PARAMETERS:
Pot_SET = 1
Rload = 440

V1
22

D9
5V,LED,LED

R44
330

R45
330

R37
330

R43
220

R1
3.3k

D7
BZX84-C5V1

QBC807-25
Q5

R2
820

D6
BZX84-C5V1

Q18
QBC846B

Q16
QBC856B

R3
2.2k

Q6
QBC846B

QBC856B

Q7
QBC846B

Q17

Q19
QBC846B

QBC856B
Q20

R47
220

R7
220

R34
1.5k

Q25
QBC846B

Q29
QMJD32C14G

Q23
QBC846B

R30   R31

R36
SET = 0.436
5k

R32
15k

QBC846B

SET = (Pot_SET)

R27
10k

R16
68

R28
1.5k

R40
100

R41
100

R42
100

R51
820

R52
820

R53
10

R39
220

D10
5V,LED,LED

R8
10k

Q26 în modul de funcţionare
Q26 este blocat

Q23 blocat în modul maximal
de funcţionare

0.47

Title
Stabilizator de tensiune cu ERS

Size
A

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Monday, November 18, 2024

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Rev
<RevCode>

Considerăm puterea disipatei de $1,73\,W$ =>

=> $I_1 = \dfrac{1,73}{22} = 78,68\,mA$

=> $P_{d_{R_2}} = P_{d_{R_4}} = P_{d_{R_3}} = 0,33 \cdot 196 = 65\,mW$

$I_g = \dfrac{(62-53)}{1,84} = 14\,mA$

$P_{d_{R_{2,4,3}}} = 0,22 \cdot 196 = 43\,mW$

$P_{d_{R_9}} = 5 \cdot 14 = 70\,mW$

$I_2 = 78,69 - 14 = 64,69\,mA$

$I_4 = 64,69 - 5,36 = 53,97\,mA$

$I_5 = 52,87$ $I_6 = 51,77$ => $I_{Eg} = 51,77 - 10 = 41,77\,mA$

$$D_8 : I_z \in [4,8 \; ; 5,4] \; [mA]$$
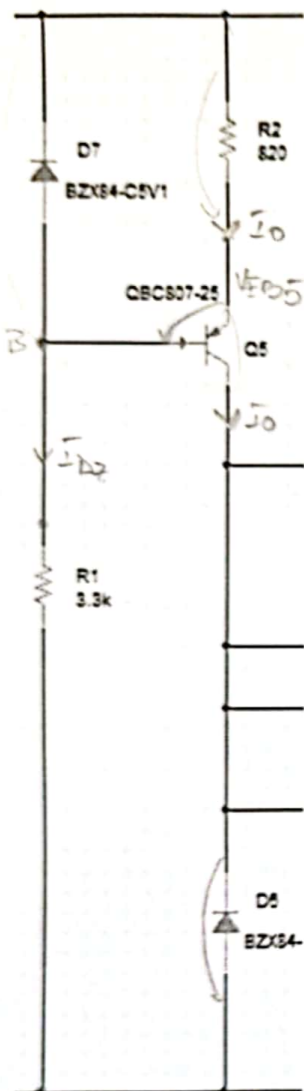
$$V_z = 5,1 \; [V]$$

$$I_0 = \frac{V_{Z_7} - V_{EB}}{R_2} \implies I_0 = \frac{5,1 - 0,7}{820} = 5,36 \cdot 10^{-3} A$$

Aprox $V_{EB} \simeq 0,7 V$

$$\implies \boxed{I_0 = 5,36 \; mA}$$

$5,36 \in [4,8 \; ; 5,4]$

$\implies$ D6 în străpungere

Considerăm cazul mefericit cu $V_{cc} = 19,8 V$

$$V_{cc} = V_{Z_7} + i_{D_7} \cdot R_1$$

$$\implies I_{D_7} = \frac{V_{cc} - V_{Z_{7}}}{R_1} = \frac{19,8 - 5,1}{3.3k} = 4,45 \; mA$$

$\implies$ D7 străpungere.

