**Embedded Systems PID PLC mini-course test template**

1. Open the given TIA Portal template file and create an integrator block with a time constant TI=1.9 sec! The cycle time of the cycle interrupt PLC task is 0.01 sec. To test the operation of the integrator block, use the square wave block given in the project file! Connect the input signal to the HMI blue elements tag and the output signal to the HMI red elements tag.

2. Make a derivative block with a time constant TD=0.15 sec! To test the operation of the derivative block, use the sine wave block given in the project file! Connect the input signal to the HMI blue elements tag and the output signal to the HMI red elements tag.

3. Create a "European style" Controller block, containing proportional, derivative and integrator channels! The T1 one block used at the DT1 channel is already given, T1=0.02 sec, the Kc proportional constant is Kc=1.5. Realize the automatic operation mode of the controller by connecting the controller output into the Input_power input of the Controlled system (already given in the TIA project)! The external disturbance (external temperature between -25-+25 C degrees) is adjusted by pot_1 and displayed by the HMI_yellow_elements. The setpoint value (desired internal temperature between +15-+30 C degrees) is adjusted by pot_0 and displayed by HMI_blue_elements. The realized inner temperature values are displayed by HMI_red_elements.

Automatic mode only
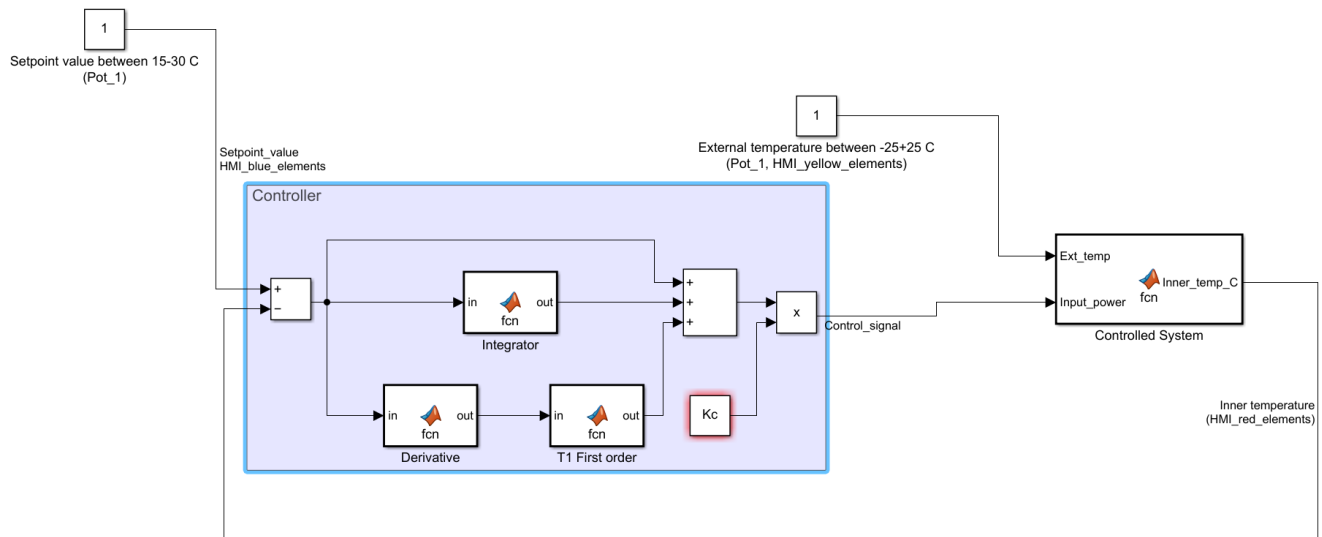
4. Make possible the switching between manual and automatic mode with the switch_0 switch! In Automatic mode (switch_0 ON) the controller output is directly fed into the controlled process power input, and the source of the setpoint value is pot_0. In Manual mode (switch_0 OFF) the input power is directly manipulated by pot_0 between 0-25 kW, and the controller is disconnected from the controlled system. In Manual mode, there is no effect associated to the desired value, therefore the desired value display elements (HMI_blue_elements) are displaying zero values.

Manual + Automatic mode (mode change using switch 0)

Setpoint value between 15-30 C
(Pot_0)

1

Switch_0_1

Setpoint_value
HMI_blue_elements

0

Constant

External temperature between -25+25 C
(Pot_1, HMI_yellow_elements)

1

Controller

in fcn out

Integrator

in fcn out

Derivative

in fcn out

T1 First order

+
+
+

x

Kc

Switch_0

Control_signal
(HMI_green_elements,
between 0-25 kW)

Ext_temp

Input_power

Inner_temp_C
fcn

Controlled System

1

Manual power between 0-25 kW
(Pot_0)

Inner temperature
(HMI_red_elements)