Name: Cayce Beames
Date: November 14, 2019
Professor Steven Gillette

Learning Objectives

- Use a datasheet to research diode performance specifications
- Understand current characteristics of a forward biased diode
- Understand current characteristics of a reverse biased diode

Notes:

1. Took all voltage measurements relative to ground (unless otherwise stated)
2. Recorded relevant measurements and calculation results in data tables
3. Recorded all measured values on the circuit schematics
4. Used all available precision in calculations, round off answers to 3 significant figures

Materials

Quantity	Description
1	Zener diode, 5.1 V, 1N4733
1	Potentiometer, 1KΩ
	Tools
2	Digital Multimeters
1	Global Specialties trainer

Setup – Data Sheet Research

1. From the data sheet, found and recorded the following values for the 1N4733A zener diode.

   Total power dissipation (P_D) – 1W

   Working voltage (V_z) – 5.1V

   Zener current ($I_Z = P_D / V_Z$) – I_z = 1W / 5.1V = 0.196A = 196mA

   Forward voltage & current (V_F, I_F) – V_F = 1.2V, I_F = 200mA

   Max surge current (I_{ZS}) – 890mA

Did not exceed the listed zener current for the 1N4733 during this lab procedure.

Procedure – Diode Current

2. Set the GS Trainer DC power supplies to +2V and -6V as shown on the circuit schematic diagram.
3. Built Circuit 1.

4. Connected one DMM between ground and the potentiometer wiper and the other in series with the diode and ground to measure I_Z, Zener diode current.
5. Used the potentiometer to set the diode bias voltage until the positive Zener current (I_Z) approaches but does not exceed 150mA. Recorded the bias voltage and Zener current in the lab spreadsheet.
6. Continued measuring and recording up to 16 current and bias voltage readings between full forward conduction (+150mA) and full reverse conduction (-150 mA). Adjusted the DMM resolution as required to achieve the best possible resolution.

Note: Observed that adjusting the current resolution on the multimeter affected the voltage drop across the potentiometer. Therefore, left the DMM resolution to mA.

Did not allow Zener current to exceed 150 mA at any time during this lab.

7. Entered all data into the lab spreadsheet to create a scatter plot showing the diode current performance curve for all points tested. Made sure that the scatter plot includes readings taken near 150 mA and -150 mA.

Results Data

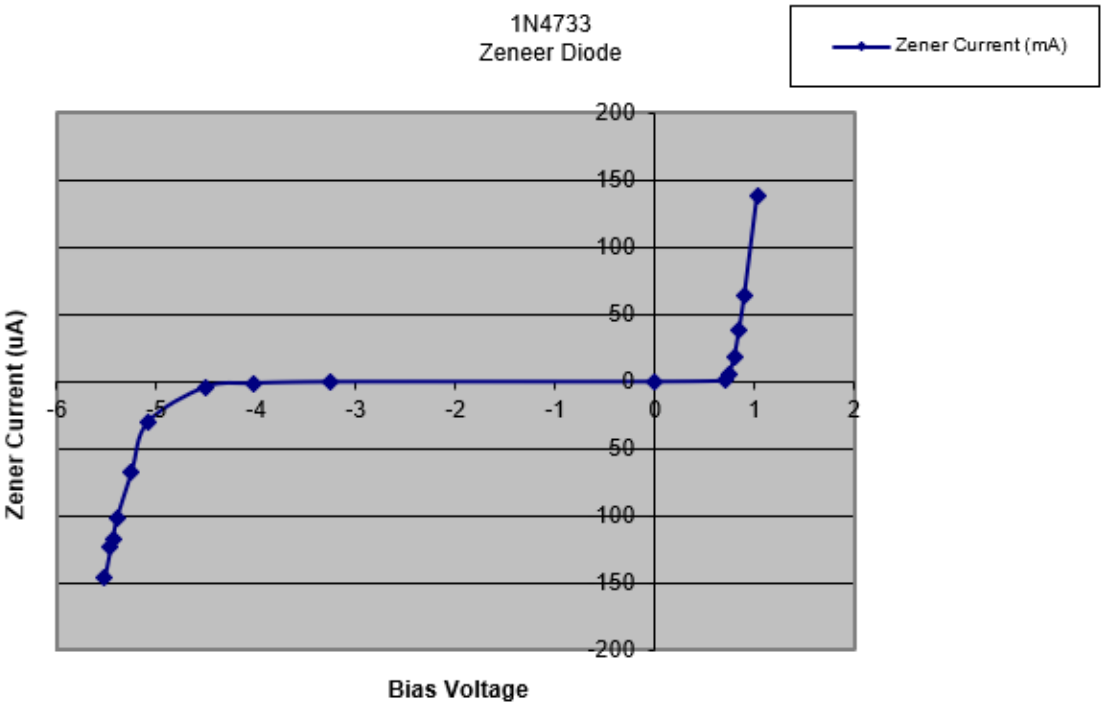
Data Sheet

P_D	V_Z	I_Z	V_F @ I_F	I_{ZS}
1W	5.1V	196mA	1.2V @ 200mA	890mA

Zeneer Performance

5.1 V Zener Diode

Bias Voltage (V)	Zener Current (mA)
1.03	138.5
0.9	63.4
0.85	39
0.80	18.4
0.75	5.9
0.70	0.8
0.00	0
-3.25	-0.1
-4.03	-1.1
-4.51	-3.9
-5.09	-30.1
-5.25	-66.7
-5.40	-101.7
-5.44	-117.4
-5.46	-123.5
-5.52	-146.2