Pt $V_{cc} = 22 V$

$$\implies i_{D_7} = \frac{22 - 5,1}{3,3} = 5,12 \; mA$$

$\implies$ D7 străpungere

$\implies$ Pt $R_1 = 3,3 k$ în ambele situații D7 este în străpungere

$$V_{cc} = I_0 R_2 + V_{EC_5} + V_{L6}$$

$$\implies V_{EC_5} = 22 - 4,39 - 5,1$$

$$= 12,51 > V_{EB_5} \implies T_5 \; RAN$$

$Q_1: P_d = 12,51 \cdot 5,36 \; mA \simeq 67 \; mW < 300 \; mW$

$D_7: P_d = 5,1 \cdot 5,12 \; mA \simeq 26,1 \; mW < 300 \; mW$

$D_6: P_d = 5,1 \cdot 5,36 \; mA \simeq 27 \; mW < 300 \; mW$

$R_2: P_d = R_2 I^2 = 820 \cdot (0,005)^2 = 0,0205 \; W \simeq 20,5 \; mW$

$R_1: P_d = R_1 \; i_{D_7}^2 = 3,3 \cdot 26,21 \simeq 86,5 \; mW$
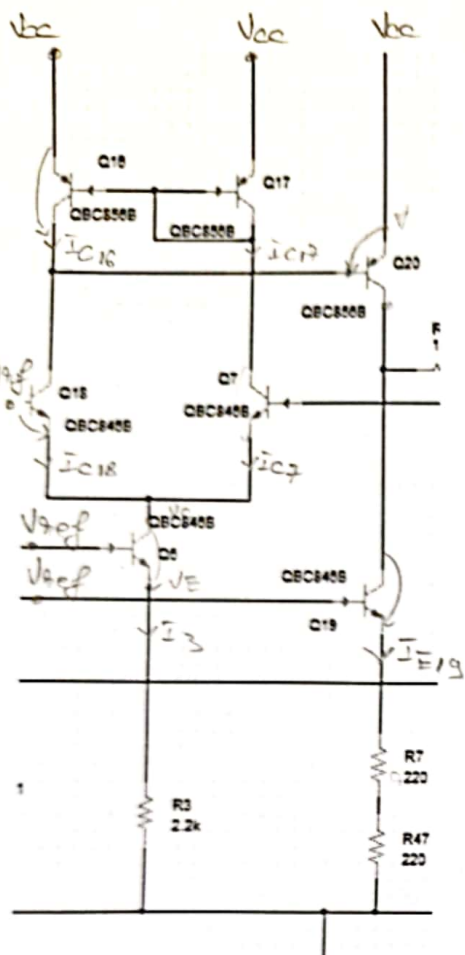
$V_{ref} = V_{BE6} + I_3 R_3$

$$I_3 = \frac{5,1 - 0,7}{2,2 k} \simeq 2, \text{ mA}$$

$V_{ref} = V_{BE19} + \bar{I}_{E19}(R_7 + R_{47})$

$$\bar{I}_{E19} = \frac{5,1 - 0,7}{440 \cdot 10^{-3}} = \frac{4,4}{0,44} \simeq 10 \text{ mA}$$

Q_{16}, Q_{17} oglindă de curent

$$\Rightarrow \bar{I}_{C16} = \bar{I}_{C17} = \bar{I}_{E16} = \bar{I}_{C17} \text{ (neglijăm}$$

curenții de bază)

$$\Rightarrow \bar{I}_{C18} = \bar{I}_{C7}$$

$$\bar{I}_{C18} + \bar{I}_{C7} = \bar{I}_3 \Rightarrow \boxed{\bar{I}_{C18} = \bar{I}_{C7} = 1,1 \text{ mA}}$$

$$\boxed{\bar{I}_{C20} = \bar{I}_{E19} = 10 \text{ mA}}$$

$V_{ref} = V_{BE18} + V_{CE6} + I_3 R_3 \Rightarrow V_{CE6} = 5,1 - 0,7 - 4,4 \simeq 0$

$\Rightarrow Q_6$ în saturație

$\Rightarrow$ **Puterea disipată pe Q_6 este foarte mică, de ordinul mW.**

$V_{CC} = V_{BE17} + V_{CE7} + I_3 R_3 \Rightarrow \boxed{V_{CE7} = 22 - 0,7 - 4,4 = 16,9} \Rightarrow \boxed{Pd_{Q7} \simeq 18 \text{ mW}} \Rightarrow Q_7 \text{ RAN}$

