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Group 4B

Week 10 Studio 2
22/10/2020

Activity 1

3. I would connect the AWG pin to pin A0 on the Arduino. This is because we are reading in voltage at specific times which is an analog input and converting it to a 10 bit value between 0 to 1023. I would also connect the GND pin on the bitscope to the GND pin on the Arduino

4. ~ include code ~

5.

sampling rate (Hz)	sampling period (ms)	Aliasing observed?
5	200	YES
10	100	YES
20	50	NO
25	40	NO
50	20	NO

sampling period = $\frac{1}{\text{sampling rate}}$, set as delay between each analogRead (A0)

8. Assuming time taken by analogRead() and Serial.print() are negligible, we can fill in the time column with the corresponding multiples of the sampling period. In my code, I used Serial.print(millis()); to generate the time column.

9. To scale the sampled values from ADC to get corresponding voltage, we can divide each 10 bit value by 1023 and multiply by 5.

= [@ ADC] * 5 / 1023

10. To generate a 10Hz sine wave plot, we can use the formula $\sin(\omega t)$

where $\omega = 2\pi f$ $\quad f = 10Hz$

using the time column, $= (SIN([@TIME] * 10 * 6.28 / 1000) + 1) * 1.65$

we divide by 1000 because time column is in milliseconds

we add 1 to shift the sine plot up and multiply by 1.65 to scale to 3.3V peak to peak.

superimposing the sampled values, Aliasing is observed for sampling rate of 5Hz and 10Hz while 20, 25 and 50 Hz still maintain sinusoidal characteristics

11. The sampling frequency of 50Hz managed to preserve the information from the 10Hz sine input the best. This is in line with the sampling Theorem where information contained in a signal is preserved if it is sampled at frequency greater than twice input frequency

