Lab. nr 06
WOBULATOR AND FREQUENCY CHARACTERISTICS

Goal: To get familiar with the operation of the wobulator. To study the frequency characteristics of the electronic circuits with wobulator.

Experiment

1. Build the circuit of Fig. 1 and test the voltage controlled generator. Measure the dependence of the output frequency on the input voltage. Draw this dependence in your raport.

2. Build the setup of Fig. 2.
Measure the amplitude-frequency characteristic of the circuit composed of two resonance circuits coupled magnetically (for the circuit scheme see Fig.3). Determine the frequency bands for the investigated circuits.
Tune the two resonance circuits coupled magnetically to get: i) over-critical coupling, ii) critical coupling and iii) weak, below critical, coupling. Register the amplitude-frequency response for each of the above situations.

3) Measure the amplitude-frequency characteristic of another circuit recommended by the instructor.

Background

1. Wobulator, parameters of the monolithic function generator XR-2206.
2. Coupled circuits and transmission of electrical signals, filters, magnetic coupling.
2. Integrated circuits, voltage adder with op-amp, rectifier with op-amp.

Pre-lab reading

[1] I. Mayergoyz, W. Lawson, *Basic Electric Circuit Theory.*
[2] W.H. Hayt, *Engineering Circuit Analysis.*
[3] W.H. Hayt, J.E. Kemmerly, *Engineering Circuit Analysis.*
[4] S. Szczeniowski *Fizyka. Tom III. (Elektryczność i magnetyzm).*
[5] T. Szczypułowski *Podstawy elektroniki.*
[6] I.P. Żerebcow *Radiotechnika.*
[7] P. Horowitz, W. Hill, *The Art of Electronics*.
[8] T. C. Hayes, P. Horowitz, *Student Manual for The Art of Electronics*.

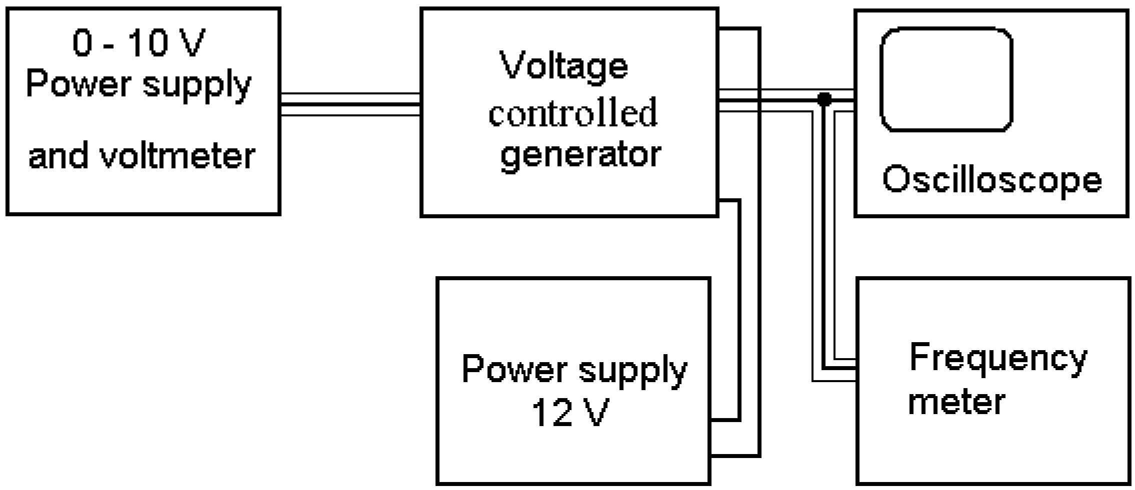


Fig. 1. Circuit for testing the voltage controlled generator.

