FUNDAMENTALS OF ELECTRONICS

Department of Robotics and Mechatronics

Faculty of Mechanical Engineering and Robotics

AGH University of Science and Technology

Rectifiers
Voltage multipliers
RC Filters

LAB 7
LAB 8

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CONDITIONS FOR PASSING THE LABORATORY

- ***laboratory report: max 10p;***
- ***two-person teams;***
- ***deadline: one week***.

EXERCISE 1 – Measuring passive components (1p)

Measure the values of the passive components by using a multimetr: R7, R8, R10, C5, C7, C8, C9, C10.

EXERCISE 2 – Half-wave rectifier without capacitor (1p)

Record the output voltage waveform from the rectifier. Read the amplitude of the input signal and the peak value of the output signal. Why is the peak value not exactly equal to the amplitude and what is the difference value?

PROCEDURE

1. Make the connections according to the electrical diagram (Fig. 1) and the assembly schematic (Fig. 2).

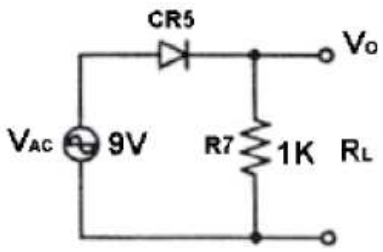

Fig. 1: Half-wave rectifier without capacitor [1]

1. Connect the transformer secondary winding to the TP1 and TP2 input terminals.
2. Set the generator output signal according to the parameters **U_{PP} = 8 V (Voltage peak-to-peak value); F = 50 Hz (Frequency); U_{DC} = 0 V (voltage offset)** - check the parameters of the signal from the generator by using an oscilloscope.
3. Connect the generator to the primary winding of the transformer.
4. Use the oscilloscope to record the output voltage of the rectifier. Read the peak value of the output. ***Use only one channel of the oscilloscope to measure output signal. The other channel should not unconnected.***

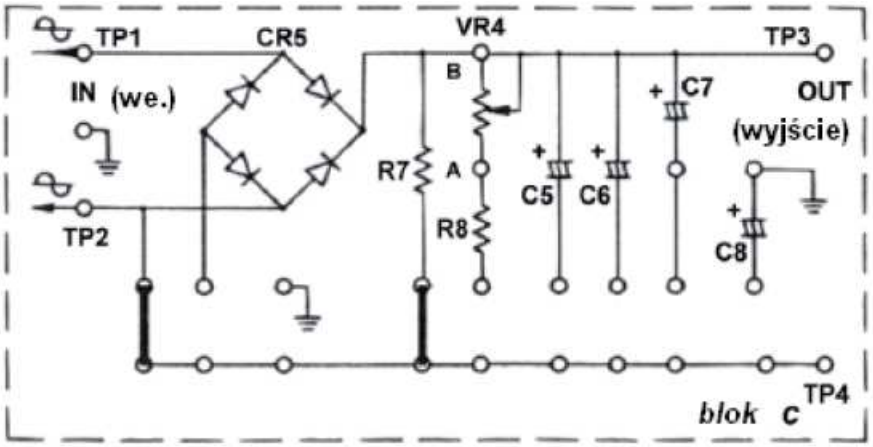

Fig. 2: Electrical assembly schematic (KL-25002 part C) - Half-wave rectifier without capacitor [1]

EXERCISE 3 – Half-wave rectifier with capacitor (1p)

Connect the capacitor C5 (10uF) to the half-wave rectifier. Record voltage waveforms from the oscilloscope. Read from the output voltage waveform, the value of the DC offset and the voltage ripple value (peak-to-peak value). What causes add the capacitor to the rectifier output? Repeat the procedure for the capacitor C6 (220uF). What is the effect of changing the capacity?

