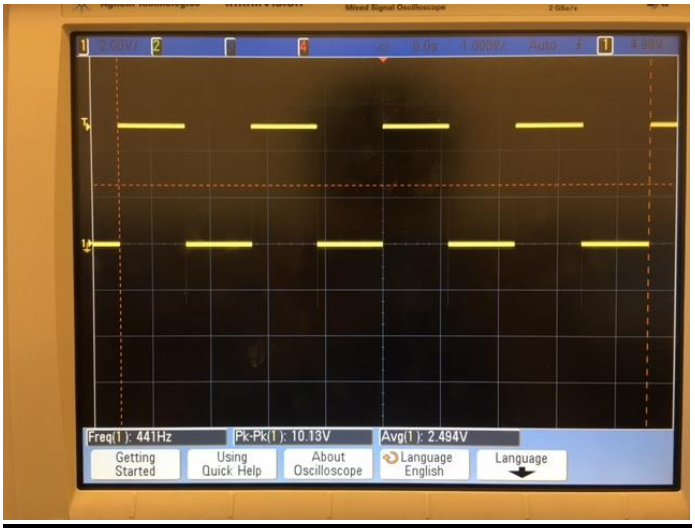
ESE 519: Real-Time and Embedded Systems **Date ____10/2/2017___**
Group No : _____1_____

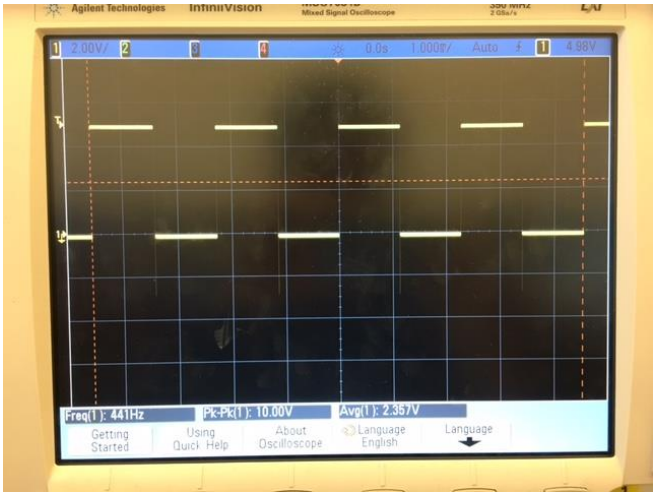
Part 2

1. Oscilloscope output



Part 3

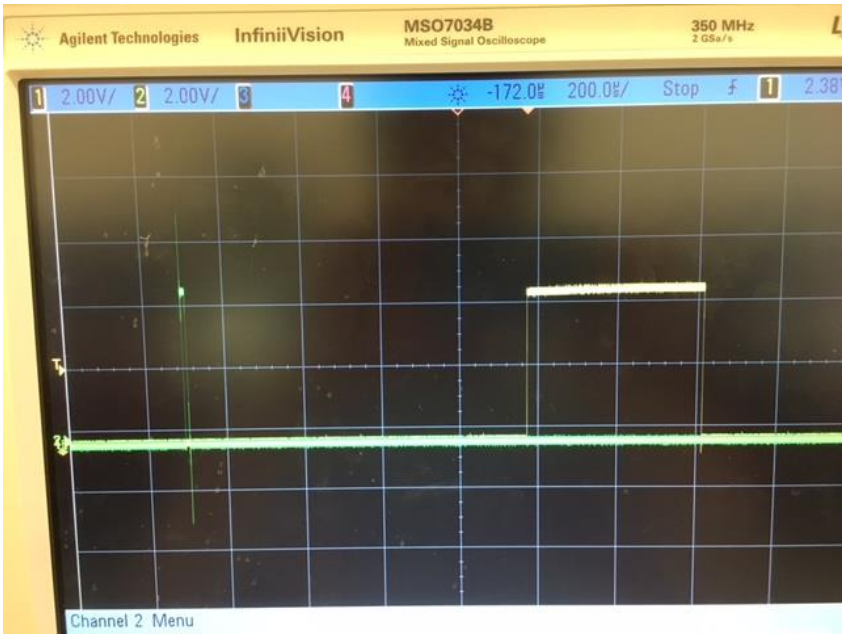
1. Oscilloscope output



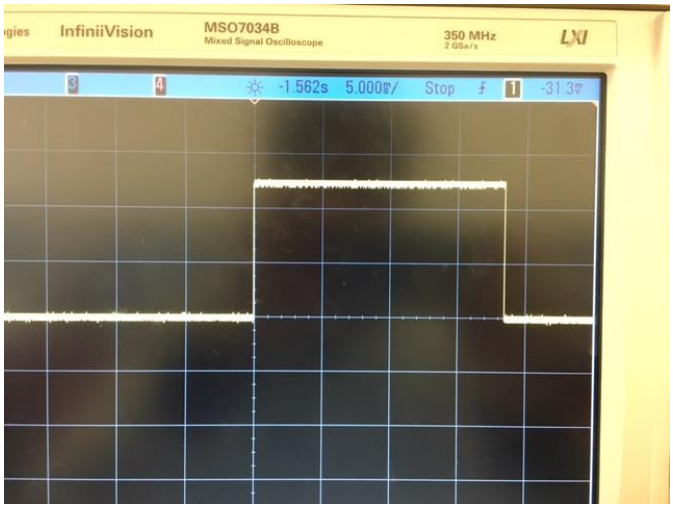
2. Why can the timer only generate one frequency when in CTC mode?
   Because in CTC mode the clock is reset to 0 whenever it matches the specified register value.

Part 4

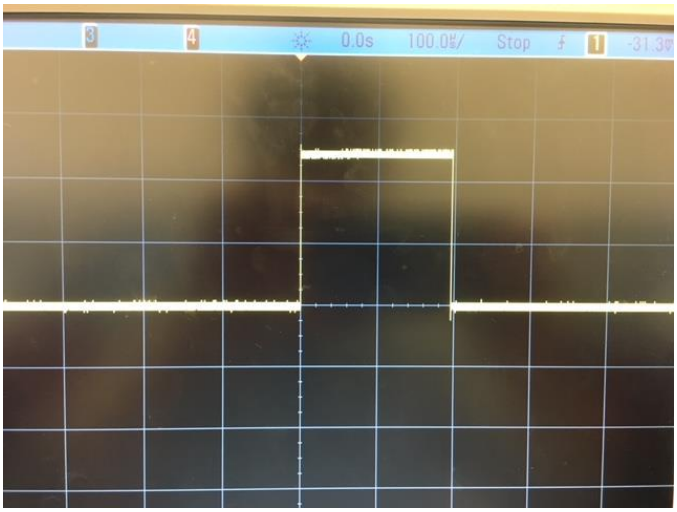
1. Oscilloscope output for the Ping sensor with TRIG output and Echo input captured. Below is a sample of trig + echo with an echo length equals to 420 us. The green pulse is the trigger whereas the yellow pulse is the echo.



2. Report the largest and smallest pulses that you can generate with the ping sensor consistently.
   We used a frequency of 16MHZ
   Largest: 18ms



