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Human-Machine Interface

Siemens SIMATIC®

FESTO

Process Control

LabVolt Series

User Guide



FESTO

User Guide

Human-Machine Interface



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Process Control

Human-Machine Interface
Siemens SIMATIC®

User Guide

52601-E0

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




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Safety and Common Symbols

The following safety and common symbols may be used in this manual and on the equipment:

Symbol	Description
	DANGER indicates a hazard with a high level of risk which, if not avoided, will result in death or serious injury.
	WARNING indicates a hazard with a medium level of risk which, if not avoided, could result in death or serious injury.
	CAUTION indicates a hazard with a low level of risk which, if not avoided, could result in minor or moderate injury.
	CAUTION used without the <i>Caution, risk of danger</i> sign  , indicates a hazard with a potentially hazardous situation which, if not avoided, may result in property damage.
	Caution, risk of electric shock
	Caution, hot surface
	Caution, risk of danger
	Caution, lifting hazard
	Caution, hand entanglement hazard
	Notice, non-ionizing radiation
	Direct current
	Alternating current
	Both direct and alternating current
	Three-phase alternating current
	Earth (ground) terminal

Safety and Common Symbols









Symbol	Description
	Protective conductor terminal
	Frame or chassis terminal
	Equipotentiality
	On (supply)
	Off (supply)
	Equipment protected throughout by double insulation or reinforced insulation
	In position of a bi-stable push control
	Out position of a bi-stable push control

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Preface

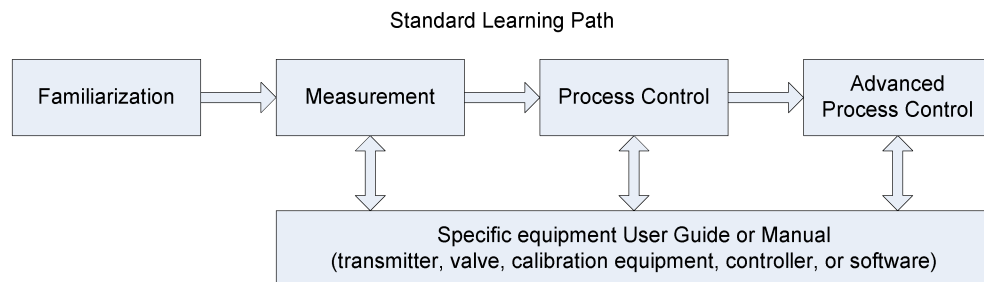
Automated process control offers so many advantages over manual control that the majority of today's industrial processes use it to some extent. Breweries, wastewater treatment plants, mining facilities, and the automotive industry are just a few industries that benefit from automated process control systems.

Maintaining process variables such as pressure, flow, level, temperature, and pH within a desired operating range is of the utmost importance when manufacturing products with a predictable composition and quality.

The Instrumentation and Process Control Training System, series 353X, is a state-of-the-art system that faithfully reproduces an industrial environment. Throughout this course, students develop skills in the installation and operation of equipment used in the process control field. The use of modern, industrial-grade equipment is instrumental in teaching theoretical and hands-on knowledge required to work in the process control industry.

