EEE - 313 Electronic Circuit Design
Lab - 2

Robin Umut Kızıl
Section - 2
22003260

EXPERIMENTAL REPORT

1) Introduction

In this lab, we were asked to design a low-dropout (0.7V max) voltage regulator. We also need to connect a second LED and this LED should be set to turn on when the regulator works properly. 10V is selected as a regulator voltage.

2) Experiment and Calculations

2.1) Calculation of β

To measure β, a multimeter, used as an ammeter, is connected to the emitter and base ends and the current is measured. If the BJT is set to ACT, β is found by proportioning the incoming current values to each other.

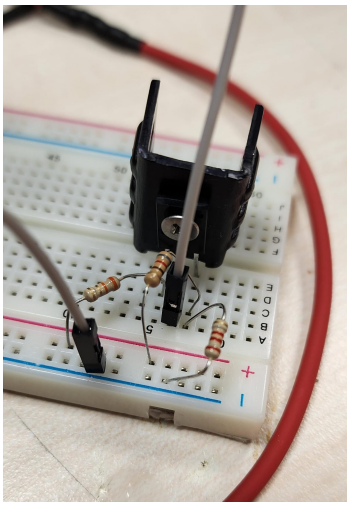

Fig. 1: Circuit of β Calculation Method

Component list:

- 3 resistor $(2.2K, 3.3, 820)$
- pnp BJT (BD136)
- voltage supply

In the preliminary method, due to the small size of the resistors (they burn), 3.3 was replaced with 50. β was measured as 262.49. In experimental, values are:

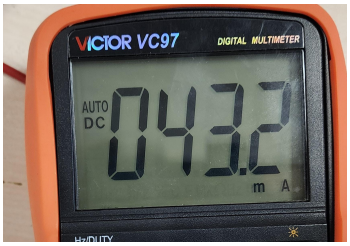

Fig. 2: Emitter Current

Fig. 3: Base Current

From here β is 240 with the error rate 8.57%.

2.2) Low-Dropout Voltage Regulator

Low-dropout voltage regulator will be made in this part and tests will be carried out on it.

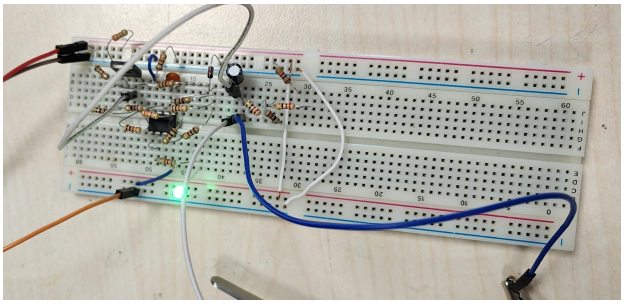

Fig. 4: Low-Dropout Voltage Regulator Circuit

Component list:

- 17 resistor $(1\ 3.3\Omega, 8\ 1K\Omega, 1\ 470\Omega, 1\ 5K\Omega, 1\ 1.1K\Omega, 3\ 2.2K\Omega, 2\ 500\Omega)$
- 2 Opamp (LM358)
- Zener diode (with 5.1 Breakdown Voltage)
- Led (L128-DRD1003500000)
- 2 capacitor $(1\mu C)$
- voltage supply

2.2.1) Voltage Regulator

When we look at various voltages, we can see that the circuit is regulated in appropriate voltage ranges and works properly.

