University of California at Berkeley
College of Engineering
Department of Electrical Engineering and Computer Sciences

EE 105 Labs

Lab Worksheet 1: Electronic Test Equipment

Name(s): Bryan Ngo, Kyle Lui

Lab Section: Thursday 08:00

Submit this worksheet to Gradescope before your lab section the week it is due.

4.1 DC Measurements

4.1.1 Power supply error:

Voltage Setting	DMM Measurement	% Error
1 V	0.99486 V	0.5%
5 V	4.9912 V	0.2%
10 V	9.9987 V	0.1%

4.1.2 Resistive divider error:

Hand Calculation	Measured	% Error
2 V	2.006 V	0.3%

Besides measurement error and error in the voltage source, what can also contribute to the total error?

Tolerance in the resistors, resistive losses in the breadboard/wires

4.1.3 Why are you not supposed to connect the DMM to the terminals of a voltage source while the DMM is in current mode?

In current mode, the DMM acts as a low-impedance device, sending a large amount of current through the power supply.

4.1.4 Current:

Hand Calculation	Measured	% Error
0.1 mA	0.099 mA	10%

4.2 AC Measurements

4.2.1 Function generator sine signal:

	Panel Setting	Expected	Measured	% Error
V_{pp}	1	2 V	2.16 V	8%
Frequency (kHz)	1	1 kHz	1.005 kHz	0.5%

4.2.2 Highest frequency sinusoid that the generator can produce with a 1 V_{pp} setting: 4 MHz

Highest frequency sinusoid produced by the signal generator: 15 MHz

At this frequency, measured an amplitude of 1.81 V_{pp}, with an error of 9.5 %

4.2.3 Smallest V_{pp} sinusoid that the generator can produce at 1 kHz:

	Panel Setting	Expected	Measured	% Error
No averaging	50 mV	100 mV	140 mV	40%
Average of 64	(Same as above)	(Same as above)	99 mV	1%

With the averaging feature turned off, does the oscilloscope **over-measure** or **under-measure** the V_{pp} value? (Please circle one.) Why?

Since the jitter in the signal is non-negligible at these magnitudes, the peak-to-peak value is higher than otherwise.

4.2.4 Resistor in the air, measured V_{pp}: 813 mV

Estimated parasitic capacitance: 11 pF (Show your work!) $C = \frac{1}{\omega R}\sqrt{\frac{1-|H(\omega)|^2}{|H(\omega)|^2}}$

4.2.5 Resistor connected to the breadboard:

	mV_{pp}	Parasitic Capacitance (pF)
Resistor connected to a terminal strip	781 mV	12.7 pF
Resistor connected to a supply strip	700 mV	16.2 pF
Resistor connected to a supply strip, ground connected to a ground strip	600 mV	21.2 pF

For which case is the parasitic capacitance the largest? Why?

The capacitance is largest when both resistor and ground are connected to buss strips. Since capacitance is proportional to the cross-sectional area of the air gap (i.e. the long metal strips), the more metal the two ends are connected to, the higher the capacitance.

4.2.6 Transfer function $|V_{out}/V_s|$ at 1 kHz:

Hand Calculation	Measured	% Error
0.85	0.95 V	11.8%

4.2.7 Frequency at which the transfer function phase is $-45°$: 1.78 kHz

Measurement procedure:

Connect channel 1 of the oscilloscope across the capacitor.
Connect channel 2 across the input signal, then measure "Phase 1→2"

4.2.8 RC time constant:

Hand Calculation	Square Wave		Sine Wave	
	Measured	% Error	Measured	% Error
0.1 ms	0.09 ms	10%	0.081 µs	19%

Which measurement is expected to be more accurate?

We would expect the square wave measurement to be more accurate since the frequency of the input signal could be a source of error with the AC measurement.

