BRAC UNIVERSITY

Inspiring Excellence

CSE251

Electronic Devices and Circuits

Exp -03 : Study of Zener Diode and Its Application in Voltage Regulation

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Date of performance: 17/10/22

Date of Submission: 24/10/22

2. Circuit Diagram:

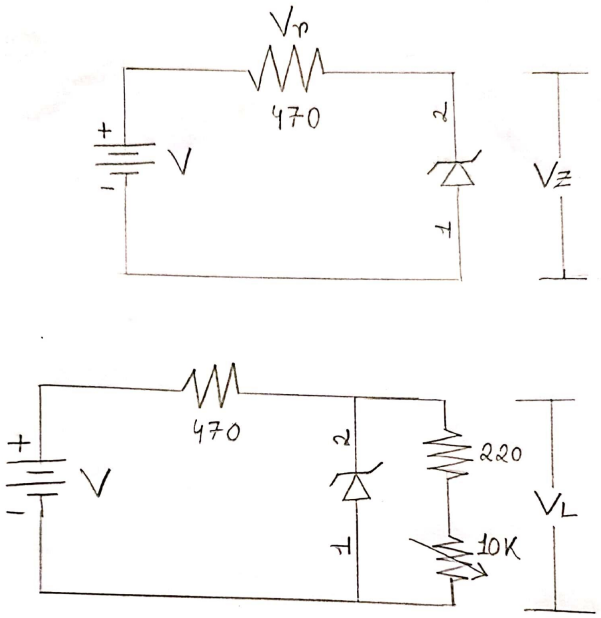


Figure : Circuit diagrams for zener diode and its application

3. Signed Data Sheet:

Group no. 5 Student ID 20101443, 21301610, 21301611

Table 1				Table 3	
V (volt)	V_R (volt)	V_Z (volt)	$I_Z = V_R/R$ (mA)	V (volt)	V_L (volt)
0	0	0.0046	0	6	5.14
1	0	0.96	0	7	5.24
2	0	1.95	0	8	5.24
3	0.0007	2.96	0.00149	9	5.28
4	0.014	3.93	0.0229	10	5.29
4.9	0.1755	4.74	0.768	11	5.3
5	0.1561	4.81	0.336	12	5.31
5.1	0.2102	4.90	0.4501	13	5.32
5.2	0.238	4.93	0.509	14	5.33
5.3	0.298	4.98	0.638	15	5.34
5.4	0.354	5.02	0.758		
5.5	0.471	5.09	1.008		
6	0.818	5.17	1.752		
7	1.795	5.24	3.843		
8	2.748	5.26	5.884		
9	3.705	5.28	7.973		
10	4.69	5.29	10.043		

$R = 212.7\,\Omega = 0.2127\,K\Omega$

Table 2		
V_{220} (24V)	V_L (volt)	$I_L = V_{220}/R_{220}$ (mA)
0.1149	5.23	0.54
0.433	5.23	2.063
0.776	5.28	3.648
1.179	5.26	5.543
1.395	5.25	6.558
1.733	5.2	8.175
2.13	4.97	10.014
2.41	4.56	11.330
2.703	4.00	12.726
3.08	3.25	14.480

17.10.22

Calculation

Load Regulation

Pick any two data from Table 2 and calculate the following quantities.

$V_{L1} = 5.25$
$I_{L1} = 6.558$
$V_{L2} = 5.28$
$I_{L2} = 3.648$

Load regulation, $\Delta V_L/\Delta I_L = \dfrac{5.28 - 5.25}{3.648 - 6.558} = -0.01$

Line Regulation

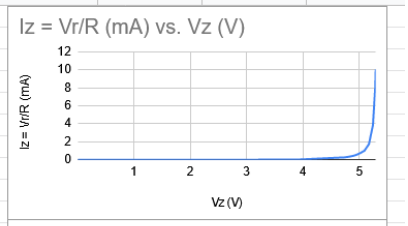
Pick any two data from Table 3 and calculate the following quantities.

