Test Project

Task D2 – Automation in water and wastewater treatment plant

EduKit PA – 2 hours

Water Technology

Submitted by:

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Introduction to Test Project

The EduKit PA system is a flexible and customizable learning platform that enables innovative experiments.

The following main components are included for your task:

- EduKit PA Basic in a cardboard box
- EduKit PA Advanced in a Systainer
- Tools for this task
- Watering can
- Extension Kit EduKit PA WorldSkills 2026 Shanghai
- EasyPort USB
- Analog cable, SysLink I/O data cable
- Tabletop power supply unit
- PC with FluidLab-PA closed-loop

Note: A range of sensors and actuators is provided. Use only the components required to fulfill this task.

Description of project and tasks

Your task involves automating the system previously built, which was a simple test bench with components from the EduKit PA Basic system. This setup was suitable for the initial test, requiring only a few additional components.

Now, your objective is to enhance and automate the system based on preparatory technical documentation, including Piping and Instrumentation Diagram (P&ID), drawings, and simplified instructions for connecting electrical components. The goal is to build and test the system thoroughly to ensure the test bench is workable for the given purpose. The component must then undergo a performance test to determine whether any improvement has been achieved.

Your task:

1. Preparation: Use the station from task D1, optimize it, and remove unnecessary components.
2. Assemble the station mechanically using the information provided.
3. Connect the electrical sensors/actuators to the I/O board.
4. Set up the station, test the component according to the requirements, and document the results.

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Instructions to the Competitor

1. Preparation: Use the station from task D1, optimize it, and remove unnecessary components.

Note for all tasks:

- *Use only the pipes that were specified in the task. Minimize the use of new pipes and water as much as possible.*
- *Do not cut the electrical cables for the sensors and actuators, so they can be reused for other tasks.*
- *Pack all unused devices neatly in the Systainer from the EduKit PA Advanced package.*
- *Place all the unused components from EduKit PA Basic system to its cardboard box.*
- *Do not damage the box of the EduKit PA Basic system or any other boxes provided.*
- *Follow the guide and best practices for all steps, including pipe cutting, cable routing, and the use of cable holders.*

2. Assemble the station mechanically using the information provided.

- The Approximate mechanical drawing of the station (Figure 1).
- Piping and Instrumentation Diagram (P&ID) (Figure 2).
- Layout of the pipe system (Figures 3-5). Build the pipe system and stabilize it at the specified fixing points on the profile system.
- Note:
- *Only use components from the EduKit PA Extension Kit and additional accessory bag, and the additional pipes from the EduKit PA Basic system.*
- *Pipes that are already installed in the EduKit PA Basic must not be used and must be in their original condition at the end to enable quick reassembly, except for the pipe connection between the lower tank and the pump, which does not need to be changed for the test setup.*
- Capacitive Sensors (BG14): Install one capacitive sensor that detects the flow of the water. The capacitive sensor must give a signal when there is flow in the pipe and no signal if there is no flow.
- MID - Flow sensor (BF2): Install the sensor in pipe system on the place from the P&ID (Figure 2) and the hand drawing (Figure 4).
- Pressure sensor (BP3): Replace the manometer to the electrical pressure sensor in the pipe system. Refer to the hand drawing (Figure 4) and the P&ID (Figure 2).
- Replace the manual control unit with the I/O-board.
- Install the I/O board on the profile of the EduKit PA Basic system lower tank.
- Attach the earthing cable from the I/O board to the specified position on the profile plate.
- Label the components according to the P&ID (Figure 2).

1. Connect the electrical sensors and actuators to the I/O board from the EduKit PA Advanced package and the EduKit PA WorldSkills 2026 Shanghai Extension Kit (Figures 8-11).

Note: For safety reasons, do not switch the system on for this part of the task.

- Capacitive Sensor (BG14)
- MID - Flow sensor (BF2)
- Pressure sensor (BP3)
- Ball valve (MB2) and Electrical feedback (BG15)
- The pump plug must be connected to the specified socket for the pump on the I/O board
- Equipotential bonding cable (PE)

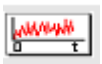
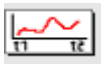
2. Set up the station and test the test bench according to the test report and document the results.

- Information about the connection between I/O-Board - EasyPort - PC - Software FluidLab-PA closed-loop is shown in Figure 12.

