Lab 1: Instrumentation

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Purpose

Learning how to use lab equipment. This includes a Digital Multi-Meter, a Function Generator, a Power Supply, and an Oscilloscope. A range of tests will be performed to get comfortable reading Voltage, Frequency, Period, and Amplitude from the Oscilloscope.

Results

Table 1: Power Supply vs DMM Voltage

Power Supply Voltage (V)	**Voltage Measured with the DMM (V)**
1.0	0.964
2.0	2.088
3.0	3.262
4.0	3.933

Table 2: Channel Voltage Calibration

	Number of Vertical Deflections	**Volts/Div Setting**	**Voltage**
Channel 1	1	0.5V	0.5V
Channel 2	1	0.5V	0.5V

Table 3: Channel Period Calibration

	Number of Vertical Deflections	**Sec/Div Setting**	**Period**
Channel 1	2	0.5ms	1ms
Channel 2	2	0.5ms	1ms

Table 4: Interpreting Frequency from the Oscilloscope

Frequency from Signal Generator (Hz)	**Number of Horizontal Divisions Peak to Peak**	**Period of Signal**	**Frequency (Hz)**
50	2.4	24ms	41.7
500	4.8	2.4ms	417
800	6.7	1.3ms	746
2500	7.4	0.74ms	1350
5000	4.7	235μs	4260
6500	8.4	168μs	5950
8000	6.9	138μs	7250

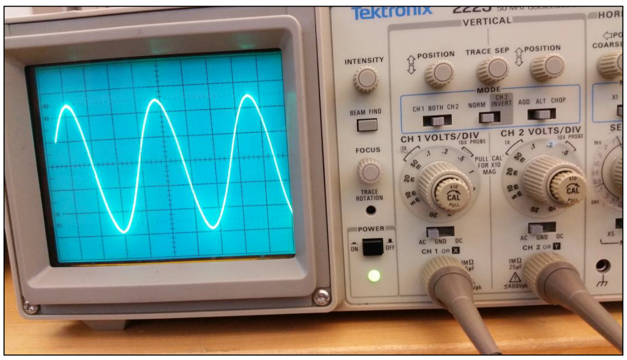

Figure 1: Oscilloscope Calibrated to 0.5 Volt/Div and 0.5 ms/Div

Voltage$_{pp}$	2.75V
Voltage$_{p}$	1.375V
Voltage$_{rms}$	0.972V
Period	1.9ms
Frequency	526.0hz

Analyzed Table for Fig.1

Table 5: Analyzed V$_{rms}$ vs DMM V$_{rms}$

Trial	**V$_{pp}$**	**V$_{p}$**	**Calculated V$_{rms}$**	**DMM V$_{rms}$**	**Percent Difference**
1*	1.0	N/A	N/A	N/A	N/A
2*	1.5	N/A	N/A	N/A	N/A
3	2.0	1	0.707	0.621	12.9%
4	3.0	1.5	1.06	0.995	6.32%
5	4.0	2	1.414	1.348	5.48%
6	6.0	3	2.121	2.000	5.87%
7	8.0	4	2.828	2.666	5.90%

**Trials 1 and 2 were not performed due to the frequency generator's inability to achieve a low voltage.*

Voltage$_{rms}$ is calculated using the equation:

$$V_{rms} = \frac{1}{\sqrt{2}} * V_p$$

Table 6: Calculating Voltage$_{pp}$ and Frequency of Waves on the New and Old Oscilloscope Generated by an External and Internal Frequency Generator.

Frequency Generator	Signal		Old		New	
	Type of Wave	Frequency (Hz)	V_{pp}	Frequency (Hz)	V_{pp}	Frequency (Hz)
External	sine	1000	4	1000	3.8	1020
	sine	2000	3.8	2083	3.8	2130
	sine	5000	3.8	5333	3.6	5.26
Oscilloscope	square	1000	8	1000	8.5	1000
	square	2000	8	2000	8.5	2000
	square	3000	8	3130	8.5	3000

Questions

1. **What is the purpose of an oscilloscope?**
   Graphically displaying changes in Voltage.

2. **What is the difference among peak-to-peak voltage, peak voltage, and rms voltage?**
   Voltage$_{pp}$ is measured to be double the amplitude, or from the highest point to the lowest point. Voltage$_{p}$ is the half of Voltage$_{pp}$, or the amplitude measured from the highest or lowest point to zero. Voltage$_{rms}$ stands for 'Root Mean Square' of the voltage, giving the mean voltage over half a period.

3. **What electrical variables can be measured with the digital multimeter?**
   Amperes (A), Voltage (V), and Ohms (Ω) can be measured from a digital multimeter.

Using the oscilloscope, set up a sine function coming from the function generator and calculate the voltage peak-to-peak, voltage peak, voltage rms, and the period of the signal.
Case 1: 2 Volt/Div and 0.2 ms/Div
Case 2: 5 Volt/Div and 50μs/Div

	Case 1	**Case 2**
Voltage$_{pp}$ (V)	8	20
Voltage$_{p}$ (V)	4	10
Period	0.84ms	210μs
Frequency (Hz)	1190	4762

Conclusion

Overall, the main purpose of this lab was achieved, although there was a lack in usage of the newer oscilloscope with the built-in function generator. Reading the voltage and period on the older oscilloscope became comfortable, along with calculating voltage$_{rms}$ and frequency. Though, there were many challenges along the way. It was difficult to accurately read the oscilloscope due to the impercision of the graph the generated frequencies were displayed on. The frequency generator was also tough to calibrate to a specific frequency due to an inaccurate calibration knob. Some equipment were also unreliable, producing incorrect frequencies or voltages. An abundance of human error is also present in the results, as many readings were eyeballed, and given the best estimation possible. This resulted in mismatches in the calculated frequency and voltage.