Critical Thinking

Diodes

1. Given a 10 volt zener diode with a maximum power dissipation of 2 watts, calculate the approximate working current using Watt's Law.

$P_Z = 2W / 10V = 0.2A = 200mA$

2. Based on your lab data, at what voltage did the diode begin reverse conduction?

During the lab, I observed that current began to flow when the voltage reached approximately -4.5V.

3. Based on your lab data, at what voltage did the diode begin forward conduction?

During the lab, I observed that current began to flow when the voltage reached approximately -0.7V.

4. Describe an application for a zener diode.

It is clear from the lab that the zener diode can be effectively used as voltage regulator. In an article published by Digikey, it also mentions that Zener diodes can be used for "voltage regulation, as reference elements, surge suppressors, and in switching applications and clipper circuits." Source: https://www.digikey.com/en/maker/blogs/zener-diode-basic-operation-and-applications

5. What did you learn from this lab?

In this lab, I learned about the basic operation of the Zener diode and how it can be used to pass and block current flow across a voltage source varied between positive and negative. This permitted exploration of the characteristics of the breakdown voltage point of the component. Understanding how the components behave allows for better understanding of the component in circuit design and troubleshooting.

Appendix A – Lab Notes

SIERRA COLLEGE	MECH 10 - Lab 17 Diode Performance	Mechatronics *Real Skills Real Jobs*
Name Payge Beaman		11/5/19

Learning Objectives

- Use a datasheet to research diode performance specifications
- Understand current characteristics of a forward biased diode
- Understand current characteristics of a reverse biased diode

Notes:

1. Take all voltage measurements relative to ground (unless otherwise stated)
2. Record relevant measurements and calculation results in data tables
3. Record all measured values on the circuit schematics
4. Use all available precision in calculations, round off answers to 3 significant figures

Materials

Quantity	Description
1	Zener diode, 5.1 V, 1N4733 V_F 775mV C=447pF ~150mA max
1	Potentiometer, 1KΩ
	Tools
2	Digital Multimeters
1	Global Specialties trainer

Setup – Data Sheet Research

1. From the data sheet, find and record the following values for the 1N4733A zener diode.

   Total power dissipation (P_D) 1W

   Working voltage (V_Z) 5.1V

   Zener current ($I_Z = P_D / V_Z$) $I_Z = \frac{1W}{5.1V} = 0.196A = 196mA$

   Forward voltage & current (V_F, I_F) $V_F = 1.2V$, $I_F = 200mA$

   Max surge current (I_{ZS}) 890mA

Do not exceed the listed zener current for the 1N4733 during this lab procedure.

Procedure – Diode Current

2. Set the GS Trainer DC power supplies to +2V and -6V as shown on the circuit schematic diagram.
3. Build Circuit 1.
4. Connect one DMM between ground and the potentiometer wiper and the other in series with the diode and ground to measure Iz,

Zener diode current.

5. Use the potentiometer to set the diode bias voltage until the positive Zener current (Iz) approaches but does not exceed 150mA. Record the bias voltage and Zener current in the lab spreadsheet.
6. Continue measuring and recording up to 16 current and bias voltage readings between full forward conduction (+150mA) and full reverse conduction (-150 mA). Adjust the DMM resolution as required to achieve the best possible resolution.

☆ ***Do not allow Zener current to exceed 150 mA at any time during this lab.***

7. Enter all data into the lab spreadsheet to create a scatter plot showing the diode current performance curve for all points tested. Be sure that your scatter plot includes readings taken near 150 mA and -150 mA.