Test report

Name:	New Test bench	Order number:	WorldSkills 2026
No.	**Activity**	**Done**	**Note/observation/result**
1	Switch off the power supply unit and drain the water from the system.	☐	
2	Do the steps from Point 2. Assemble the station mechanically and Point 3. Connect the electrical sensors and actuators.	☐	
3	Close the drain valves VV5, VV3.		
4	Fill 2.5L water into the tank VE1.	☐	
5	Connect the EasyPort USB to the power supply unit and connect all required cables.	☐	
6	Switch on the power supply unit and then connect the USB cable to the PC.	☐	
7	Switch on the pneumatic power supply unit and set it to 4.0 ±0.1 bar.	☐	
8	Start the FluidLab PA closed-loop software and select the "EduKit PA- WorldSkills 2026" station if it is not already selected. Click on "EasyPort Initialize" so that the EasyPort is displayed and a connection to the station is active.	☐	
9	Go to the "Setup" menu and check that the digital and analog signals are working and display the correct values for the given information. Figure 13 shows the correct parameters to be used for the test report. Adjust them if necessary.	☐	
10	The function of the BG14 must be that the sensor detects the flow/no-flow condition of the water. The capacitive sensor must give a signal when water is present and no signal if there is no water present. The signal must be displayed visually in the software at the correct input.	☐	
11	The function of the BG15 must be such that the sensor must detect the open and closed positions of the ball valve. The signals must be displayed visually in the software at the correct inputs.	☐	
12	The BF2 must function with the given information and show the same flow value so that the display value is correct in the software in L/h compared with the value of the sensor in L/min. You are not allowed to change parameters in the sensor settings! If the displayed value does not correspond to the sensor value, call the support team.	☐	
13	The ball valve VV2 works when you open and close via the software by on/off switch Digital Output 0. It must	☐	

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	open within 1-2 s and must close within 3-4 s. Note: The timing is based on the movement of the sensor signals, and not on the sound of the pneumatic actuator emptying or filling. The timing check must be carried out without running the pump.		
14	Setup the pump motor controller -QA1 (Figure 8) so that, in analog mode, the maximum flow is reached at a value between 9.5 – 9.9 V compared to the maximum flow achieved in the digital mode of the pump.		
20	**Test No.1** **Read the flow value from the software with the MID - Sensor**	☐	
21	How much flow is obtained through only the manual valve VV1?	☐	_____ L/h
22	How much flow is obtained through only the ball valve VV2?	☐	_____ L/h
23	How much flow is obtained through the manual valve VV1 and ball valve VV2?	☐	_____ L/h
30	**Test No. 2** **Create a flow to pump voltage diagram** - Go to the "Characteristics" menu. - Draw a diagram "BF2 Flow" to "Pump voltage" so that the pump runs for 60s from 0V to 10V and for another 60s from 10V to 0V in one diagram. The change of the pump voltage must go automatically. Only the ball valve VV2 is open for this task. - Click "Start" when you configure the settings to run the automatic sequence - Click the "Disk/JPG Symbol " and save the file on the desktop and document the results from the diagram. *- Note: Only the saved file on the desktop with the filename specified in the protocol will be checked!*		File Name: Task_D2_Point30.jpg Flowrate: _____ L/h At point of 5V when the pump voltage increases from 0…10V _____ L/h At point of 5V when the pump voltage decreases from 10…0V
40	**Test No. 3** **Set up the station so that the system always runs in a good pressure range. This is required to protect the system against overpressure.** - Go to the menu "closed-loop Control- continuous". - Choose  instead  - Select as presetting " BP3-Pressure", - Set the right Digital Outputs that are required for this task. When you run the pump in analog mode, only the ball valve VV2 is open. - Under "Select manip. Value", select - "A_Out0 PL1 Pump"		File Name: Task_D2_Point40.jpg

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	- Choose the right setpoint SP for 160 mbar and without a pump offset. - Decide which controller type must be used: P, I, PI (math), PI, PD, PID, and select suitable controller values. - 2.5L is in the lower tank VE1 and valves VV1 and VV2 are both closed. - Click "Start" **Goal task** sequence for the documentation - The given time values are from the start point after clicking "Start": - The system must stabilize at the target pressure within 5 s. The Pressure must be within a range of 160 ±10 mbar, with no overshoot exceeding 180 mbar. - Open the ball valve between 10 s and 12 s after start using the speed settings from Step 13 and close the ball valve again after 20 s and 22 s after start. - Click "Stop" between 28 s and 30s *Note: The system must have a maximum pressure fluctuation of 140 mbar to 180 mbar and must return to a stable pressure of 160 mbar ±10 mbar within 5 seconds after the ball valve changes the position.* - Click the "Disk/JPG Symbol " and save the file on the desktop and document the results from the diagram. **The diagram must only have one test sequence!** *- Note: Only the saved file on the desktop with the given filename from the protocol will be checked!* *Note: When the process is complete, the system should be still turned on and the FluidLab PA closed-loop software should remain open in the Setup menu.*		
Date and finish time	_____	**Test carried out by:**	Country: _____ Competitor: _____

To continue.

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Figure 1. Approximate design of the new EduKit PA layout.

Figure 2. P&ID of the test system.

Figure 3. Use the same Pipe system as in task D1.

Figure 4. Hand drawing of the route of the new pipe system, based on the starting point from Task D1, and the components that must be used (Additional guidance - Figure 5).

1: 45° push fit connector – design like 690590; 2: 371988; 3: 170701;

4: MID Flow sensor; 5: Transparent pipe; 6: 170701: 7: Pressure sensor (electrical)

Note: You must determine the length of the pipe yourself.

Figure 5. Pipe connectors.

Figure 6. Component positions:

1: Raised pipe holder; 2: Pneumatic hose holder; 3: Pneumatic unit - Manometer facing to the front; 4: Pneumatically actuated ball valve; 5: Electric cable holder - mounted on the narrow side.