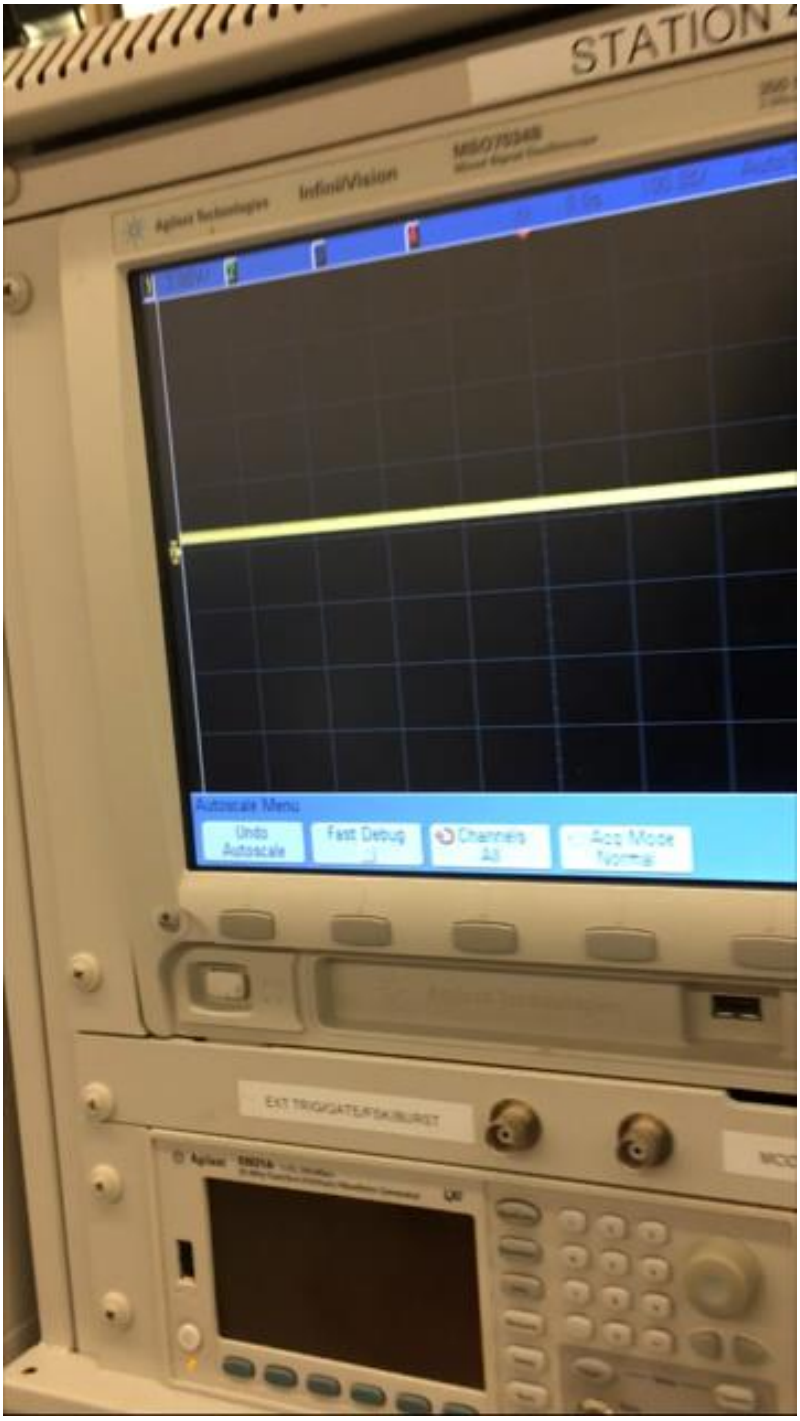
Smallest: 200us



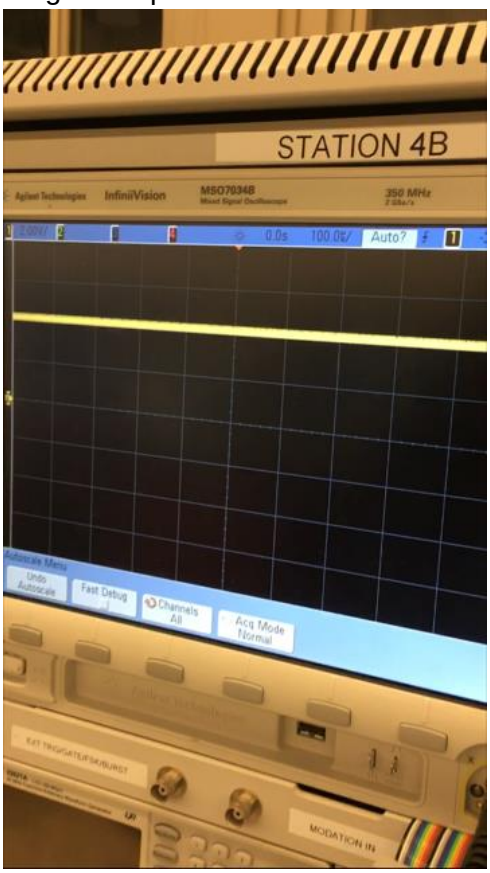
Part 5

1. Oscilloscope output for the Light sensor

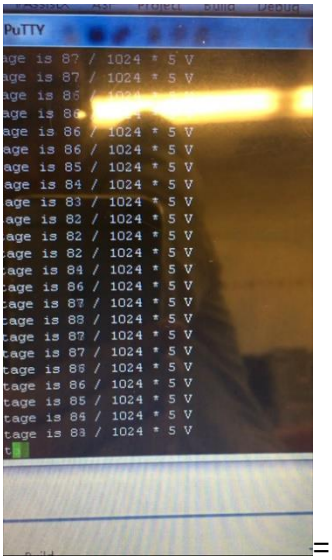
Smallest output: about 0.4 V



Largest output: about 4.2 V

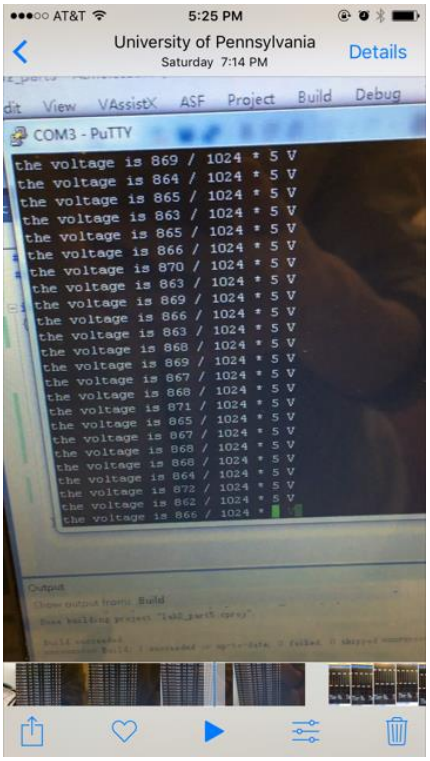


2. Sample of ADC values printed on the terminal output
   Smallest output: 80 / 1024 * 5 ~= 0.4V



=