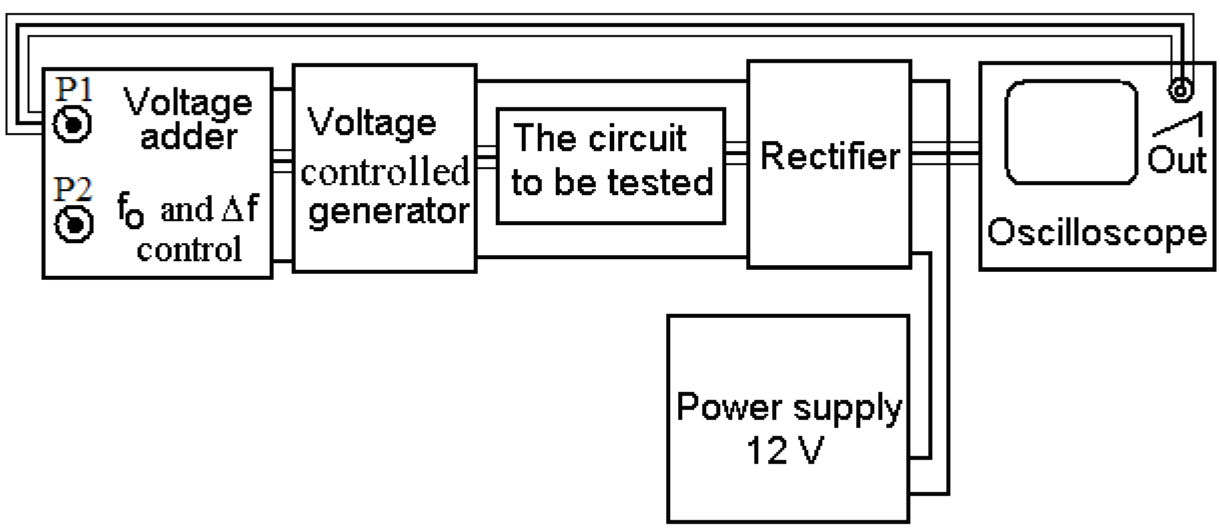


Fig. 2. Setup for the investigation of the amplitude-frequency characteristics of the electronic circuits. P1 – is a potentiometer that controls the width of the frequency band to scanned $\Delta f = f_{max} - f_o$. P2 – is a potentiometer that controls the value of f_o – the initial frequency of the scan.

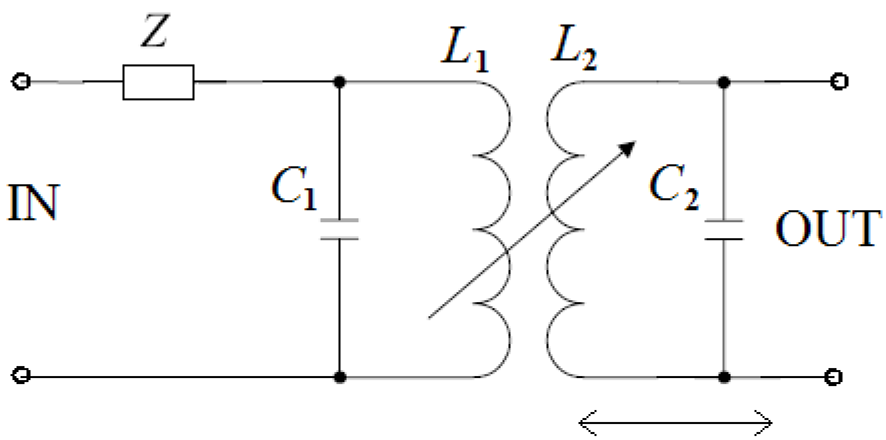


Fig. 3. Electric circuit composed of two resonance circuits (nearly identical) coupled magnetically. By changing the distance between L_1 and L_2 coils the frequency band can be modyfied.