Figure 7. MID Flow sensor

Figure 8. Electrical I/O Board

For the wiring, the connections should be:

1) -XD1 = for all digital signals 2) -XD3 = for all analog signals

3) -XD20= Pump system PL1 4) -XE0 = for all Equipotential cables

5) -QA1 = Motor controller

Figure 9. Electrical diagram of the digital block(-XD1) on the I/O board. I4-sensor capacitive BG14 (BK= 5(I4); BN = 24VB; BU = GND B); Sensor box BG15(BK= 6(I5); WH=7(I6); BN = 24VB; BU = GND B)

Note: Only the function is evaluated so that no bare wires are visible and observe Figure 6.

Figure 10. Electrical diagram of the digital block(-XD1) on the I/O board.

Ball valve VV2(A1= 9 (Q0); A2=GND_A; Equipotential cable to block -XE0)

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Figure 11. Electrical diagram of the analogical block (-XD3) on the I/O Board.

(AI CH1)- flow sensor BF2 0-10 V -> 0-10L/min (WH= 2; BN = 24VB; BU = GND B); (AI CH2)-pressure sensor BP3 (WH=3; BN =24VB; BU = GND B);

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Figure 12. EasyPort connection.

Figure 13. Setup menu - Help: Pop up messages - Mouse over.

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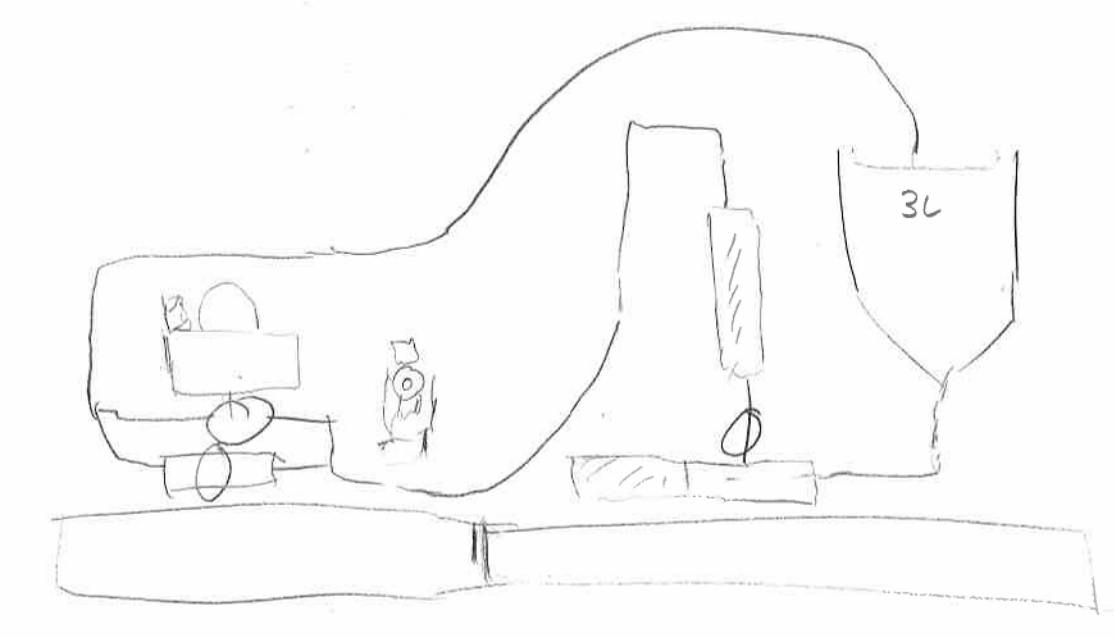


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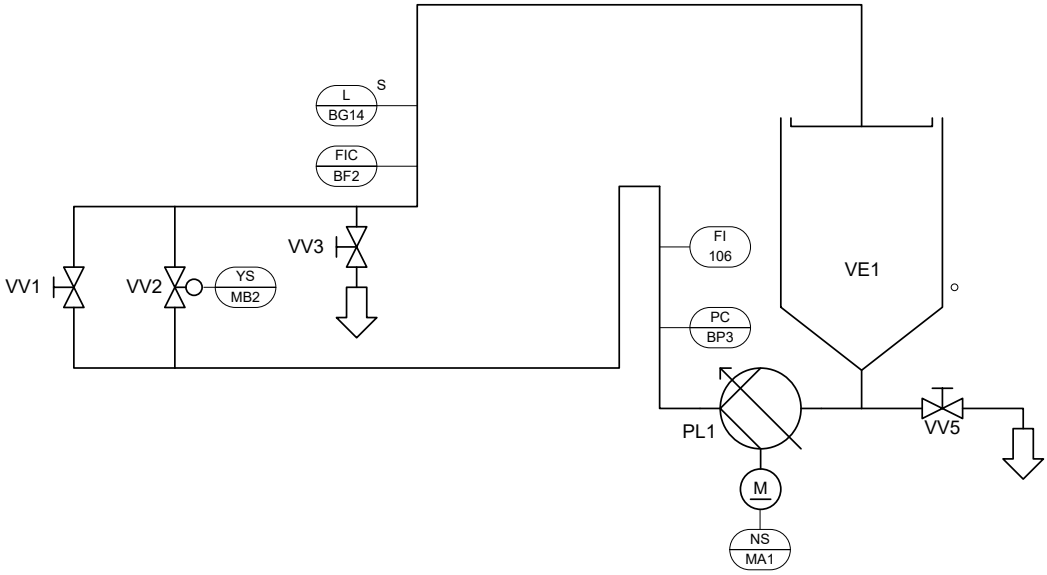


Figure 2. P&ID of the test system.

