UNIVERSITY OF CALIFORNIA AT BERKELEY
College of Engineering
Department of Electrical Engineering and Computer Sciences

EE105 Lab Experiments

Report 2: Electronic Test Equipment

Solutions

3.1.1 Record the error in the power supply at +1 V, +5 V, and +9 V.

Voltage Setting	DMM Measurement	% Error
1 V	1.092 V	9.2 %
5 V	5.112 V	2.24 %
9 V	9.332 V	3.57 %

3.1.2 What is the error (in percent)? What is another error factor that may cause deviation from the ideal?

1.408 V measured across the 20 kΩ. From hand calculations, it should be $\frac{2}{3} \cdot 2\ \text{V} = 1.333\ \text{V}$, so there is a 5.6 % error.

The error may be from the resistor values, which might deviate from the ideal given values by ±10 %. The gold band on the resistors indicate the error tolerance. For example, typical values are 19.8 kΩ for the 20 kΩ resistor and 9.965 kΩ for the 10 kΩ resistor.

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

The DMM tutorial has the answer. An ammeter has a very low impedance so that it does not affect the branch current, so attaching it to a voltage source would result in essentially a short circuit. The resulting large current might damage the DMM. In reality, power supplies can deliver only so much current and ammeters are generally built with fuses to prevent damage, but it's still a bad idea to hook up an ammeter in parallel to a voltage supply (and the measurement would be useless anyway).

3.1.4 Measure the current and compare the value to your hand calculation.

Measured: 0.071 mA
Calculated: $\frac{2\ \text{V}}{30\ \text{k}\Omega} = 0.066\ \text{mA}$.

The calculated and measured values agree quite well (less than 10 % error).

3.2.1 What is the error on the function generator output at 1 kHz, 1 V_{p-p} after taking the voltage division factor into account?

Measured V_{p-p}: 2.094 V
Measured frequency: 1 kHz (or 0.996 kHz, bounces between both values).
The voltage error is $\frac{0.094}{2} = 4.7\ \%$. The frequency error is 0 % or 0.4 %.

3.2.2 What is the highest frequency sinusoid that the generator can produce with a 1 V_{p-p} panel setting? What is the error in the panel according to the oscilloscope?

The highest frequency setting on the panel is 52.5 MHz. At this setting, the oscilloscope measures 51.81 MHz, giving an error of 1.5 %.

3.2.3 What is the smallest V_{p-p} that the function generator can produce at 1 kHz? What is the error? Without averaging, does the oscilloscope **over-measure** or **under-measure** the V_{p-p} value? (circle one)

10 mV_{p-p} is the smallest signal the function generator can produce. The oscilloscope has trouble measuring it at all, but displays about 5 mV peak-to-peak, under-measuring the result. Usually, a noisy signal will increase the measured value (since the signal's maxima and minima are increased by noise), but here the oscilloscope just can't pick it up.

3.2.4 What is the shortest pulse that the function generator can produce at 500 mV height and 1 kHz repetition frequency?

The shortest pulse width is 8 ns. The oscilloscope shows that the pulse is no longer a clean rectangular pulse, but rather something resembling a sinc.

3.2.7 Calculate the value of $|\frac{v_o}{v_s}|$ at 1 kHz from your oscilloscope measurements.

Measured: $\frac{860 \text{ mV}}{1 \text{ V}} = 0.86$.

3.3.1 Attach the printed plot of the 100 Ω I-V characteristic.

See Figure 1.

3.3.2 Attach the printed plot of the diode I-V characteristic.

See Figure 2.

3.3.3 What is the V_O value calculated from your load-line? Does it match the value measured with the DMM?

Calculated: 0.67 V, Measured: 0.679 V. The values match within a reasonable error (less than 2 %).

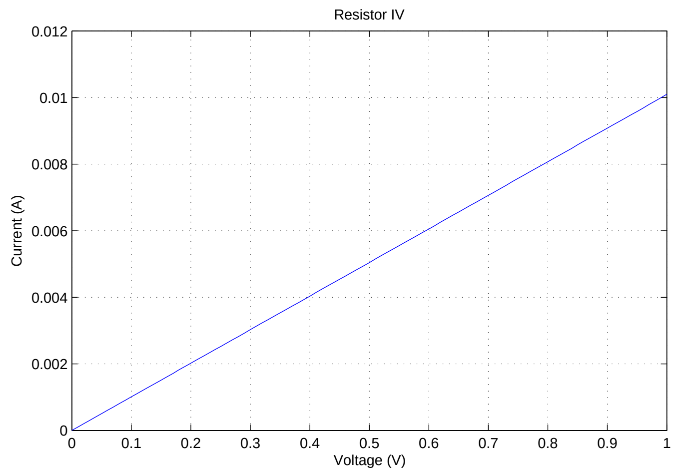

Figure 1: Resistor I-V characteristic plotted in Matlab

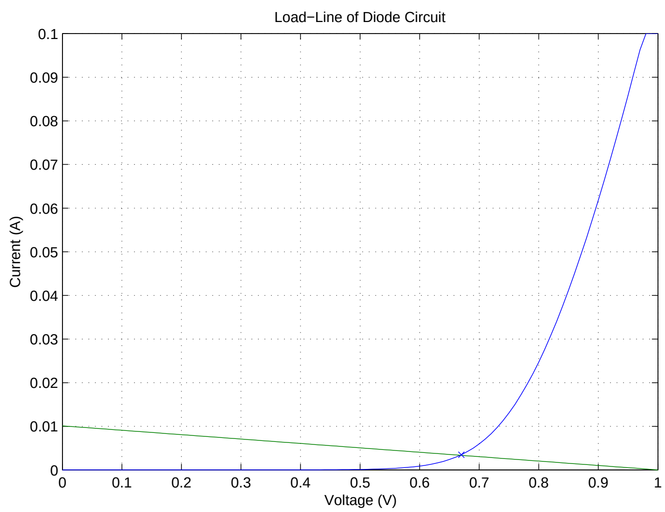

Figure 2: Load line plotted in Matlab