**1 laboratory work**

**DC biasing**

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**Work aim:** During laboratory work you will analyze DC biasing schematics (presented at figures 1, 2, 3, 4, 5) and learn how to prototype simple schematic using breadboard.

**TASKS**

1. Build schematic shown on pictures 1, 2, 3, 4, 5. Transistor pinout can be read from its datasheet. For all schematics supply voltage is equal to +10V. For all schematics measure DC voltages Ub, Uc, Ue. Using Ohms. Kirchofs law calculate DC currents (Ic, Ib, Ie), h21e, Ube, Uce for all circuits.

1 table.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Circuits.    Parameters | 1 circuit | 2 circuit | 3 circuit | 4 circuit | 5 circuit |
| 1 fig. | 2 fig. | 3 fig. | 4 fig. | 5 fig. |
| *Ek,* *V* | 10.26 | 10.03 | 10.04 | 10.04 | 10.03 |
| *Uk,* *V* | 4.35 | 4.62 | 3.6 | 6.3 | 6.12 |
| *Ik,* *mA* | 2.9 | 11.57 | 1.28 | 17.27 | 18.06 |
| *Ub, V* | 2.17 | 3.21 | 0.60 | 0.68 | 0.68 |
| *Ib,* *mA* | 0.035 | 0.068 | 0.0076 | 0.087 | 0.094 |
| *Ue,* *V* | 1.50 | 2.50 | 0 | 0 | 0 |
| *Ie,* *mA* | 2.99 | 11.57 | 1.29 | 17.36 | 18.15 |
| *U*c*e,* *V* | 2.85 | 2.12 | 3.6 | 6.3 | 6.12 |
| *Ube,* *V* | 0.67 | 0.71 | 0.60 | 0.68 | 0.68 |
| *β h*FE *h*21*e* | 85.04 | 168.70 | 167.60 | 197.70 | 191.80 |

2. For all circuits calculate gain at 2 kHz frequency. For this. connect generator to circuits input and measure the voltage on output. Gain is calculated by formula

*uout*

*KU* = .

*uin*

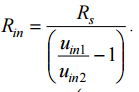
where: *uout* – voltage on output, *uin* – voltage on input (generator voltage).

2 table.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Circuits  Parameters | 1 | 2 | 3 | 4 | 5 | 1\* | 3\* |
| *uin,* *mV* | 110 | 48 | 42 | 41 | 48 | 110 | 40 |
| *uout,* *mV* | 1280 | 150 | 6400 | 2320 | 2200 | 420 | 6480 |
| *K* | 11.64 | 3.13 | 152.38 | 56.59 | 45.83 | 3.82 | 162 |

\* Capacitors *C*1 switch off.

3. Calculate for all circuits input resistance. For this connect resistor Rs is series to the input and measure voltage before (uin1) resistor and after (uin2). When calculate input resistance using formula



3 table.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Circuits  Parameters | 1 | 2 | 3 | 4 | 5 | 1\* | 3\* |
| *uin*1, *mV* | 130 | 10.5 | 10.3 | 10 | 10.1 | - | 10.2 |
| *uin*2, *mV* | 80 | 5.13 | 6.5 | 3.3 | 5.6 | - | 3.3 |
| *Rin.,* *Ω* | 5116.80 | 951.49 | 1703.68 | 490.57 | 1239.47 | - | 476.35 |
| *Rs,* *Ω* | 3198 | 996 | 996 | 996 | 996 |  | 996 |

\* Capacitors *C*1 switch off.

