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Department of Electrical Engineering.

Project of: Basic Electronics Engineering

Topic: Zener diode as voltage and line regulator.

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Teacher's Signature

- Title: Zener diode characteristics as line and load regulator.

- Introduction to the topic:

A voltage regulator is an electronic circuit that provides a stable DC voltage independent of the load current, temperature and AC line voltage variations. A zener diode of break down V_Z is reverse connected to an input voltage source V_1 across a load resistance R_L and a series resistor R_S . The voltage across the zener will remain steady at its break down voltage V_Z for all the values of zener current I_Z as long as the current remains in the breakdown region. Hence a regulated Dc output voltage $V_0 = V_Z$ is obtained across R_L , whenever the input voltage remains within a minimum and maximum voltage. Basically there are two type of regulations such as:

Line Regulation: In this type of regulation, series resistance and load resistance are fixed, only input voltage is changing. Output voltage remains the same as long as the input voltage is maintained above a minimum value. Percentage Line regulation = $\left(\frac{\Delta V_{OUT}}{\Delta V_{IN}} \right) \times 100\%$.

Load Regulation: In this type of regulation, input voltage is fixed and the load resistance is varying. Output volt remains same, as long as the load resistance is maintained above a minimum value. Percentage Load regulation = $\left(\frac{V_{NL} - V_{FL}}{V_{FL}} \right) 100\%$.

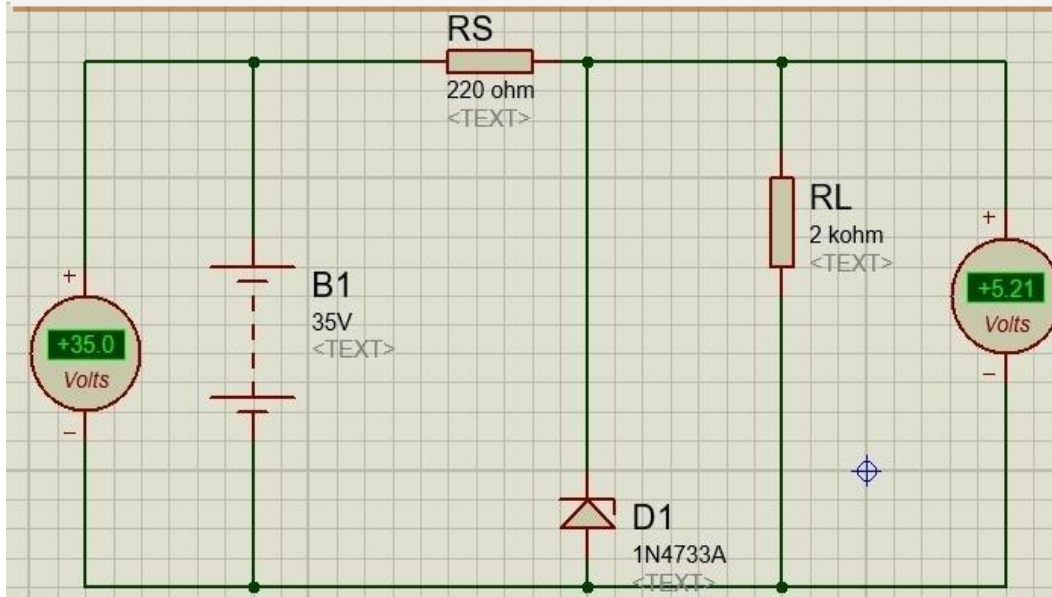
- **Components required:**

Zener diode, resistor, rheostat, voltmeter, ammeter, DC source.