4.3 Parameter Analyzer Basics

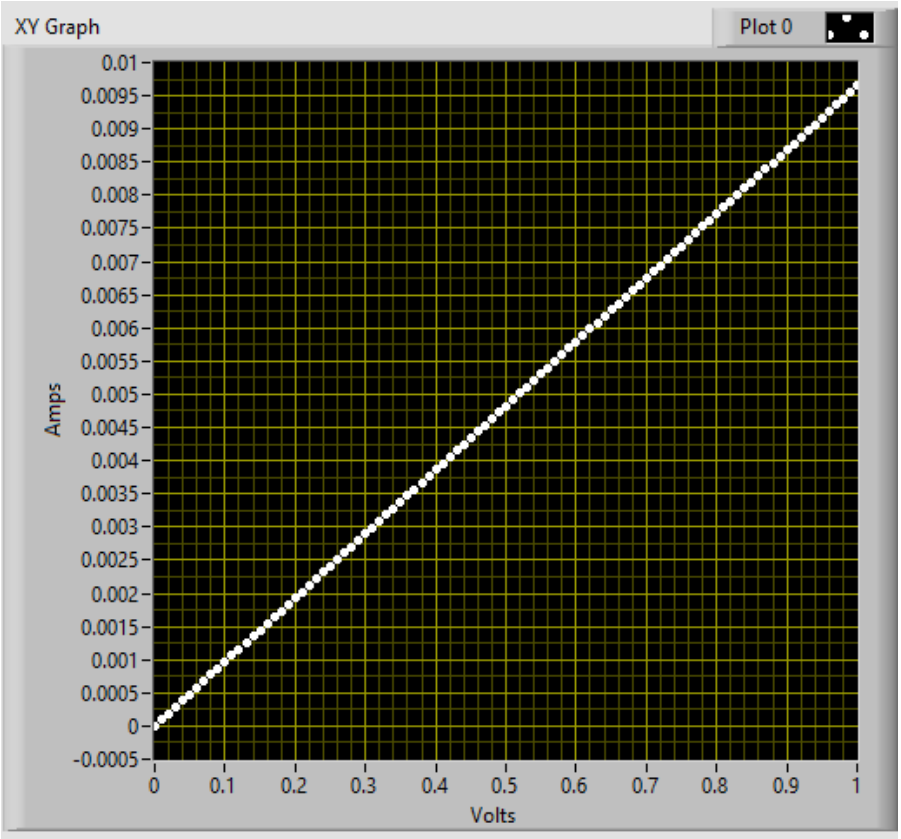
4.3.1 Attach the plot of the 100 Ω resistor I-V characteristic. What is the measured resistance according to your plot?

4.3.2 Attach the plot of the diode I-V characteristic.

4.3.3 Diode voltage V_{out}:

Calculated from I-V Curves	Measured	% Error
0.7 V	0.67 V	4.2%

4.3.1


XY Graph
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Volts
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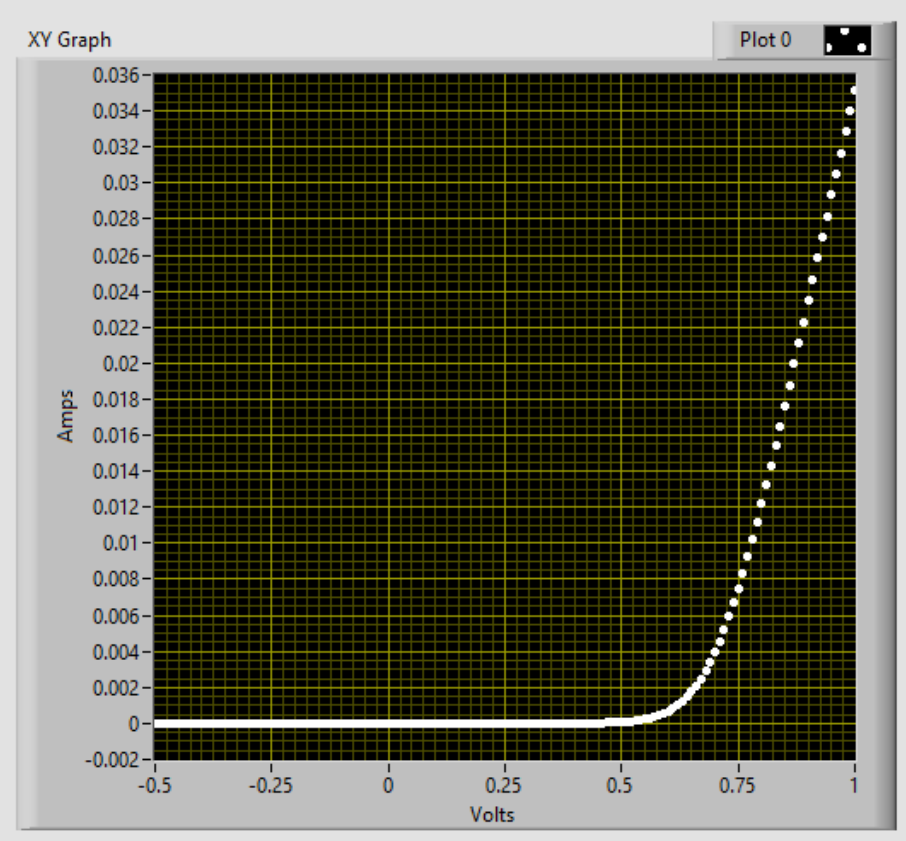
4.3.2


XY Graph
Plot 0
Amps
Volts
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0.034
0.032
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1