Practice Task 2
Parametric linear voltage regulator

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Summary

1. Parametric linear voltage regulator

2. Control test

Practice 2

https://clck.ru/32cCpP

https://forms.yandex.com/cloud/6364aa9c5056902467fc8160/\

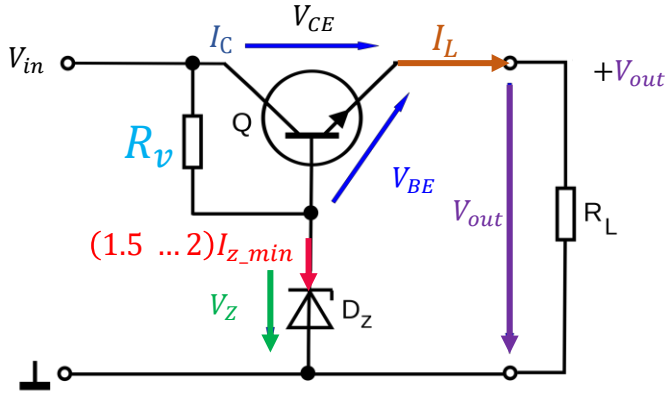
1st deadline: 28.10.2024 23:59 (GMT +8)

Please, be very careful with your HDU/ITMO numbers: some elements of the task will be checked automatically, and wrong ID or variant data will cause a wrong (sometimes-zero score) for your task

The accuracy of the answer should be at least **2 digits** after 0 or **2 meaning digits** (Examples: 0.**20**, 153.**99**, **1.00** but 0.000**19**, 0.0000000**60**)

Pay attentions to the units [V], [A], [mA], [mV] – answer should be in units, provided in the question

Parametric linear voltage regulator



$$R_V = \frac{V_{in_{min}} - V_Z}{(1.5 \ldots 2)I_{z\_min} + \frac{V_{out}}{R_L(1 + h_{FE})}}$$

Where

$\boldsymbol{V_{in} = V_S \pm \Delta V_S}$ is the source voltage with ripples

$\boldsymbol{V_{in_{min}} - V_Z}$ is the minimum voltage to be maintained across $\boldsymbol{R_V}$,

$\boldsymbol{(1.5 \ldots 2)I_{z\_min}}$ is the minimum current to be maintained through the Zener diode,

$\boldsymbol{V_{out}}$ is the voltage on load resistor $\boldsymbol{R_L}$,

$\mathbf{h_{FE}}$ **is** the forward current gain of the transistor.

$$h_{FE} = \frac{I_C}{I_B} = \frac{I_E - I_B}{I_B} = \frac{I_L - I_B}{I_B}.$$

Parametric linear voltage regulator

1. Calculate load current

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

2. Define required stabilized voltage

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

3. Chose the transistor according to the requirements:

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

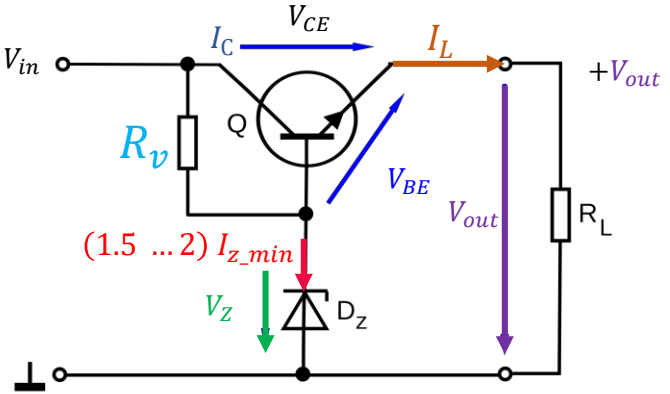
$I_{C\_max} > 2I_L =$ [A]

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

$$R_v = \frac{V_{in_{min}} - V_Z}{(1.5 \ \ldots 2) I_{z\_min} + \frac{V_{out}}{R_L(1 + h_{FE})}} = \frac{V_{Rv_{min}}}{(1.5 \ \ldots 2) I_{z\_min} + \frac{I_L}{(1 + h_{FE})}} =$$ [Ω]

$$I_B = \frac{I_L}{(1 + h_{FE})}$$

$$V_{Rv_{min}} = V_{in_{min}} - V_Z = ((1.5 \ \ldots 2) I_{z\_min} + I_B) R_v$$



Parametric linear voltage regulator

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$$R_v = \frac{V_{in_{min}} - V_Z}{(1.5 \ \ldots 2) I_{z\_min} + \frac{V_{out}}{R_L (1 + h_{FE})}} = \frac{V_{Rv_{min}}}{(1.5 \ \ldots 2) I_{z\_min} + \frac{I_L}{(1 + h_{FE})}} = \quad [\Omega]$$

$$I_B = \frac{I_L}{(1 + h_{FE})}$$

$$V_{Rv_{min}} = V_{in_{min}} - V_Z = ((1.5 \ \ldots 2) I_{z\_min} + I_B) R_v$$

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	

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

ITMO

Thank you for your attention!