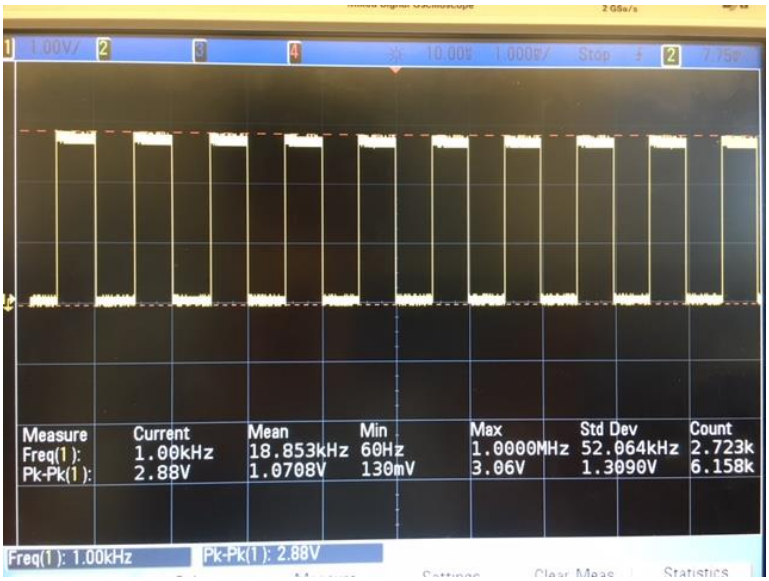
Largest output: 860 / 1024 * 5 ~= 4.2V



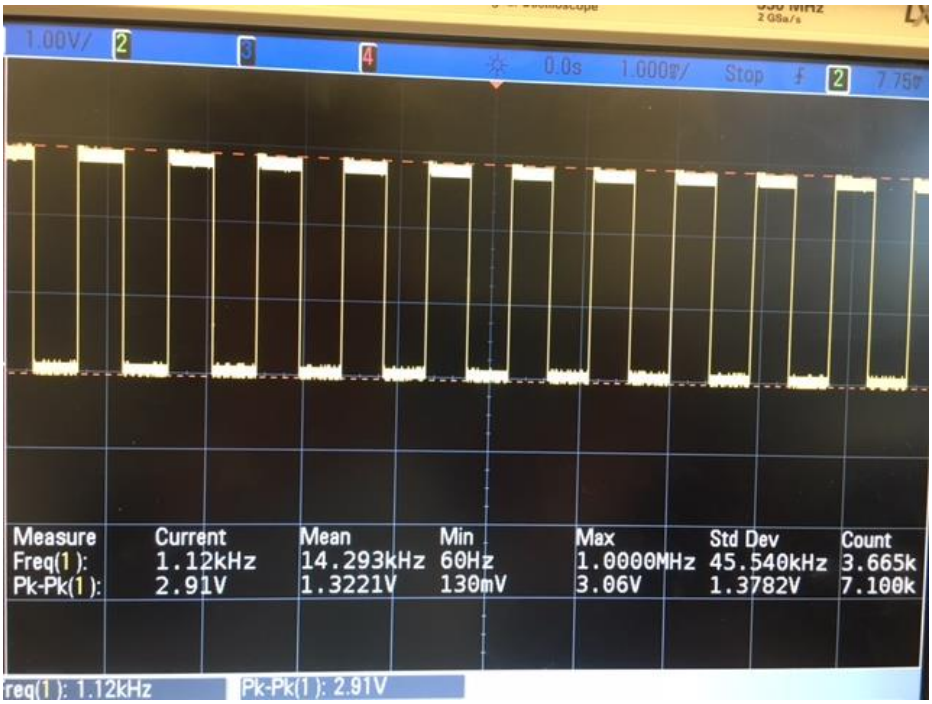
3. Report the maximum and minimum values that you can produce
   The minimum values we can produce is 80, whereas the max is 870.

Part 6

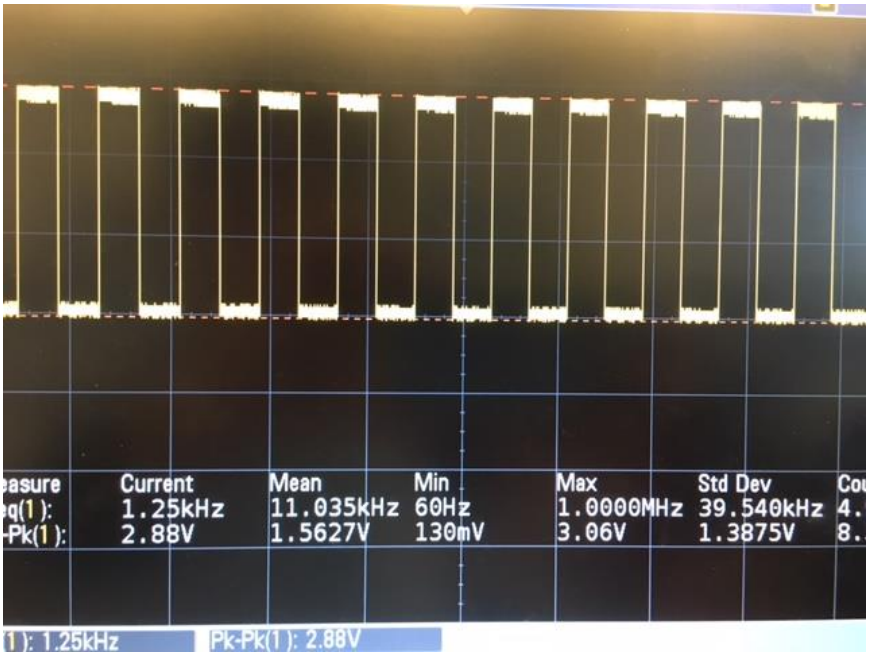
1. For each of the frequencies generated, save the output waveform on oscilloscope.
   1 KHZ



