Name _____ Section _____

PURPOSE

To obvserve the forward and reverse characteristics of a silicon diode
To perform a diode check using a VOM and a DMM
To construct and troubleshoot simple diode circuits.

EQUIPMENT

LAB SUPPLIED PARTS

DC power supply
DMM
VOM

PARTS KIT PARTS

Set of meter leads
Set of clip to clip jumper leads
1 - 100 kΩ resistor
1 - 1 kΩ resistor
1 - 1N400X diode

Pre-Lab - See Page 4 of this Lab

INTRODUCTION

Figure 1 shows a typical diode. A diode is forward biased when its anode is more positive and its cathode. As ***forward current (I_F)*** increases, the ***forward voltage (V_F)*** will also increase. V_F increases at a very low rate when the diode is operated above its ***knee voltage (V_K)***

Band denotes Cathode (K)

Figure 1 Typical 1N4004 Diode

Testing a diode using a VOM A diode can be tested using a VOM. The VOM does not provide us with an accurate testing method, but it will tell us if the diode is good or bad. You will find that the VOM will give you a different forward resistance depending on the range you choose. This is normal. The important thing is that the meter reads a relatively low forward resistance in one direction, and a very high resistance in the opposite direction. We are looking for the ratio (forward to reverse) of these resistances to be at least 1000 to 1. A ratio of 1000 to 1 or better indicates a good diode.

Testing a diode using a DMM Most modern DMM's have a diode checker function, which allows you to determine the actual voltage across the forward biased diode. If the forward voltage falls within the expected range (around 0.7 volts), the diode is considered good. Measuring across the diode in reverse bias should show over range if the diode is good.

Important Note The Fluke DMMs that we are using in the lab do not accurately measure the forward bias voltage. They do however, give us a reasonable indication of this voltage.

Procedure: Part 1 - Diode Check Using VOM and DMM

1) Use the VOM on resistance (Ω) function to measure the forward and reverse resistance of the diode and record the results in Table 1.

   Set the VOM to the lowest R(Ω) range (RX1) to measure forward resistance. Record these values in Table 1.

2) Calculate the resistance ratio using these 2 values. It should exceed 1000:1 for a good diode.

2) Use the DMM to perform a diode check and record the results in Table 1.

Note Do not check diodes using the DMM on any range that does not have the diode symbol on it. (⊣▶⊢) This symbol guarantees that the range will check the diode properly. Use of other ranges will give you an erroneous reading!!

Table 1 VOM		
Forward Resistance	**Reverse Resistance**	**Resistance Ratio**

Table 2 DMM	
Forward Voltage	**Reverse**

Part 2 -The Forward Biased Diode

1) Construct the circuit shown in Figure 2.

2) Measure and record the forward voltage across the diode (V_F) for each increment of current (I_F) in Table 3.

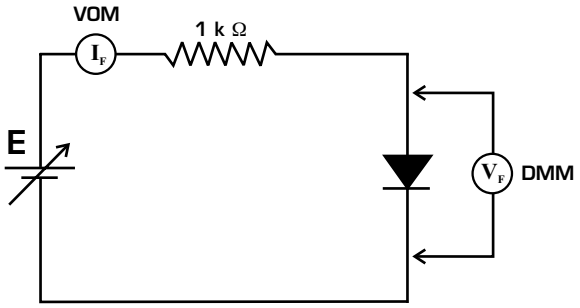


Figure 2 Measuring forward current and voltage

Use the DMM as a voltmeter across the diode.
Use the VOM as an ammeter to measure the current.

Start V_S at 0V, and the Current Control Dial to approximately half the rotation.

Increase V_S until the VOM (ammeter) reads 0.5mA.
Measure the voltage across the diode with the DMM (voltmeter) and record the result in Table 2.

***** NOTE: Use the 2V range on the DMM to give 3 decimals of accuracy. (Do not round off your answers.)***

Table 3 Forward Current (I_F) versus Forward Voltage (V_F)

Forward Current I_F	Forward Voltage V_F	Forward Current I_F	Forward Voltage V_F
0.5 mA		**6.0 mA**	
1.0 mA		**7.0 mA**	
2.0 mA		**8.0 mA**	
3.0 mA		**9.0 mA**	
4.0 mA		**10.0 mA**	

Part 3 -The Reverse Biased Diode

The reverse current through a p-n junction is typically very small (nA). Measuring this current with our ammeter is not possible. We can however, measure the voltage that appears across R_1 in Figure 3. Using Ohm's Law,, we can calculate the reverse current.

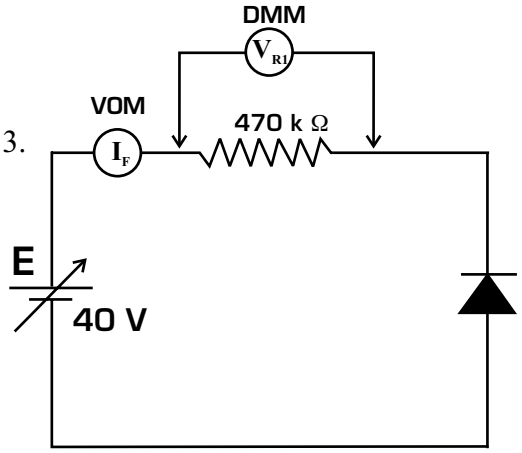


Figure 3 Calculating Reverse leakage Current

1) Construct the circuit shown in Figure 3.

