Experiment F1

Passive filters

Before you start to perform an experiment you are obliged to have mastered to the following theoretical subjects:

1. DC and AC currents. Voltage, current intensity and electric resistance. [1], [2].
2. Principle of electrical measurements. [3], [4].
3. Four-terminal network. [1], [2].
4. Principle of oscilloscope operation. [5].
5. Passive electronic elements. [6], [7], [8].
6. Electric circuits RC, LC and RLC. [8], [9], [10], [11], [12], [13].

Purpose

To understand and analyze the operations of the passive filters.

Experimental procedure

The frequency dependence of the output voltage for passive low-pass RC filter.

1. Make the resistance measurements for all positions of switch S1 using DMM ohmmeter and calculate the measuring errors.
2. Connect the circuit according to the diagram given in Fig. 1.
3. Select the sine waveform (without the DC OFFSET) by using the function select switch on the Function Generator (FG) front panel and connect the output of FG to the both CH1 input of oscilloscope and input of passive filter (use T junction to divide the signal from the output of FG).
4. Connect the output of passive filter to CH2 input of oscilloscope.
5. Set the input signal amplitude (U_{in}) to 4V.
6. Select position of the switch S1according to recommendations of supervisor.
7. Measure the output voltage (U_{out}) increasing the frequency of the input signal from 10Hz to 1MHz.
8. Record the obtained result on the data sheet in the Table 1.

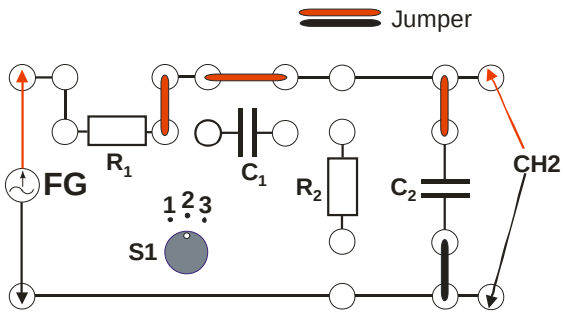

Fig.1. Scheme of connection diagram for passive low-pass RC filter.

Table 1.

f [Hz]	Δf [Hz]	U_{in} [V]	ΔU_{in} [V]	U_{out} [V]	ΔU_{out} [V]	U_{out}/U_{in}	$\Delta(U_{out}/U_{in})$	a [N]	Δa [N]	k [dB]	Δk [dB]

where

$$a = -\ln\frac{U_{out}}{U_{in}}[N]$$

and

$$k = -20\log\left|\frac{U_{out}}{U_{in}}\right|[dB]$$

The frequency dependence of the output voltage for passive band-pass Wien filter.

1. Make the resistance measurements for all positions of switch S1 using DMM ohmmeter and calculate the measuring errors.
2. Connect the circuit according to the diagram given in Fig. 2.
3. Select the sine waveform (without the DC OFFSET) by using the function select switch on the Function Generator (FG) front panel and connect the output of FG to the both CH1 input of oscilloscope and input of passive filter (use T junction to divide the signal from the output of FG).
4. Connect the output of passive filter to CH2 input of oscilloscope.
5. Set the input signal amplitude (U_{in}) to 4V.
6. Select position of the switch S1 according to recommendations of supervisor.
7. Measure the output voltage (U_{out}) increasing the frequency of the input signal from 10Hz to 1MHz.
8. Record the obtained result on the data sheet in the Table 2.
9. Observe slip of phase input signal relatively to output signal in points A, B, C, D and E. Draw the oscillograms for several chosen frequencies and the shapes of signals (sine, triangular and rectangular).

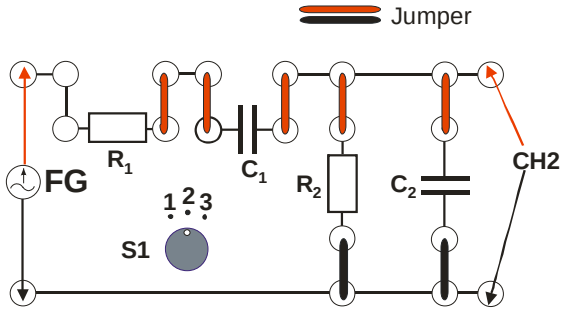

Fig. 2. Scheme of connection diagram for passive band-pass Wien filter .

Table 2.

f [Hz]	Δf [Hz]	U_{in} [V]	ΔU_{in} [V]	U_{out} [V]	ΔU_{out} [V]	U_{out}/U_{in}	$\Delta(U_{out}/U_{in})$	a [N]	Δa [N]	k [dB]	Δk [dB]

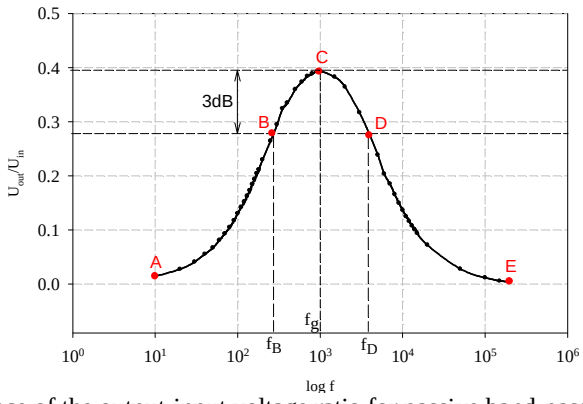

Fig.3. The frequency dependence of the output-input voltage ratio for passive band-pass Wien filter.

Report elaboration

Report has to be composed of :

1. Front page (by using a pattern),
2. Description of the experimental purposes,
3. Schematic diagrams and tested circuits,
4. List of the used instruments and devices (id. number, type, setting and ranged values),
5. Measuring results (including oscillograms and tables),
6. Drawings and analysis of obtained results ($U_{out}/U_{in}(f)$, a(f) and k(f)),
7. Final remarks and conclusions.

References

[1] F. Przezdziecki, A. Opolski, *Elektrotechnika i elektronika*, PWN, Warszawa, 1986.
[2] M. Krakowski, *Elektrotechnika teoretyczna*, PWN, Warszawa, 1983.
[3] B. B. Oliver, J. M. Cage, *Pomiary i przyrządy elektroniczne*, WKŁ, Warszawa, 1978.
[4] B. Żółtowski, *Wprowadzenie do zajęć laboratoryjnych z fizyki*, Skrypt PŁ, Łódź, 2001.
[5] J. Rydzewski, *Pomiary oscyloskopowe*, WNT, Warszawa, 1994.
[6] User manuals of the oscilloscope, power supply, function generator and DMMs.
[7] R. Śledziewski, *Elektronika dla Fizyków*, PWN, W-wa, 1984.
[8] T. Stacewicz, A. Kotlinki, *Elektronika w laboratorium naukowym*, PWN, W-wa, 1994.
[9] R. Resnick, D. Halliday, *Fizyka*, vol. II, PWN, W-wa, 1998.
[10] A. Hennel, W. Szuszkiewicz, *Zadania i problemy z Fizyki*, vol. II, PWN, W-wa, 1993.
[11] A. Januszajtis, *Fizyka dla Politechnik – Fale*, vol. III, PWN, W-wa, 1991.
[12] http://www.national.com/an/AN/AN-779.pdf
[13] http://www-ferp.ucsd.edu/najmabadi/CLASS/ECE53B-LAB/05-W/LAB/filter.pdf