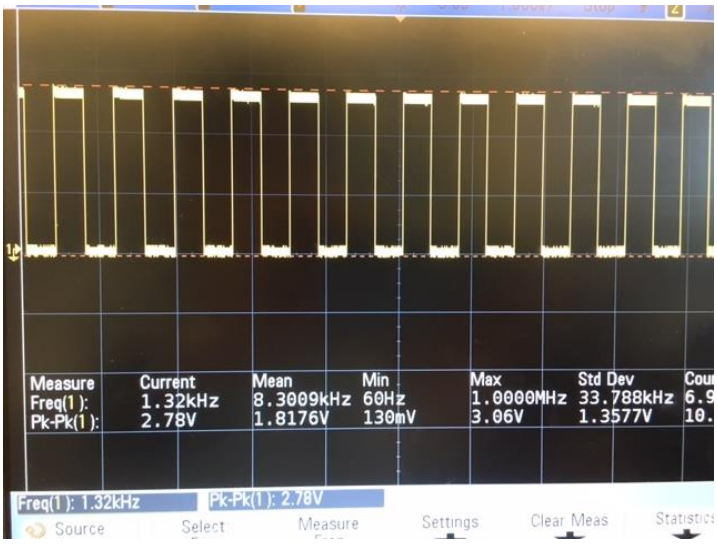
1.122 KHZ



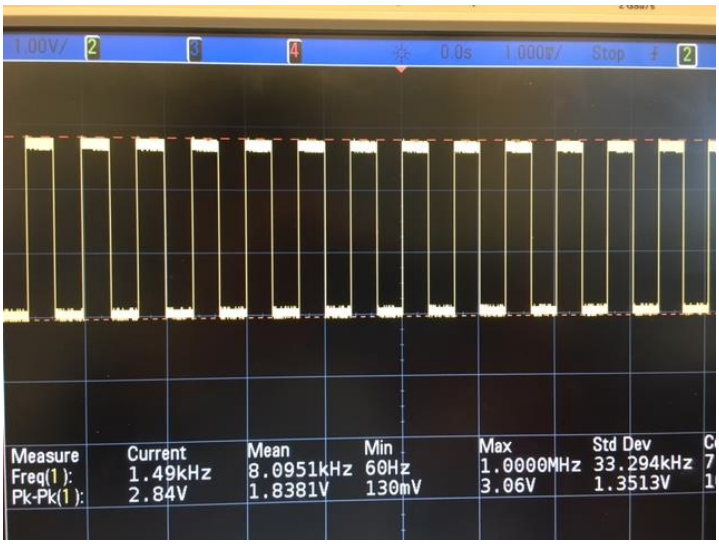
1.26 KHZ



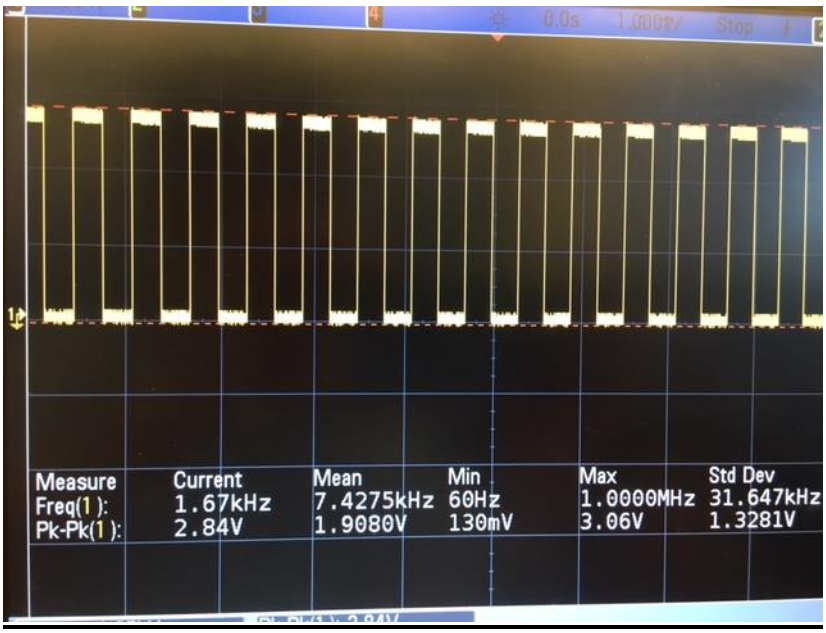
1.335 KHZ



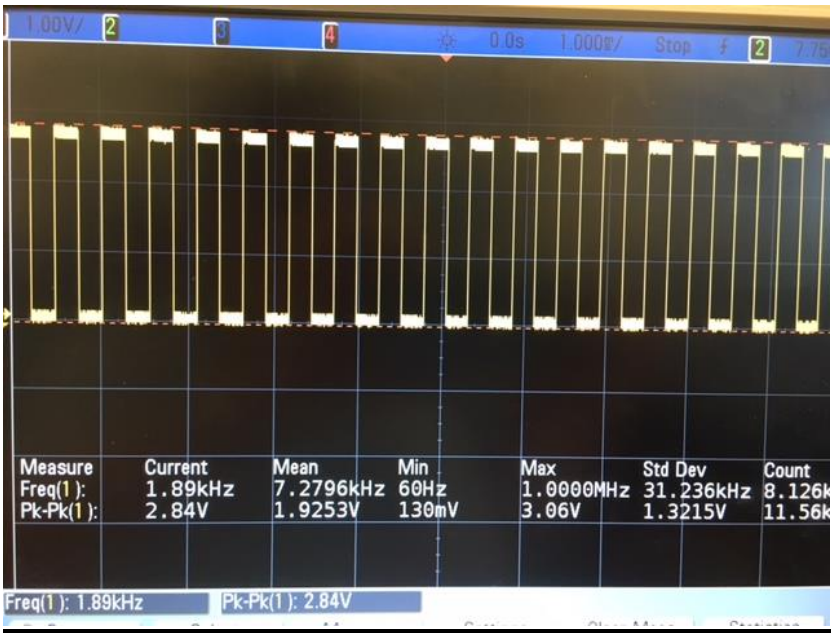
1.498 KHZ



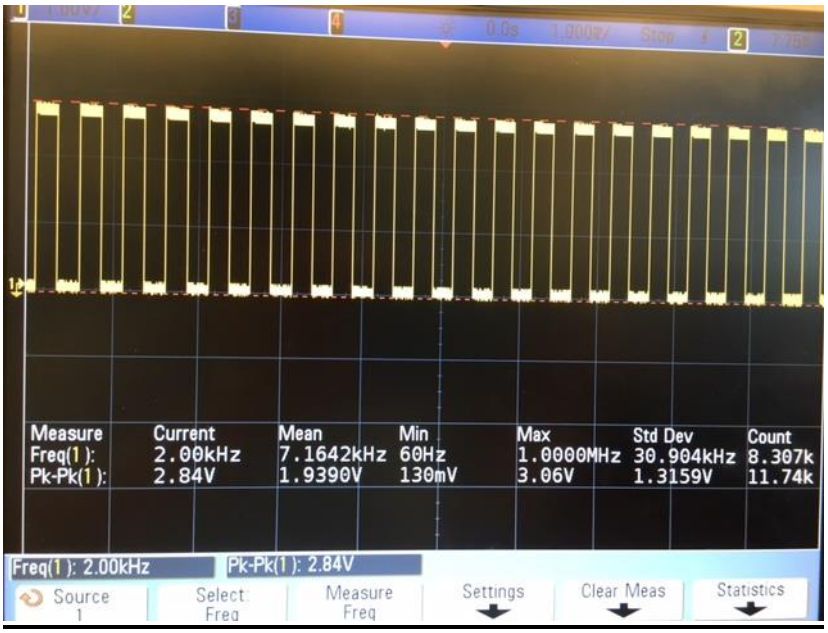
1.682 KHZ



1.888 KHZ



2KHZ

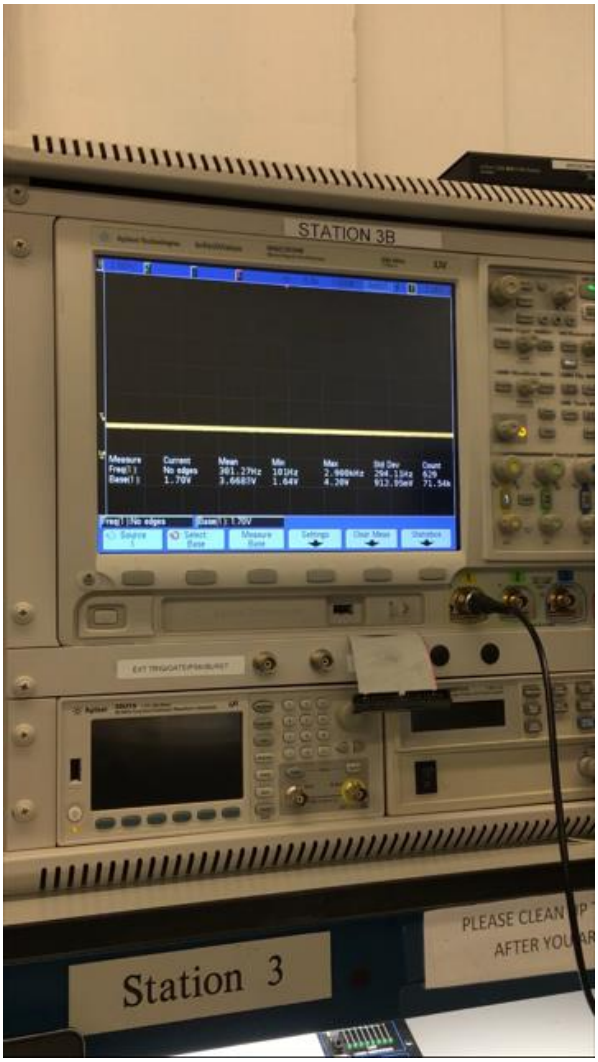

Measure Current Mean Min Max Std Dev Count
Freq(1): 2.00kHz 7.1642kHz 60Hz 1.0000MHz 30.904kHz 8.307k
Pk-Pk(1): 2.84V 1.9390V 130mV 3.06V 1.3159V 11.74k
Freq(1): 2.00kHz
Pk-Pk(1): 2.84V
Source 1
Select Freq
Measure Freq
Settings
Clear Meas
Statistics

Part 7

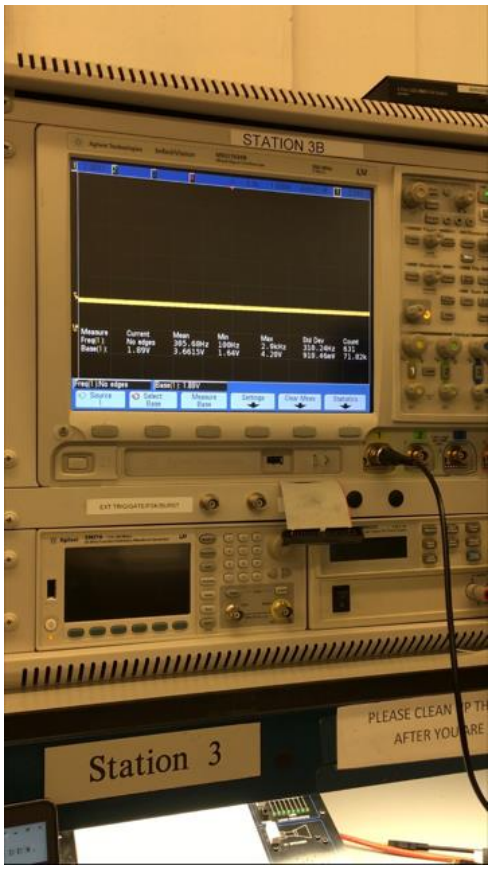
1. Oscilloscope output for the op-amp output

Due to the rangefinder's unstable output, we can only detect 5 clear output voltages, whereas the other 3 groups give less obvious voltage changes. However, the functionality matches the expectation: the voltage at the output of the op amp increases as the distance increases. Below is the 5 obvious groups' voltage ordered from small distances to large distances.