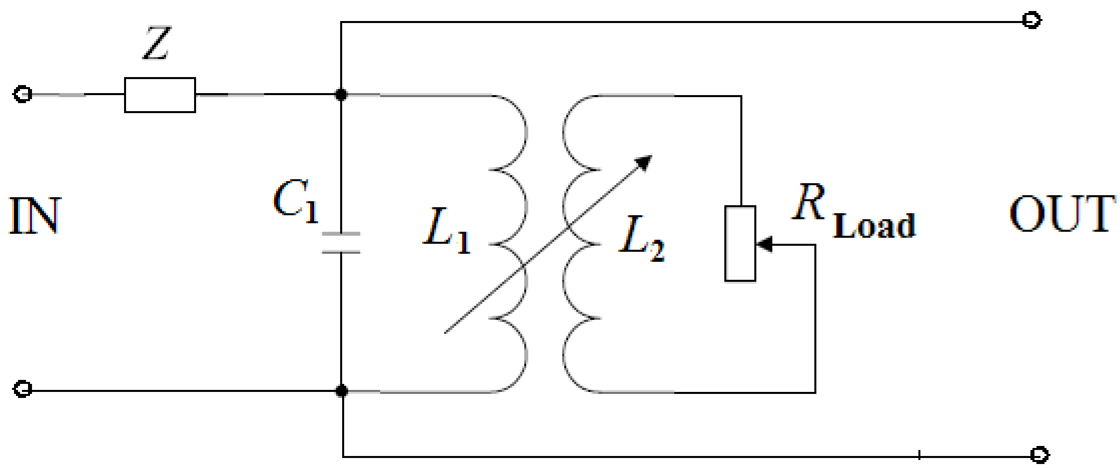


Fig. 3b. Electric circuit composed of resonance circuit and magnetically coupled load. By changing the value of the load resistor R_{Load} the frequency response of the circuit can be modified.

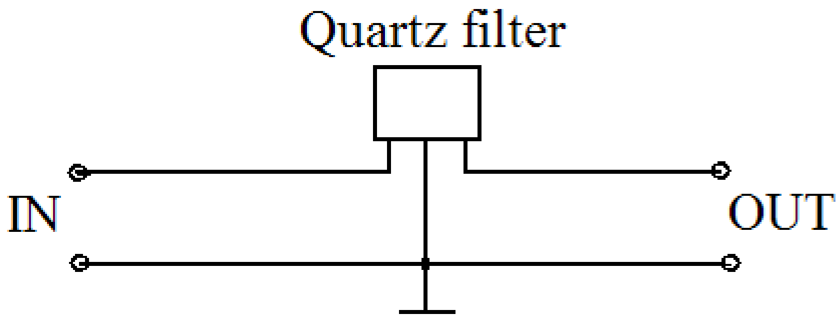
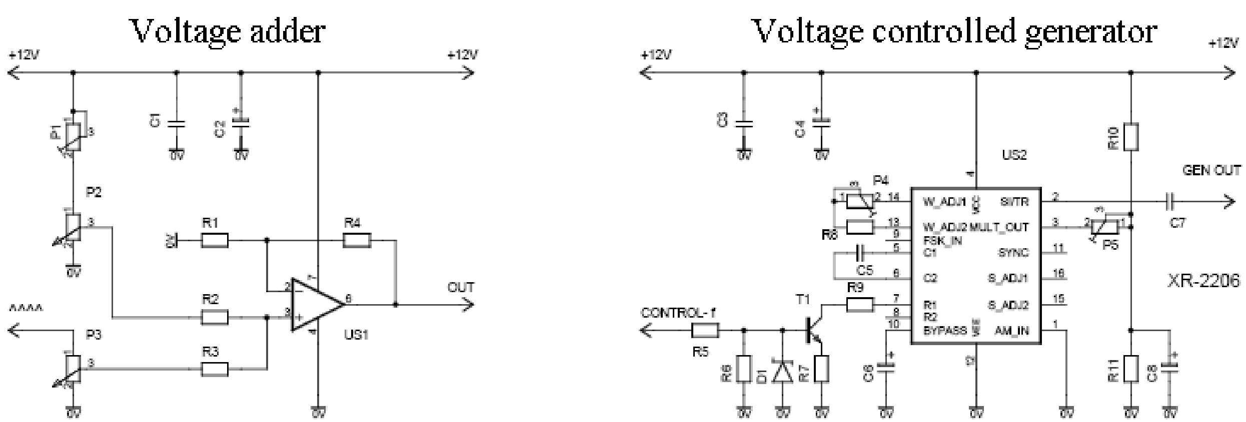


Fig. 3c. Quartz filter for the additional measurements of frequency response of the electric circuits.



R1-500k	C1-100nF	US1-TLC 271
R2-500k	C2-100uF	US2-XR2206
R3-500k	C3-100nF	US3-CA3140
R4-500k	C4-470uF	D1-DZo11V
R5-100k	C5-1nF	D2-1N4148
R6-100k	C6-1uF	T1-BC338
R7-1k	C7-470nF	P1-5k
R8-150ohm	C8-47uF	P2-10k
R9-100ohm	C9-100nF	P3-10k
R10-4k7	C10-100uF	P4-200ohm
R11-4k7	C11-470nF	P5-20k
R12-100k	C12-12nf	
R13-10k		

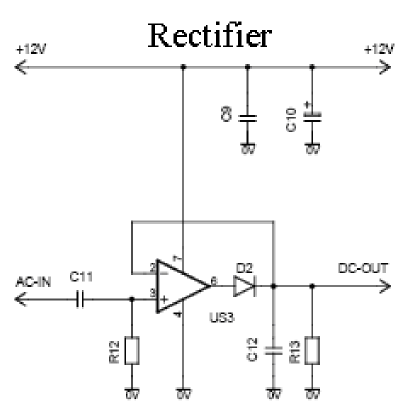


Fig. 4. Schemes of three basic units: voltage adder, voltage controlled generator and rectifier.