**In the report submit:** Schematics; formulas; measurements and calculation results; explanations; conclusions.



Fig. 1

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Rb1, *Ω*** | **Rb2, *Ω*** | **Rc, *Ω*** | **Re1, *Ω*** |  |  |  |
| 18.420E+3 | 5.370E+3 | 1.980E+3 | 500.7 |  |  |  |
| **Ek, *V*** | **Uk, *V*** | **Ub, *V*** | **Ue, *V*** |  | **Uke, *V*** | **Ube, *V*** |
| 10.26 | 4.35 | 2.17 | 1.5 |  | 2.85 | 0.67 |
| **Ib, *A*** | **Ik, *A*** | **Ie, *A*** |  |  | **β** |  |
| 35.100E-6 | 2.985E-3 | 2.996E-3 |  |  | 85.04 |  |



Fig. 2

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Rb1, *Ω*** | **Rc, *Ω*** | **Re1, *Ω*** |  |  |  |  |
| 99.450E+3 | 467.70 | 216.10 |  |  |  |  |
| **Ek, *V*** | **Uk, *V*** | **Ub, *V*** | **Ue, *V*** |  | **Uke, *V*** | **Ube, *V*** |
| 10.03 | 4.62 | 3.21 | 2.5 |  | 2.12 | 0.71 |
| **Ib, *A*** | **Ik, *A*** | **Ie, *A*** |  |  | **β** |  |
| 68.580E-6 | 11.570E-3 | 11.570E-3 |  |  | 168.71 |  |



Fig. 3

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Rb1, *Ω*** | **Rd1, *Ω*** | **Rc, *Ω*** |  |  |  |  |
| 3.200E+3 | 388.000E+3 | 5.010E+3 |  |  |  |  |
| **Ek, *V*** | **Uk, *V*** | **Ub, *V*** | **Ue, *V*** |  | **Uke, *V*** | **Ube, *V*** |
| 10.04 | 3.6 | 0.6 | 0 |  | 3.6 | 0.6 |
| **Ib, *A*** | **Ik, *A*** | **Ie, *A*** |  |  | **β** |  |
| 7.669E-6 | 1.285E-3 | 1.293E-3 |  |  | 167.56 |  |



Fig. 4

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Rb1, *Ω*** | **Rb2, *Ω*** | **Rc, *Ω*** |  |  |  |  |
| 98.500E+3 | 99.300E+3 | 216.5 |  |  |  |  |
| **Ek, *V*** | **Uk, *V*** | **Ub, *V*** | **Ue, *V*** |  | **Uke, *V*** | **Ube, *V*** |
| 10.04 | 6.3 | 0.68 | 0 |  | 6.3 | 0.68 |
| **Ib, *A*** | **Ik, *A*** | **Ie, *A*** |  |  | **β** |  |
| 87.360E-6 | 17.270E-3 | 17.360E-3 |  |  | 197.69 |  |



Fig.5

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Rb, *Ω*** | **Rc, *Ω*** |  |  |  |  |  |
| 99.300E+3 | 216.50 |  |  |  |  |  |
| **Ek, *V*** | **Uk, *V*** | **Ub, *V*** | **Ue, *V*** |  | **Uke, *V*** | **Ube, *V*** |
| 10.03 | 6.12 | 0.68 | 0 |  | 6.12 | 0.68 |
| **Ib, *A*** | **Ik, *A*** | **Ie, *A*** |  |  | **β** |  |
| 94.160E-6 | 18.060E-3 | 18.150E-3 |  |  | 191.80 |  |

**Considerations:**

Values of current are obtained in an idirect manner by measuring resistance values and by omh’s law find currents

Notes: high noises encountered during measurements on circuit 2

**Conclusions:**

**we set on several circuits to analyze DC biasing circuits. Main aim of this laboratory work was learing how to prototyping simple shematics using breadboard and basic electronic components such as transistors, capacitors and resistors. First part of process was realizing the circuit on the lab shematics on breadboard then we used wave generator to test the circuit response with known input signals furthermore we measured these responses using analog oscilloscope but some circuits were so noisy we had to configure it again according to measurements. we measured voltages on legs of transistor and power supply then we used these measurements to calculate current with ohm’s law. On second part of process we measured input and output voltages when alternative current was apllied then we use these voltages to find out gain with given formula. on third part of process  
we used additional resistor on input voltage and measured voltage on each leg of resistor to calculate input resistor with the given formula**