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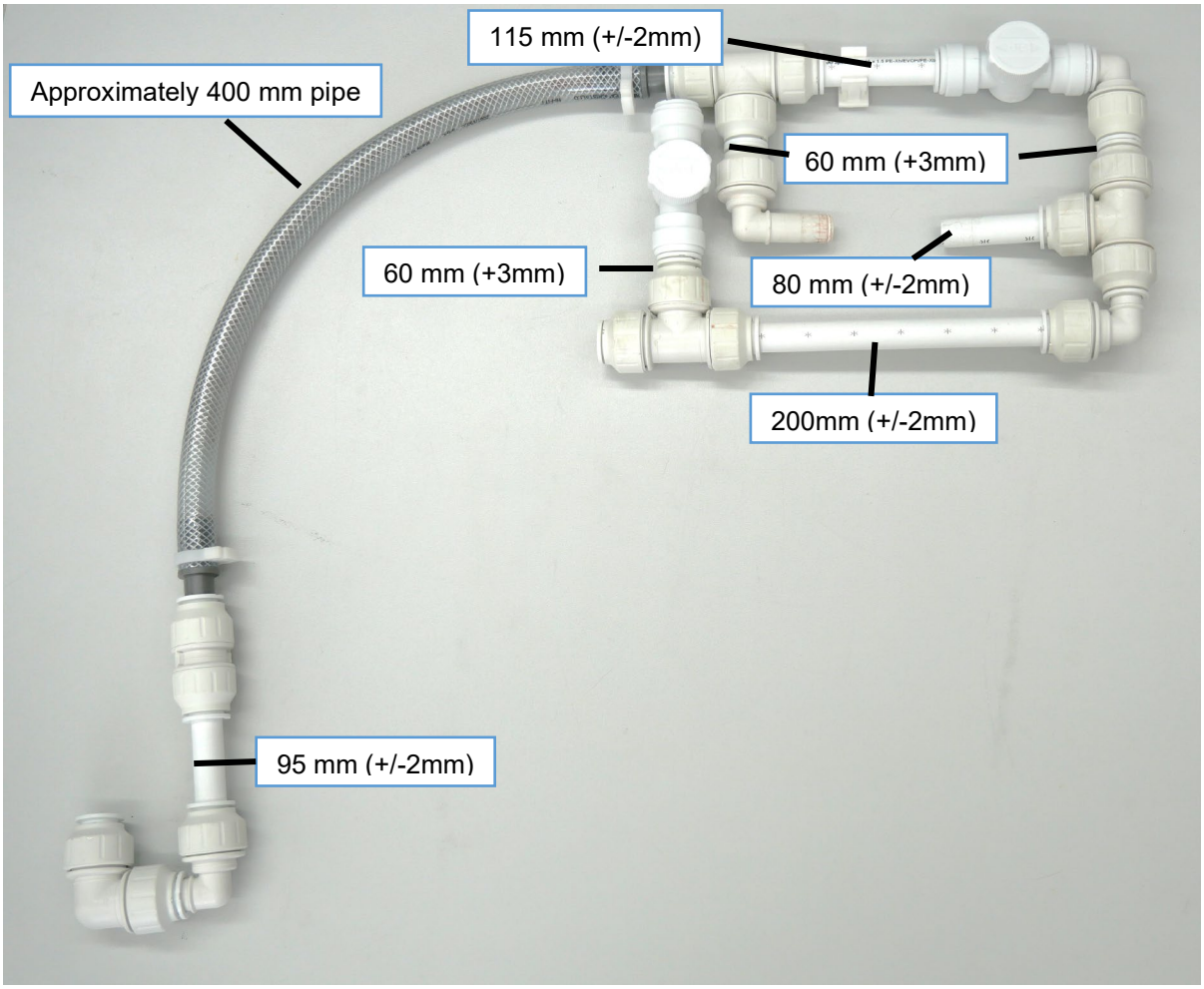


Figure 3. Use the same Pipe system as in task D1.