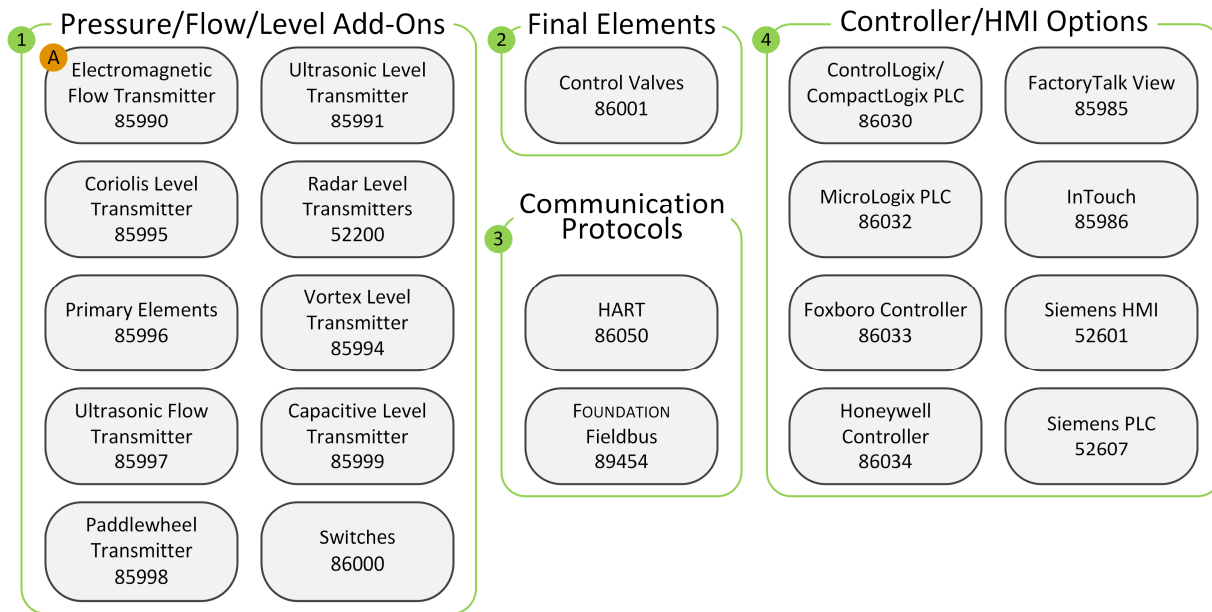
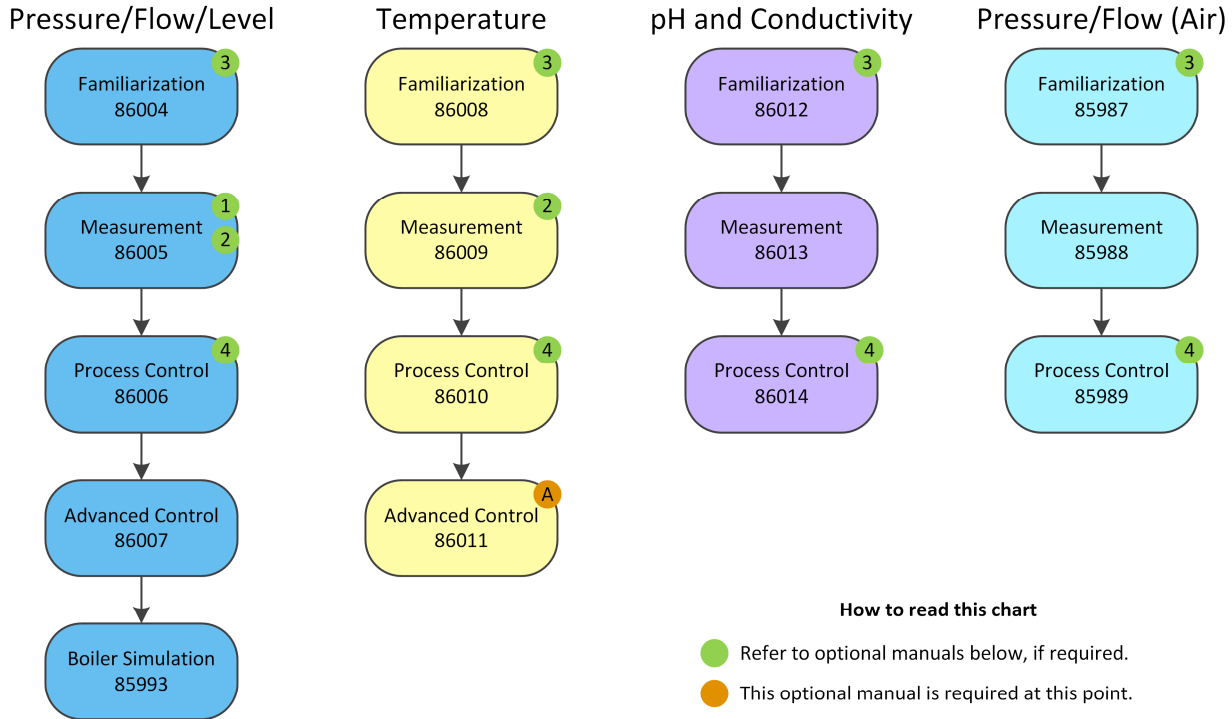
The modularity of the system allows the instructor to select the equipment required to meet the objectives of a specific course. Two mobile workstations, on which all of the equipment is installed, form the basis of the system. Several optional components used in pressure, flow, level, temperature, and pH control loops are available, as well as various valves, calibration equipment, and software. These add-ons can replace basic components having the same functionality, depending on the context. During control exercises, a variety of controllers can be used interchangeably depending on the instructor's preference.

We hope that your learning experience with the Instrumentation and Process Control Training System will be the first step toward a successful career in the process control industry.



Preface

Manuals of the 353X Series



Preface

We invite readers of this manual to send us their tips, feedback, and suggestions for improving the book.

Please send these to did@de.festo.com.

The authors and Festo Didactic look forward to your comments.

