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# *Laboratory 2: Basics of Signals*

## *Part 1:Experimental equipment and devices*

1. Arduino Development Board
2. MATLAB

## *Part 2:Experimental content*

1. Generate some basic signals using signal generator.
2. Determine important properties of a signal by visual inspection and algorithmic approaches.
3. Mathematically model the generated signals.
4. Appreciate the relationship between analogue signals and their digital version.

## *Part 3:Experimental procedure and results*

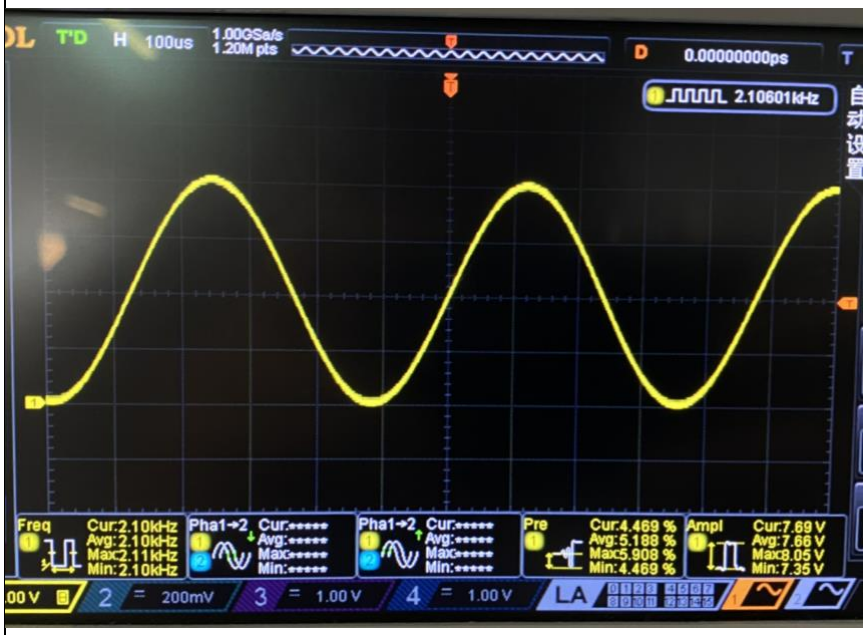
### Task 1

### (1) Procedure

Use signal generators to create a sinusoid where its frequency (in Hz) is equal to 2106Hz The amplitude is 5.00V and the starting phase is 0.00. The relevant signal is displayed on the oscilloscope and the amplitude, period, angular frequency and phase obtained by visual inspection are displayed

### (2)Results


The DC component is 0.




The DC component is not 0.

### Your comments and opinions on the results:

At DC component 0, I can get the signal at a frequency of 2.11kHz with a amplitude of 5.00V.

## Task2

## (1) Procedure

Change the input signal to square and triangular wave signal, repeat the task1 pass operation, observe the experimental results

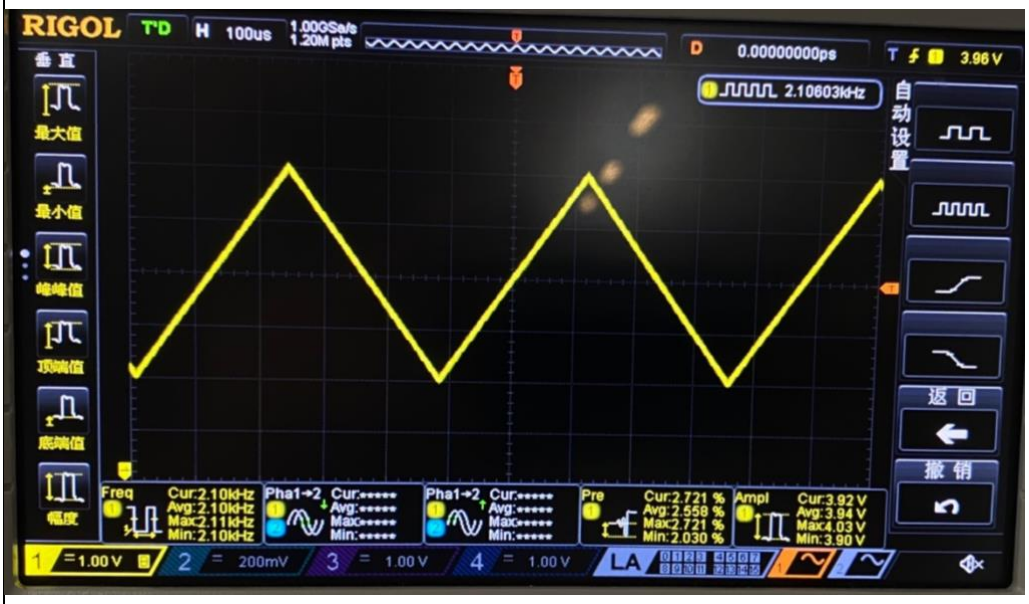
## (2)Results

Square wave signal


The DC component is not 0

The DC component is 0

Triangular waves




The DC component is not 0


The DC component is 0

**Your comments and opinions on the results:**

At DC component 0, we can get the signal at a frequency of 2.11kHz with a amplitude of 5.00V.

