FUNCTION GENERATOR WITH OP-AMP

I. OBJECTIVES

a) To determine the domains for the amplitude and frequency of the rectangular, triangular and sinusoidal generated signals.

II. COMPONENTS AND INSTRUMENTATION

We use the experimental assembly in Fig. 4. For the differential supply we need a dc voltage source. We will visualize the voltages in the circuit using a dual channel oscilloscope.

III. PREPARATION

P1. Rectangular and triangular signal generator with Op-amp

- For the circuit in Fig. 1., what is the function of the U1A operational amplifier and the role of the Q_1Q_3 group, connected at the output?
- What are the amplitudes of the voltages in the *OutD* and *Dreptunghi* points, if it is known that the Q_1Q_3 group acts like two *ZD 7V5*, connected anode to anode, and *J9 - J10* and *J11 - J12* are not connected? Draw the two waveforms.
- For the circuit in Fig. 1., what is the function of the U1B operational amplifier together with the capacitors on the feedback (alternatively connected in the circuit)?
- Draw the voltages in the *Dreptunghi* and *Triunghi* points, for the capacitors alternatively connected in the circuit.
- What kind of adjustment does *Pot1* do, together with one of the capacitors C_1, or C_2?
- Compute the minimum and maximum frequency of the rectangular voltage (*Dreptunghi* output) for each of the two capacitors (alternatively connected in the circuit).
- Compute the value of the fraction *k* of the *Pot1* potentiometer for C_1 connected in the circuit for which the rectangular voltage has a frequency of *5KHz*?

- Compute the value of the fraction *k* of the *Pot2* potentiometer for C_2 connected in the circuit for which the rectangular voltage has a frequency of *10KHz*?

P2. Sine wave generator with Op – amp

- What is the function of the circuit in Fig. 2. and the role of the first Op - amp (*U2A*)?
- What is the role of the *Pot2* potentiometer?
- Draw the voltages from the *Triunghi* (from the previous exercise) and *Sinus* points.

P3. Amplitude adjustment circuit

- For the circuit in Fig. 3. specify the function of the U3B Op - amp. What kind of adjustment can be done using this circuit (pay attention to the *Pot3* potentiometer)?
- Compute the minimum and maximum values for the gain of the circuit.
- Compute the minimum and maximum values of the amplitudes of the rectangular, triangular and sinusoidal signals, from the *Out* terminal of the Op - amp (*U3B*) and the amplitudes of the output signals if *k=0.5* (for *Pot3*).

IV. EXPLORATIONS AND RESULTS

1. Rectangular and triangular signal generator with Op - amp

Exploration

- For the circuit in Fig.1. apply a differential voltage ±15V in the points *J1* and *J2*.
- Use the jumpers to connect *J9* with *J10* and visualize on the oscilloscope the voltages in the *OutD* and *Dreptunghi*, *Dreptunghi* and *Triunghi* points.
- Using the *Pot1* potentiometer, determine the minimum and maximum values of the frequency of the rectangular signal (*Dreptunghi* output).
- Adjust *Pot1* in order to obtain a signal with a frequency of 5KHz at the *Dreptunghi* output.
- Disconnect *J9* from *J10,* connect *J11* with *J12* and determine once again, using *Pot1*, the minimum and maximum values of the frequency of the rectangular signal.

- Adjust *Pot1* in order to obtain a signal with a frequency of 10KHz at the *Dreptunghi* output.
- Disconnect *J11* from *J12*, reconnect *J9* with *J10* and determine once again, using *Pot1*, the minimum and maximum values of the frequency of the rectangular signal.