About This Manual

This user guide is designed to familiarize you with the human-machine interface (HMI) developed by Festo Didactic under the Siemens architecture. It explains how to use the SIMATIC HMI with the supported controller.

This user guide is intended for both instructors and students.

Required software

The required software applications are preinstalled on the HMI.

Systems of units

Units are expressed using the International System of Units (SI) followed by the units expressed in the U.S. customary system of units (between parentheses).

Getting Started

Terminology to identify process variables may differ from one controller manufacturer to another and from what is found in textbooks. Using PV (process variable) in place of controlled variable is common. Also, CV (control variable) is frequently used in place of manipulated variable.

Prerequisites

This section explains how to get started with the Siemens human-machine interface (HMI) designed to work with the Instrumentation and Process Control Training System, series 353X. Before proceeding with this section, be sure that:

- The PLC is properly connected and running a program suited to work with the HMI.
- The PROFINET communication between the HMI, the PLC, and the drive(s) is functional.

The need for graphic terminals

Industrial processes may use hundreds of components. Each of these components requires the attention of a technician at one time or another, particularly when the system is started up or shut down.

Most industrial systems are autonomous; however, they still need monitoring in case something goes wrong. Monitoring a system includes displaying and extracting information from raw data. For example, a monitoring system can use the pressure inside a gas tank to deduce the temperature of the gas.

Even small systems need a convenient solution for monitoring. It is usually not a viable solution to monitor components using only lights and buttons. The user should be able to assess the status of the system rapidly and apply changes using a main control panel. Graphic terminals are an excellent solution to interact with the components of a system. The HMI provided with the training system has an interface close to what is commonly found on an industrial graphic terminal.

Hardware and software components

SIMATIC HMI

The SIMATIC® HMI, shown in Figure 1, is manufactured by Siemens. Its 483 mm (19 in) display has a 1366x768 resolution. Its color touch-screen interface allows the user to monitor and control of some of the Instrumentation and Process Control Training System features. This terminal has a pre-programmed interface developed with the various components of the system in mind. The device comes with all the required software preinstalled.

The device is energized when the power input at the back is connected to a wall outlet and the power switch is turned on. The terminal has two PROFINET communication ports, three USB ports, and a display port.



Figure 1. SIMATIC HMI, Model 46973.

The SIMATIC HMI is a touch-screen computer with a Windows® operating system. Although the interface is designed for touch-screen inputs, some complementary software applications, such as SIMATIC Process Device Manager (PDM), are more easy to use when used with a mouse and keyboard. Connect any additional input devices to one of the USB ports.

Starting the HMI

1. Turn on the touch screen using the switch at the back of the device.
2. The interface should launch automatically. If not, click on the *WinCC Runtime Loader* icon on the desktop and click *Start*.



If you need to restart the graphic terminal, be sure to turn it off for at least 10 seconds.

Familiarization with the Interface

Home screen

Figure 2 shows the **Home** screen that appears when you start the interface. In the bottom-right corner of this window, a **Quit** button allows you to exit the application.

Each screen of this interface has a series of buttons giving access to screens or displaying pop-up windows. Buttons linked to a specific loop are usually located in the PID loop panel. For example, each loop has a **Configuration** button that gives access to the configuration window of the loop. Generic buttons, such as the **Access PLC I/O** button, are located at the bottom of the screen.

The **Home** screen displays two PID loop panels at the same time. In the left portion of this screen, different visualizations are shown.