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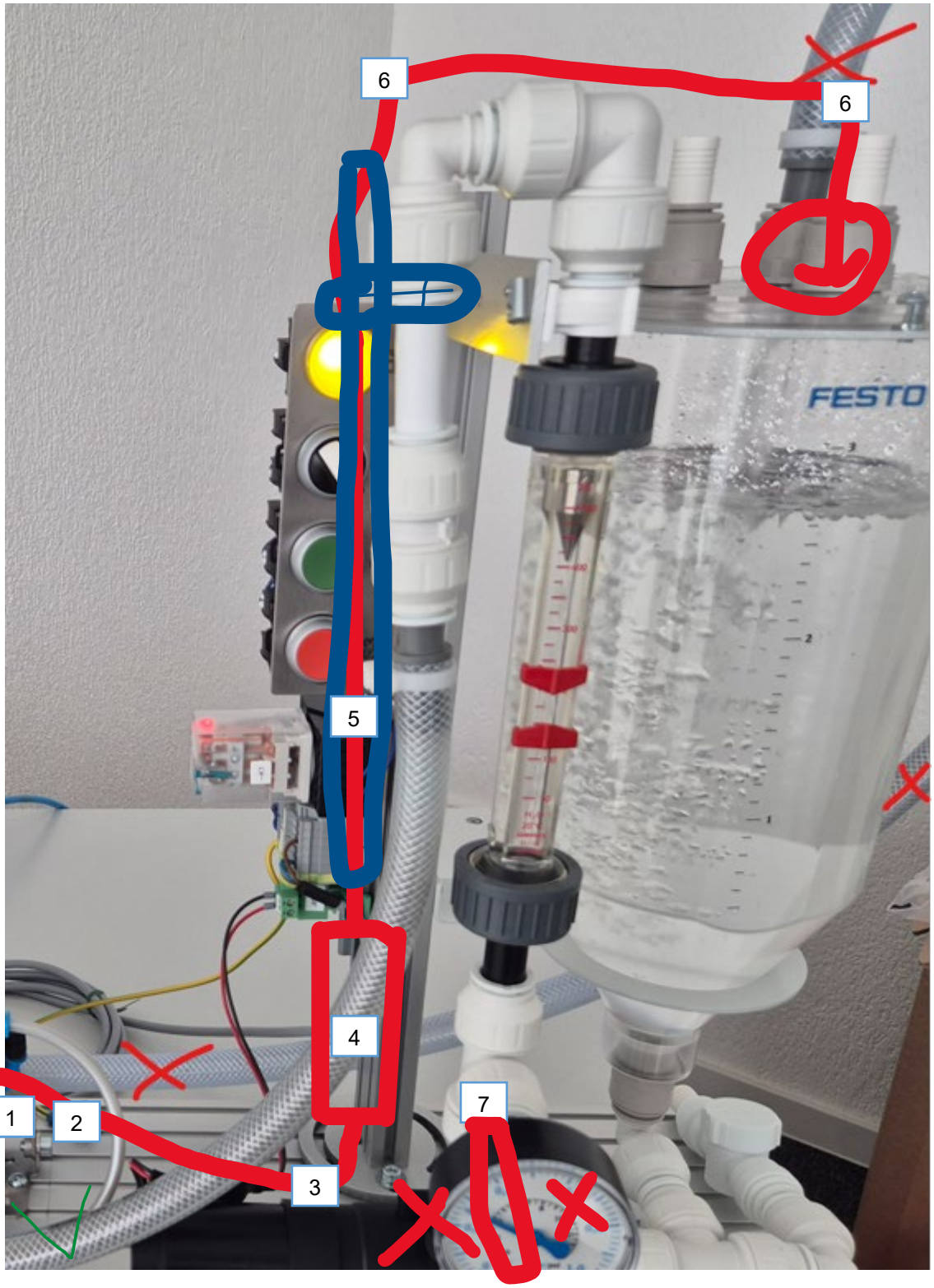


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Note: You must determine the length of the piping yourself.