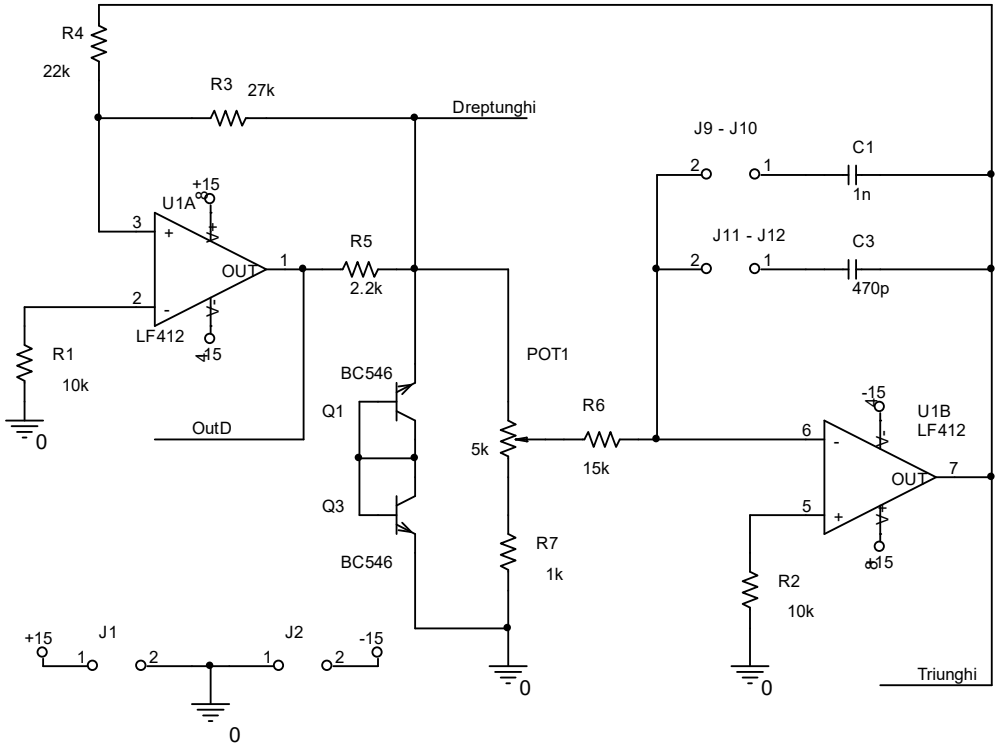

Fig. 1. Rectangular and triangular signal

Results

- The voltages in *OutD* and *Dreptunghi* points.
- The voltages in *Dreptunghi* and *Triunghi* points.
- The minimum and maximum values of the frequency of the rectangular signal, for the C_1 capacitor (*J9* with *J10*).
- The minimum and maximum values of the frequency of the rectangular signal, for the C_2 capacitor (*J11* with *J12*).
- The value of the frequency of the rectangular signal, using the capacitor C_1 for *Pot1* adjusted to obtain frequency of 10KHz using capacitor C_2.

2. Sine wave generator with Op – amp

Exploration

- Disconnect all the jumpers from the circuit.
- For the circuit in Fig. 2 supply the points *J1* and *J2* with differential voltage ±15V.

