Table of contents

1. Introduction
2. Objectives
3. Circuits under Test
4. Experimental Result
5. Conclusion and Remark
6. Appendix: Prelab Assignment

Introduction

The report for lab 2 i.e., Voltage Regulators took place on 3 Feb 2021.Appendix at the end is the prelab Assignment.

Objective

The objective of lab 2 is to examine the voltage regulator’s characteristics. There are three types of Voltage regulators that were considered in this lab:

1. A resistive voltage driver which has two resistor connected in series and a load in parallel to one of the resistor. The circuit has a voltage of 10V passing through.
2. A Zener diode-based voltage regulator which has a Zener diode connected in series with a resistor and load in parallel to the Zener diode. The circuit has a voltage of 10V passing through.
3. A diode-based voltage regulator which has a resistor and a bunch of diodes connected in series so that it forms a voltage of 6.3V and a load in parallel to the diode. The circuit has a voltage of 10V passing through.

Circuit under Test

In this experiment there are three types of voltage regulators used in the circuits which are Zener diode regulator, voltage driver, and the forward based diode regulator. We use potentiometer and BJT to simulate load which draw different amount of current from the Vo. The most important part of the simulation is to assign a variable load in terms of load current. This can be simulated from 2N3904BJT and a potentiometer. The potentiometer can be adjusted by the user but by adjusting potentiometer we also adjust load current.

Diagram, schematic

Description automatically generated

Fig 1: The circuit is used to create a current load.

The next step contains adding a voltage regulator (which has two resistors in series) from the above circuit.

Diagram, schematic

Description automatically generated

Fig 2: This figure shows the resistive voltage driver used with the help of adjustable current load.

The next step contains swapping the voltage regulator (which has two resistors in series) with the voltage regulator (which has a resistor and a Zener diode) from the above circuit.

Diagram, schematic

Description automatically generated

Fig 3: This figure shows the Zener diode-based voltage regulator used with the help of adjustable current load.

The next step contains swapping the voltage regulator (which has a resistor and a Zener diode) with the above voltage regulator (which has a resistor and a forward based diode) from the above circuit.

Diagram, schematic

Description automatically generated

Fig 4: This figure shows the forward biased diode-based voltage regulator used with the help of adjustable current load.

Experimental Result

The following values are obtained by setting the =10V. the potentiometer is used ti obtain the value of current load and this is used to get he values.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|  | 0 | 0.1 | 0.2 | 0.3 | 0.4 | 0.5 | 0.6 | 0.7 | 0.8 |
|  |  | 6.245 | 6.168 | 6.018 | 5.963 | 5.911 | 5.815 | 5.795 | 5.743 |

E2. Output voltage as a function of load current in the circuit of figure 2. (according to this report )

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|  | 0 | 0.1 | 0.2 | 0.3 | 0.4 | 0.5 | 0.6 | 0.7 | 0.8 |
|  |  | 6.325 | 6.245 | 6.165 | 6.036 | 5.98 | 5.921 | 5.864 | 5.839 |

E3. Output voltage as a function of load current in the circuit of figure 3. (according to this report)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|  | 0 | 0.1 | 0.2 | 0.3 | 0.4 | 0.5 | 0.6 | 0.7 | 0.8 |
|  |  | 6.472 | 6.452 | 6.418 | 6.397 | 6.388 | 6.323 | 6.296 | 6.254 |

E4. Output voltage as a function of load current in the circuit of figure 4. (according to this report)

Conclusion Remark

C1. Based on the prelab calculations of P1, fictitious load resistance, RL = Vo/IL, that corresponds to each of the currents specified in the Table P1, (refer to the pre-lab assignment), Table C1 is completed below

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|  | 6.2 | 5.96 | 5.56 | 5.22 | 4.97 | 4.59 | 4.28 | 3.96 | 3.57 |
|  | ∞ | 5.96 | 2.78 | 1.74 | 1.24 | 0.91 | 0.71 | 0.57 | 0.45 |

Table C1. Equivalent load resistance for voltage divider of figure1. (according to lab manual.)

We can calculate Thevenin resistance which is 346.6Ω. because Thevenin voltage is an open circuit across the terminal when

C4. The graph of E2, E3 and E4 are represented in a single graph C4

V1=values of Vo in table E2(voltage driver)

V2=values of Vo in table E3(Zener diode)

V3=values of Vo in table E4(forward biased)

Slope = ||

Graph C4

Graph c4 represents different values of current load and Vo in three same circuits attached with three different regulators. In this graph we can also see that the current load is the only variable in this graph in three different situations and it ranges from 0 to 8 according to the tables. We can see that v3 in the graph is the most stable compared to the other two and second comes v2 and the least stable is v1. Voltage divider’s Vo’s range is 5.743V – 6.245V and the Zener diode’s range is 5.839V – 6.325V and the forward biased diode’s Vo’s range is 6.254V – 6.472V.

So we can say that the graph matches with the mathematical equation where voltage driver’s graph is purely based on the ohm’s law, Zener diode’s graph has higher exponential graph and the forward biased diode has lesser exponential graph.

C5. Aside from the Zener diode-based voltage regulator being stable in terms of the values of for different current load we can safely say that this is less sensitive to any fluctuations in the supply voltage. So, the change in voltage across the string of the diode is greater than Zener diode regulator.

Appendix: prelab-Assignment

Text

Description automatically generated with medium confidence

Table P1

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|  | 6.2 | 5.96 | 5.56 | 5.22 | 4.97 | 4.59 | 4.28 | 3.96 | 3.57 |

Graph P1

Text

Description automatically generated

Table P2

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|  | 5.19 | 5.18 | 5.17 | 5.16 | 5.15 | 5.14 | 5.13 | 5.12 | 5.11 |

Graph P2