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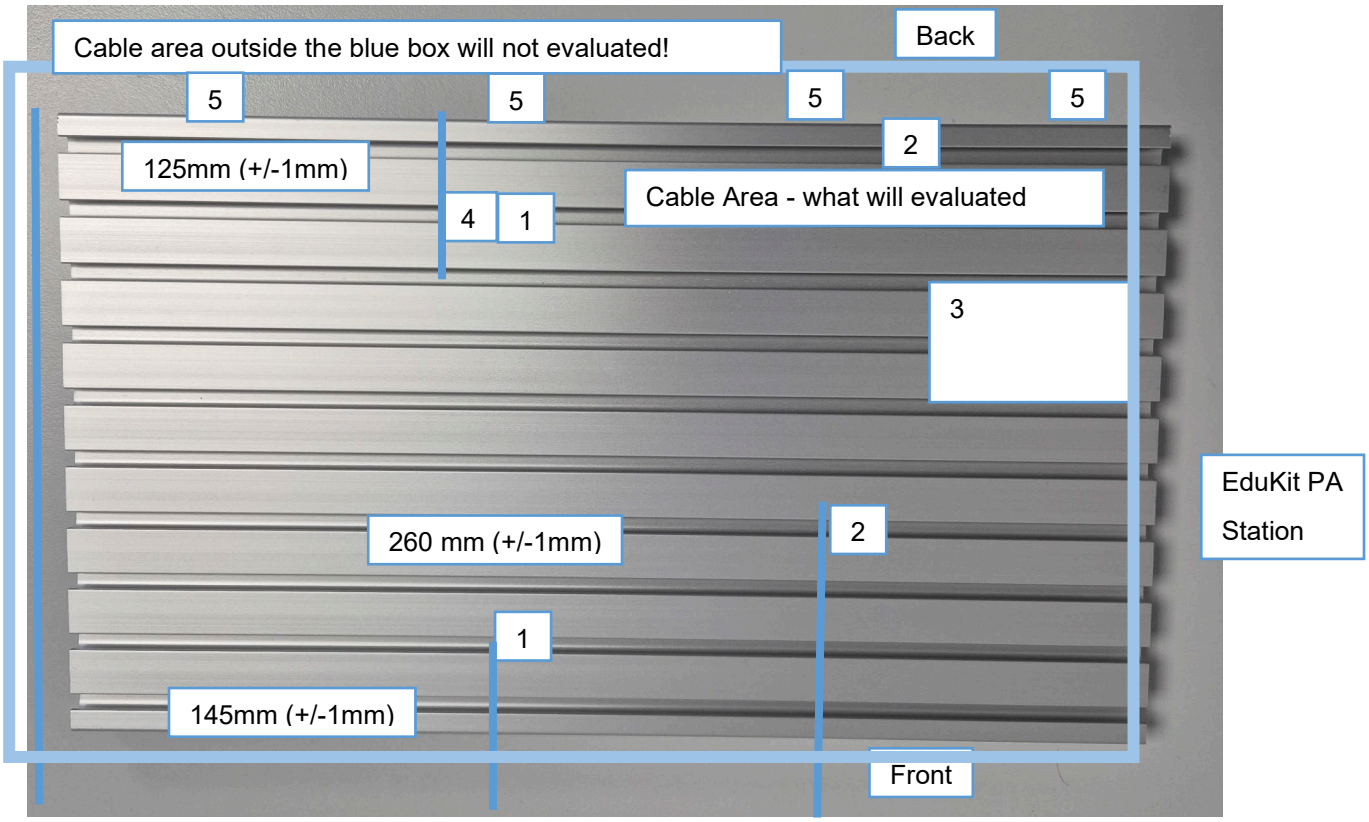


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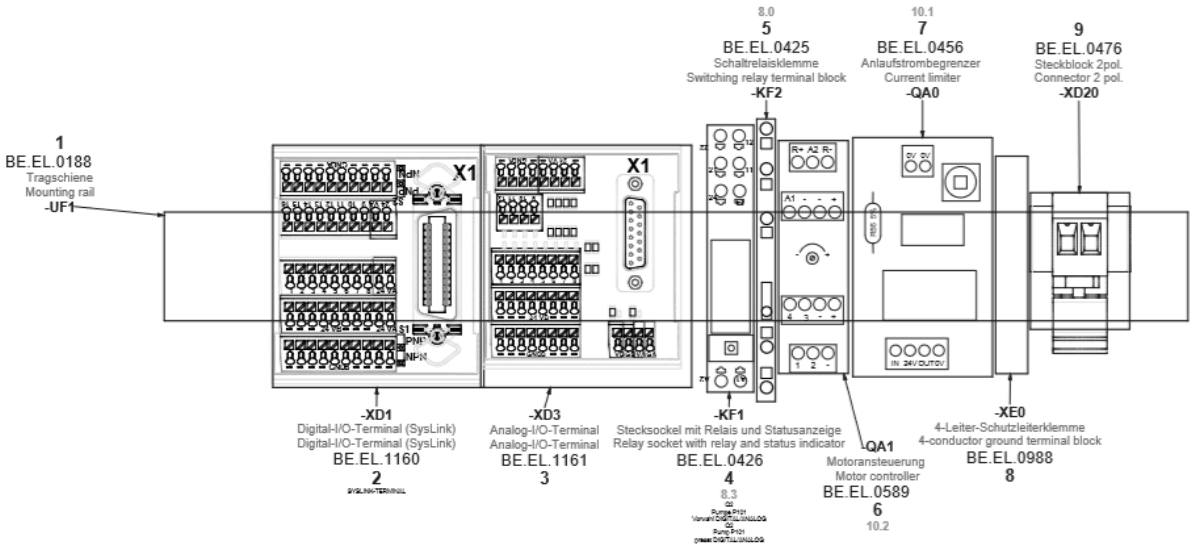