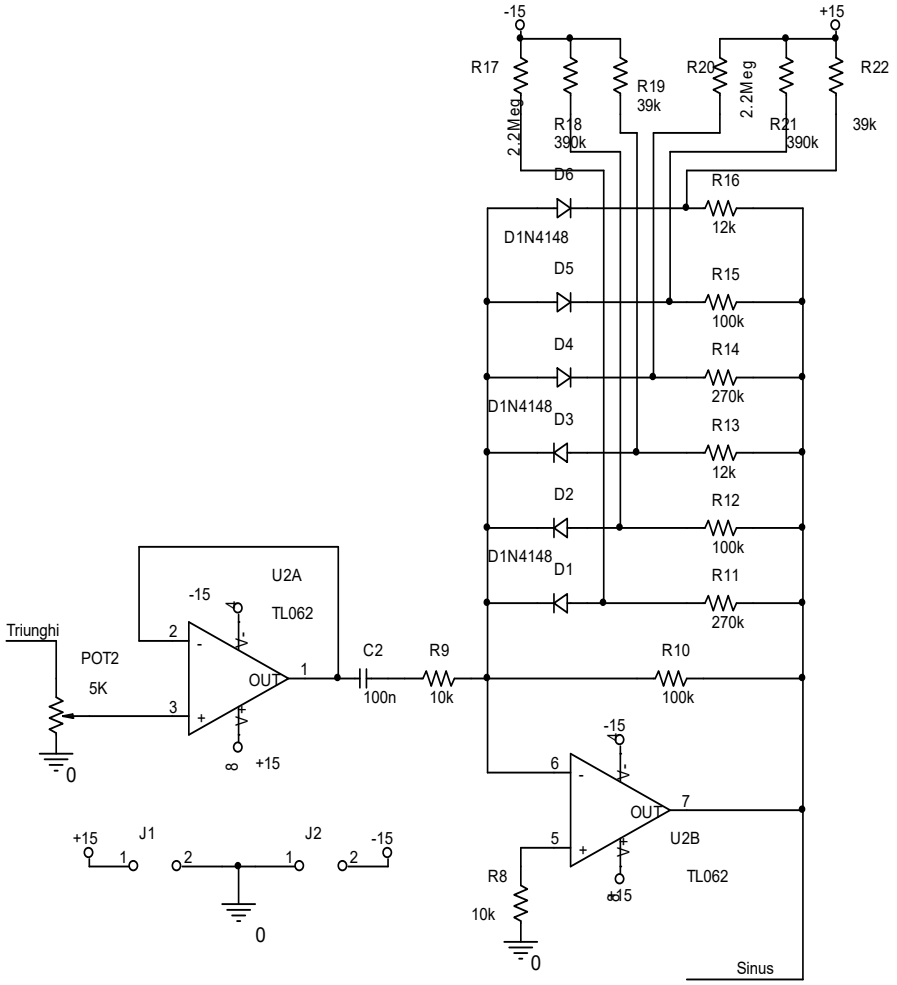

Fig. 2. Sine wave generator

- Use the jumpers to connect *J9* with *J10* and visualize on the oscilloscope the voltages in the *Triunghi* and *Sinus* points.

- Modify the value of the *Pot2* potentiometer until the voltage at the *Sinus* output is a sine wave and determine its amplitude, from the oscilloscope.
- Using the *Pot1* potentiometer, determine the minimum and maximum values of the frequency of the sine wave (*Sinus* output).
- Disconnect *J9* from *J10,* connect *J11* with *J12* and determine once again, using *Pot1,* the minimum and maximum values of the frequency of the sine wave.

Results

- The voltages in the *Triunghi* si *Sinus* points.
- The amplitude value of the sine wave (*Sinus* output).
- The minimum and maximum values of the frequency of the sine wave for the capacitor C_1 (*J9* with *J10*).
- The minimum and maximum values of the frequency of the sine wave for the capacitor C_2 (*J11* with *J12*).

3. Amplitude adjustment circuit

Exploration

- Disconnect all the jumpers from the circuit.
- For the circuit in Fig. 3. supply the points *J1* and *J2* with differential voltage ±15V.