12. The Nyquist frequency for a sampling rate of 50Hz is $\frac{50}{2} Hz$

$= 25Hz$ //

sampling | Arduino 1.8.13

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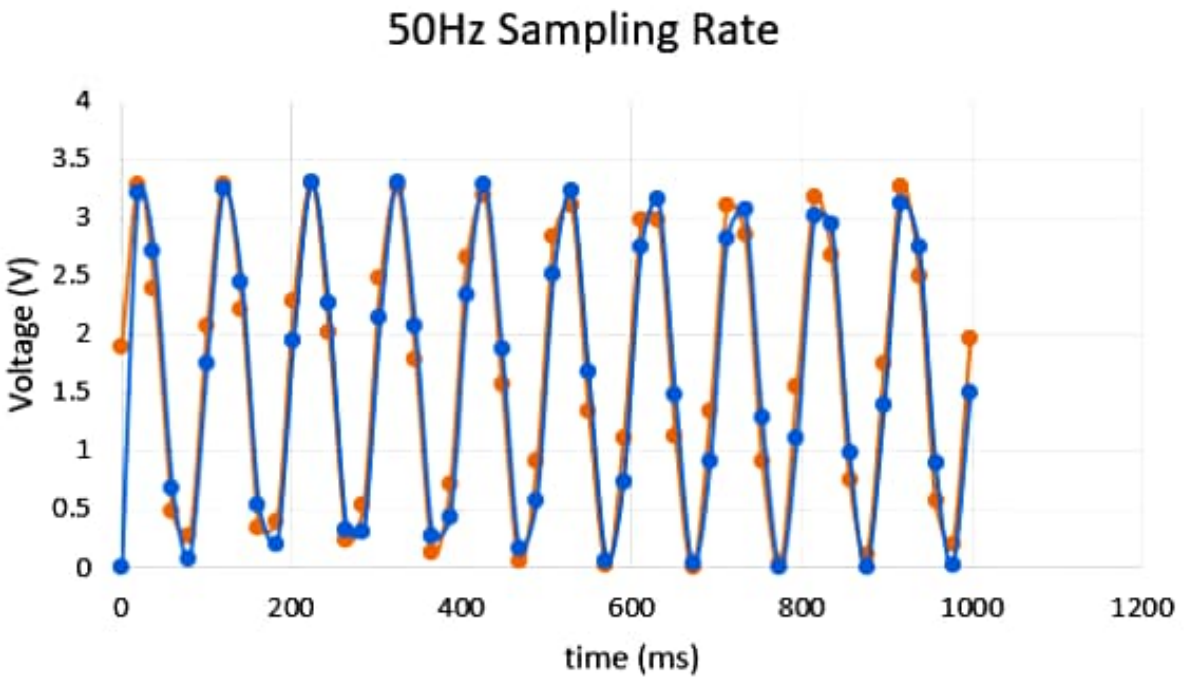
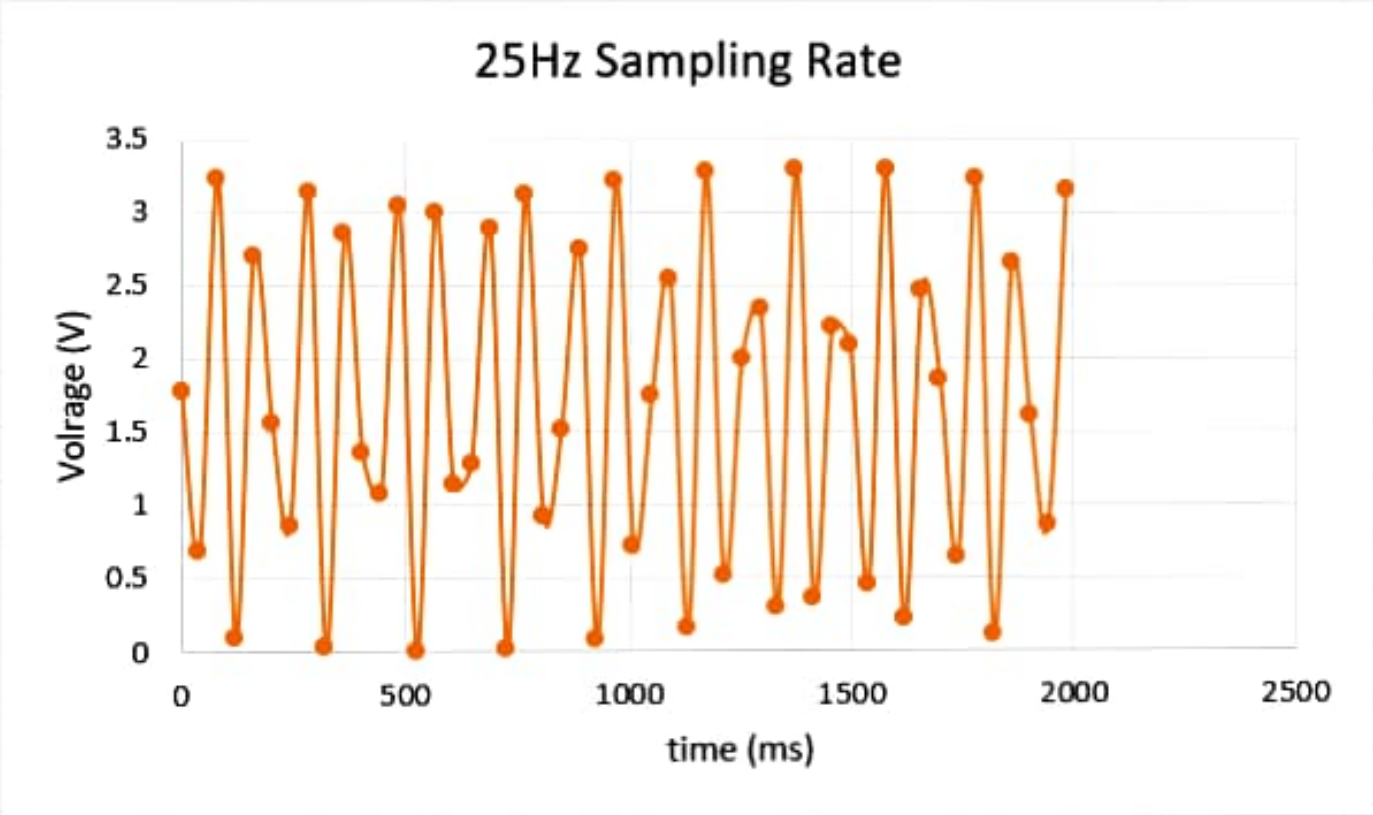
sampling §

```
#define AWG 0 //INPUT at A0

int period = 20; //change for each sampling rate

void setup() {
  Serial.begin(9600); //begin serial communication
  for (int i = 0; i < 50; i++){ //50 samples for each sampling rate
    int val = analogRead(AWG);
    Serial.print(millis());     //print time
    Serial.print(",");          //delimiter
    Serial.println(val);        //print sampled value
    delay(period);
  }

}
```

