Solid State Electronics – Unit 3: Zener Diodes

Lab – Working with Zener Diode

Name: _____

All portions of LAB 2 ZENER DIODE LAB covered in this document must be completed and verified before moving on.

OBJECTIVES

1. Assemble circuits using zener diodes.
2. Understand zener diode ratings
3. Learn how zener diodes function in DC circuits.
4. Use digital meters to measure voltages at various points in zener diode circuits.
5. Troubleshooting of zener diode circuits.

MATERIALS

- DC Power Supply
- Multimeter
- 12v zener diode
- resistors
- Breadboard

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PROCEDURE

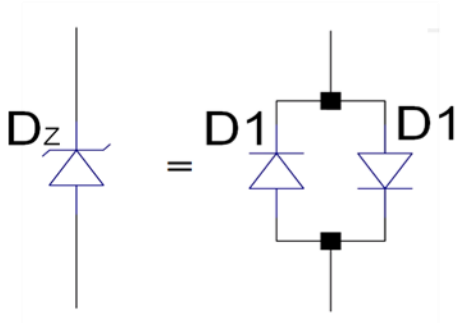
PART A: Zener diode specifications

See the specification sheet.

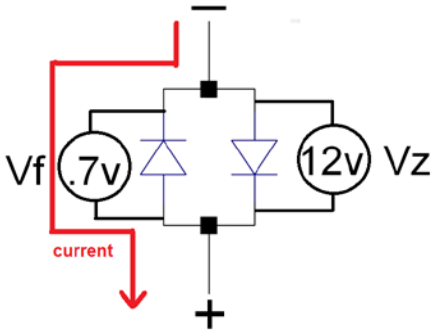
http://www.jameco.com/Jameco/Products/ProdDS/1538081.pdf

PART B: Zener diode characteristics

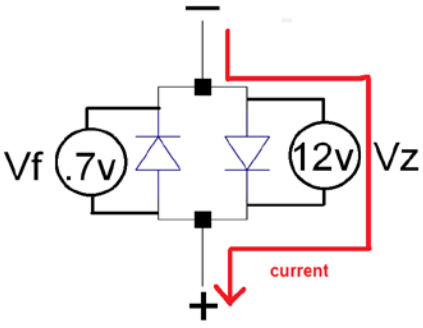
Step 1. A zener diode can act like two diodes connected in reverse parallel as shown.



If a zener diode is connected in forward bias mode like a conventional diode, as in the previous lab, there will be about .7 volts across it. If the zener is connected in reverse bias mode there will be a voltage across the diode equal to the zener voltage. We will use a 12 volt zener for our lab. Therefor, our diode would have 12v across it if reverse biased. In the examples, current will not flow in one direction unless the is at least about .7 volts across the zener diode. In the reverse biase mode, current flows only after there is 12 volts across the zener diode.



OR



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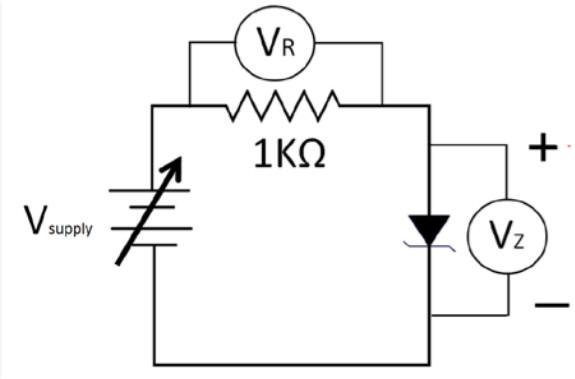
Step 3. This concept that the diode will have a predictable voltage across it will enable us to use the diode to keep voltage constant across another component or point in the circuit.

Step 4: Set up the following circuit. This will demonstrate the forward bias characteristics of a zener diode.



Step 5: Adjust V_{supply} in order to make the voltage across the zener diode (VZ) equal to the voltage values in the following table.

Step 6: Once the voltage across the zener (VZ) is reached, measure the voltage across the 1KΩ resistor (VR). Place the value for VR in the table. For each value of VR calculate, using Ohm's Law, the current through the resistor. This will also be the current through the zener diode.

