Department of Electronic and Telecommunication Engineering

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EN2111 Electronic Circuit Design

Linear Power Supply - Group 37

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$37 \bmod 5 \Rightarrow 2$

mid Input V. = 16

mid output V = $16 - 8 + (37 \bmod 3)$

$= 8 + 1$

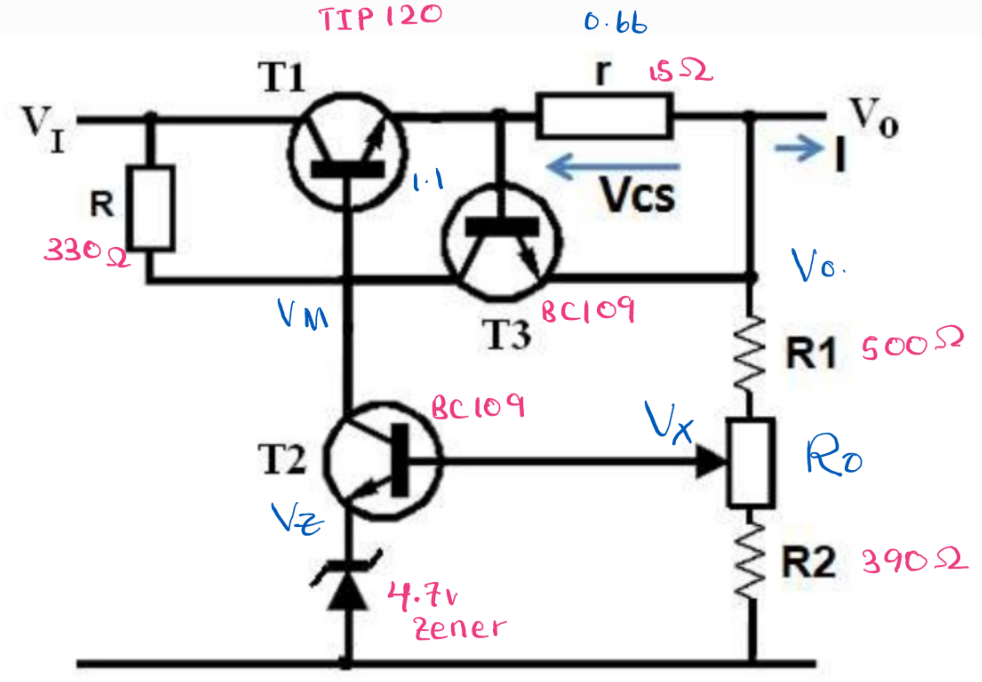
$= 9$ ± 3

Input Voltage Range : 16 ± 2

14 – 18 V

Output Voltage Range : 9 ± 3

: 6 – 12 V



Given data:

$T_2 \rightarrow$ BC109

$T_3 \rightarrow$ BC109

max. I = 100mA.

① Calculations & component selection.

- **T_1 (pass element)**

We need to find maximum power dissipation through T_1 (pass element)

$$P = (V_{CE\,max})(I_{max})$$

$$= (18-6)\,V \times 0.1\,A$$

$$= 1.2W$$

So we had to select a transistor with maximum power rating more than 1.2W

We found TIP120 for T_1 which had a power dissipation of 2W

$T_1 \rightarrow$ TIP 120

Derate above 25°C		0.52	W/°C
Total Power Dissipation @ T_A = 25°C Derate above 25°C	P_D	2.0 0.016	Watts W/°C
Unclamped Inductive Load Energy (1)	E	50	mJ

- **zenor diode**

since our minimum output voltage was 6V
We needed V_z to be less than 5.3V
∴ $(6V - 0.7V)$.

∴ Our selected zener 1N4732
which had 4.7 zener voltage

- **R_1 and R_2**

We kept the value of R_1 fixed
$R_1 \rightarrow 500\Omega$

and selected zener $V_z \Rightarrow 4.7V$
T_2 is a BC109; and it's always on active region

$$V_x = 4.7 + 0.7 = 5.4$$

$$5.4 = \left(\frac{R_{T_{max}}}{0.5 + R_{T_{max}}}\right) 6 \qquad 5.4 = \left(\frac{R_{T_{min}}}{0.5 + R_{T_{min}}}\right) 12$$

$$\frac{5.4}{2} + 5.4 R_T = 6 R_T \qquad \frac{5.4}{2} + 5.4 R_{T_{min}} = 12 R_T$$

$$R_{T\,max} = 4.5k\Omega \qquad R_{T_{min}} = 400\Omega$$

since
$R \Rightarrow 500\Omega$

We needed $R_0 + R_2 = R_T$ to vary between $400\,\Omega$ to $4.5\,k\Omega$

Approximately we used $390\,\Omega$ for R_2 and a 10K potentiometer

R_T vary $\Rightarrow$ 390 + 10K

- r in the current limiting circuit

Since we used BC109 for T_2

r was calculated as follows

$$V_{BE\ cutoff} = I_{max} R$$

$$0.66 = 0.1 \times r$$

$$r = 6.6\,\Omega$$

- R

V_{BE} of TIP 120 $\rightarrow$ 1.1V

$$\frac{V_{I\,min} - V_{m\,max}}{R} > I_{Test\ zenor}$$

$$\frac{14 - (12 + 0.66 + 1.1)}{R} > 1\,mA$$

$$R < 300\,\Omega$$

We approximately used $330\,\Omega$ for R_1

(2) Observations.