$\boxed{V_{EC16} = V_{BE20} = 0,7 V} \Rightarrow \boxed{Pd_{Q16} = 0,7 \cdot 1,1 \simeq 700 \mu W}$ Q_{16} RAN

$V_{CC} = V_{EC16} + V_{CE18} + I_3 R_3 \Rightarrow \boxed{V_{CE18} = 22 - 0,7 - 4,4 = 16,9} \Rightarrow \boxed{Pd_{Q18} \simeq 18 \text{ mW}}$ Q_{18} RAN

$V_{CC} = V_{EC17} + V_{CE7} + I_3 R_3 \Rightarrow \boxed{V_{EC17} = 22 - 16,9 - 4,4 = 0,7 V} \Rightarrow Pd_{Q17} \simeq 700 \mu W$ Q_{17} RAN

$V_{out} = -V_{BE25} + V_{CE18} + \bar{I}_{E19}(R_7 + R_{47}) \Rightarrow \boxed{V_{CE19} = 11 + 0,7 - 4,4 = 7,3 V} \Rightarrow \boxed{P_{Q19} = 73 \text{ mW}}$ Q_{19} RAN

$V_{CC} = V_{EC20} + V_{CE19} + \bar{I}_{E19}(R_7 + R_{47}) \Rightarrow \boxed{V_{EC20} = 22 - 7,3 - 4,4 = 10,3 V} \Rightarrow \boxed{Pd_{Q20} \simeq 100 \text{ mW}}$

Q_{20} RAN

$Pd_{R3} = R_3 \cdot \bar{I}_3^2 = 2,2 \cdot 4 \simeq 8 \text{ mW} < 125 \text{ mW}$

$Pd_{R7} = R_7 \cdot \bar{I}_{E19}^2 = 220 \cdot 100 = 22 \cdot 10^3 W = 22 \text{ mW} < 125 \text{ mW}$

$Pd_{R47} = 22 \text{ mW} < 125 \text{ mW}$

$V_{R34} = V_{C20} - V_{B25}$

$V_{EC20} = V_{E20} - V_{C20}$

$V_{E20} = V_{CC} = 22$

$V_{C20} = 22 - 10,3 = 11,7$

$V_{BE25} = V_{B25} - V_{E25}$ $V_{E25} = V_{out} = 11 V$

$V_{B25} = 0,7 + 11 = 11,7$

$\Rightarrow V_{R34} \approx 0 \Rightarrow$ Polarizată pe R_{34} este forarte mică

$V_{n} V_{EB29} = V_{E29} - V_{B29} \Rightarrow V_{B29} = 22 - 0,7 = 21,3$

$\Rightarrow \boxed{V_{E25} = 21,3 - 11 = 10,3 V} \Rightarrow Q_{25}$ RAN

$I_{C25} = I_{B29} << 0 \Rightarrow$ Pd Q_{25} este de ordinul μW

$\Rightarrow I_{E29} = I_{C29} = 41,77 mA$

$\boxed{V_{EC29} = V_{E29} - V_{C29} = 22 - 11 = 11 \quad V} \Rightarrow Q_{29}$ RAN

$\boxed{Pd_{Q29} = 41,77 \cdot 11 = 459,47 \, mW < 15 W}$

$V_{ref} = V_{out} \cdot \dfrac{R_8}{R_{27} + R_8 + R_{28} + R_{16}}$

$\Rightarrow V_{out} = 5,1 \cdot \dfrac{21,56}{10} \approx 11 V$

$I_7 = 41,77 mA$

$V_{ref} = i_8 R_8 = \dfrac{5,1}{10} = 0,5 \, mA \Rightarrow \boxed{Pd_{R8} = 10 \cdot 0,25 = 2,5 \, mW}$

$\boxed{Pd_{R27} = 10 \cdot 0,25 = 2,5 \, mW}$

$\boxed{Pd_{216} = 0,068 \cdot 0,25 = 1,7 \cdot 10^{-3} \, mW = 1,7 \, \mu W}$

$\boxed{Pd_{R28} = 1,5 \cdot 0,25 = 375 \, \mu W}$