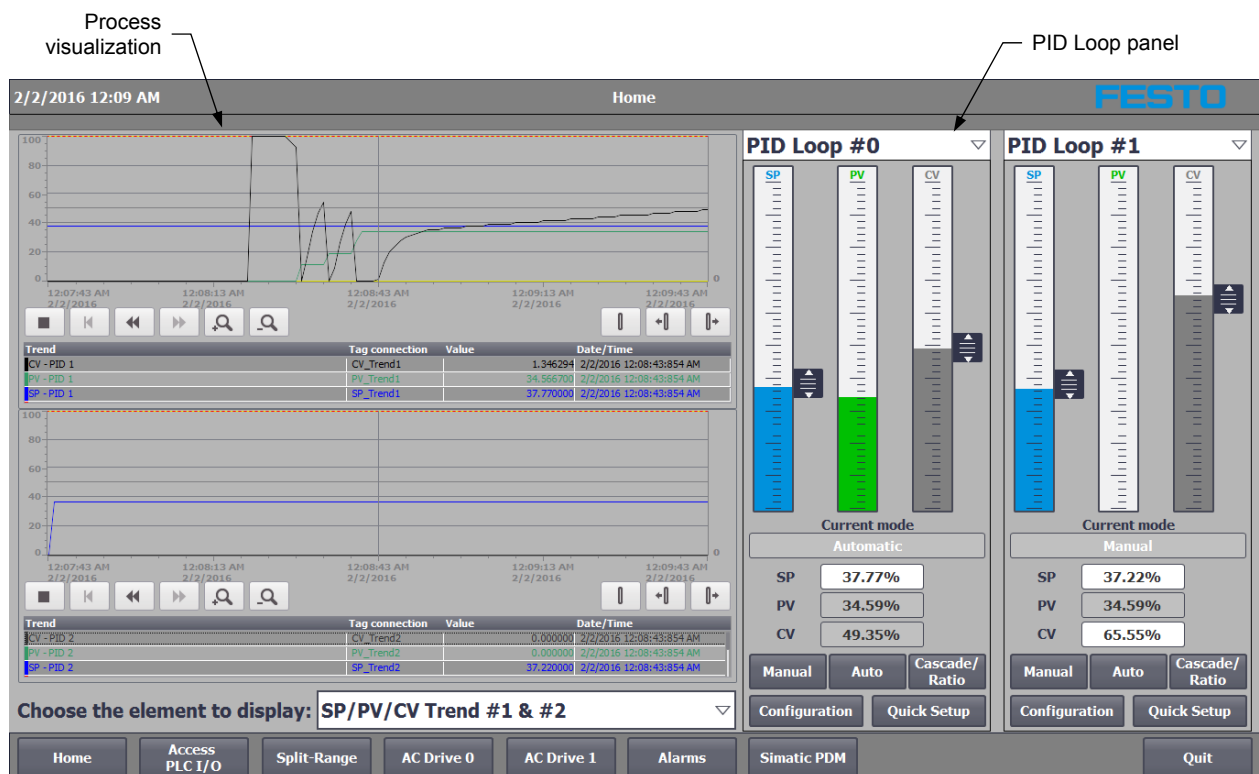


Figure 2. Home screen.

Control loop configuration

Up to eight loops can run at the same time; they are numbered from 0 to 7. To access a loop status and configuration, first select the loop identification from the drop-down list (Figure 3).

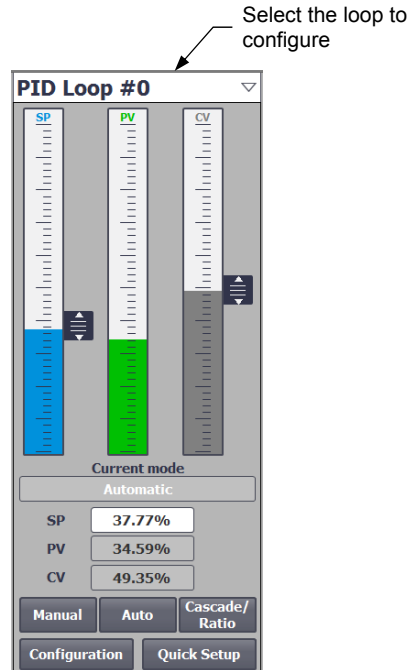


Figure 3. PID loop selection.

To configure a loop for your process, click on the *Configuration* button. This opens the *PID Configuration* screen (Figure 4).