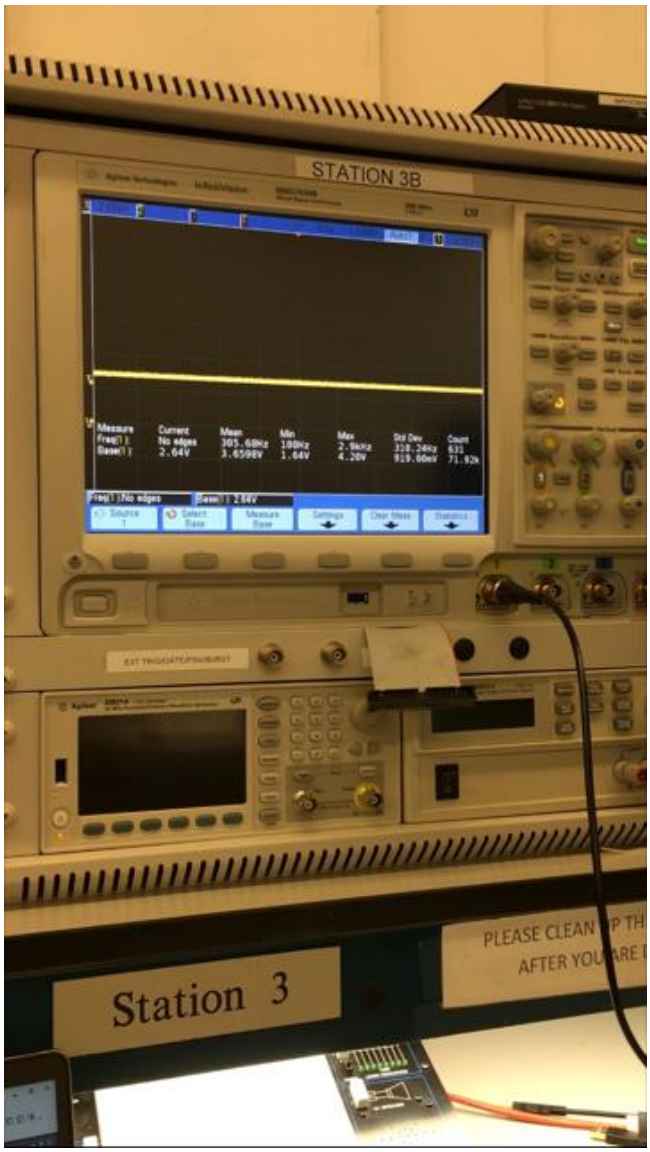
1.7V



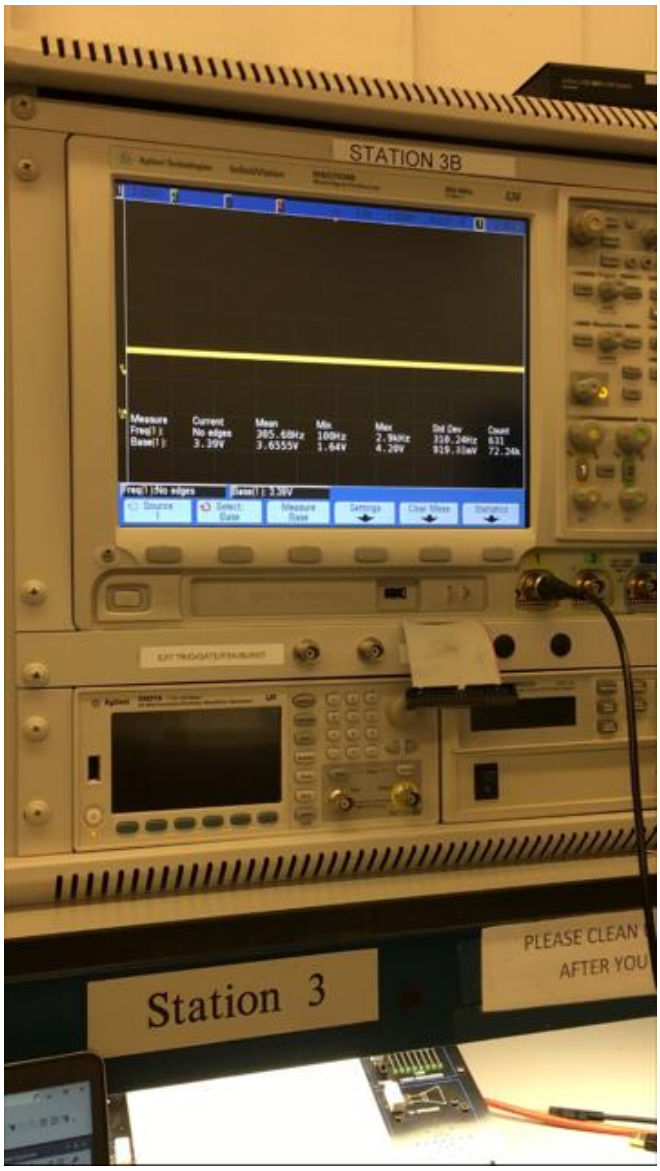
1.89V



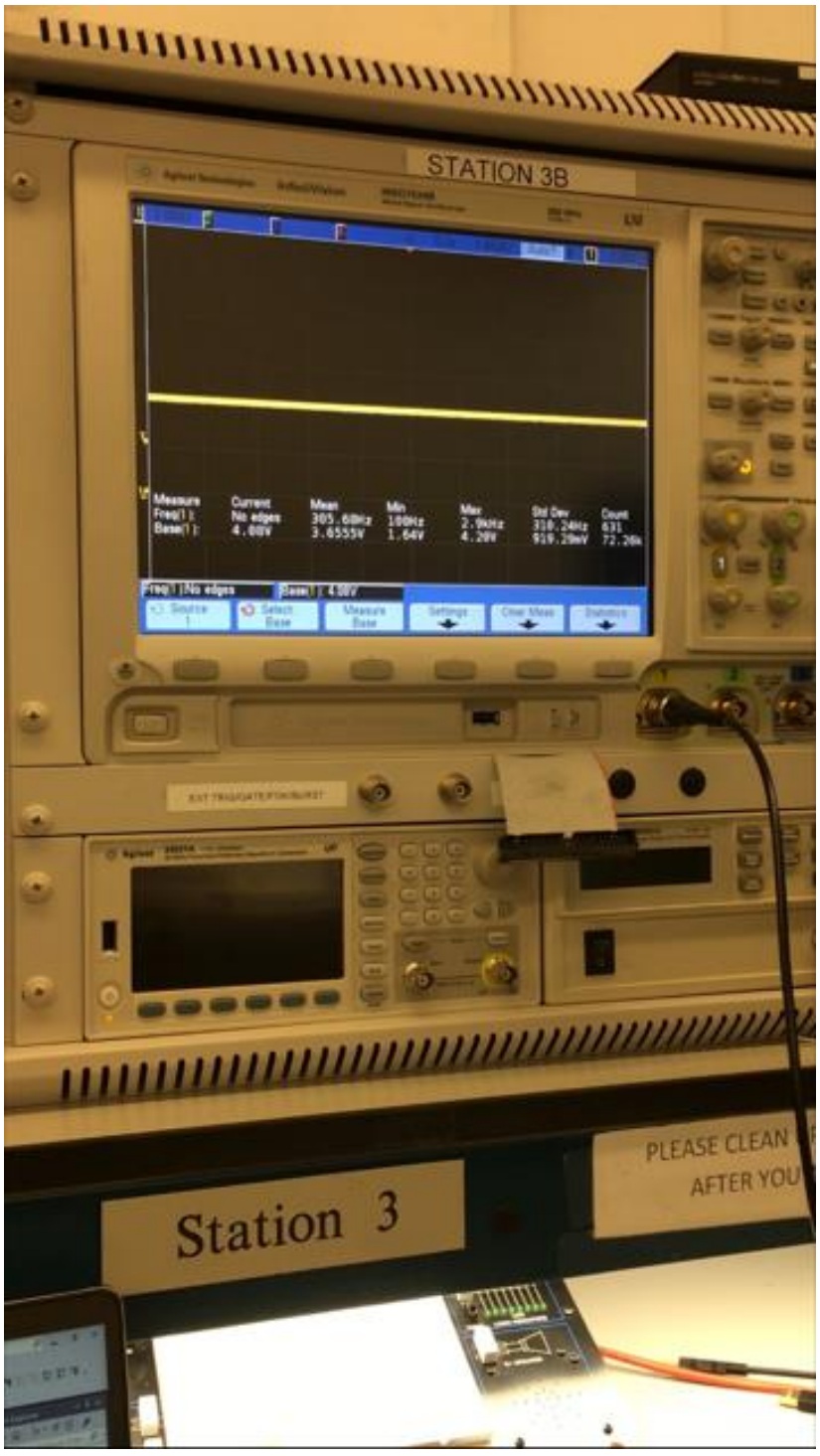
2.64 V



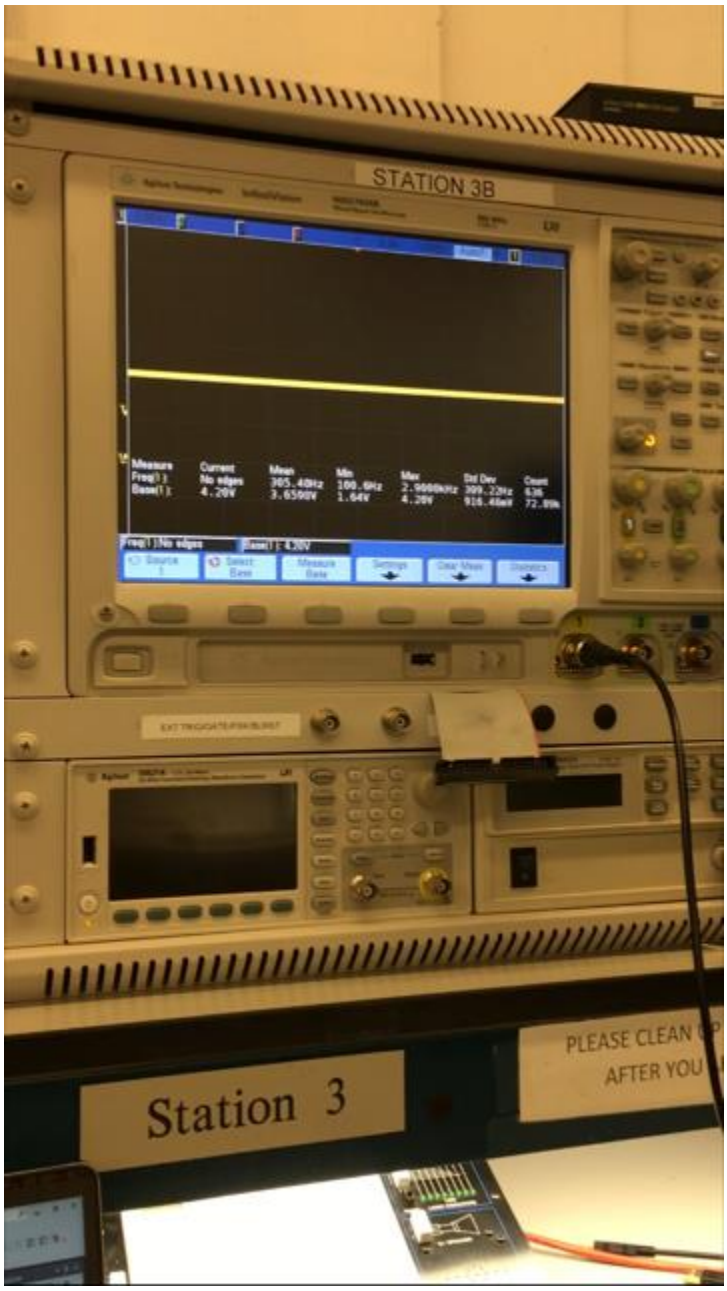
3.39V



4.08V



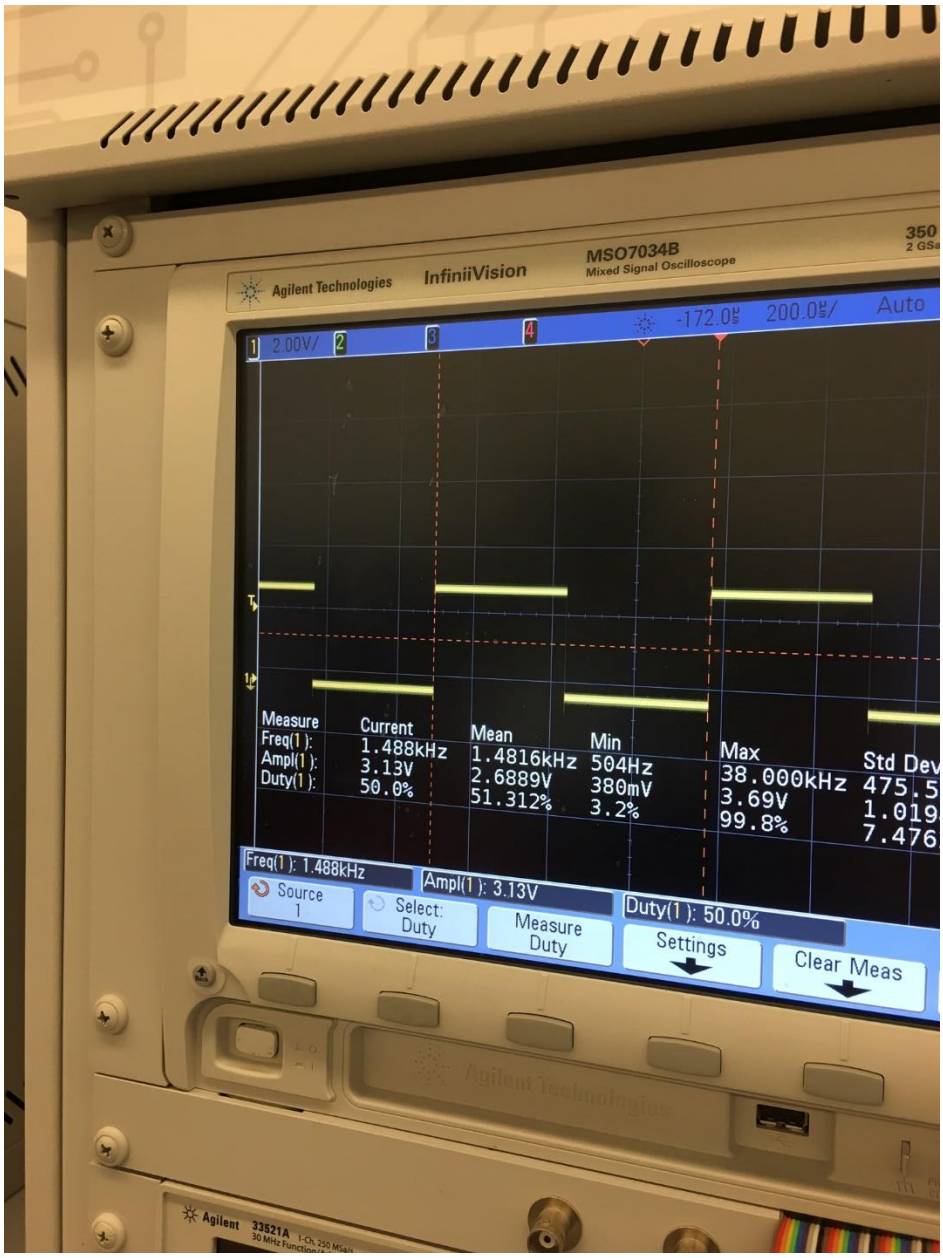
4.20V



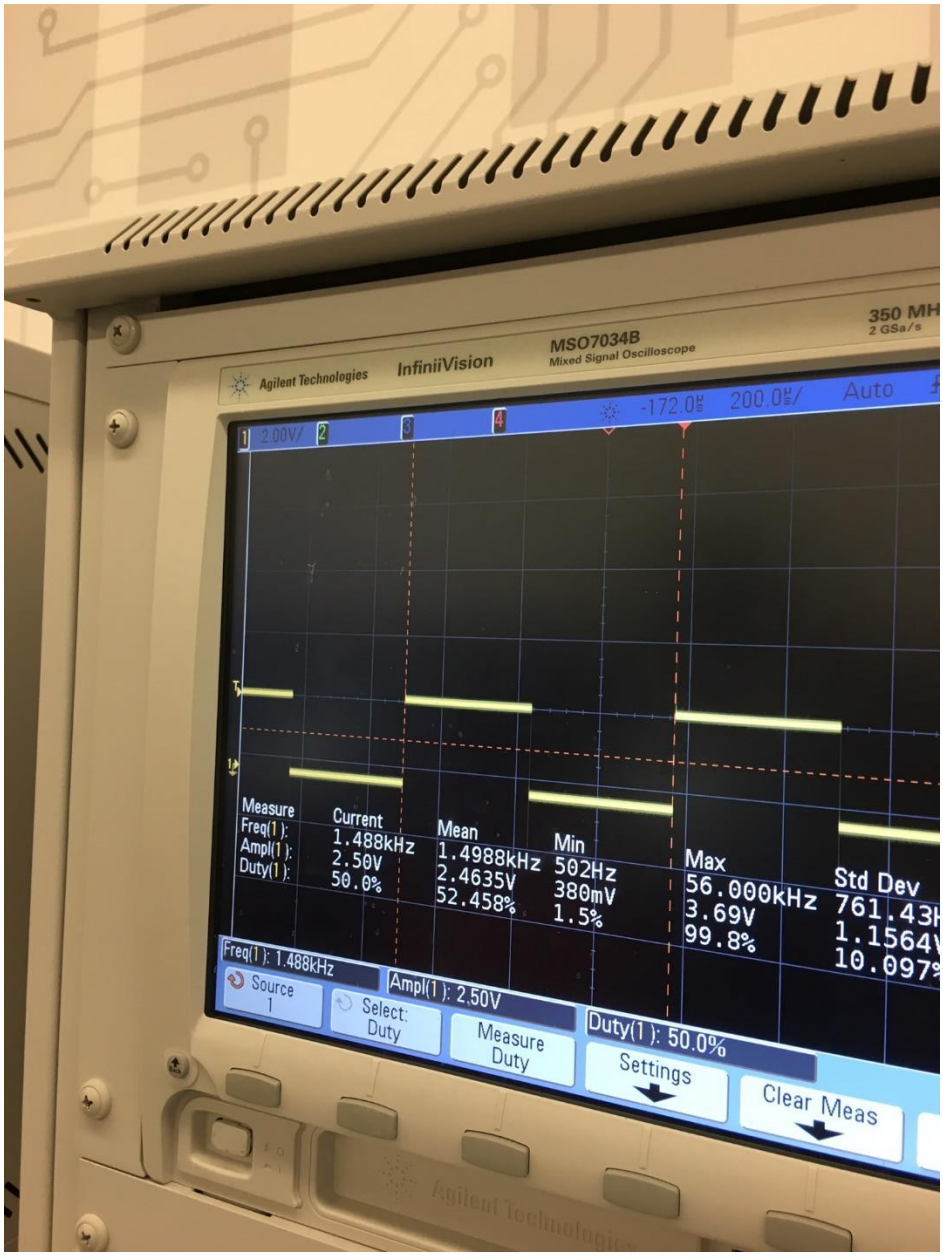
Part 8

Note: in order to capture clear results, we replaced the speaker with a 100 ohms resistor.

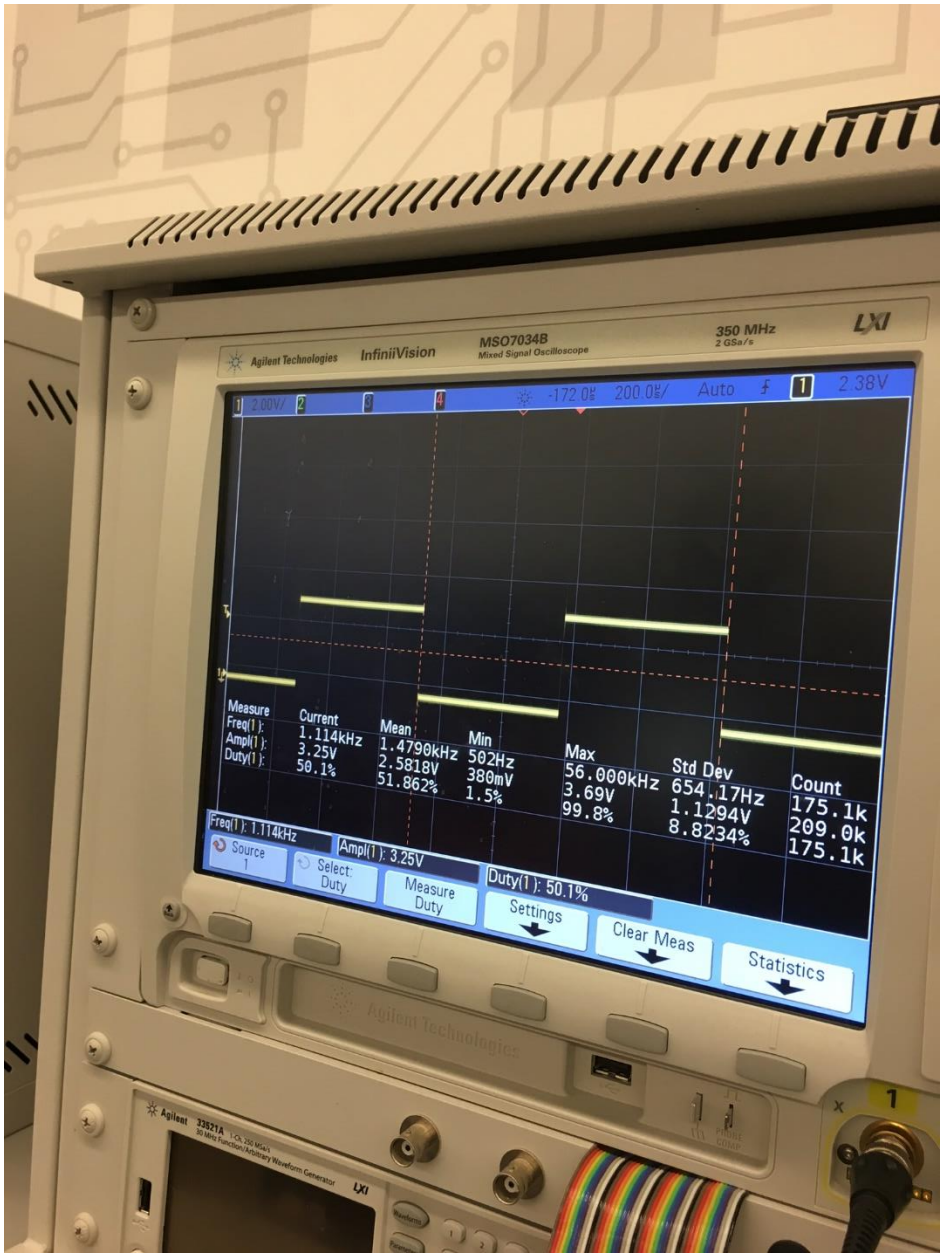
1. Oscilloscope output for the final circuit showing both amplitude variation and frequency variation