## Task 3

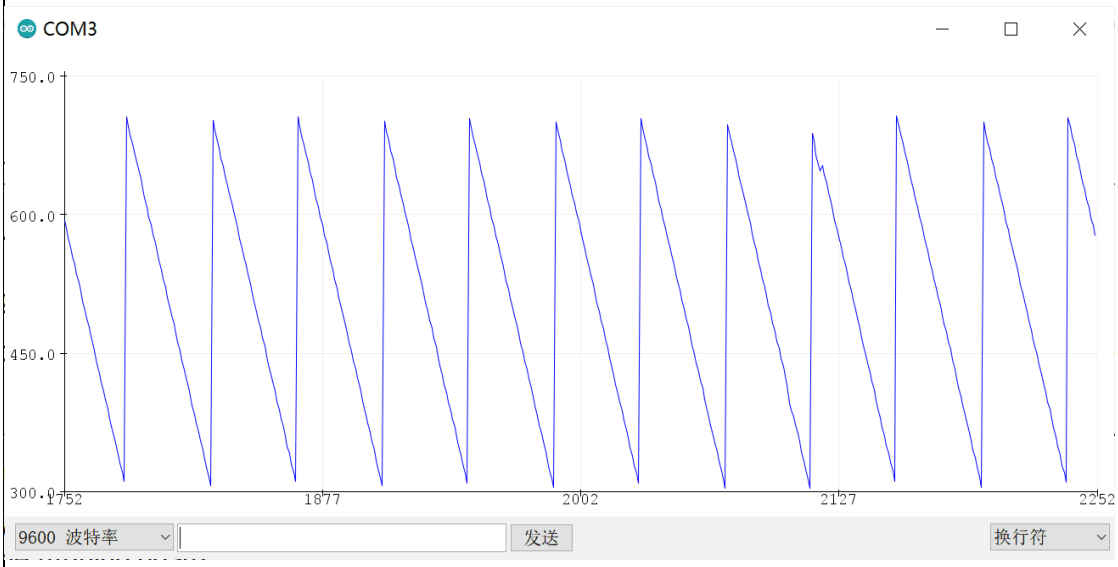
## (1) Procedure

The periodic signal generator and the Arduino plate are used to produce jagged signals, and the frequency and amplitude of the signal are determined by observing the image. Write code to obtain signal data, and on the drawing software, according to the data obtained in the serial monitor, the drawing software is used to draw the relevant function image

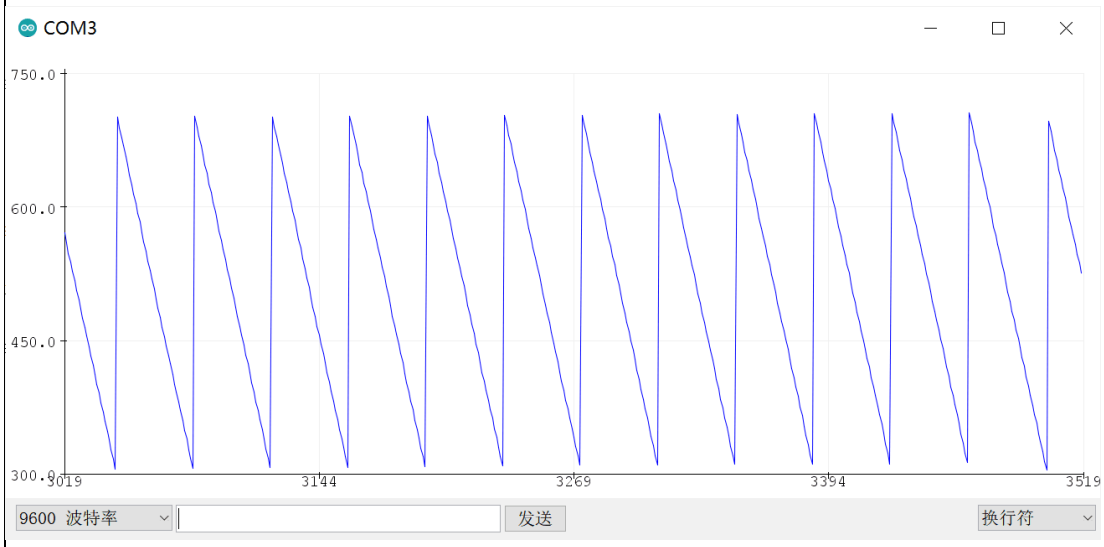
## (2)Results

Use the delay function in Arduino to choose the interval between two reads.

