

# Labor of Fundamentals of Electronics and Power Electronics

## Exercise No. 5

### AUDIOFREQUENCY POWER AMPLIFIER

#### 5.1 Basic information

For the purposes of obtain the single-stage audiofrequency power amplifier based on bipolar transistor are this exercise. It is possible to make tests of common emitter amplifier with or without emitter feedback for AC voltage component. It is possible to use the voltage divider to establish the bias point of transistor too with or without emitter feedback for DC voltage component. The panel of the console include additionally too the integrated audiofrequency power amplifier UL1495.

#### References:

- Grebene A. B.: Bipolar and MOS analog integrated circuit design
- Buckingham M. J.: Noise in electronic devices an systems
- Titze U., Schenk Ch.: Semiconductors and circuits
- Titze U., Schenk Ch.: Układy półprzewodnikowe
- Baranecki A.: Laboratorium układów elektronicznych. Cz. 1
- Kaźmierowski M.P., Matysik J. T.: Wprowadzenie do elektroniki i energoelektroniki
- Jaczewski J., Opolski A., Stolz J.: Podstawy elektroniki i energoelektroniki
- Baranowski J., Czajkowski G. Układy elektroniczne. Cz. 1

#### 5.2 Description of exercise

The front panel of the exercise console is show on Figure 5.1.

This panel contain following circuits and elements:

- measurement and short-circuit sockets,
- coupling capacitances (input:  $1\ \mu\text{F} + 10\ \mu\text{F}$ , output  $10\ \mu\text{F}$ ) and blocking capacitances (emitter of transistor  $2 \times 10\ \mu\text{F}$ ),
- safety resistance to preserve the transistor. Value of resistance in voltage divider is  $1.8\ \text{k}\Omega$  and  $100\ \Omega$ . Value of collector resistance is  $200\ \Omega$ ,
- IC of amplifier UL1495 connected with standard elements recommended by application notes.

The panel of the console is powered by controlled voltage ( $U_R = 5\text{V} \div 18\text{V}$ ) from the main panel. This voltage is supplied by special internal connector (press the buttons  $U_R$  and  $5 - 18\ \text{V}$ ).