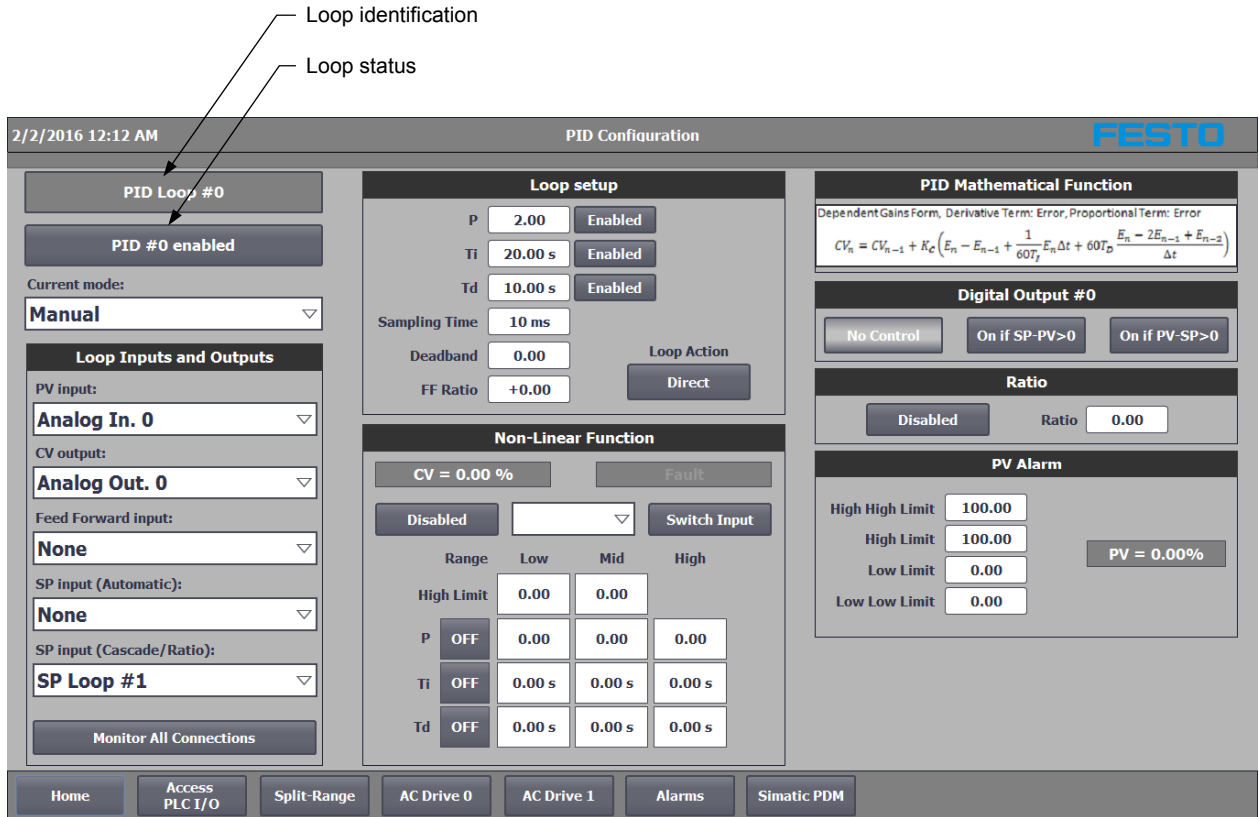


Figure 4. PID loop configuration screen.

This screen contains several parameters for the current loop. Some parameters are mandatory, while others are optional or enabled only in some modes.

Inputs and outputs

In the inputs and outputs section of the screen, you can configure the process variable input (PV), control variable output (CV), feedforward input (FF), and set points (SP) for both the automatic and cascade/ratio modes (Figure 5). Select the appropriate input and output signals from the appropriate drop-down list.

For example, select *Analog Input #1* from the *PV input* drop-down list to use this PLC input as a process variable for your loop. Examples of PID, on-off, and cascade control loops are given later in this manual.

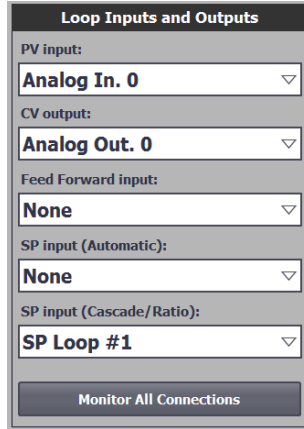


Figure 5. Loop inputs and outputs configuration.

Press *Monitor All Connections* to access a table where all inputs and outputs are shown for each control loop. Pressing *Reset All* sets the PV, CV, FF, and SPs for all loops to their default values. A parameter set to *None* is not assigned.

	PV	CV	SP (Automatic)	SP (Cascade/Ratio)	Feed Forward Input
Loop #0	AI 0	AO 0	None	SP Loop #1	None
Loop #1	AI 1	AO 1	None	SP Loop #0	None
Loop #2	None	None	None	SP Loop #0	None
Loop #3	None	None	None	SP Loop #0	None
Loop #4	None	None	None	SP Loop #0	None
Loop #5	None	None	None	SP Loop #0	None
Loop #6	None	None	None	SP Loop #0	None
Loop #7	None	None	None	SP Loop #0	None

Figure 6. Monitor connections pop-up window.

Loop setup

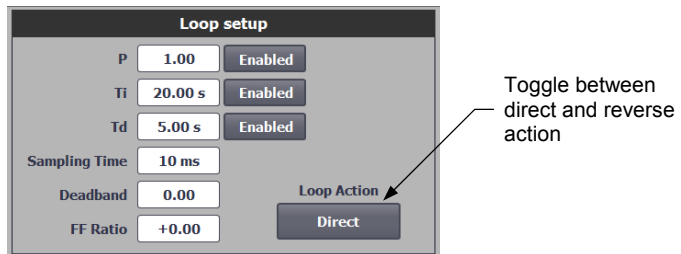


Figure 7. Loop parameters.