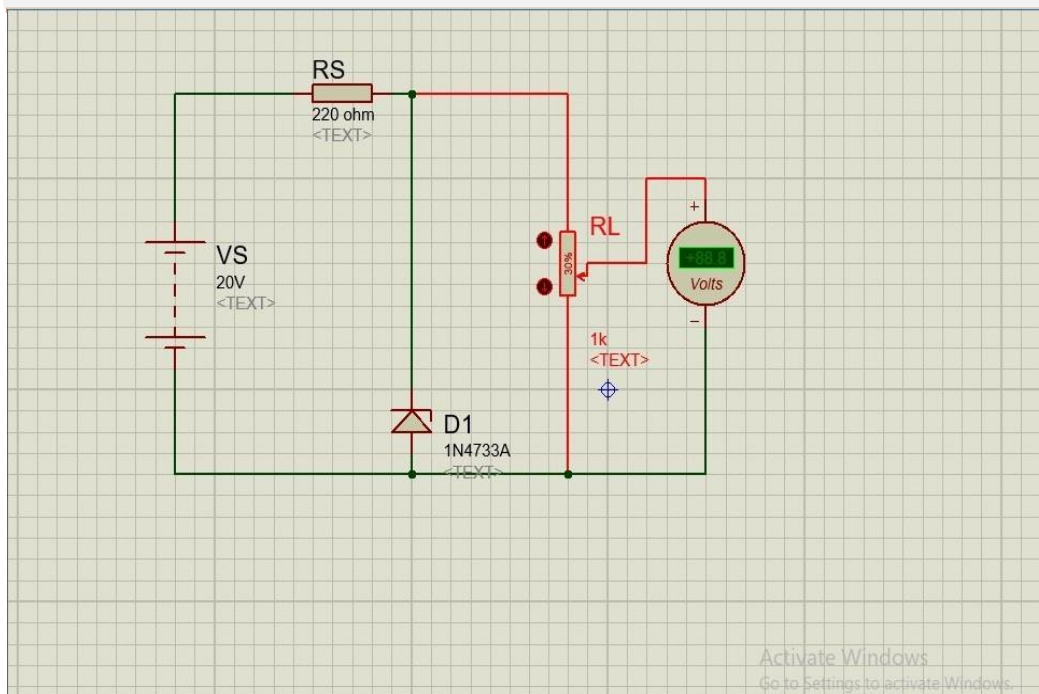
- **Software used:** Proteus.

- Circuit diagrams:

Zener diode as line regulator



Zener diode as load regulator

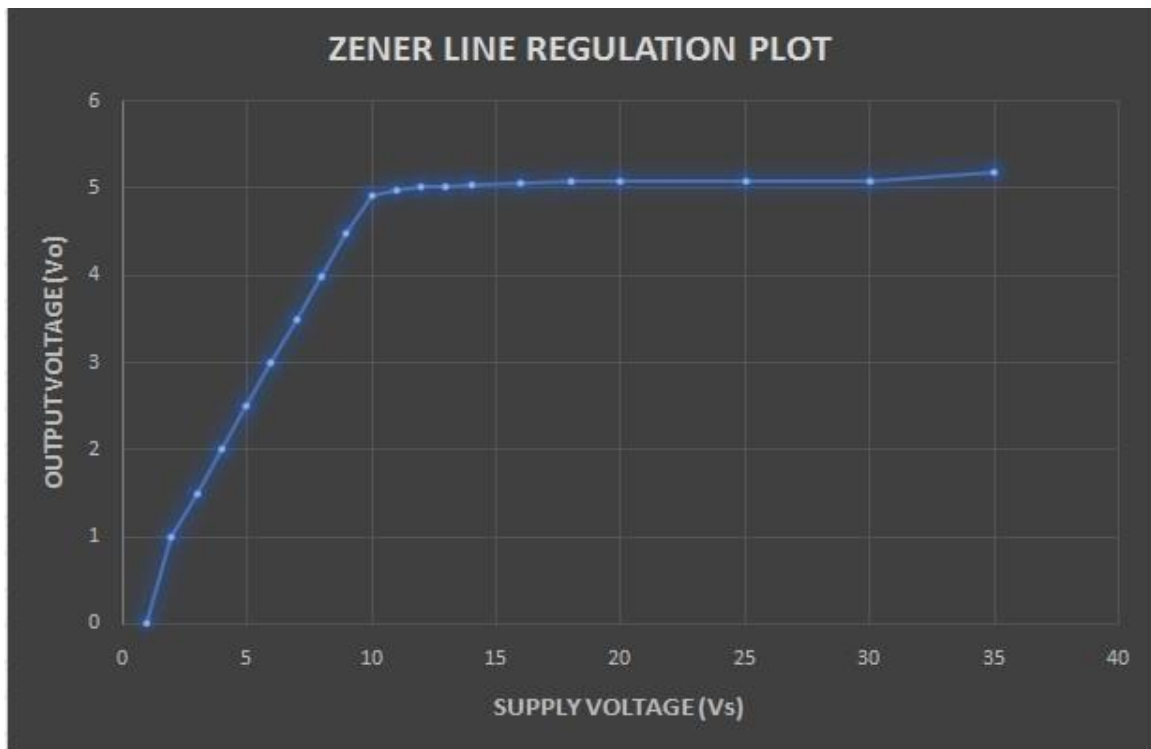


- Obervation Tables:

| ZENER LINE REGULATION | | | |
|---|---|---|--|
| $R_s = 220 \text{ Ohm}$ Zener voltage (V_z) = 5.1 Volt $R_L = 2 \text{ Kohm}$ | | | |
| SL. NO. | UNREGULATED SUPPLY VOLTAGE (V_s) Volt | REGULATED OUTPUT VOLTAGE (V_o) Volt | % VOLTAGE REGULATION (V_o/V_s) x 100 |
| 1 | 1 | 0 | 50 |
| 2 | 2 | 1 | 50 |
| 3 | 3 | 1.5 | 50 |
| 4 | 4 | 2 | 50 |
| 5 | 5 | 2.5 | 50 |
| 6 | 6 | 3 | 50 |
| 7 | 7 | 3.5 | 50 |
| 8 | 8 | 4 | 50 |
| 9 | 9 | 4.5 | 50 |
| 10 | 10 | 4.94 | 49.4 |
| 11 | 11 | 5 | 45.45 |
| 12 | 12 | 5.03 | 41.92 |
| 13 | 13 | 5.04 | 38.76 |
| 14 | 14 | 5.05 | 36.07 |
| 15 | 16 | 5.07 | 31.68 |
| 16 | 18 | 5.09 | 28.28 |
| 17 | 20 | 5.1 | 25.5 |
| 18 | 25 | 5.1 | 20.4 |
| 19 | 30 | 5.1 | 17 |
| 20 | 35 | 5.2 | 14.85 |

| Zener Load Regulation | | | |
|---|-------------------------------|--|--|
| $R_s = 220 \text{ Ohm}$ Zener voltage (V_z) = 5.1 volt Supply Voltage (V_s) = 20 Volt No Load Voltage (V_{NL}) = 5.14 Volt | | | |
| SL. NO. | LOAD RESISTANCE (R_L) Ohm | REGULATED OUTPUT VOLTAGE (V_{FL}) Volt | % VOLTAGE REGULATION $[(V_{NL} - V_{FL})/V_{FL}] \times 100$ |
| 1 | 1000 | 5.11 | 0.6 |
| 2 | 950 | 4.85 | 5.97 |
| 3 | 900 | 4.6 | 11.74 |
| 4 | 850 | 4.34 | 18.43 |
| 5 | 800 | 4.09 | 25.37 |
| 6 | 750 | 3.83 | 34.2 |
| 7 | 700 | 3.58 | 43.58 |
| 8 | 650 | 3.32 | 54.82 |
| 9 | 600 | 3.03 | 69.64 |
| 10 | 550 | 2.81 | 82.92 |
| 11 | 500 | 2.55 | 101.57 |
| 12 | 450 | 2.3 | 123.48 |
| 13 | 400 | 2.04 | 152 |
| 14 | 350 | 1.79 | 187.2 |
| 15 | 300 | 1.53 | 236 |

- Graphs:



- Precautions:

1. Make sure that the connections are tight.
2. Take care to apply suitable forward and reverse voltages across the zener diode so that suitable forward and reverse currents flow through the diode. Otherwise the diode may be damaged.

- Conclusion:

V-I reverse characteristics of Zener diode, we (Zener voltage, here V_Z) the reverse voltage remains constant while the current goes on increasing abruptly. But, while performing the experiment it should be noted that the maximum current rating of the Zener is not cross operation. The forward characteristics of Zener are the same as that of a simple diode.

- References:

- <https://www.youtube.com/watch?v=Ylxy50FF33Y>
- <https://www.youtube.com/watch?v=IUpjuKCZRAI>
- https://www.electronics-tutorials.ws/diode/diode_7.html