PROCEDURE

1. Make the connections according to the assembly schematic (Fig. 3).

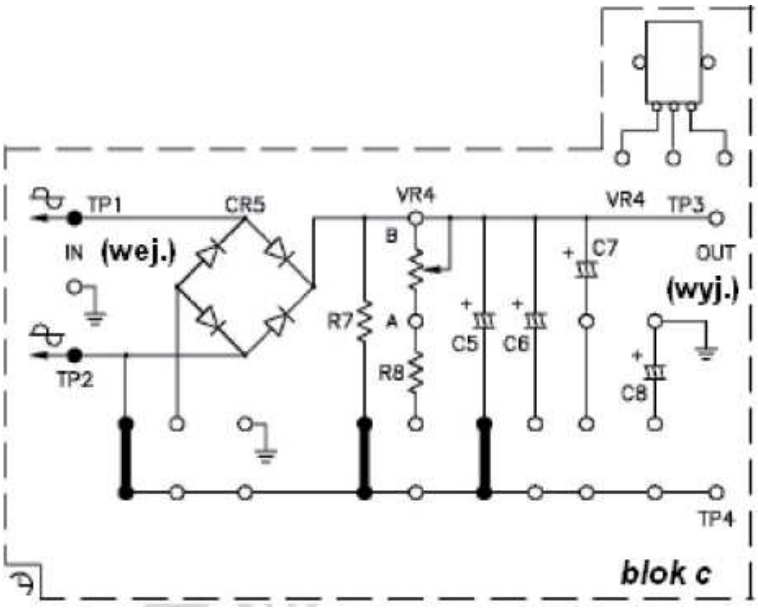

Fig. 3: Electrical assembly schematic (KL-25002 part C) - Half-wave rectifier with capacitor [1]

2. Connect the transformer secondary winding to the TP1 and TP2 input terminals.
3. Set/check the generator output signal: U_{PP} = 8 V; F = 50 Hz; U_{DC} = 0 V.
4. Connect the generator to the primary winding of the transformer.
5. Use the oscilloscope to record the output voltage of the rectifier. Read the DC offset value and voltage ripple from the rectifier output. ***Use only one channel of the oscilloscope to measure output signal. The other channel should not unconnected.***
6. Repeat step 5 for capacitor C6.

EXERCISE 4 – Full-wave bridge rectifier without capacitor (1p)

Record the voltage output waveform form the full-wave bridge rectifier. Why is the output voltage waveform of a half-wave rectifier different from the output waveform of a full-wave rectifier? What are the advantages and disadvantages of a full-wave rectifier in comparison to half-wave rectifier?

PROCEDURE

1. Make the connections according to the assembly schematic (Fig. 4).

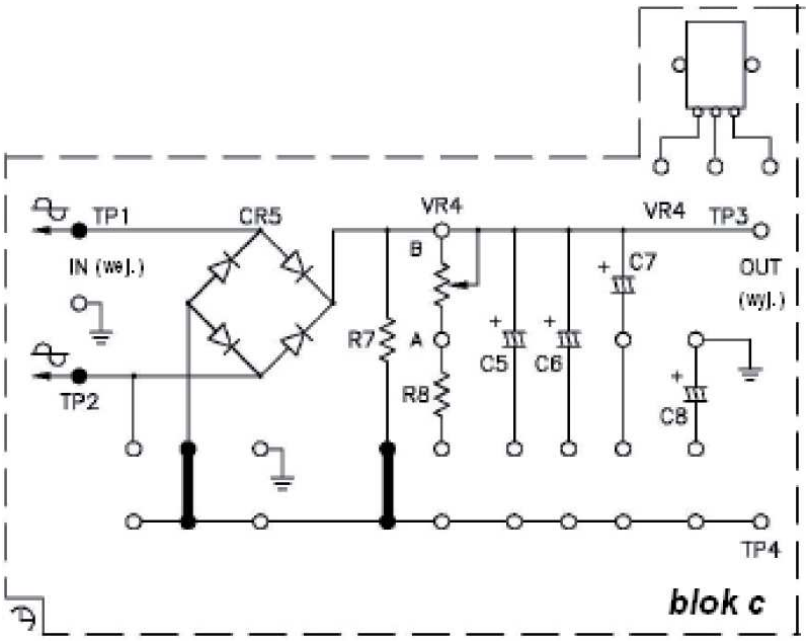

Fig. 4: Electrical assembly schematic (KL-25002 part C)
Full-wave bridge rectifier with capacitor [1]

2. Connect the transformer secondary winding to the TP1 and TP2 input terminals.
3. Set/check the generator output signal: U_{PP} = 8 V; F = 50 Hz; U_{DC} = 0 V.
4. Connect the generator to the primary winding of the transformer.