VZ	VR	IR = IZ = VR/R
.1v		
.2v		
.3v		
.4v.		
.5v.		
.6v.		
.7v.		
.8v		

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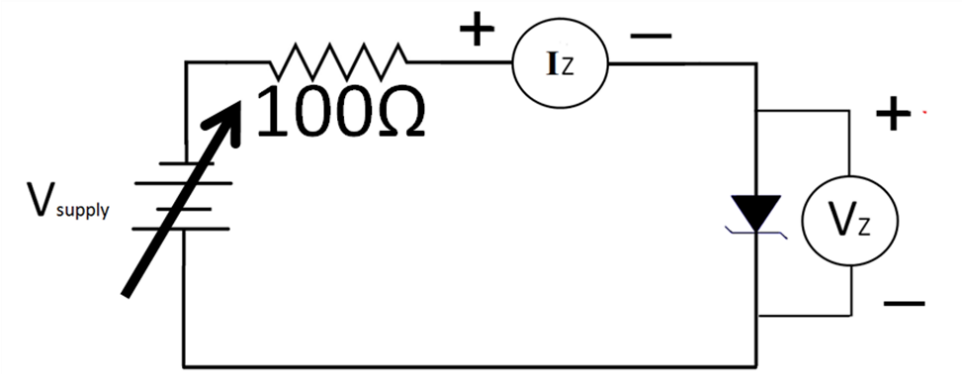
Step 7: In order to determine the reverse bias characteristics of the zener diode we will configure the circuit as follows: The 1KΩ resistor is changed to a 100Ω. The power supply polarity is reversed.



Step 8: Adjust V_{supply} in order to make the current through the zener diode (IZ) equal to the current values in the following table. For each of the values of current (IZ) record the voltage across the zener diode (VZ).

Iz	Vz
50 µA	
100 µA	
1mA	
5mA	
10mA	
15mA	
20mA	
25mA	
30mA	

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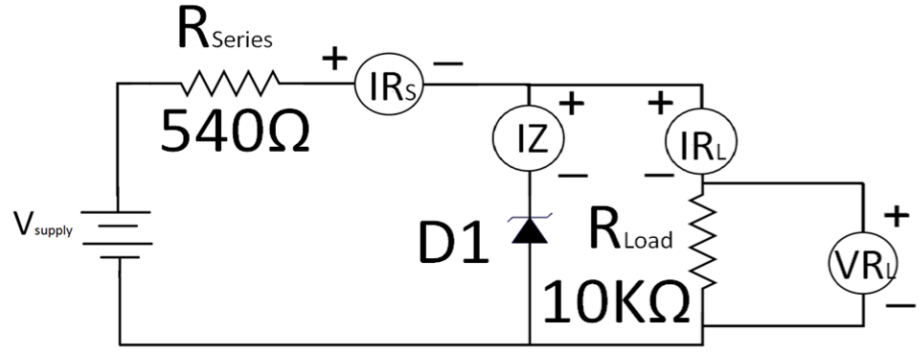
PART C: Zener diode voltage regulator

Two important specs for voltage regulators are Line regulation and load regulation.

- **Line regulation:** voltage level despite changes to the input voltage level.
- **Load regulation i**s the ability of a regulator to maintain a constant voltage, or current level at the output. The regulator should be able to do this despite changes in the regulator's load.

Step 9. The zener diode can be used as a voltage regulator as long as the current rating for the diode is not exceeded.

Step 10. Connect the following circuit.



To show line regulation complete the following.

Step 11. Set the supply voltage to 0 volts.

Step 12. Measure the voltage across the load and place the value in the table.

Step 13. Increase the value of the supply voltage in increments of 1 volt as shown in the table. Measure the voltage across the load and record the value for each increment.

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V_{supply}	V_{Load}
0v	
1v	
2v	
3v	
4v	
5v	
6v	
7v	
8v	
9v	
10v	
11v	
12v	
13v	
14v	
15v	
16v	
17v	
18v	
19v	
20v	

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Step 14. Graph the results using Excel.

To demonstrate the load regulation complete the following.

Step 15. This will determine how the voltage is regulated with a changing load (resistance).

Step 16. Use the same circuit as used for line regulation.

Step 17. Complete the chart for the given loads. Begin with the supply voltage set for 15 volts. Also begin with the load value of 10KΩ. Each measurement will be made with the supply at 15 volts as loads are decreased. A decrease in load resistance means an increase in load current.

R_L	V_L	$I_L = V_L/R_L$	$I_S = (V_{SUPPLY} - V_L) / R_S$	$I_Z = I_S - I_L$	$P_Z = (V_L)(I_Z)$
10KΩ					
8.2KΩ					
6.8KΩ					
4.7KΩ					
2.2KΩ					

Step 18. Looking at your graph, was a certain amount of voltage overhead needed for the circuit to regulate?

Yes No

Step 19. Did a changing load have an impact on the regulation of the circuit?

Yes No

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