Laboratory report

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| Subject of the exercise: | Application Techniques of Logic Controllers (Exercise 11.) |
| **Date:** | <year>. <month>. <day> |
| **Students name:** | <name 1>  <name 2>  <name 3> |
| **Course and group No.** | Course: <Course No>, <Group No.> |
| **Supervisors:** | <name 1>, <name 2> |
| **Desk No.:** |  |

Measurement Tasks

1. Identification of system components
   1. With the help of the laboratory instructor verify the measurement configuration: identify the hardware components, the connections of the thermal process and the software components of the man-machine interface. List the following system components:

The hardware components of the system:

The components of the man-machine interface:

1. Basic operation of the thermal process and the measurement framework
   1. At zero heating and 100% ventilator settings measure the output temperature of the heating process (ambient temperature, ).

<results >

* 1. By raising the heating voltage verify that the overheating protection circuit operates. Temperatures exceeding the maximum temperature limit should be indicated by a high temperature event (red ”Nyugta” button in the upper right corner). Verify that the overheating protection circuit turns the heating process off. Measure the turn-off temperature. Acknowledge the overheating signal (click the red” Nyugta” button) and verify that the heating process is operating normally.

< results >

* 1. Measure the steady state temperature value at a given heating and ventilator settings provided by the lab instructor. These heating and ventilator settings are used as the working point values for further measurements.

Working point heating voltage ():

Working point ventilator value:

Measured steady state temperature ():

* 1. Measure the maximum heating voltage for which the overheating protection does not shuts off. Use the constant ventilator setting from exercise 2.3.

< results >

1. Identification of the thermal process
   1. Identify the thermal process for the working point (heating voltage, ventilator setting) given in exercises 2.3. Set the heating cooling values and wait until the system settles (the output temperature is constant). Start the data recorder by clicking the “*Adatmentés start”* button. In the “*Adatmentés”* window set the directory of the data file to *…Matlab/work* and select a name for the data file. Raise the heating voltage value by *2V* (step response input). When the system settles again stop the recording by clicking the “*Adatmentés vége*” button. Visualize the results in Matlab environment (use the *plot* command and the *edit, copy figure* menu command to import the curves). Verify that the MATLAB and WinCC environments provide similar results.

< results, Matlab figures >

* 1. Approximate the heating process by a first order system. From the measured data and curves identify the static gain and the time constant of process. Compare the identified process to the measured data. (Use the *step* and *lsim* commands).

< results, Matlab figures, conclusions >

1. Closed loop control of the temperature.
   1. Based on the identified process parameters design a PI controller. Adjust the ventilator to the same level used for the identification. Select the continuous PI controller with saturation (9. controller). From the user interface apply a constant reference signal (red, “Alapjel”) and verify that the output temperature follows it. If the system is stabilized apply small step input signals (for example 5ºC step input) and record and evaluate the results. Adjust the controller parameters that the response is fast and the output overshoot does not exceeds 10%.

< results, curves, conclusions >

* 1. Examine the parameter sensitivity of the control loop. Set constant reference signal. When the system settles apply a disturbance signal by reducing the ventilator setting to half of its previous value. Record and evaluate the results. How the output and control signal is changed? How much static error is resulted by applying the disturbance?

< results, curves, conclusions >

1. Programming the PLC with Simatic Manager
   1. Write a PLC program for FC10 function block which executes the task chosen by the laboratory instructor. The program should be compiled, downloaded and its operation verified. ***Since*** ***the*** ***FC10 function block is evaluated automatically in every sampling period, a separate program cycle is not needed.***

Switch the digital outputs depending on the temperature.

Indicate by a selected digital output if the temperature stays in a given interval.

Indicate by a digital output if the temperature exceeds a given limit for longer than a given time.

Indicate by a flashing digital output if the temperature exceeds a given limit.

Implement a combinatorial logic circuit given by the instructor.

Realize a simple two state controller (bing-bang control) for the temperature control.

<PLC progam >