Lab Experiment Part 1: Measure AC-Signal Properties Lab ReportBy: Haseeb Ahmed

Ahmed, Haseeb

GROUP MEMBERS:ALBI ISMAILAJ AND NABIL [Company address]

Introduction:

The purpose of this experiment was to familiarize students with AC waves, their properties and how to measure them using the provided tools. The experiment also helped to understand the difference between theory and applying the concepts in reality and understand how different errors in measurement may lead to a slightly different result.

Theory:

An AC current refers to an alternating by directional current which changes over time. It can be represented by **$I(t) = I_0 \sin(wt)$,** where **I_0** is the amplitude and **w** is the frequency of the source.

The RMS is the amount of power the DC supply generates which is the same as the AC supply.

Periodic signals refer to signals that repeat in the same manner over time. The formula for such a signal is **$u(t) = u(t + nT)$.**

Execution:

Part 1: Measure AC signal Properties

Setup:

Tools Used:

- Power supply from the workbench
- AC signal generator
- Breadboard
- Oscilloscope
- Toolbox from the work bench
- TENMA multimeter
- ELABO multimeter

The settings for the generator were:

Function = Square

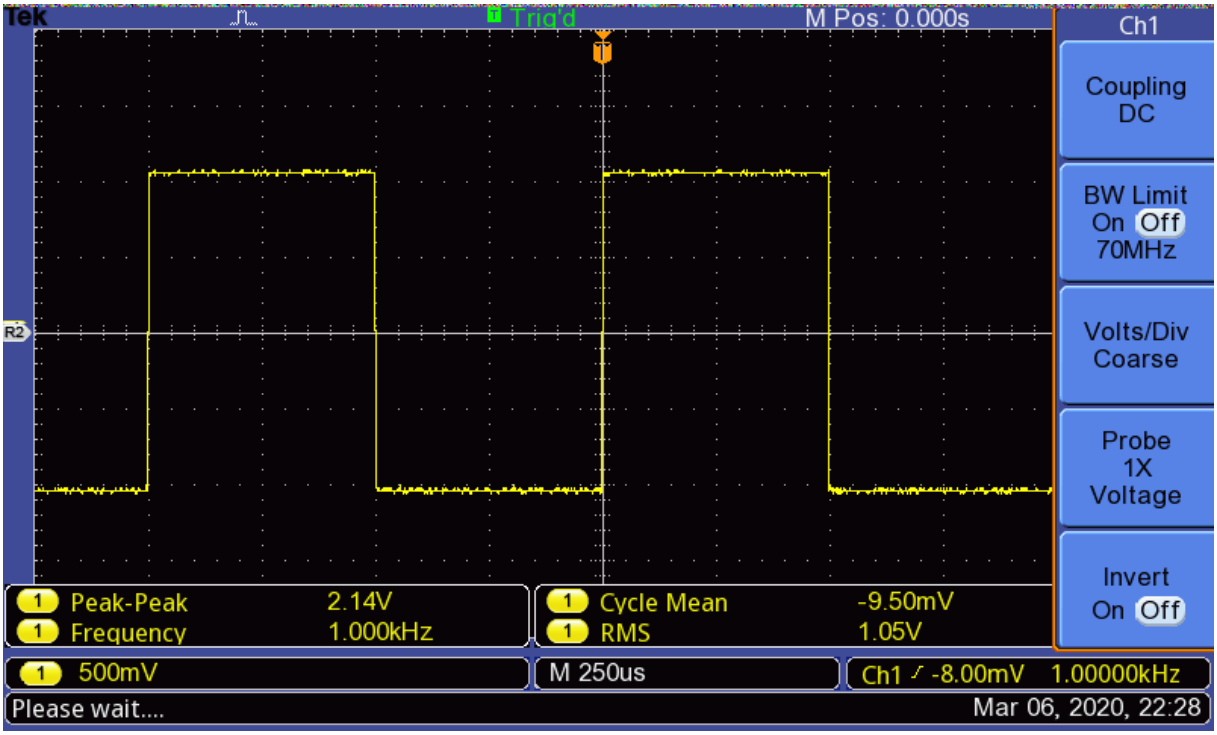
Frequency = 1kHz

Amplitude = set to 2 Vpp measured at the oscilloscope!!

