ITMO University

PRACTICE TASK 2 REPORT
«Parametric linear voltage regulator»
Principles of Circuits

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1. Work purpose: to study parameters of parametric linear voltage regulator

Goals:

1) Calculate parameters of Parametric linear voltage regulator

2) [Optional] Find transistor and Zenner diode corresponding to the requirements

2. Starting data

- **Source voltage amplitude, [V]** $V_S = 35$
- **Voltage ripple [V]:** $\Delta V_S = 1$
- **Voltage required on the load [V]:** $V_{OUT} = 30.5$
- **Load resistance, [Ω]:** $R_L = 110$
- **Base-emitter voltage [V]:** $V_{BE} = 0.7$
- **Minimum current to be maintained through the Zener diode [mA]:** $I_{Z_{min}} = 2$
- **Forward current gain of the transistor (I_C/I_B):** $h_{FE} = 110$

3. Calculations

1. Calculate load current

$$I_L = \frac{V_{out}}{R_L} = 0.277 \quad [A]$$

2. Define required stabilized voltage

$$V_Z = V_{out} + V_{BE} = 31.2 \quad [V]$$

3. [optional] Choose the transistor according to the requirements:

$$V_{CE\_max} = (1.5 \ldots 2)V_{in\_max} = 72 \quad [V]$$

$$I_{C\_max} > 2I_L = 0.554 \quad [A]$$

4. Choose R_v is selected based on the condition that current $(1.5 \ldots 2)I_z$ should flow through the transistor at a minimum input voltage

$$R_{vmax} = \frac{V_{in_{min}} - V_Z}{(1.5)I_z + \frac{V_{out}}{R_L(1+h_{FE})}} = \frac{V_{Rv_{min}}}{(1.5)I_z + I_B} = 509.28 \quad [\Omega]$$

$$R_{vmin} = \frac{V_{in_{min}} - V_Z}{(2)I_z + \frac{V_{out}}{R_L(1+h_{FE})}} = \frac{V_{Rv_{min}}}{(2)I_z + I_B} = 430.90 \quad [\Omega]$$

5. Choose R_v correspondingly to E24 Series of standard resistor values.

E24	Nominal values of resistances							
1.0	0.01 Ω	0.1 Ω	1 Ω	10 Ω	100 Ω	1 kΩ	10 kΩ	100 kΩ
1.1	0.011 Ω	0.11 Ω	1.1 Ω	11 Ω	110 Ω	1.1 kΩ	11 kΩ	
1.2	0.012 Ω	0.12 Ω	1.2 Ω	12 Ω	120 Ω	1.2 kΩ	12 kΩ	
1.3	0.013 Ω	0.13 Ω	1.3 Ω	13 Ω	130 Ω	1.3 kΩ	13 kΩ	
1.5	0.015 Ω	0.15 Ω	1.5 Ω	15 Ω	150 Ω	1.5 kΩ	15 kΩ	
1.6	0.016 Ω	0.16 Ω	1.6 Ω	16 Ω	160 Ω	1.6 kΩ	16 kΩ	
1.8	0.018 Ω	0.18 Ω	1.8 Ω	18 Ω	180 Ω	1.8 kΩ	18 kΩ	
2.0	0.02 Ω	0.2 Ω	2.0 Ω	20 Ω	200 Ω	2.0 kΩ	20 kΩ	
2.2	0.022 Ω	0.22 Ω	2.2 Ω	22 Ω	220 Ω	2.2 kΩ	22 kΩ	
2.4	0.024 Ω	0.24 Ω	2.4 Ω	24 Ω	240 Ω	2.4 kΩ	24 kΩ	
2.7	0.027 Ω	0.27 Ω	2.7 Ω	27 Ω	270 Ω	2.7 kΩ	27 kΩ	
3.0	0.03 Ω	0.3 Ω	3.0 Ω	30 Ω	300 Ω	3.0 kΩ	30 kΩ	
3.3	0.033 Ω	0.33 Ω	3.3 Ω	33 Ω	330 Ω	3.3 kΩ	33 kΩ	
3.6	0.036 Ω	0.36 Ω	3.6 Ω	36 Ω	360 Ω	3.6 kΩ	36 kΩ	
3.9	0.039 Ω	0.39 Ω	3.9 Ω	39 Ω	390 Ω	3.9 kΩ	39 kΩ	
4.3	0.043 Ω	0.43 Ω	4.3 Ω	43 Ω	430 Ω	4.3 kΩ	43 kΩ	
4.7	0.047 Ω	0.47 Ω	4.7 Ω	47 Ω	470 Ω	4.7 kΩ	47 kΩ	
5.1	0.051 Ω	0.51 Ω	5.1 Ω	51 Ω	510 Ω	5.1 kΩ	51 kΩ	
5.6	0.056 Ω	0.56 Ω	5.6 Ω	56 Ω	560 Ω	5.6 kΩ	56 kΩ	
6.2	0.062 Ω	0.62 Ω	6.2 Ω	62 Ω	620 Ω	6.2 kΩ	62 kΩ	
6.8	0.068 Ω	0.68 Ω	6.8 Ω	68 Ω	680 Ω	6.8 kΩ	68 kΩ	
7.5	0.075 Ω	0.75 Ω	7.5 Ω	75 Ω	750 Ω	7.5 kΩ	75 kΩ	
8.2	0.082 Ω	0.82 Ω	8.2 Ω	82 Ω	820 Ω	8.2 kΩ	82 kΩ	
9.1	0.091 Ω	0.91 Ω	9.1 Ω	91 Ω	910 Ω	9.1 kΩ	91 kΩ	

$$R_{vmin} < R_{vE24} = 470 < R_{vmax} \quad [\Omega]$$

4. Conclusions

Conclusions should contain:

1) Value of R_{vE24}

   $470[\Omega]$

2) [Optional] Which transistor correspond to the required parameters? Try to find one.

T_{amb} = 25 °C unless otherwise specified.

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
V_{CEO}	collector-emitter voltage	open base		-	-	80	V
I_C	collector current			-	-	1	A
I_{CM}	peak collector current	single pulse; $t_p \leq 1$ ms		-	-	2	A