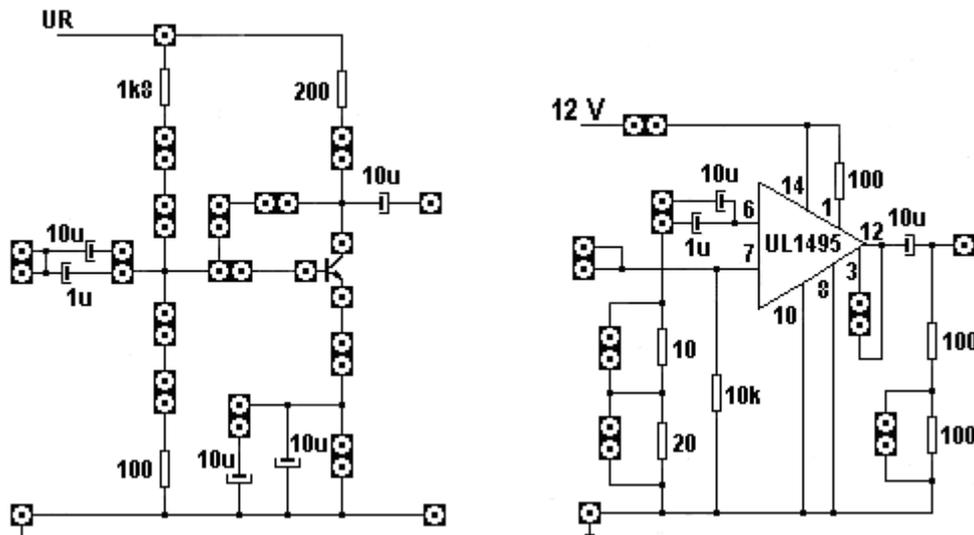


Fig. 5.1

## 5.3 Schedule of exercise

### 5.3.1 Test of common emitter transistor amplifier. Fig. 5.2.

- Choose value of collector resistance  $R_3$  about  $100\ \Omega \div 1\ \text{k}\Omega$ .
- Set the supply voltage  $U_R=15\ \text{V}$ .
- To make class A amplifier establish resistance divider ( $R_1, R_2$ ).
- The function generator connect to amplifier input connector. Establish frequency at  $f = 1\ \text{kHz}$  and amplitude  $0\ \text{V}$ .
- Turn on the oscilloscope and connect the measurement probe to amplifier output connector.
- Observe course of voltage on oscilloscope during increasing amplitude of input voltage. If output signal is different then sine for low input signal it is necessary to change bias point.
- After establish bias point measure the maximal value of amplitude of input signal. The output signal can't be distorted.
- For frequency  $f=1\ \text{kHz}$  measure voltage gain of circuit.
- Measure lower and upper limit of frequency and calculate the frequency pass band.
- Plot the amplifier pass band characteristic.

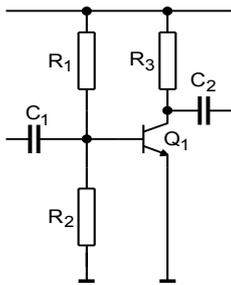


Fig. 5.2

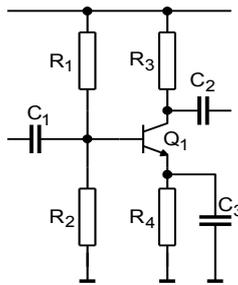


Fig. 5.3

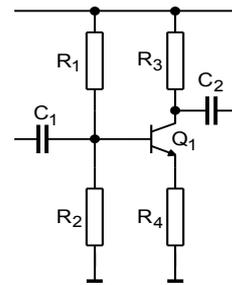


Fig. 5.4

### 5.3.2 Test of common emitter transistor amplifier with voltage divider supply and resistance connected to emitter. Fig. 5.3.

- Choose value of collector resistance  $R_3$  about  $100\ \Omega \div 1\ \text{k}\Omega$ .
- Choose value of emitter resistance  $R_4$  ( $100\ \Omega, 200\ \Omega$  or  $333\ \Omega$ ).
- Make tests according to point 5.3.1. b ÷ j.

### 5.3.3 Test of common emitter transistor amplifier with feedback. Fig 5.4.

- Disconnect the capacitor  $C_3$  from circuit 5.3.
- Make tests according to point 5.3.1. b ÷ j.

### 5.3.4 Test of integrated audiofrequency power amplifier. Fig. 5.5

- Choose the equalizing capacitance  $C_k$  about  $220\ \text{pF} \div 220\ \text{nF}$ . Choose the capacitance  $C_1$  and resistance  $R_1$ .
- The function generator connect to amplifier input connector. Establish frequency at  $f=1\ \text{kHz}$  and amplitude  $0\ \text{V}$ .
- Turn on the oscilloscope and connect the measurement probe to amplifier output connector.
- Observe course of voltage on oscilloscope during increasing amplitude of input voltage.
- Measure the maximal value of amplitude of input signal. The output signal can't be distorted.
- For frequency  $f=1\ \text{kHz}$  measure voltage gain of circuit.
- Measure lower and upper limit of frequency and calculate the frequency pass band.
- Plot the amplifier pass band characteristic.

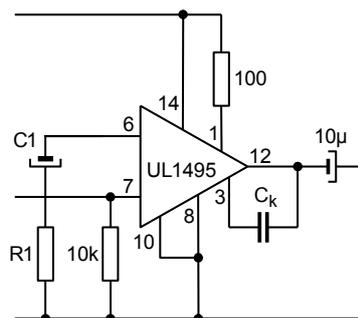


Fig. 5.5