Offset = 0 V

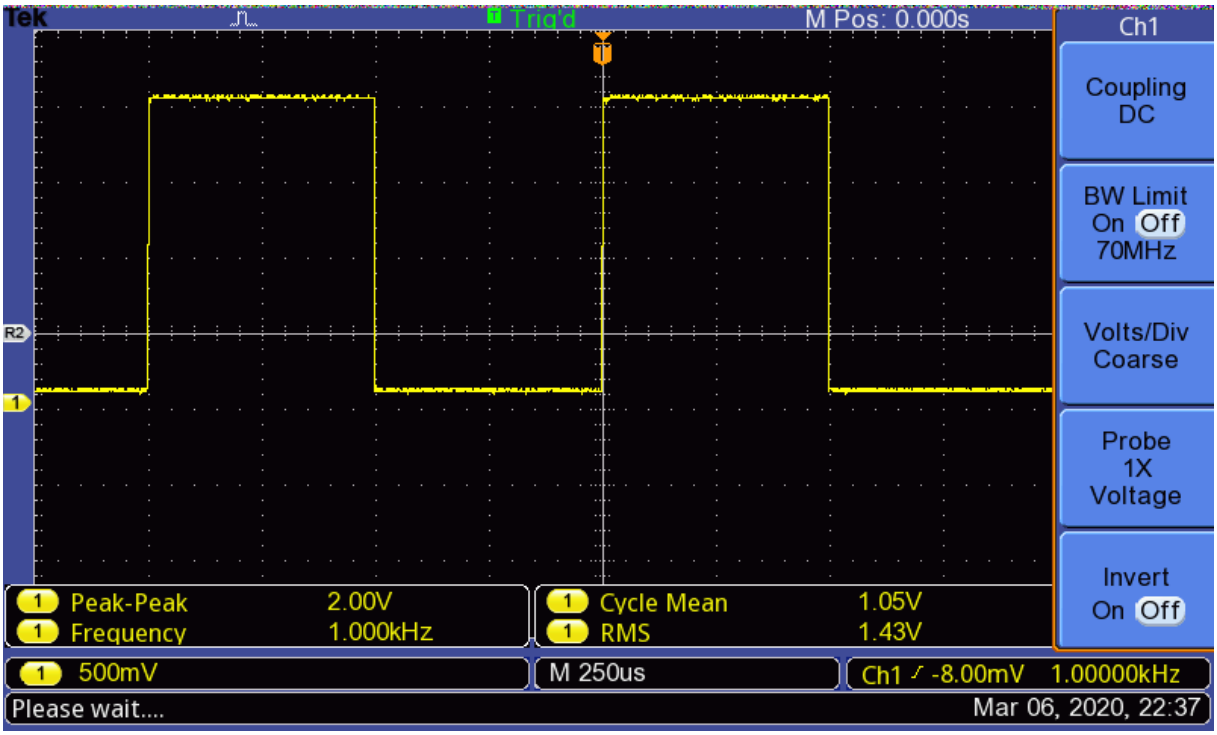
Amplitude/ Offset setting results in a ±1V wave

Steps given in the lab manual were followed, the appropriate circuit was set up and the values asked to be recorded are shown below:



DC range	-22.3 mV
AC range	0.997 V

The offset was then set at 1V. The values were recorded again as follows:



ac range	1.002	v
dc range	0.94	v

The generator setting were then changed to:

Function = Triangle ('Ramp' for Agilent 33220A generator!)