In the *Loop setup* section, you can configure the PID parameters of the loop such as the proportional gain (P), the integral time (Ti), and the derivative time (Td) (Figure 7). Each of these parameters has a button to its right to enable or disable it (to set a loop for P control only, for example).

Additionally, the loop sampling time, a dead band, and a feedforward ratio can be configured.

In the lower-left corner of the **Loop setup** section, a button allows the user to switch the control loop between direct and reverse action.

Non-linear function

Some control schemes require changing the PID loop parameters as a function of an input variable. Either the controlled variable (CV) or the process variable (PV) can be set as the input signal.

Two types of non-linear functions are available (Figure 8). The **2 Ranges** and **3 Ranges** functions allow setting two or three series of PID parameters depending on the value of the input. The limit below which each series of parameters are enabled must be set in **High Limit** field(s).

For example, you may select the **2 Ranges** function, select the CV input, and set the high limit of the low range to 40%. With this setup, the low-range PID parameters are used for the control loop when the controlled variable is below 40% and the mid-range PID parameters are used when the controlled variable is above 40%.

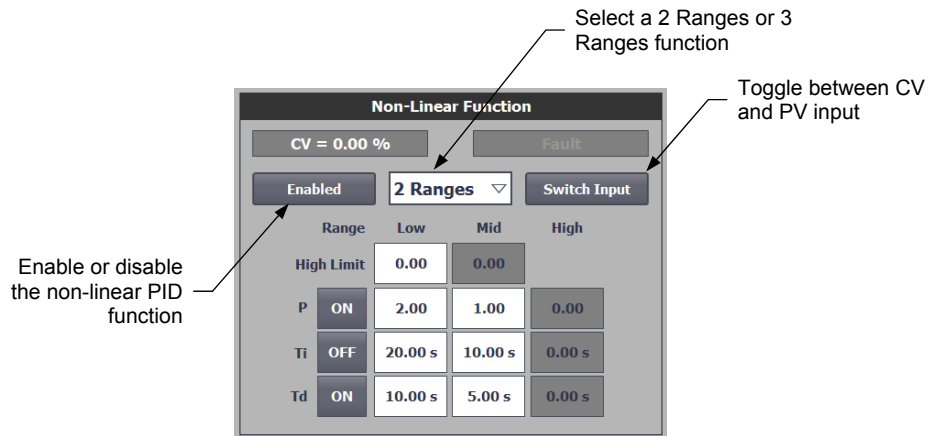


Figure 8. Non-linear function.

Loop digital output

Each control loop can be linked to the digital output corresponding to the loop number. This output is on or off depending on the value of the process variable compared to the set point (Figure 9). If **On if SP-PV>0** is enabled, the digital output is actuated if the process variable is below the set point. If **On if PV-SP>0** is enabled, the output is actuated if the process variable is above the set point. The digital output is not controlled if **No Control** is enabled.

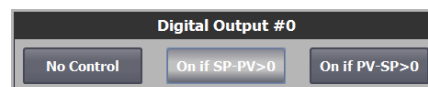


Figure 9. Loop digital output.

Process variable alarm

The process variable configured in the control loop can be used to trigger alarms. In the **PV Alarm** section of the **PID Configuration** screen, you can configure high high, high, low, and low low limit alarms on the process variable (Figure 10).

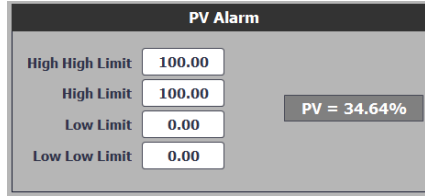


Figure 10. Process variable alarms.

Managing control loops

You can display up to two different control loops on the **Home** screen of the interface (Figure 11). Use the buttons below the vertical bar graphs of the loop variables to quickly enable or disable functions or to modify the loop PID parameter without opening the configuration screen.

The **Manual** button sets the control loop to the manual mode. In this mode, you can change the value of the controlled variable (CV) manually. PID parameters are ignored in this mode.

The **Auto** button sets the control loop to the automatic mode. In this mode, the controller determines the value of the controlled variable using the PID parameters of the loop.

The **Cascade/Ratio** button enables the SP input used for the cascade and ratio mode.

Finally, the **Quick Setup** button opens a PID-parameters pop-up window (Figure 11). In this window, you can rapidly change the set point and the PID parameters of the loop without opening the configuration screen.