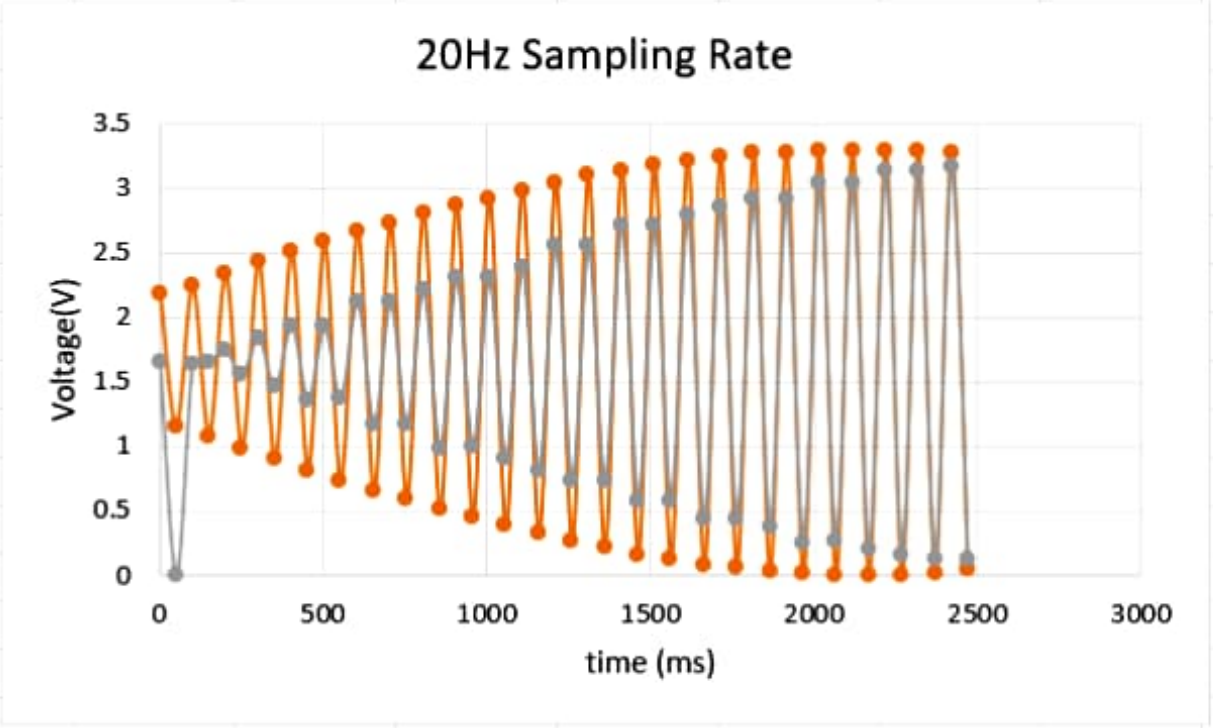
TIME	ADC	VOL	SINE
0	386	1.884766	0
20	672	3.28125	3.218918
39	490	2.392578	2.703328
60	98	0.478516	0.682707
80	53	0.258789	0.079463
101	424	2.070313	1.748306
121	674	3.291016	3.246569
142	454	2.216797	2.451425
162	70	0.341797	0.526719
183	81	0.395508	0.199485
203	466	2.275391	1.948693
224	675	3.295898	3.295963
244	413	2.016602	2.269311
265	48	0.234375	0.323356
285	111	0.541992	0.306373
305	508	2.480469	2.144609
325	667	3.256836	3.299912
346	367	1.791992	2.077927