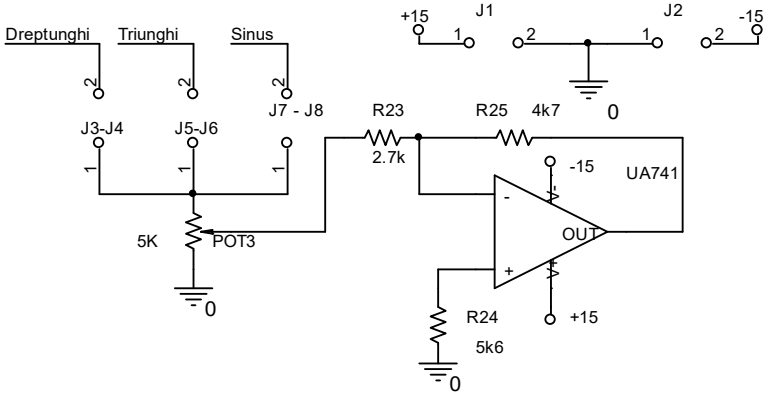

Fig. 3. Amplitude adjustment circuit

- Use the jumpers to connect *J9* with *J10.*

- To modify the amplitude of the rectangular signal, connect *J3* with *J4*. Visualize the signal from the *Dreptunghi* and *Out* points.
- Modify *Pot3* (from minimum to maximum) the minimum and maximum values of the amplitude of the output voltage (*Out*).
- Check if for *Pot3* set at half, you get a value of the amplitude of the output voltage V_{Out} inside the interval you determined.
- To modify the amplitude of the triangular signal, disconnect *J3* from *J4* and connect *J5* with *J6*. Visualize the signal from the *Triunghi* and *Out* points.
- Modify *Pot3* (from minimum to maximum) the minimum and maximum values of the amplitude of the output voltage (*Out*).
- Check if for *Pot3* set at half, you get a value of the amplitude of the output voltage V_{Out} inside the interval you determined.
- To modify the amplitude of the sinusoidal signal, disconnect *J5* from *J6* and connect *J7* with *J8*. Visualize the signal from the *Sinus* and *Out* points.
- Modify *Pot3* (from minimum to maximum) the minimum and maximum values of the amplitude of the output voltage (*Out*).
- Check if for *Pot3* set at half, you get a value of the amplitude of the output voltage V_{Out} inside the interval you determined.

Results

- The voltages in the *Dreptunghi* and *Out* points.
- The minimum and maximum values of the amplitude of the output voltage V_{Out}.
- The value of the amplitude of V_{Out} for *Pot3* set at half.
- The voltages in the *Triunghi* and *Out* points.
- The minimum and maximum values of the amplitude of the output voltage V_{Out}.
- The value of the amplitude of V_{Out} for *Pot3* set at half.
- The voltages in the *Triunghi* and *Out* points.
- The minimum and maximum values of the amplitude of the output voltage V_{Out}.
- The value of the amplitude of V_{Out} for *Pot3* set at half.

REFERENCES

1. Oltean, G., Circuite Electronice, UT Pres, Cluj-Napoca, 2007, ISBN 978-973-662-300-4

2. M. Ciugudean, T. Mureşan, H. Cârstea, M. E. Tănase, Electronica aplicată cu circuite integrate analogice. Dimensionare, Editura de Vest, Timisoara, 1991, ISBN 973-36-0081-4
3. http://www.bel.utcluj.ro/dce/didactic/fec/

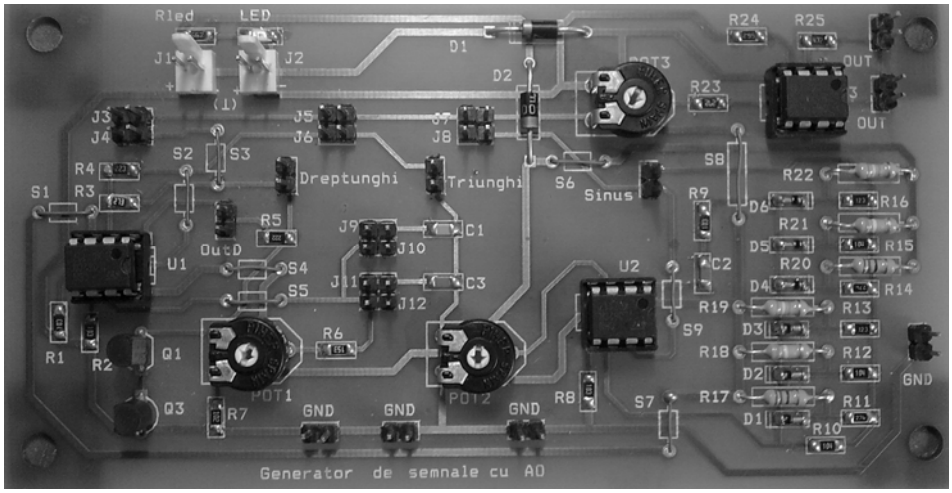

Fig. 4. Experimental assembly