    1) Default frequency and amplitude under the current conditions (lightness, obstacle positioning). As you can see the voltage is 3.13V, and the frequency is 1.488KHZ.


Agilent Technologies
InfiniiVision
MSO7034B
Mixed Signal Oscilloscope
2.00V/
-172.0ns
200.0ns/
Auto
Measure
Current
Mean
Min
Max
Std Dev
Freq(1):
1.488kHz
1.4816kHz
504Hz
38.000kHz
475.5
Ampl(1):
3.13V
2.6889V
380mV
3.69V
1.019
Duty(1):
50.0%
51.312%
3.2%
99.8%
7.476
Freq(1): 1.488kHz
Ampl(1): 3.13V
Duty(1): 50.0%
Source 1
Select: Duty
Measure Duty
Settings
Clear Meas
Agilent 33521A

2) Shorter the distance: expect an amplitude drop
As you can see the voltage drops to 2.5V



3) Dimmer the light: expect a frequency drop
As you can see, the frequency drops to about 1.122KHZ



2. Terminal output with values of ADC from light sensor and Ping sensor pulse widths
1) Default

```
The ADC is : 412 , and the Pulse_width is: 89125
The ADC is : 412 , and the Pulse_width is: 92215
The ADC is : 412 , and the Pulse_width is: 81493
The ADC is : 410 , and the Pulse_width is: 81616
The ADC is : 410 , and the Pulse_width is: 71470
The ADC is : 410 , and the Pulse_width is: 81085
```