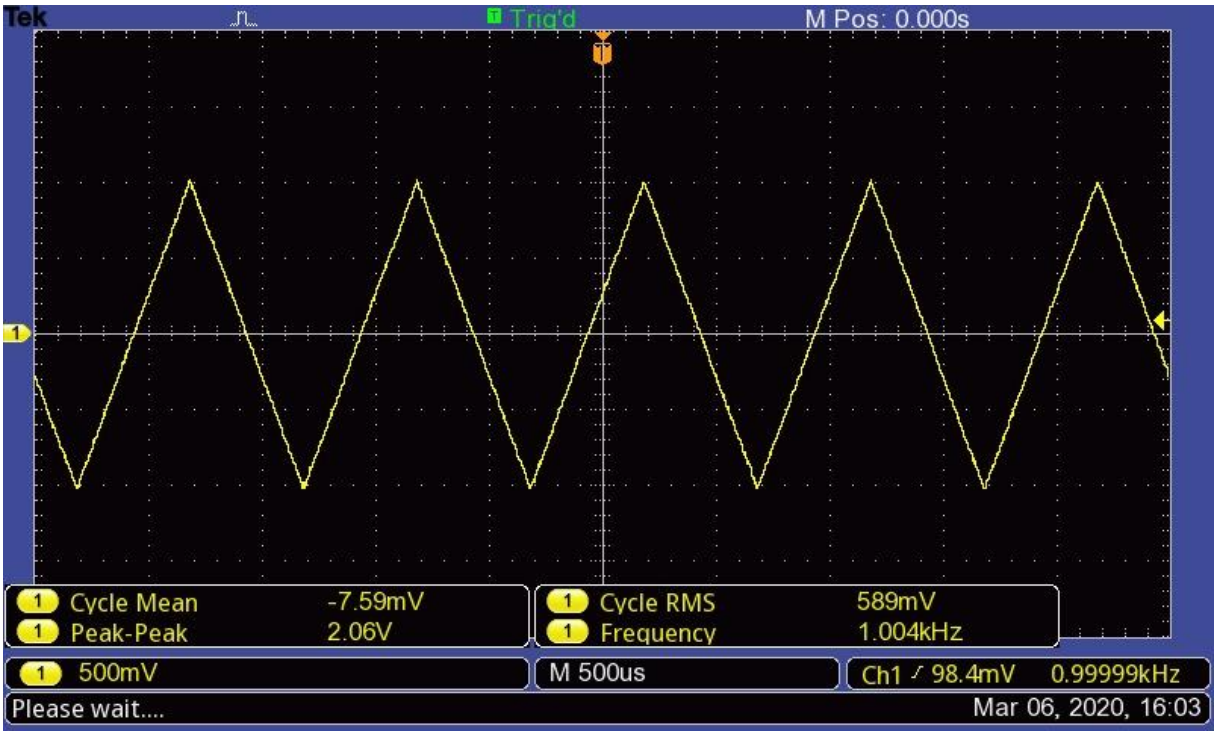
Symmetry = 50% (only for Agilent 33220A generator!)

Frequency = 1kHz

Amplitude = set to 2 Vpp measured at the oscilloscope!!