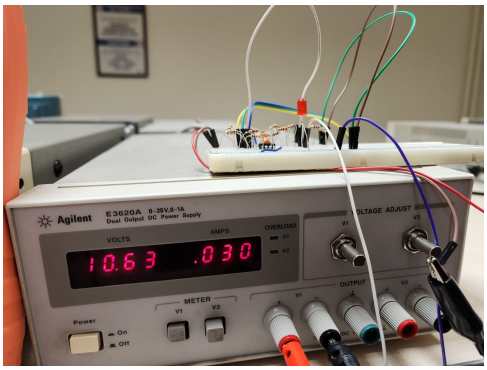

Fig. 5: Circuit With The Supply Voltage $10.63V$, Led Is Off, No Regulation

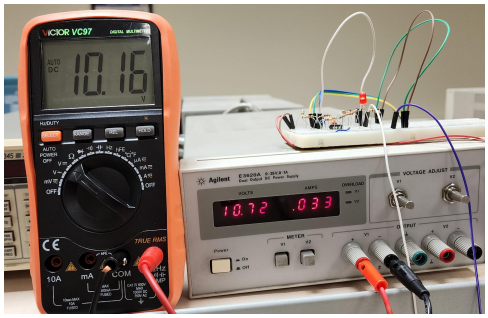

Fig. 6: Circuit With The Supply Voltage $10.72V$, Led Is On, Regulation On

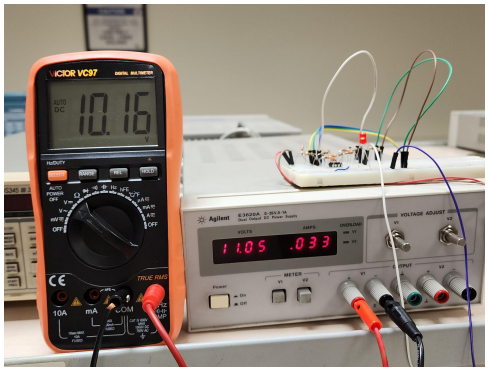

Fig. 7: Circuit With The Supply Voltage $11V$, Led Is On, Regulation On

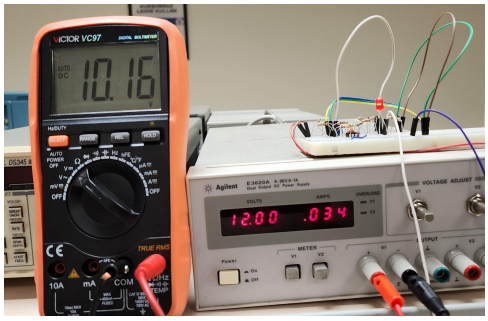

Fig. 8: Circuit With The Supply Voltage $12V$, Led Is On, Regulation On

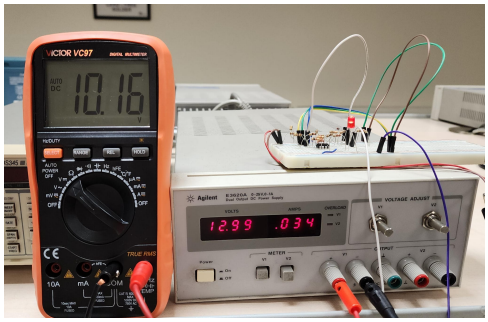

Fig. 9: Circuit With The Supply Voltage $13V$, Led Is On, Regulation On

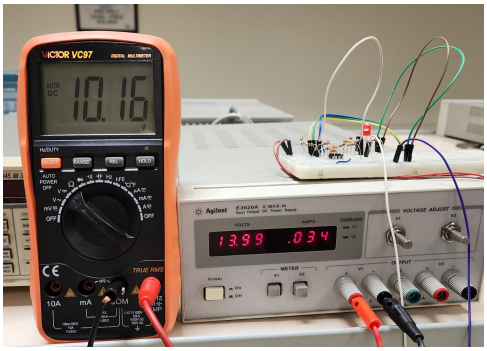

Fig. 10: Circuit With The Supply Voltage $14V$, Led Is On, Regulation On

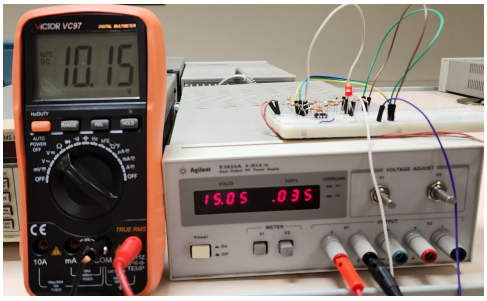

Fig. 11: Circuit With The Supply Voltage $15V$, Led Is On, Regulation On

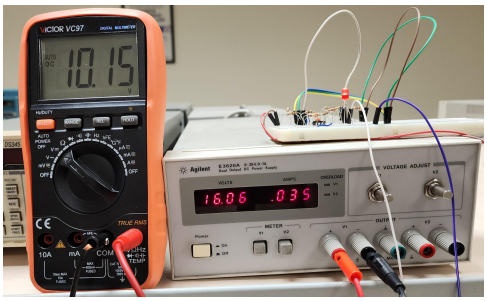

Fig. 12: Circuit With The Supply Voltage $16V$, Led Is On, Regulation On

2.2.2) Output Current Experiments

In this part, the ammeter connected to the output load will first be connected to 500Ω, and then the 100Ω and $2K\Omega$ resistors in series will be placed. After than then as a short circuit will be implemented and the output current will be measured in all variations. Supply Voltage is set to 12V. Measured values:

Fig. 13: Output Current while 500Ω Resistor Placed

Fig. 14: Output Current while $2K\Omega$ Resistor Placed

Fig. 15: Output Current while 100Ω Resistor Placed

When the circuit works as a voltage regulator, the output current is $19.26mA$.
The other values are $5.63mA$ and $98mA$, as expected, they are between $5mA$ and $100mA$.

If the supply voltage is set to 10.7 volts, the output short circuit current is:

Fig. 16: Output Current At short Circuit

The short circuit current of 141 is among those that meet the conditions.