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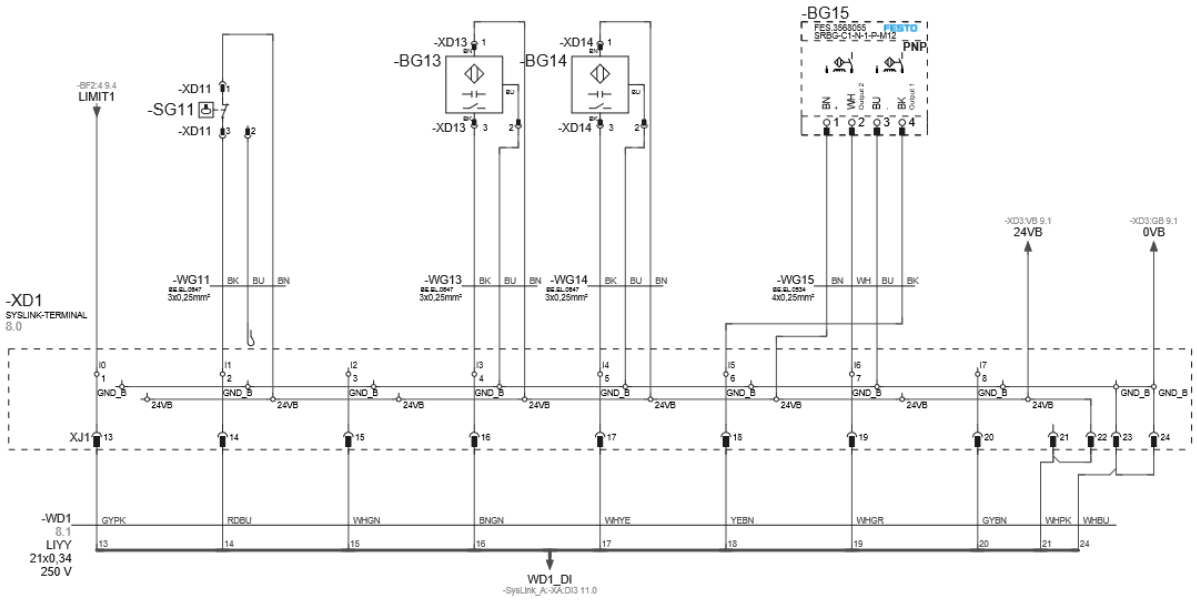


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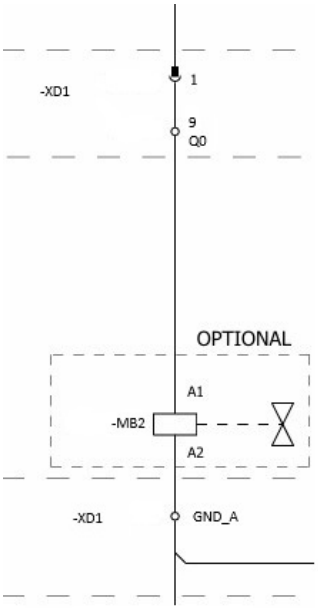


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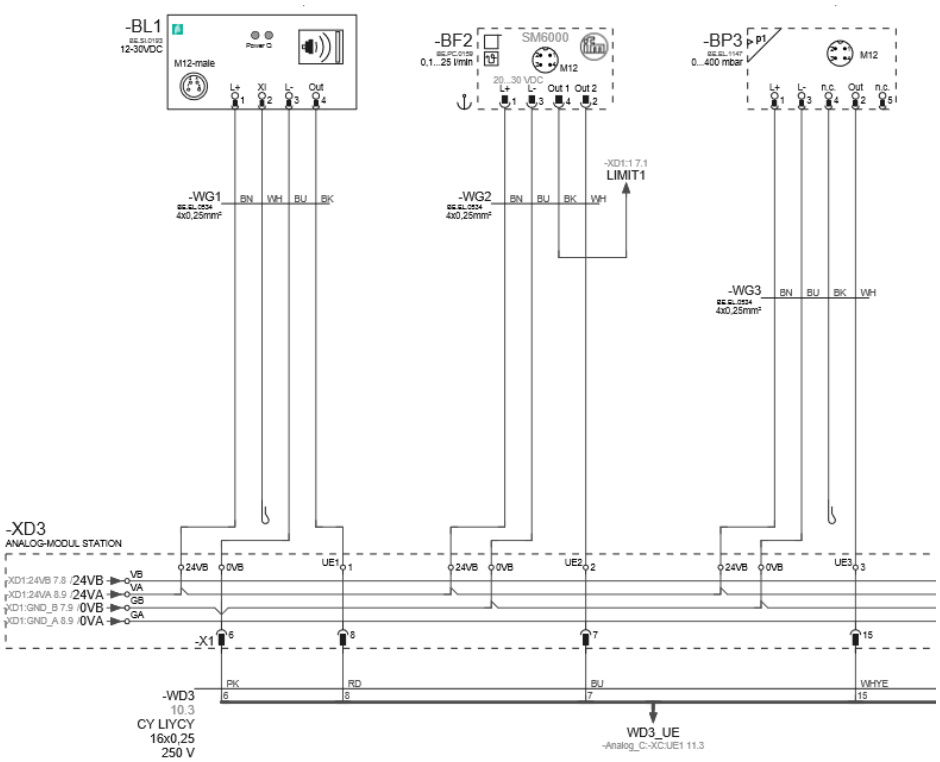