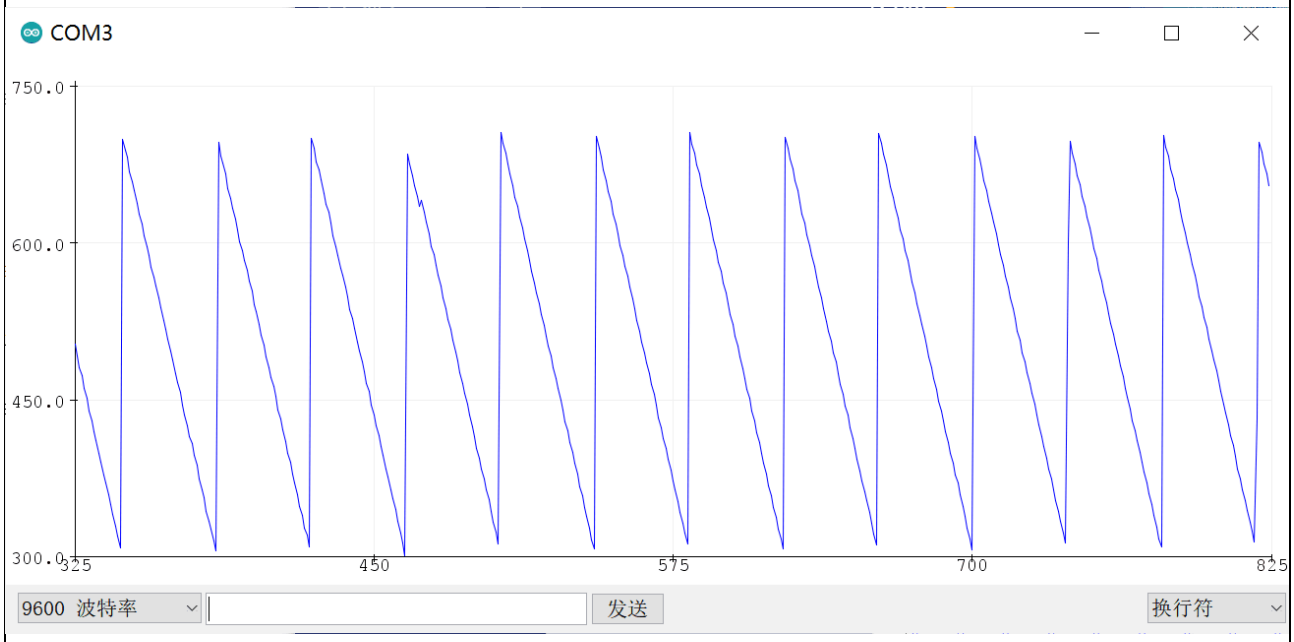
When delay 10ms



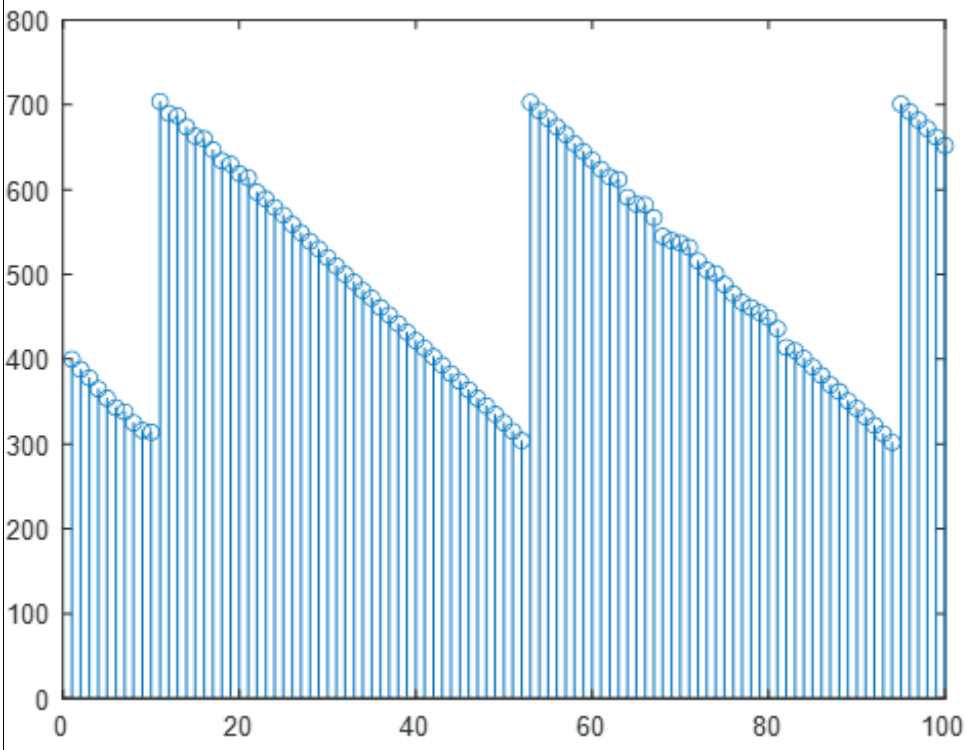

When delay 50ms




When delay 100ms



Plot the obtained signal using a plotting tool of your choice. (e.g., use the command plot in Matlab, Python ).




The image obtained by the oscilloscope is shown below

## Your comments and opinions on the results:

**code**

```
val=
[400,388,378,365,354,343,338,325,316,314,704,690,687,674,663,660,647,634,630,619,614,597,58
9,579,570,559,549,539,530,520,510,500,491,481,472,461,452,442,432,422,413,403,393,383,374,3
64,354,345,335,325,315,304,703,693,684,674,665,654,645,635,624,615,612,591,583,582,567,545,
540,537,532,516,505,501,488,477,467,461,455,449,436,414,410,401,391,381,370,362,351,342,332
,322,312,302,701,692,682,672,662,652];
Maxval=[];
Minval=[];
maxV = [];
minV = [];
cnt = 1;
for k = 2:length(val)-1
if(val(k) < val(k+1)&&val(k) < val(k-1))
minV(cnt) = val(k);
Minval(cnt) = k;
end
if(val(k) > val(k+1)&&val(k) > val(k-1))
maxV(cnt) = val(k);
Maxval(cnt) = k;
cnt = cnt+1;
end
end
x = 1:100;
stem(x,val)
```

VPP = (maxV(1)-minV(2)+maxV(2)-minV(3))/2

per = (Minval(2)+Minval(3)-Maxval(1)-Maxval(2))/8

**comment**

Based on the data we get on the Arduino board, we write relevant code to plot and measure the data to get the following

VPL = 400.5000

Per = 10.2500

[400,388,378,365,354,343,338,325,316,314,704,690,687,674,663,660,647,634,630,619,614,597,589,579,570,559,549,539,530,520,510,500,491,481,472,461,452,442,432,422,413,403,393,383,374,364,354,345,335,325,315,304,703,693,684,674,665,654,645,635,624,615,612,591,583,582,567,545,540,537,532,516,505,501,488,477,467,461,455,449,436,414,410,401,391,381,370,362,351,342,332,322,312,302,701,692,682,672,662,652]

The actual signal image shown in the oscilloscope is close to the analog image we obtained based on the secretary's analysis. The frequency and peak-to-peak amplitude of the signal Conforms to the experimental expectations.

