EXERCISE 50

# TEST OF TRANSIENT STATES

**II. Laboratory tests**

**1. Description of the test system**

**Equipment and components used:**

tested system TRANSIENT STATES

stabilized power supply (5V)

set of data acquisition system

 - digital oscilloscope with memory **Hameg**

 - computer with ocilloscope software **SP107**

 - printer

*Measuring ciruit*

**To the power supply**

**input S0**

**1**

**RS**

**U**

**0**

**6**

**W3**

**L**

**C**

**8**

**RR**

**W4**

**P1**

**4**

**W2**

**W1**

**2**

**7**

**9**

**5**

**3**

**To the oscilloscope**

**inputs S1**

**(S1\* & S1\*\*)**

**To the oscilloscope**

**input S2**

RL

**U** *- supply voltage (5V)*

P2

P3

Z

C1 The

0

C2 The

C3 the

0

C4 the

**Rs** *- serial resistor (50)*

**L** *–* inductor *(Rl - inductor resistance)*

**C** *- capacitor*

**RR** *- resistor (100)*

**W1, W2, W3, W4** *- switches*

**P1, P2, P3** *- switches*

**Z** *- button shorting capacitor*

**2, 3, 4, 5, 6, 7, 8, 9** *- connection terminals*

**S0, S1, S2** *– BNC sockets, where S0 – power signal, S1 – supply voltage signal (S1\* - observed on oscilloscope) and voltage of test element (S1\*\* - observed on oscilloscope), S2 – oscilloscope triggering signal.*

**Initial settings:**

 P1 at position 0,

 W1, W2, W3, W4 at position OFF (down),

 P2 and P3 at position 0,

 S0 socket connected to the power supply,

 stabilized power supply (5V) enabled,

 switched on computer with the printer,

 switched on the HAMEG oscilloscope,

 output socket S1\* (first slot S1) connected to CHI channel,

 output socket S1\*\* (second slot S1) connected to CHII channel,

⇒ for observation of voltage on the test object,

 activate the **CHII** button
(the message is displayed at the bottom of the screen: y2:1V =),

 activate the **SINGLE** button
(preparation of the oscilloscope by pressing the button again – indicated by a light diode **RES** next to the lighted diode **SGL**).

⇒ for observation of current in the circuit (voltage from resistor Rs = 50,

 activate the **CHII** key with the **DUAL**button, and the **INV** button**.**
(on the bottom of the screen should display message: y1:1V= + y2:1V=).
In both channels set the same reinforcements.

 activate the **SINGLE** button (preparation of the oscilloscope by pressing the button again – indicated by a light diode **RES** next to the lighted diode **SGL**),

**2. RC circuit tests**

During test of the RC circuit, two cases should be used: with capacities C1 and C2.

Diagram of the RC circuit test system is shown below.

**1**

**RS**

**U**

**C1** the

**C2** the

**P2**

**P1**

**0**

2.1. Switching on the DC voltage

**Steps for observing signals when switching on the DC voltage and to determine the time constant of these signals.**

1. Realize the initial settings. Connect terminals 2-4, and 3-5.

Set the P2 switch to the C1 position (serial circuit of the Rs and C1 elements).

 Switch W2 to ON position (up).

 2) Set the oscilloscope to observe the appropriate course case.

Proposed settings for observing the shape of the voltage waveform 1V/cm

(CH II), and 20ms/cm, while observing the current waveform 1V/cm (CH I)

and 1V/cm (CH II).

 3) When the oscilloscope was prepared (the green RES LED is lighted),

 attach the U = 5V voltage to the system by switching P1 to position 1.

 On the oscilloscope we get the correct course. Switch P1 to position 0.

 4) Usinga program running after turning on the computer, read the data

 from the oscilloscope by selecting the READ option on the monitor screen.

 The transmission is triggered (the RM light on the oscilloscope desktop)

 which the expected signal will be displayed on the monitor screen.

1. Prepare the received course for printing by selecting the printer icon in the mouse.

 Print a course that is suitable for determining the time constant of the

circuit. On the basis of the determined plotting of the constant time and known resistance circuit, determine the capacity of the system.

 Perform the above steps for the C2 capacity (P2 at position C2).

 The proposed setpoints for the time base signal amplification 50ms/cm.

2.2. Discharge of the capacitor

 The above steps are also performed for the C2 capacity (P2 in position C2).

 The proposed setpoints for the time base signal amplification 50ms/cm.

**3. RL circuit test**

It is practically impossible to perform an ideal inductor, because it will always have

a certain internal resistance. The test system used a inductor containing approx. 5000 coils wounded with copper wire with a diameter of 0,25mm2.

The inductor has a certain RL resistance and this consequence is impossible to

observation voltage only on the L inductance itself.

To minimize the impact of RL resistance, you can connect additional (parallel) to the inductor resistor Rr= 100. The measurement system is shown below:

**1**

**L**

**RL**

**RS**

**U**

**0**

**P1**

*real inductor*

3.1. Switching on the DC voltage

**Steps for observing signals when switching on the DC voltage,**

**and to determine the time constant of these signals.**

1. Realize initial settings. Connect terminals 2-6, and 3-7.

 Switch W3 to ON position (up).