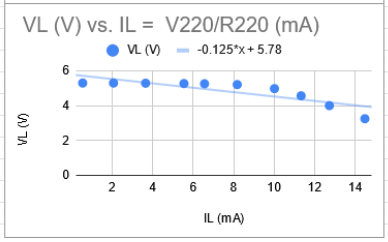
$V_{L1} = 5.28$
$V_1 = 9$
$V_{L2} = 5.29$
$V_2 = 10$

Line regulation, $\Delta V_L/\Delta V = \dfrac{5.29 - 5.28}{10 - 9} = 0.01$

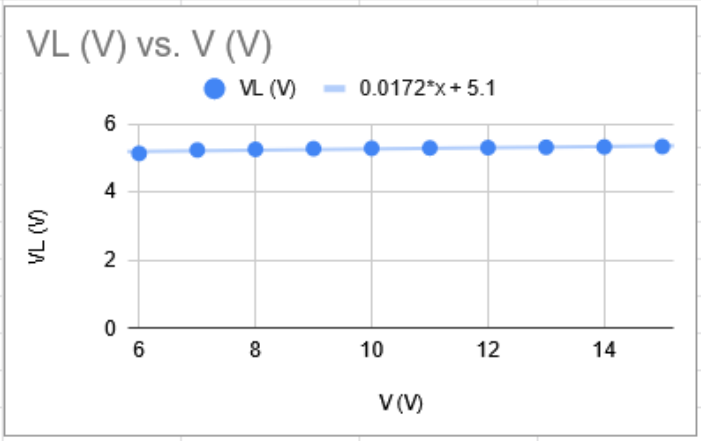
4. Graph From Table 1, Table 2 and Table 3:

V (V)	Vr (V)	Vz (V)	Iz = Vr/R (mA)	V220 (V)	VL (V)	IL = V220/R220
0	0	0.0046	0	0.1147	5.29	0.54
1	0	0.96	0	0.439	5.29	2.063
2	0	1.95	0	0.776	5.28	3.648
3	0.0007	2.96	0.00149	1.179	5.26	5.543
4	0.014	3.93	0.0299	1.395	5.25	6.558
4.9	0.1255	4.74	0.268	1.739	5.2	8.175
5	0.1561	4.81	0.334	2.13	4.97	10.014
5.1	0.2102	4.9	0.4501	2.41	4.56	11.33
5.2	0.238	4.93	0.509	2.707	4	12.726
5.3	0.298	4.98	0.638	3.08	3.25	14.48
5.4	0.354	5.02	0.758			
5.5	0.471	5.09	1.008			
6	0.818	5.17	1.752			
7	1.795	5.24	3.843			
8	2.748	5.26	5.884			
9	3.705	5.28	7.933			
10	4.69	5.29	10.043			





V (V)	VL (V)
6	5.14
7	5.24
8	5.26
9	5.28
10	5.29
11	5.3
12	5.31
13	5.32
14	5.33
15	5.34



Tabulated Result:

Load Regulation (mV/mA)		Line Regulation (mV/V)	
From Experiment (graph)	Theoretical Calculation	From Experiment (graph)	Theoretical Calculation
−0·125	−0·01	0·0172	0·01

Table 4

Here in the result we can notice that there is a difference between the calculation from the experiment graph and the theoretical calculation. We can see that from the graph we can get a more accurate value compared to the theoretical one. As the calculation made from the graph is software based and it gives more accuracy. Hardware lab datasets don't give accurate results as there are usually small errors from the hardware, and also these are manmade operations that altogether don't give the perfect results.

Discussion:

The Zener diode behaves just like a normal general-purpose diode when biased in the forward direction, that is Anode positive with respect to its Cathode. However, unlike a conventional diode that blocks any flow of current through itself when reverse biased, that is the Cathode becomes more positive than the Anode, as soon as the reverse voltage reaches a predetermined value, the zener diode begins to conduct in the reverse direction. From the I-V characteristics curve(graph 1) above, we can see that the zener diode has a region in its reverse bias characteristics of almost a constant voltage regardless of the value of the current flowing through the diode. This voltage remains almost constant even with large changes in current providing the zener diodes current remains between the breakdown current and its maximum current.

Load regulation is the ability to maintain its specified output voltage even in the presence of varying load. Here the pot is connected in series with the fixed load. So when we vary the pot the total load voltage varies too. We varied the pot then we

observed that for the minimum change in the load voltage we get to see that current is increasing.

Line regulation maintains a constant output voltage even though the input voltage is varying keeping load resistance fixed. From the graph 3 we can see that the input voltage is increasing but no significant change in output voltage.