Maritime University of Szczecin

Faculty of Marine Engineering

Department of Physics and Chemistry

Physics Laboratory

Laboratory Manual

Determining the resonance in a series RLC connection

English version written by
dr Agata Kowalska

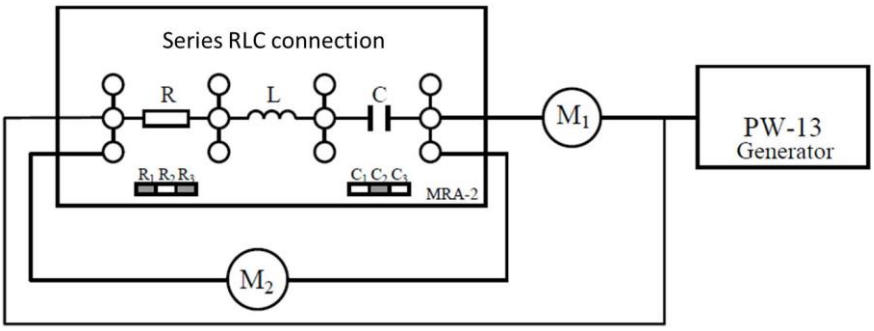
Szczecin 2018

Equipment:

1. PW-13 generator.
2. MRA-2 resonant circuit.
3. Two multimeters.

Exercise:

1. Check if the circuit is set according to the scheme:

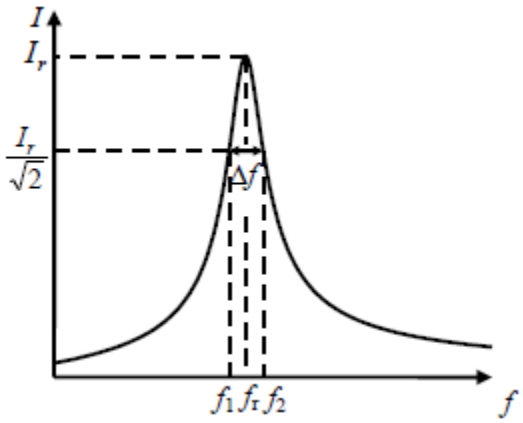


   - PW-13 generator: generator multiplier · 1, voltage range 10 V,
   - MRA-2 resonant circuit: pushed switches: R_1 and C_2,
   - multimeter M_1: set on the AC – 20 mA range,
   - multimeter M_2: switch in the "FREQ" position.

2. Turn on the generator and multimeters. Set the frequency of the generator so that the M_2 meter showed f = 1000 Hz. Using the "OUTPUT VOLTAGE" potentiometer (it can be found on the generator), set the value of the voltage supplying the resonant circuit on U = 3V (we always read the value of the voltage in the upper right part of the window of the M_2 meter. The same meter indicates the frequency.
3. Examine the dependence of current I flowing in the R_1LC_2 circuit from the frequency f in the 1000 – 9000 Hz range. During the measurements keep a constant value of the power supply voltage U = 3.000 ±0.010 V, by adjusting its value with the "OUTPUT VOLTAGE" potentiometer.
4. On the basement of the obtained results, specify the frequency range in which the resonant frequency occurs. Then, changing the frequency f, determine with an accuracy of 10 Hz its resonance value – at this value current reaches the maximum.
5. Examine the dependence of current I flowing in the R_1LC_2 circuit from the frequency f in the (f_r – 1000, f_r + 1000) Hz range, every 200 Hz. During the measurements keep a constant value of the power supply voltage U = 3.000 ±0.010 V, by adjusting its value with the "OUTPUT VOLTAGE" potentiometer.
6. Repeat steps described in steps 3 – 5 for R_2LC_2 and R_1LC_3 systems.
7. Set the generator frequency to 1000 Hz.
8. On one graph draw dependencies $I(f)$ for all examined RLC systems. Draw the trend lines in the charts to form resonance curves.
9. From the obtained graphs, read the current I_r in resonance and frequencies f_1, f_2 and f_r. calculate the angular frequencies:

$$\omega_r = 2\pi f_r$$

$$\Delta\omega = \omega_2 - \omega_1 = 2\pi(f_2 - f_1)$$



10. Transforming dependencies:

$$I_r = \frac{U}{R}, \quad \Delta\omega = \frac{R}{L}, \quad \omega_r = \frac{1}{\sqrt{LC}}, \quad Q = \frac{1}{R}\sqrt{\frac{L}{C}}$$

calculate the resistance *R*, inductance *L*, capacity *C* and the Q-factor of the circuit for each *RLC* system being tested.

11. Complete the table:

	I_r	f_r	f_1	f_2	Δf	ω_r	$\Delta\omega$	R	L	C	Q
	[mA]	[Hz]	[Hz]	[Hz]	[Hz]	[Hz]	[Hz]	[Ω]	[H]	[F]	[–]
R_1LC_2											
R_2LC_2											
R_1LC_3											

Table:

Measuring system: R_1LC_2

f [Hz]	1000	2000	3000	4000	5000	6000	7000	8000	9000
I [mA]									

f [Hz]						f_r = ……					
I [mA]											

Measuring system: R_2LC_2

f [Hz]	1000	2000	3000	4000	5000	6000	7000	8000	9000
I [mA]									

f [Hz]						f_r = ……					
I [mA]											

Measuring system: R_1LC_3

f [Hz]	1000	2000	3000	4000	5000	6000	7000	8000	9000
I [mA]									

f [Hz]						f_r = ……					
I [mA]											