Results Data

Data Sheet

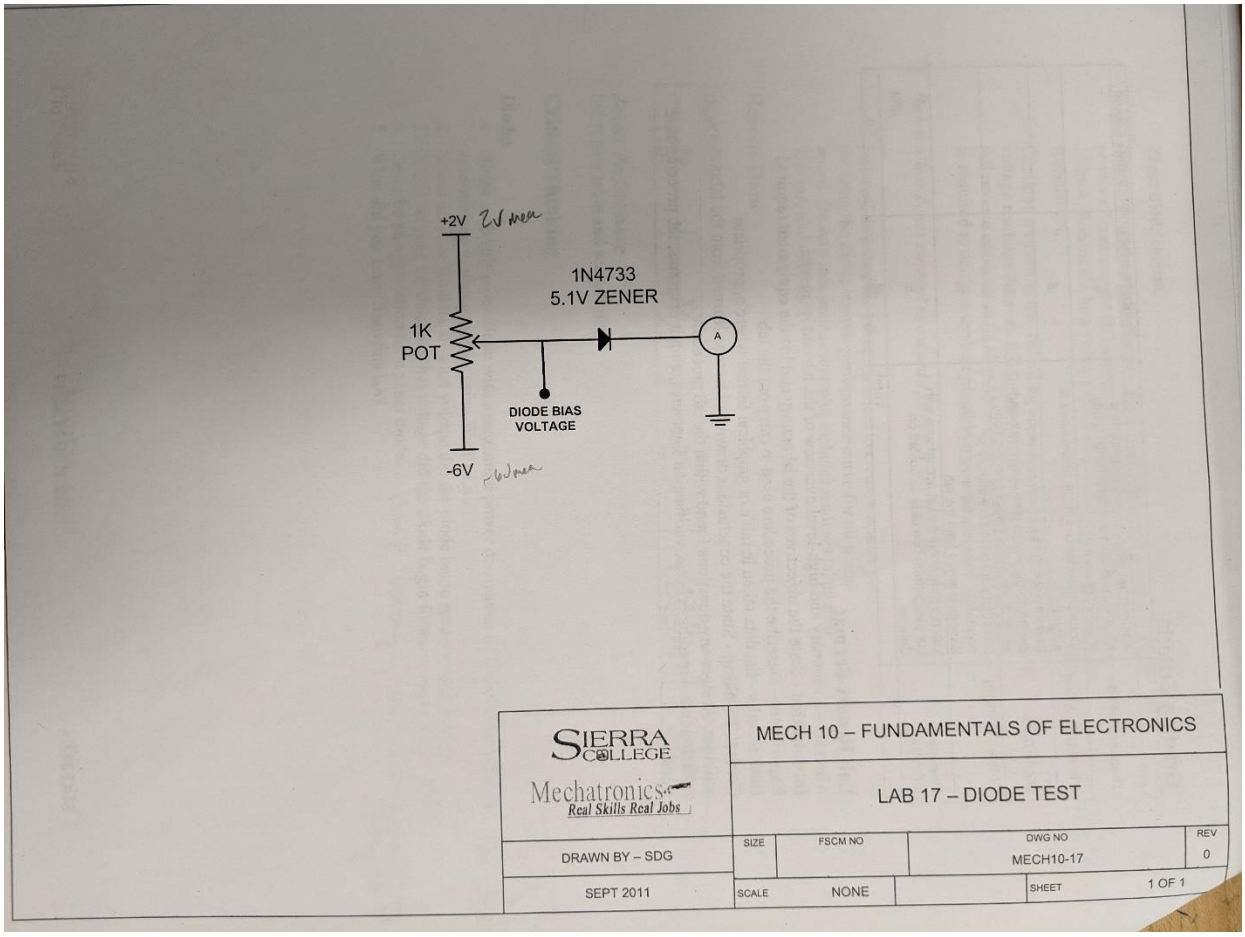
P_D	V_Z	I_Z	V_F @ I_F	I_{ZS}
1W	5.1V	196mA	1.2V @ 200mA	890mA

Zeneer Performance
Insert data table and scatter plot.

Critical Thinking

Diodes

1. Given a 10 volt zener diode with a maximum power dissipation of 2 watts, calculate the approximate working current using Watt's Law. $\frac{2W}{10V} = .2A$ (200mA)
2. Based on your lab data, at what voltage did the diode begin reverse conduction? −4.5V
3. Based on your lab data, at what voltage did the diode begin forward conduction? +0.7V
4. Describe an application for a zener diode. Cheap voltage regulator @ working Voltage Vz
5. What did you learn from this lab?



Grading Criteria

		Points Possible	Points Earned
Documentation	Abstract, introduction, experiment, data results, conclusions, attachments, clarity, spelling, grammar	**10**	
Diode Data Sheet	Diode performance specifications listed & accurate	**5**	
Diode Data	Performance data taken accurately; displayed on scatter plot; within expected zener diode performance specifications	**15**	
Critical Thinking	Questions answered completely & accurately. State conclusions drawn and lessons learned from the lab	**10**	
On-time submittal	Lab report is submitted in accordance with the assignment due date as posted on Canvas	**5**	
	Total	**45**	

Lab Report Format

Abstract - a summary and high-level overview of the lab and its results
Introduction - State the objectives of the laboratory and list the equipment required
Experiment - Describe the procedure used to carry out the lab
Data Results - list data taken in table or graphical format where appropriate
Critical Thinking - State the conclusions drawn and lessons learned from the laboratory activities. Answer any questions found within the lab procedure.

Attachments – grading criteria, verification signatures, circuit diagrams, lab procedures & notes