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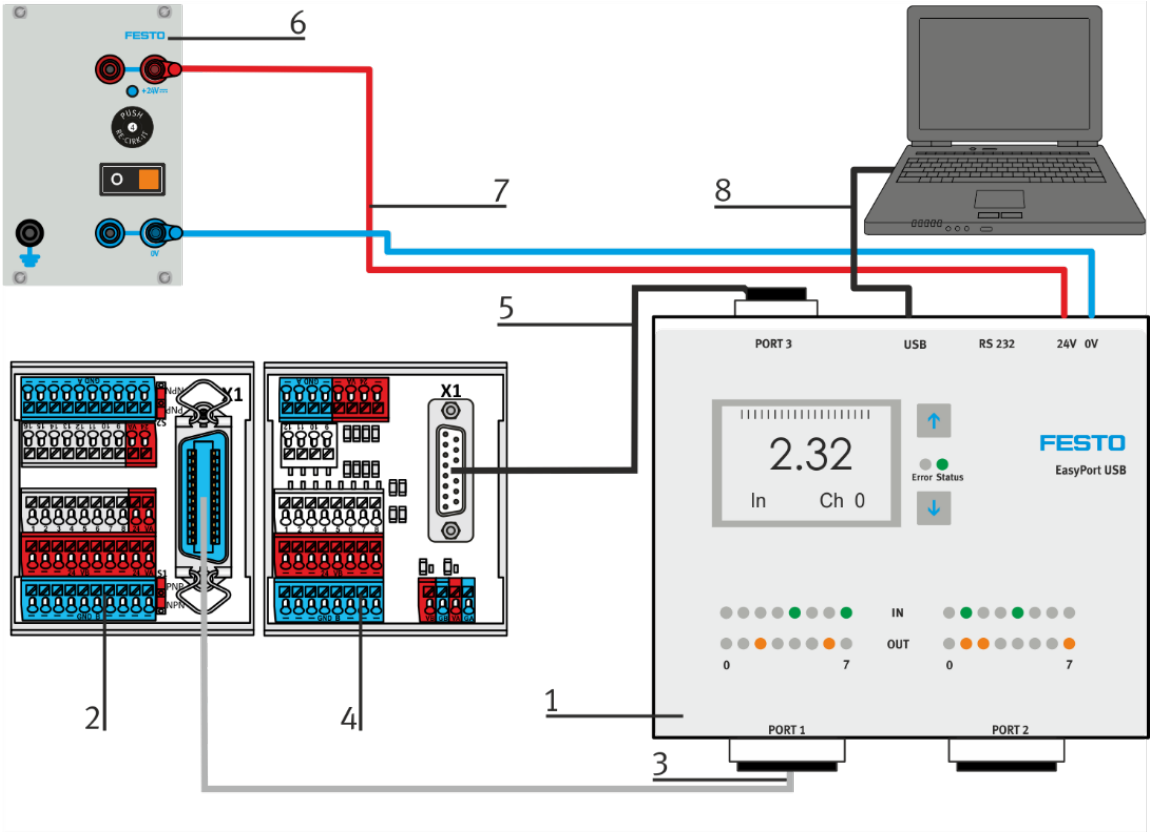


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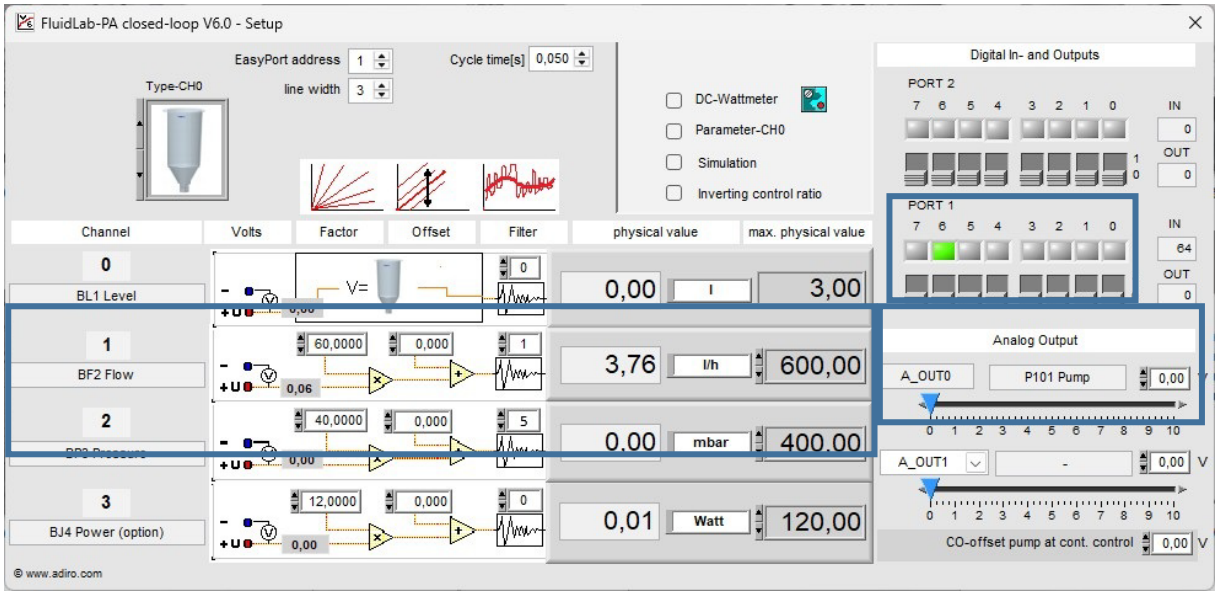


Figure 13. Setup menu - Help: for Popup messages, hover the Mouse.

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Task Forms

Country: _____ Competitor Name: _____

Marking Scheme

The task evaluation will be made according to the Competition Information System (CIS) of Water Technology 2026.

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