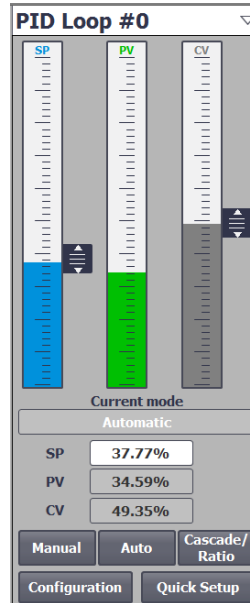


Figure 11. PID loop display.

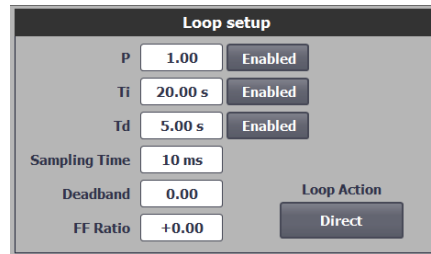


Figure 12. Loop setup pop-up window.







Process visualization

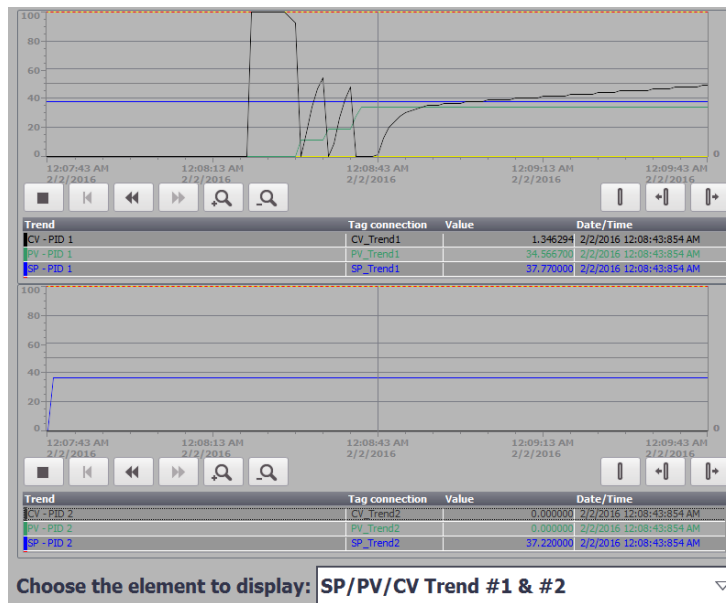
Visualizations of the process loops are shown at the left of the [Home](#) screen. The default visualization is two trend recorders, one for each of the control loops selected at the right. Several other visualizations are available. Use the drop-down list at the bottom of the visualization section to change the type of view.

Figure 13 to Figure 18 show the different types of visualizations available. Table 1 gives details on the controls of the trends.

Table 1. Visualization control buttons.

Icon	Function
	Start data plotting on the trend
	Stop data plotting
	Jump to the beginning of the recording
	Move backward on the trend timeline

Icon	Function
	Move forward on the trend timeline
	Zoom in on the data
	Zoom out on the data
	Center the cursor on the trend. The values of the plotted variable at the cursor position are shown in a table at the bottom of the screen
	Move the cursor left
	Move the cursor right



Use this menu to change the type of visualization

Figure 13. Process control visualization – two trends display.

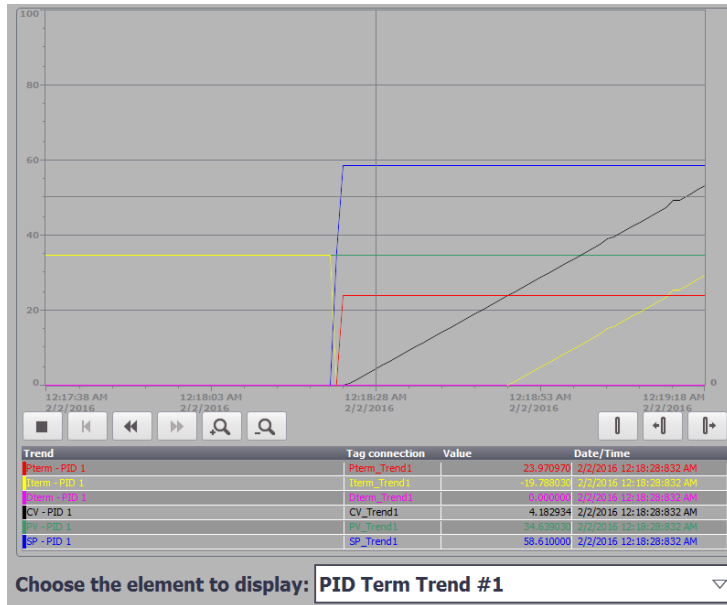


Figure 14. Process control visualization – single PID trend display.