Situation	expected Value	Measured Value	Error Rate
500Ω	$20mA$	$19.26mA$	3.7%
$2K\Omega$	$5.31mA$	$5.63mA$	6%
100Ω	$91.8mA$	$98mA$	6.7%
short circuit	$139mA$	$141mA$	1.43%

TABLE I: Table of Error Rates

2.2.3) Dissipated Power

When we measure dispersed power, we find the value $188{,}74mW$ with 500Ω and $19.26mA$, which is in accordance with the desired values.

2.2.4) Heat Sink Temperature

In this park, a multimeter will be connected to measure the temperature of the transistors and then the stable temperature will be checked while the output load passes to 80ma.

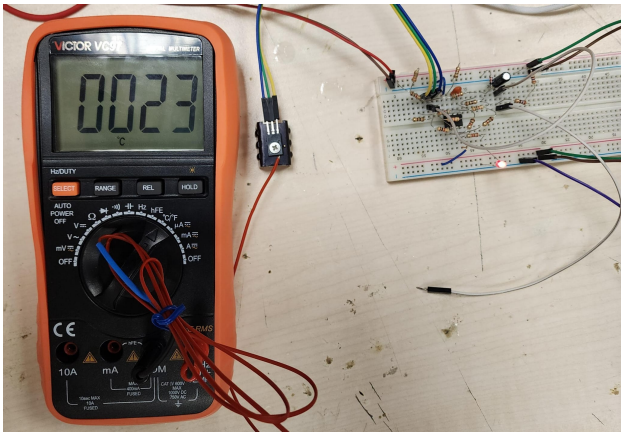

Fig. 17: Case Tempeture and Heat Calculation Circuit

As can be seen above, the temperature will be measured by connecting the temperature measuring end of the ammeter right next to the BJT heat sink. And case temperature measured 23 with error rate 4.34%.
A 120ohm resistor is connected to the load resistor to pass 80 mA and the temperature measurement is as follows.

Fig. 18: Heat Calculation

Expected Value	Measured Value	Error Rate
$51.4°C$	$45°C$	12.4%

TABLE II: Table of Error Rate

The error rate is within the acceptable range.

3) DipTrace Circuit

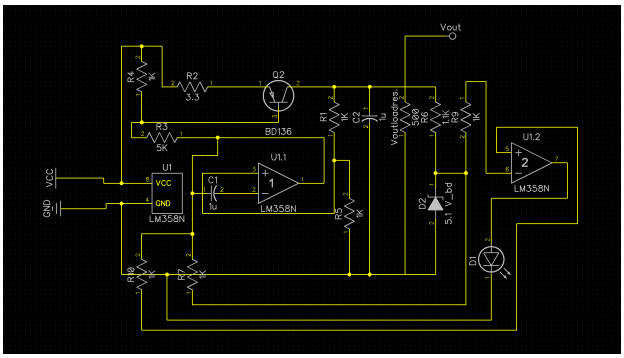

Fig. 19: DipTrace circuit

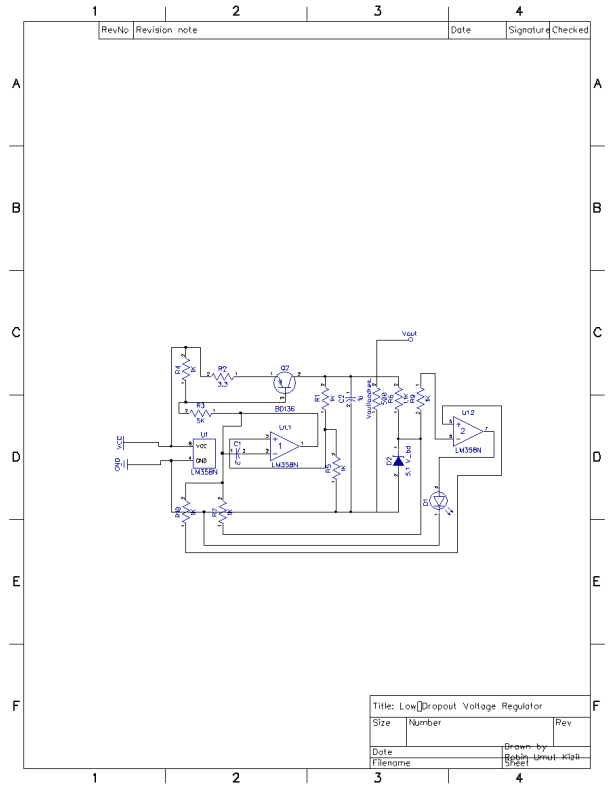

Fig. 20: DipTrace circuit 2

4) Conclusion

As a result, the low-dropout voltage regulator circuit was built and integrated, and the required values were within the appropriate range. Due to the 10 V selected in the circuit, our LED worked correctly when regulating the circuit between 10.7 and 16 V and various current measurements were correct.