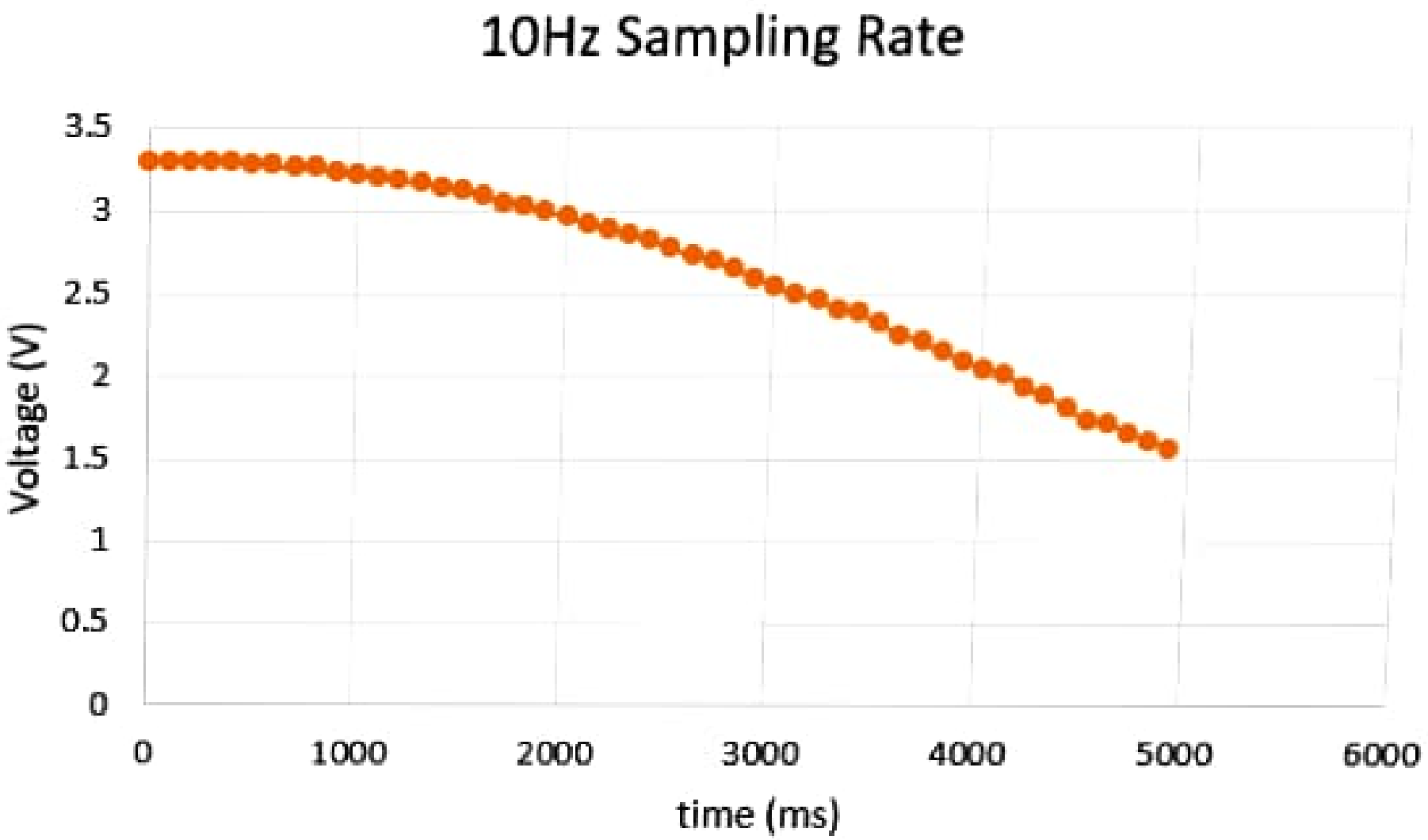


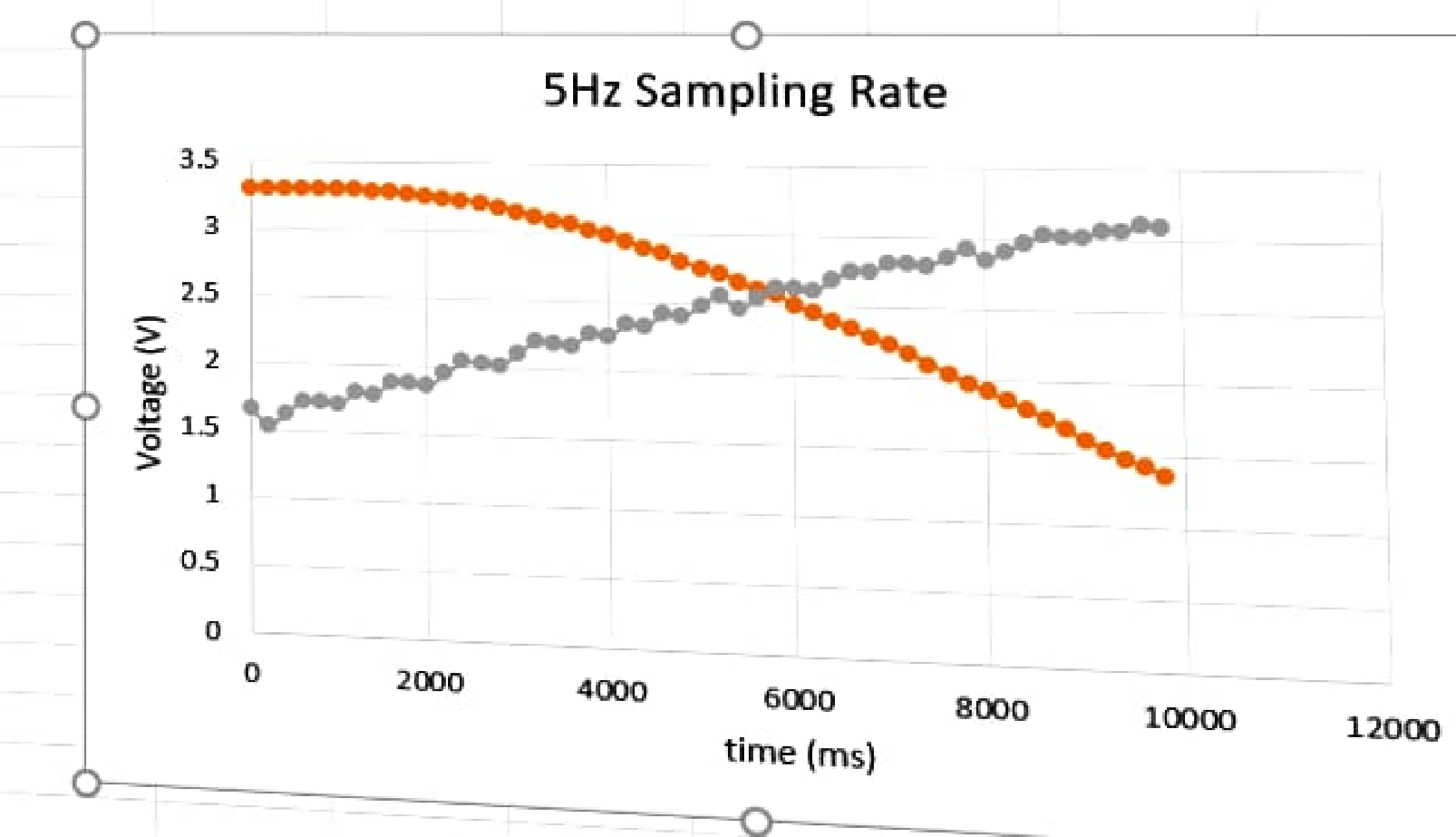
Column1	Column2	Columr
		0
0	363	1.772461
39	140	0.683594
80	663	3.237305
120	20	0.097656
160	554	2.705078
201	321	1.567383
241	177	0.864258
282	643	3.139648
322	5	0.024414
363	584	2.851563
403	277	1.352539
444	221	1.079102
484	624	3.046875
525	0	0
565	615	3.00293
606	232	1.132813
646	263	1.28418
687	593	2.895508



	A	B	C	D
1	Column1	Column2	Columr	Columr
2	0	448	2.1875	1.65
3	50	237	1.157227	0
4	100	461	2.250977	1.644744
5	150	221	1.079102	1.657884
6	201	480	2.34375	1.743059
7	251	203	0.991211	1.559565
8	302	498	2.431641	1.841043
9	352	185	0.90332	1.461567
10	403	516	2.519531	1.938349
11	453	167	0.81543	1.364239
12	503	530	2.587891	1.933172
13	553	150	0.732422	1.369417
14	605	546	2.666016	2.129544
15	655	133	0.649414	1.172971
16	705	561	2.739258	2.124513
17	755	120	0.585938	1.178005
18	806	575	2.807617	2.217823
19	857	104	0.507813	0.988476
20	907	588	2.871094	2.309116
21	957	94	0.458984	0.993294
22	1007	599	2.924805	2.304294
23	1058	80	0.390625	0.904276




10Hz Sampling Rate
Voltage (V)
3.5
3
2.5
2
1.5
1
0.5
0
0
1000
2000
3000
4000
5000
6000
time (ms)


5Hz Sampling Rate
Voltage (V)
3.5
3
2.5
2
1.5
1
0.5
0
0
2000
4000
6000
8000
10000
12000
time (ms)