1. Adjust the oscilloscope appropriately to observe the voltage shape between the terminals 2-3, or the current shape of the test circuit. The proposed settings to observe the shape of the voltage waveform 1V/cm (CH II), and 5ms/cm, foro bservations of the current waveform 0.5 V/cm (CH I and CH II).
2. When the oscilloscope was prepared, attach the voltage U = 5V, by switching P1 to position 1. On the oscilloscope screen, we get the right course.
3. Use the computer program to read the data from the oscilloscope by selecting the READ option on the monitor screen. The expected signal will be displayed on the monitor screen.
4. Prepare the received course for printing by selecting the printer icon.

 Print a course that is suitable for determining the time constant of the circuit. Based on the determined the time constant and value voltage on the inductor terminals, determine the resistance value RL, and inductance of the inductor L.

3.2. Short circuit through inductor

 The steps for observing the signals during the switch off the DC voltage in the RL system, and for the determination of the time constant of these signals shall be performed analogously as in 3.1. By switching P1 from position 1 to position 0.

**4. RLC circuit test**

During testing the RLC circuit, two options were used with different capacities for observation of overdamped and underdamped circuits (diagram below).

**P3**

**P2**

**1**

**RS**

**U**

**C1** the

**C3** the

**P1**

**0**

**L**

**RL**

4.1. Switching on of the DC voltage in the overdamped circuit

**Steps for observing signals while switching on the DC voltage.**

 1) Realize initial settings. Connect terminals 2-6, 7-4 and 5-3.

 Set the P3 switch in the 0 and P2 to position C1.

 Switch the W2 and W3 switches to ON position (up).

1. Adjust the oscilloscope appropriately to observe the shape of the voltage or current in circuit.

 *Proposed settings 1V/cm (CH I, CH II), and 10ms/cm.*

 When the oscilloscope is prepared (green RES diode is lighted),

 attach the U = 5V voltage to the circuit by switching P1 to position 1 (up).

 On the oscilloscope we get the correct course. Switch P1 to 0.

1. Using a computer program, read the data from the oscilloscope by selecting the READ option on the monitor screen. The expected signal will be displayed on the monitor screen.
2. Prepare the resulting waveform and print the received waveforms.

4.2. Switching off the DC voltage in the overdamped circuit

**The steps to observe the signals must be performed analogously as in section 4.1. by switching P1 from position 1 to position 0.**

4.3. Switching on the DC voltage in the underdamped circuit

The steps for observing signals during the switching on the DC voltage in the oscillating circuit perform similarly to the aperitic circuit (4.1), but when the P2 switch is set to pos. 0 and P3 in pos. C3 (circuit with capacity C3).

*The proposed settings for this case are 1V/cm and 5ms/cm for voltage observation, and 0.5V/cm (CH I), 0.5 V/cm (CH II) and 5ms/cm for current shape observation.*

4.4. Switching off the DC voltage in the underdamped circuit

The steps for observing signals when switching off the DC voltage in the oscillating circuit do the same as for the aperitic circuit (4.2), but when setting the P2 switch in pos. 0 and P3 in pos. C3 (circuit with capacity C3).

*The proposed settings for this case are 1V/cm and 5ms/cm for voltage observation, and 0.5V/cm (CH I), 0.5 V/cm (CH II) and 5ms/cm for current shape observation.*

**5. Summary of results.**

1. for RC and RL circuits.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Circuit type** | **** | **iu** | **uu** | **R** | **L** | **C** |
| ms | A | V |  | H | F |
| **RC1** |  |  |  |  | ⎯ |  |
| **RC2** |  |  |  |  | ⎯ |  |
| **Rl** |  |  |  |  |  | ⎯ |

1. for RLC circuits.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Circuit type** | s1 | **s2** | **iu** | **uu** | **R** | **L** | **C** |
| 1/s | 1/s | A | V |  | H | F |
| **RLC1** |  |  |  |  |  |  |  |
| **RLC3** |  |  |  |  |  |  |  |

**iu** – determined current vaule

**uu** – determined voltage value on terminals 2-3,

**R**, **L**, **C** - total parameters of resistance, inductance and capacitance of the circuit.

⇒ On the basis of measurements and calculations make up both tables.

For inductor circuits, it is important to remember its resistance RL (i.e. R = RS+ Rl).

⇒ For RLC circuit, designate the elements of the characteristic equation

(S1 and S2), and determine the circuit using equations (57), (58) and (59).

⇒ Perform additional calculations for the specified values of the real circuit parameters: RS=50, RL=120, C1=220F, C2=1000F, C3=2,2F, C4=14,1F and L=0,4H. Compare the results obtained from the calculations and form the measurements.

**III. Conclusions and observations.**

The report shall include: computer prints, calculation of characteristic parameters (can be placed under printed courses), tables, conclusions and remarks of the laboratory studies which were carried out.