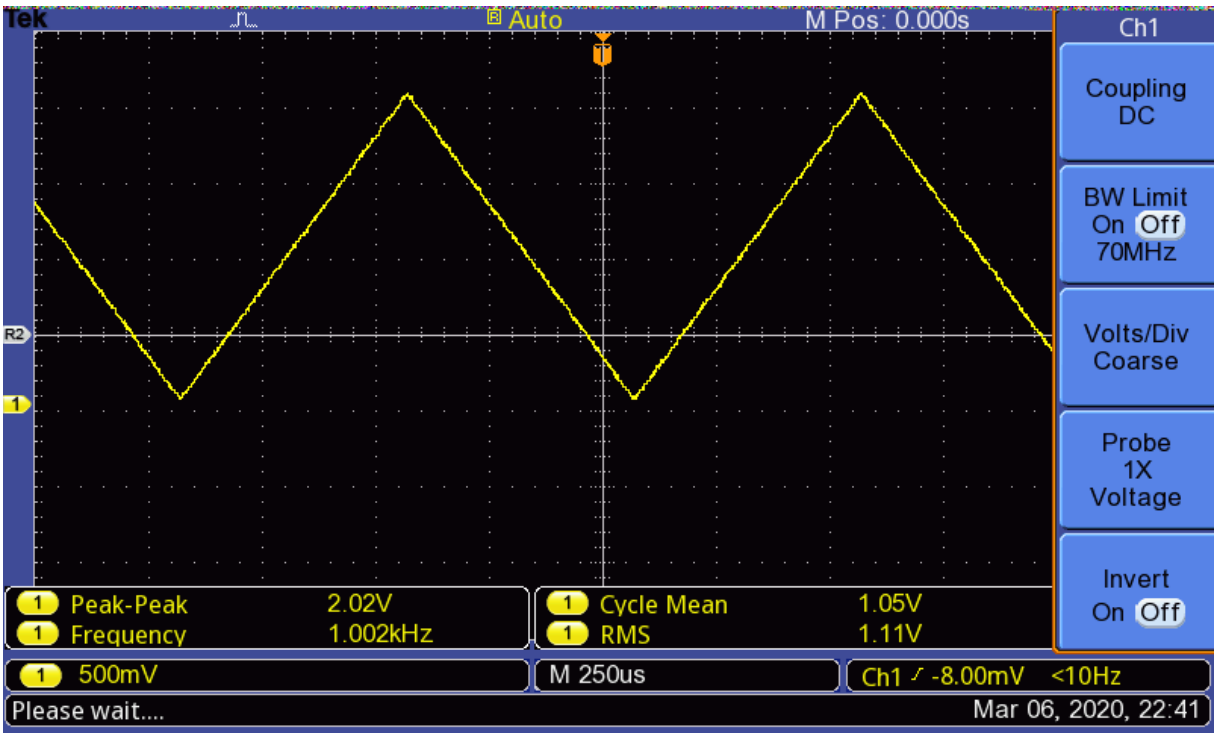
Offset = 0 V

Amplitude/ Offset setting results in a ±1V wave



dc	-15.23	mv
ac	0.535	v

The offset at the generator was again changed to 1V and the measurements are as follows:



dc	0.956	v
ac	0.528	v

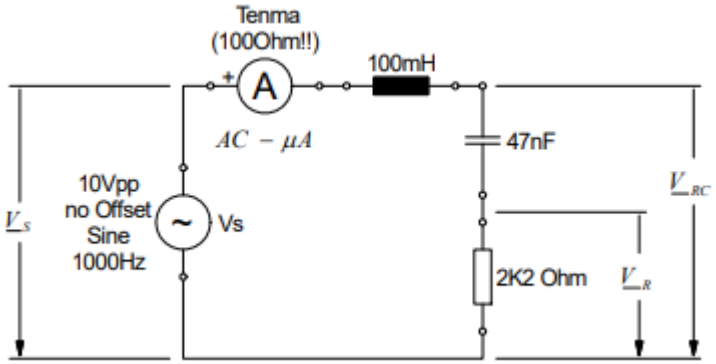
Part 2: Measure AC circuit Properties

Setup:

Tools Used:

- Power supply from the workbench
- AC signal generator
- Breadboard
- 47nf capacitor
- RLC Meter
- 100mH inductor
- Oscilloscope
- Toolbox from the work bench
- TENMA multimeter
- ELABO multimeter

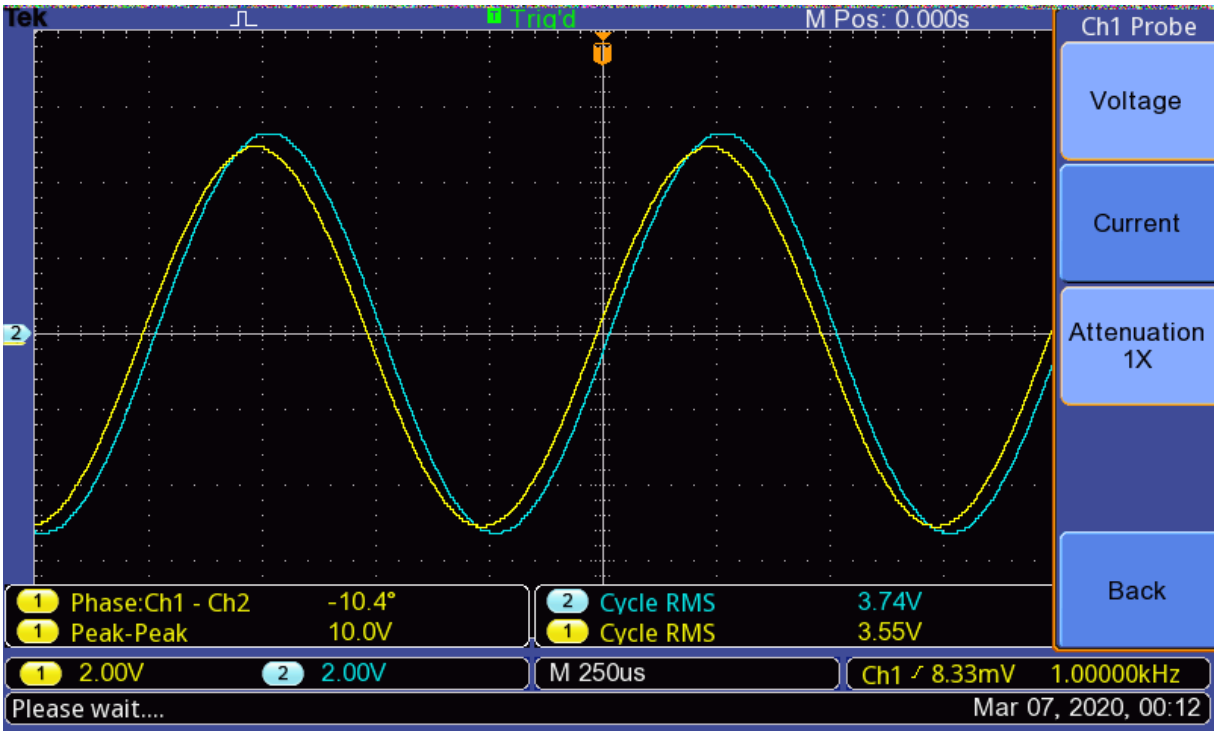
Steps given in the lab manual were followed, the appropriate circuit was set up exactly as shown below:

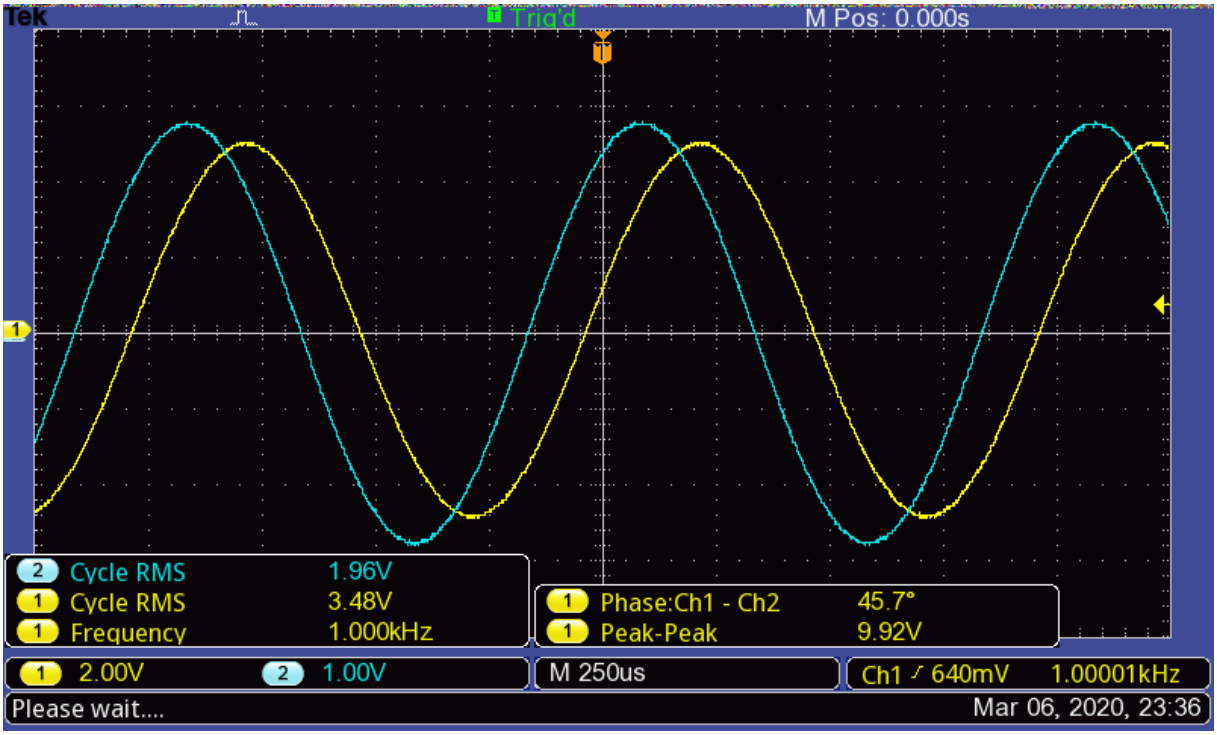


The values for the Capacitor and the inductor given by the RLC meter are:

Element of th	R [Ohm]	L [H]	C [F]
Resistor	2196.2		
Capacitor(CP)	332.6*10		4.607*10
Inductor(LS)	391.08	100.45*10	

The steps were followed and the values recorded are as presented in the table below:





vr	1.9802	v
vs rms	3.562	v
vrc	3.74	v

Evaluation:

Part 1: Measure AC signal Properties

Calculate the theoretical ¯v and V of the Square wave for offset 0 V and 1 V. The following formula is implemented in the generator:

According to the calculation, For offset = 0 ¯ v=-2.14V and V=2.14V

For offset = 0 = 1 ¯ v=1 and V=3

• Calculate the theoretical ¯v and V of the Triangle wave for offset 0 V and 1 V. The following formula is implemented in the generator:

According to the calculation, at t=0

For offset = 0 ¯ v=2.06V and V=2.06

For offset = 1 ¯ v=2.06V and V=2.06

For offset = 1 ¯ v=3.02V and V=3.06

If you focus on the multimeter:

- What did you measure in DC an AC range?

We saw different values for the ac and dc readings since the ac voltage does not change with an offset while the dc voltage changes with an offset.

Compile a table for every signal with all measured (multimeter, oscilloscope) and calculated values. Give reasons for differences compared to the set values, discuss errors and error sources.

The table is in the execution. The difference is due to the environmental conditions or the instrument error. The oscilloscope may pick up noise and other disturbances which might have resulted in the different than expected values. The generator also has an error range for the output. All of the reasons above result in different calculated and measured values.

• Calculate all ˆi and ˆu values using the nominal (theoretical) input voltage and the measured impedance values at 1KHz.

• Determine ˆu over every component from the measured current and voltage values.

• Compile a table with all measured and calculated ˆi and ˆu values. Compare and discuss errors!

• Calculate the impedance(resistance and reactance!) of R, L and C from the measured current and voltages.

Determine the element values, use the same representation circuits as for the measurement with the LCR meter. (L=series, C=parallel)

• Compile a table with all measured and calculated element values. Compare and discuss the different errors!

Impedance and phasor is calculates as:

$z_{l=R_l+j\omega L}$=391.08 +j3155729.82

$z_{c=\frac{1}{\frac{1}{RC}+j\omega c}}$=$4.59 * 10^{-17} - 6.67 * 10^{-7} j$

R=3196.2

Total resistance=3587.28+j3155729.82

I=v/R=$1.8 * 10^{-9} - 1.59 * 10^{-6} j$

$$v_{l=} j5.058 * 10^{-3} - 9.92 * 10^{12}$$

$$v_{c=} - j1.2 * 10^{-15} + 1.1 * 10^{-12}$$

$$v_{rc=} - j5.1 * 10^{-6} + 5.75 * 10^{-6}$$

Measured	Value	Calculated	value
Current	396mA	Current	$1.8 * 10^{-9} - 1.59 * 10^{-6} j\ A$
Vr	1.9802V	Vr	$-j5.1 * 10^{-6} + 5.75 * 10^{-6}$
Vrc	3.562 V	Vrc	$-j5.1 * 10^{-6} + 5.75 * 10^{-6}$

Once again the errors may have been induced to the instrument(either the oscilloscope or the generator) or due to environmental factors which may have changed the results seen on the oscilloscope.

Conclusion:

After the experiment we realized the fundamental properties of an AC circuit and found how we have to be very careful with the measured values from the oscilloscope as it has a very high percentage error and may also be affected by external conditions. We found how the

calculations become complex when we include components such as a capacitor and an inductor. The measured values were found to be different than the theoretical values due to a number of conditions such as the instrument, the environment or even the componants like the capacitor or the inductor hence it never hurts to be mindful of the possible errors involved when performing the experiments and taking measurments.

References:

Lab Manual

Data Sheet