2) Adjust the DC supply until the voltage across the diode is exactly 40V.

7) Use the DMM to measure the voltage across the 470 k resistor and record the result. Be Exact!!
(You should be using the 200mV range)

V_{R1} = _____ (measured)

8) Remove the 470 k resistor from the circuit and measure the actual resistance and record the result.

R_1 = _____ (measured)

9) Calculate the reverse current through the junction using Ohm's Law. Show your calculation below.

_____

_____

I_R = _____

Part 4 Questions

1) In Table 1, the forward voltage (V_F) increased as the current (I_F) increased. What accounts for this?

_____

2) The reverse current (IR) is comprised of two currents. List these two currents.

1) _____ 2) _____

3) What causes the two reverse currents above? What factors will cause each current to increase?

_____

_____

_____

_____

_____

_____

_____

Pre Lab

The Forward Biased Diode

1) Using Electronic Workbench, build the circuit shown in Figure 2 on page 2 of Lab 10. Your circuit should look similar to the circuit shown in Figure 1.

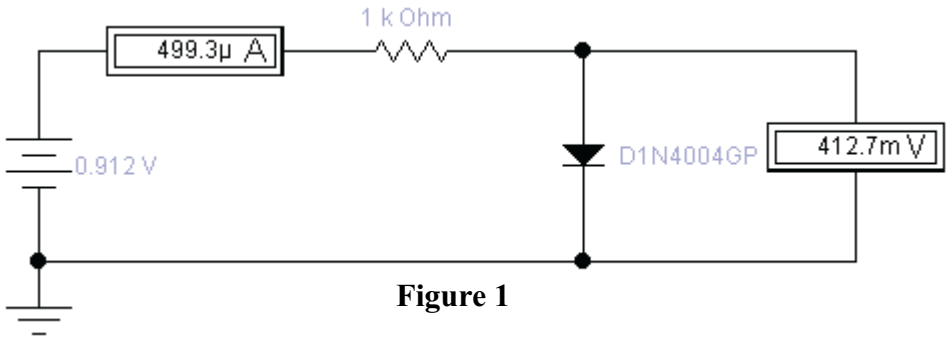


Figure 1

Measure and record the forward voltage across the diode for each increment of current in Table 3. You will have to carefully adjust the voltage of the power supply to see what value of current that it gives you on the ammeter.

Get the value of current on the ammeter as close to the value shown in the table as possible. It may not be possible to get it dead on, but it should be very close. Note the figure above. The voltage is set at 0.912 V and this gives us 499.3 A of current. This is close enough to the 500 A (0.5 mA) listed in Table 1**.**

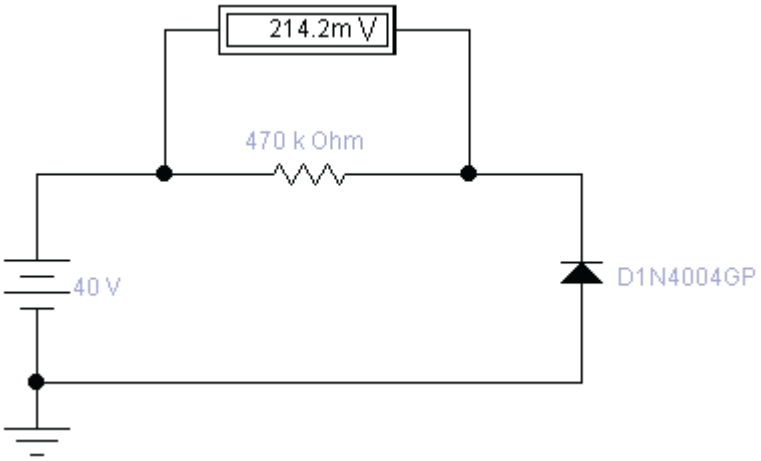
Note: The above figure uses Electronics Workbench Version 5. If you use ***version 4*** you should find that a voltage of 1.22 V gives a current of 498 A You may not get exactly these values but they should be close.

Table 4 Forward Current (I_F) versus Forward Voltage (V_F)

Forward Current I_F	Forward Voltage V_F	Forward Current I_F	Forward Voltage V_F
0.5 mA		**6.0 mA**	
1.0 mA		**7.0 mA**	
2.0 mA		**8.0 mA**	
3.0 mA		**9.0 mA**	
4.0 mA		**10.0 mA**	

The Reverse Biased Diode

Construct the circuit to measure the reverse current that is shown in Figure 3 of the lab. It should look like the circuit shown here.



Set the voltage of the power supply at 40 V.

Measure the voltage appearing across the 470 k resister V_{R1}. Record it here .

V_{R1} _____

Using the value of R_1 of 470 k and the value of V_{R1}, calculate the reverse current through the junction using Ohm's Law.

I_R _____