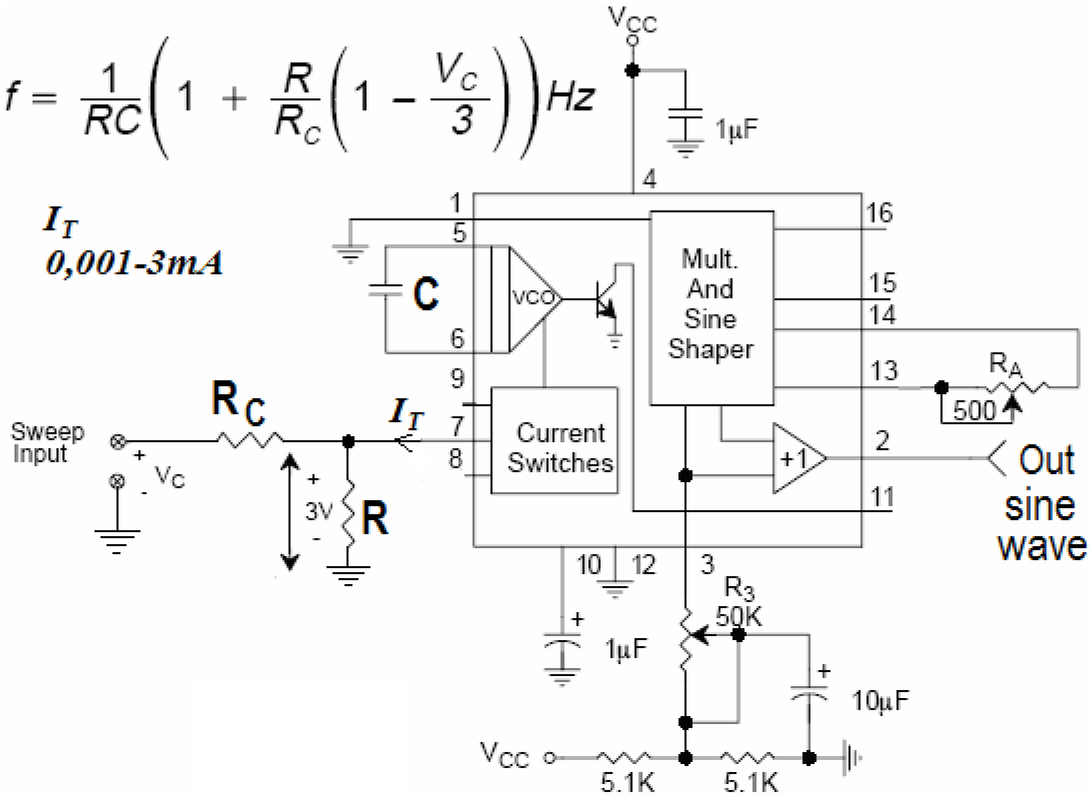


Fig. 5. Circuit for sine wale generation with minimum harmonic distortion, drawn on the basis of data sheet (EXAR-Corp).

Frequency Sweep and Modulation:

Frequency of oscillation is proportional to the total timing current, I_T, drawn from Pin 7 or 8:

$$f = \frac{320 I_T(mA)}{C(\mu F)}\ Hz$$

Timing terminals (Pin 7 or 8) are low-impedance points, and are internally biased at +3V, with respect to Pin 12. Frequency varies linearly with IT, over a wide range of current values, from 1µA to 3mA. The frequency can be controlled by applying a control voltage, V_C, to the activated timing pin as shown in *Figure* 4. The frequency of oscillation is related to VC as:

$$f = \frac{1}{RC}\left(1 + \frac{R}{R_c}\left(1 - \frac{V_c}{3}\right)\right) Hz$$

where V_C is in volts. The voltage-to-frequency conversion gain, K, is given as:

$$K = \partial f / \partial V_c = -\frac{0.32}{R_c C}\quad Hz/V$$

CAUTION: *For safety operation of the circuit, I_T should be limited to $\leq$ 3mA.*