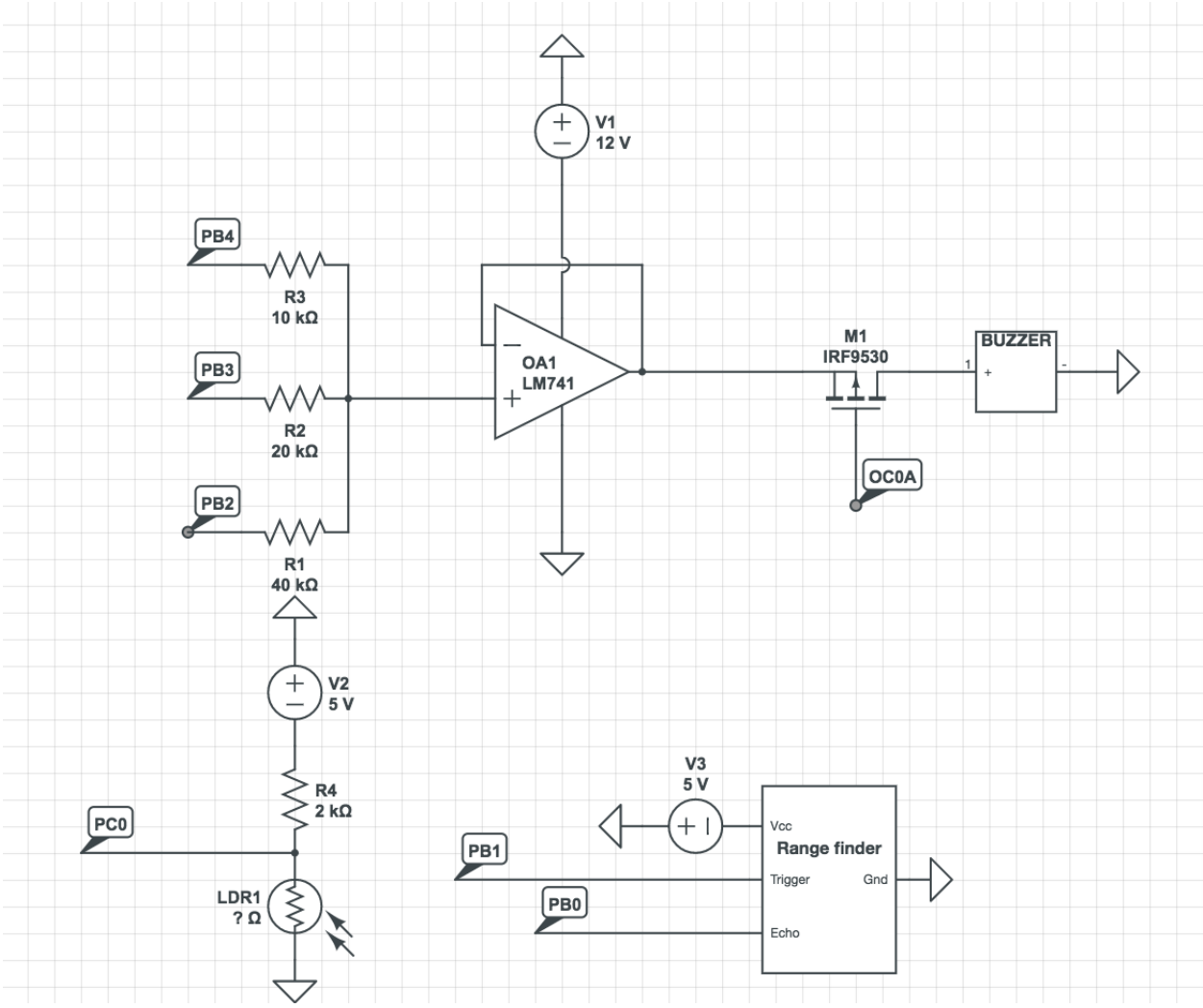
2) Shorter the distance

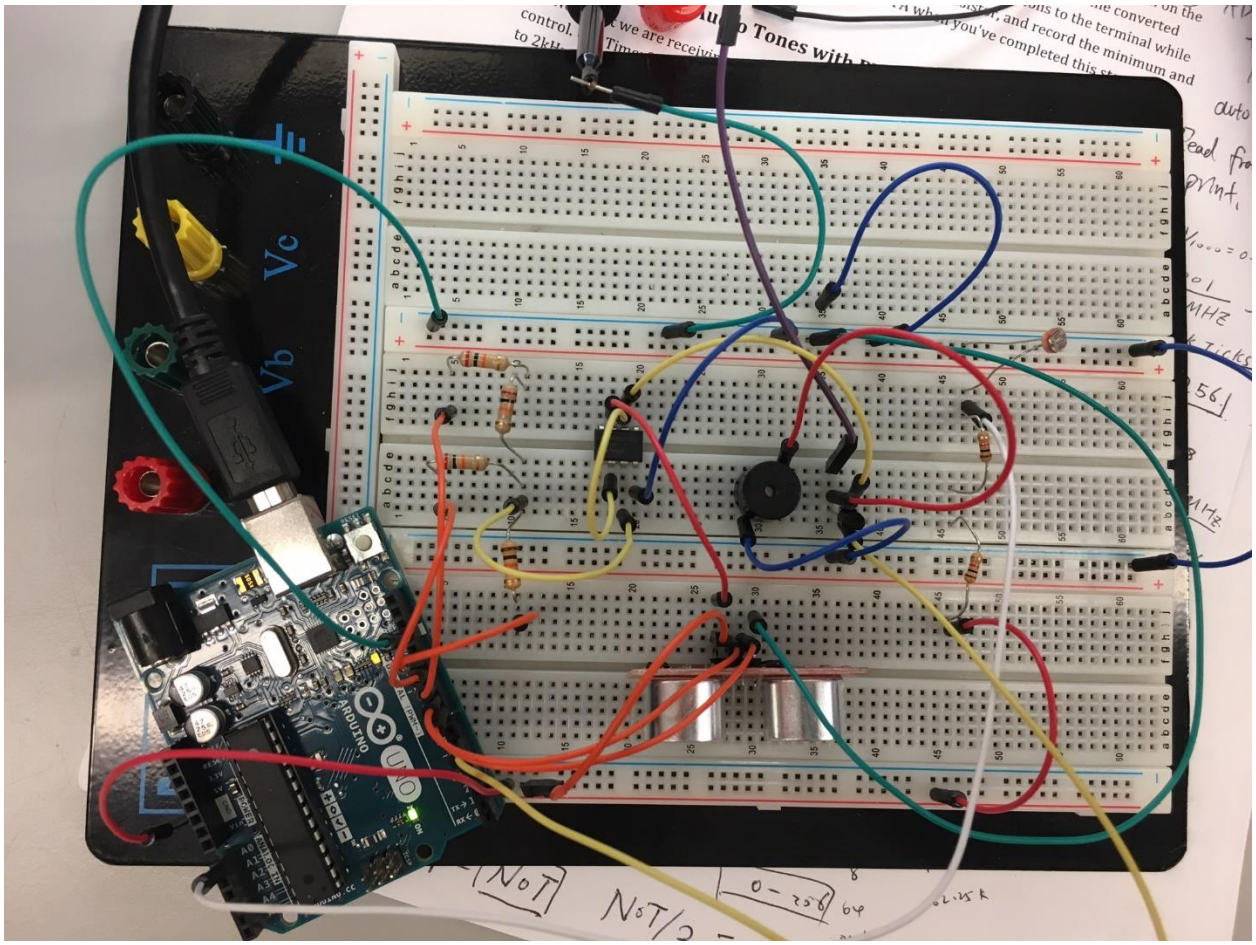
```
The ADC is : 454 , and the Pulse_width is: 10794
The ADC is : 407 , and the Pulse_width is: 10605
The ADC is : 451 , and the Pulse_width is: 10986
The ADC is : 411 , and the Pulse_width is: 10797
```

3) Dimmer the light

```
The ADC is : 782 , and the Pulse_width is: 55932
The ADC is : 798 , and the Pulse_width is: 92644
The ADC is : 788 , and the Pulse_width is: 55569
The ADC is : 791 , and the Pulse_width is: 91177
The ADC is : 791 , and the Pulse_width is: 59337
The ADC is : 788 , and the Pulse_width is: 60342
The ADC is : 787 , and the Pulse_width is: 59637
The ADC is : 784 , and the Pulse_width is: 60534
The ADC is : 783 , and the Pulse_width is: 60534
```

3. Final diagram of your hardware setup





Note : Please ensure codes for all the section have been pushed to git repository before due date (11.59 pm, October 4,2017)