5. Use the oscilloscope to record the output voltage of the rectifier. Read the peak value of the output. ***Use only one channel of the oscilloscope to measure output signal. The other channel should not unconnected.***

EXERCISE 5 – Full-wave bridge rectifier with capacitor (1p)

Connect the capacitor C5 (10uF) to the full-wave bridge rectifier. Record the output voltage waveforms from the oscilloscope. Read from the output waveform the DC offset and the voltage ripple. Compare the results to the half-wave rectifier with a capacitor. Add resistor R8 (only R8 without VR4) as load. What is the impact of the load change? Repeat the procedure for the capacitor C6 (220uF). What is the effect of changing the capacity?

PROCEDURE

1. Make the connections according to the assembly schematic (Fig. 5).

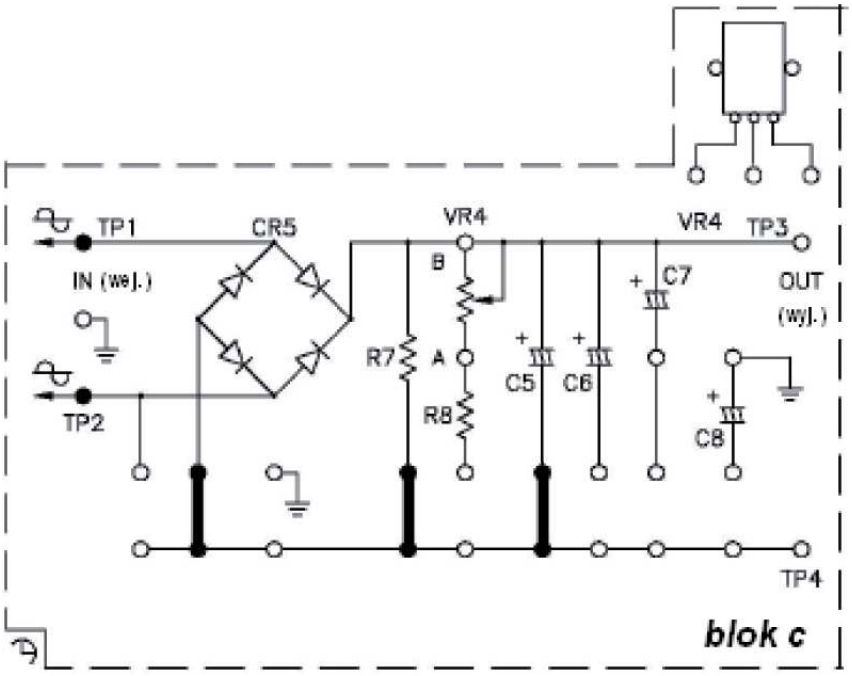

Fig. 5: Electrical assembly schematic (KL-25002 part C)
Full-wave bridge rectifier with capacitor [1]

2. Connect the transformer secondary winding to the TP1 and TP2 input terminals.
3. Set/check the generator output signal: U_{PP} = 8 V; F = 50 Hz; U_{DC} = 0 V.
4. Connect the generator to the primary winding of the transformer.
5. Use the oscilloscope to record the output voltage of the rectifier. Read the DC offset value and voltage ripple from the rectifier output. ***Use only one channel of the oscilloscope to measure output signal. The other channel should not unconnected.***

6. Add a additional load in the form of a R8 resistor, read the value of the DC offset and the value of voltage ripple from the rectifier output.
7. Repeat steps 5 and 6 for capacitor C6.