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*Part 4: A summary of what you gained in the lab.*

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## SUMMARY

**sine wave :** Because the sine wave generator output waveform has high precision, stability and low distortion, it is usually used as a standard signal for electronic performance experiments and parameter measurement

**square wave:**In the real world, square waves have only limited bandwidth because the general electronic parts only high (1) and low (0) two values, square waves are naturally produced, and widely used in digital switching circuits. Because square waves can quickly move from one value to another (i.e. 0→ 1 or 1→0), square waves are used as clock signals to accurately trigger synchronization circuits.

**Triangular waves**, also known as jagged waves, are mainly used in crT scanning circuits for display devices. Such as oscilloscopes, video tubes, monitors, etc

## 1. How digital signals are generated from their continuous version.

Sampling the contact time signal allows us to get a discrete time signal, but the discrete time signal is still continuous in magnitude, and after quantifying it on the amplitude, we can get a discrete amplitude signal, so the digital signal is discrete in both time domain and amplitude

## 2. Why digital signals are often represented by integers.

In the transmission circuit of digital signal, because the circuit can only represent two signals, that is, binary representation method, the circuit can only represent two states, the circuit's pass and short, so the digital signal is usually represented in integer form

## 3.the effect if the sampling interval is large.

The larger the sampling frequency, the more accurate the image, and the closer the resulting data and the image being drawn are to the actual situation.