since the output current was limited to 98 mA
we had to use 15 Ω resistor for th r resistor

* Line variation was around 0.01 V per 1V input voltage variation

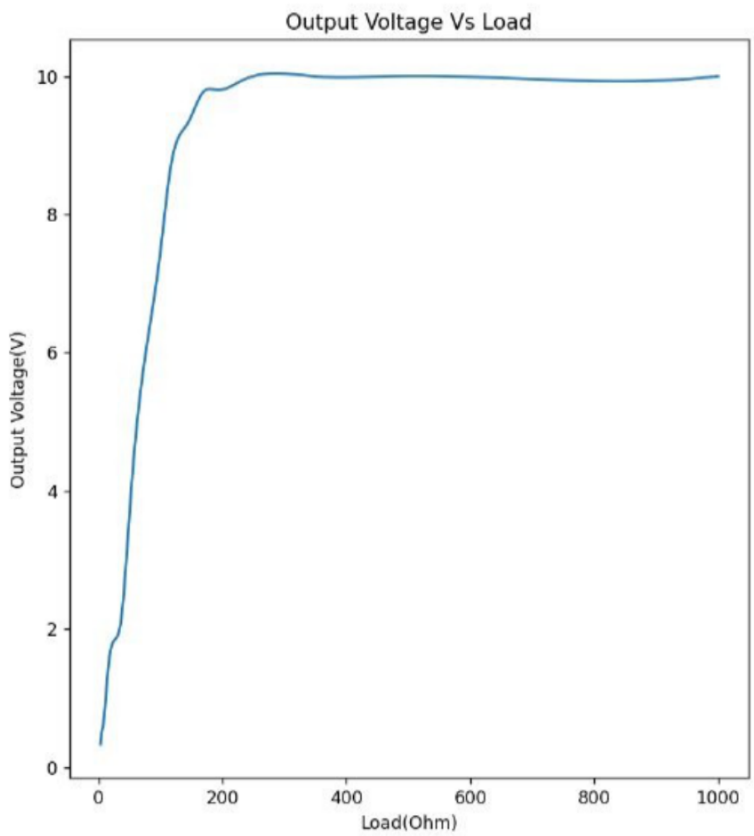
* Output current was limited at 0.098 A //

② Voltage, Current Vs Load Graphs.

Load variation

We fixed the input Voltage to 18V

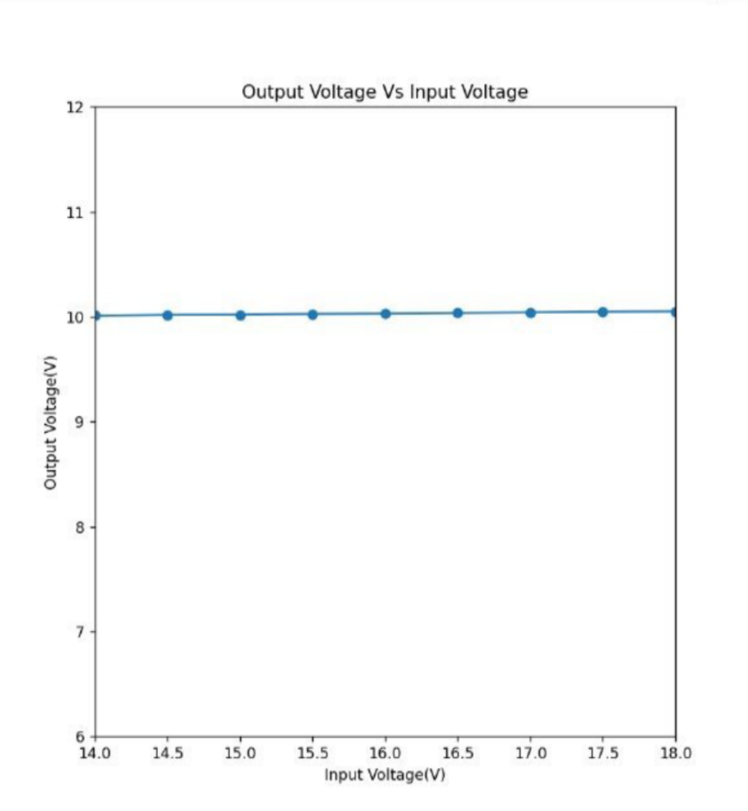
Load (Ω)	Output (V)
3.3	0.3346
3.9	0.3830
5.6	0.5488
6.2	1.37
14.7	2.11
36	3.89
51.6	5.28
65.58	7.48
100	8.61
115	9.32
114	9.75
167	9.80
191	9.94
232	10
334	10



Line Variation

- 0.01 v/1v

Input V (V)	Output (V)
14	10.012
14.5	10.018
15	10.021
15.5	10.024
16.	10.033
16.5	10.037
17	10.041
17.5	10.044
18	10.052


Output Voltage Vs Input Voltage
12
11
10
9
8
7
6
Output Voltage(V)
14.0
14.5
15.0
15.5
16.0
16.5
17.0
17.5
18.0
Input Voltage(V)

Our circuit.