EXERCISE 6 – Voltage multiplier (1p)

Record the output voltage waveform from the voltage multiplier. Read the voltage ripple and the DC output value. What is the effect of changing the load (by using the R6 potentiometer)?

PROCEDURE

1. Make the connections according to the assembly schematic (Fig. 6).

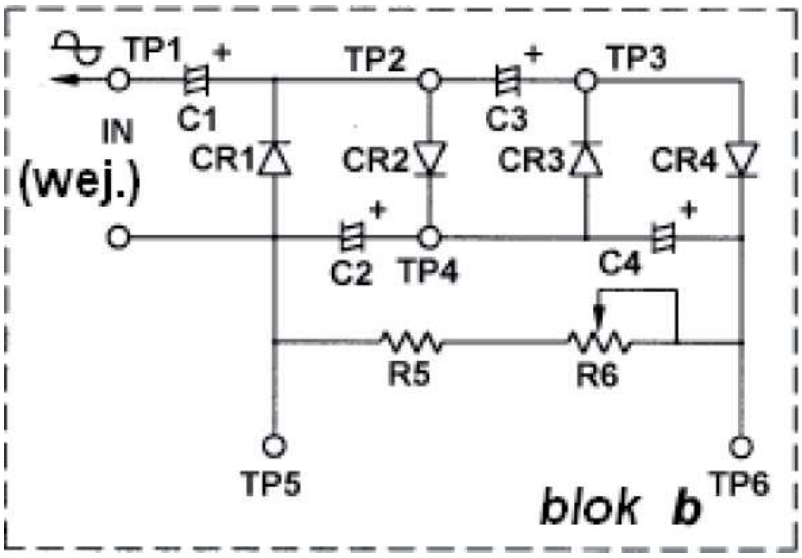

Fig. 6: Electrical assembly schematic (KL-25002 part b)
Voltage multiplier [1]

2. Connect the transformer secondary winding to the input terminals of part b KL-25002.
3. Set/check the generator output signal: U_{PP} = 8 V; F = 50 Hz; U_{DC} = 0 V.
4. Connect the generator to the primary winding of the transformer .
5. Use the oscilloscope to read the voltage value in points TP4 and TP6.
6. Change the resistance of the R6 potentiometer (load change).

EXERCISE 7 – RC Low-Pass Filter (LPF) (2p)

Set up the circuit - the resistance R10 and the capacitance C10 (without transformer). Identify the amplitude-frequency and phase-frequency characteristics of the filter in the frequency range 1 Hz – 1 kHz. You have to measure input and output voltage (e.g. peak-to-peak) to calculate the gain and delay time to calculate phase-shift. You can use two channel of the oscilloscope to measure input and output signal at the same time. You can use measure feature of the oscilloscope to read voltage and delay time.

Use a logarithmic scale on the x-axis and a linear scale on the y-axis. Next, read the 3dB frequency from the graph and compare it with the calculated.

EXERCISE 8 – RC High-Pass Filter (HPF) (2p)

Set up the circuit - the resistance VR3 (set 12k value) and the capacitance C9 (without transformer). Identify the amplitude-frequency and phase-frequency characteristics of the filter in the frequency range 1 Hz – 1 kHz. You have to measure input and output voltage (e.g. peak-to-peak) to calculate the gain and delay time to calculate phase-shift. You can use two channel of the oscilloscope to measure input and output signal at the same time. You can use measure feature of the oscilloscope to read voltage and delay time.

Use a logarithmic scale on the x-axis and a linear scale on the y-axis. Next, read the 3dB frequency from the graph and compare it with the calculated.

REFERENCES

[1] Laboratorium z podstawowych układów elektronicznych KL-210: Rozdział 2 – Prostowniki i filtry, Rozdział 4 – Układy różniczkujące i całkujące, Rozdział 5 – Właściwości tranzystora.