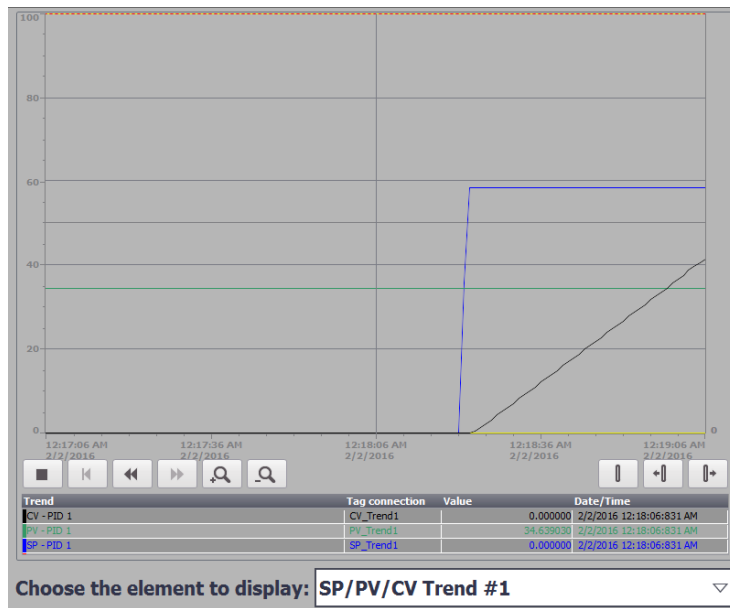


Figure 15. Process control visualization – single SP/PV/CV trend display.

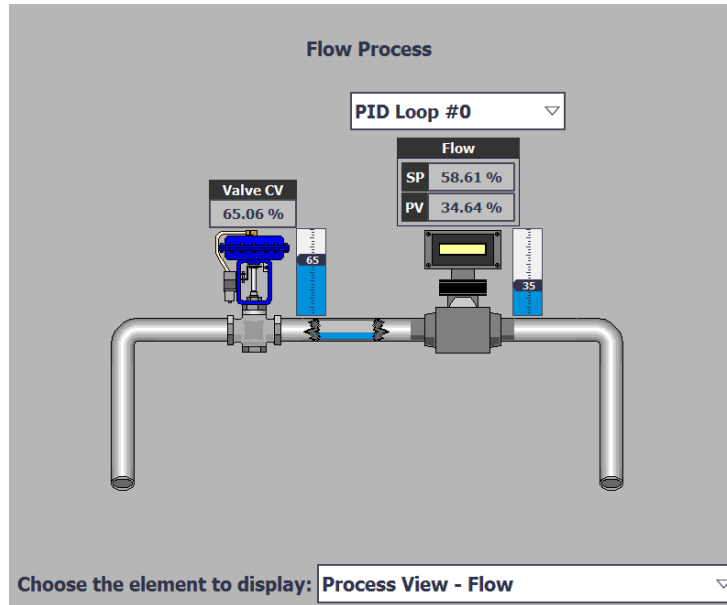


Figure 16. Process control visualization – flow process.

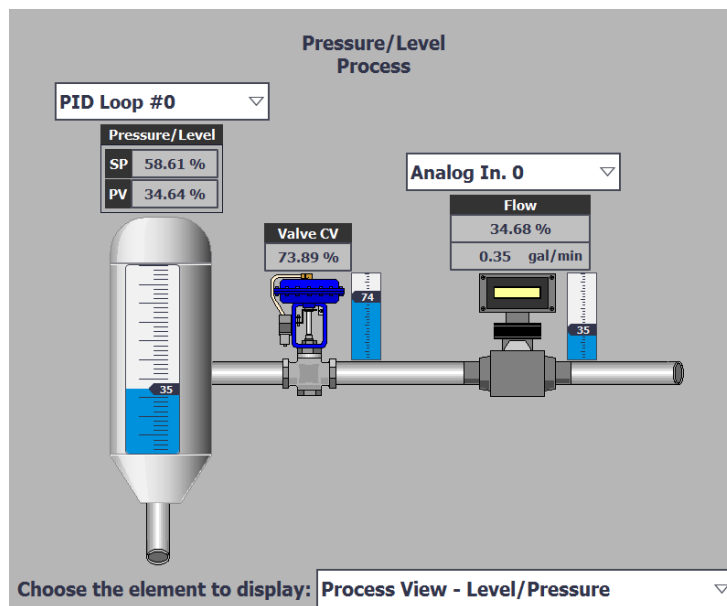


Figure 17. Process control visualization – pressure/level process.

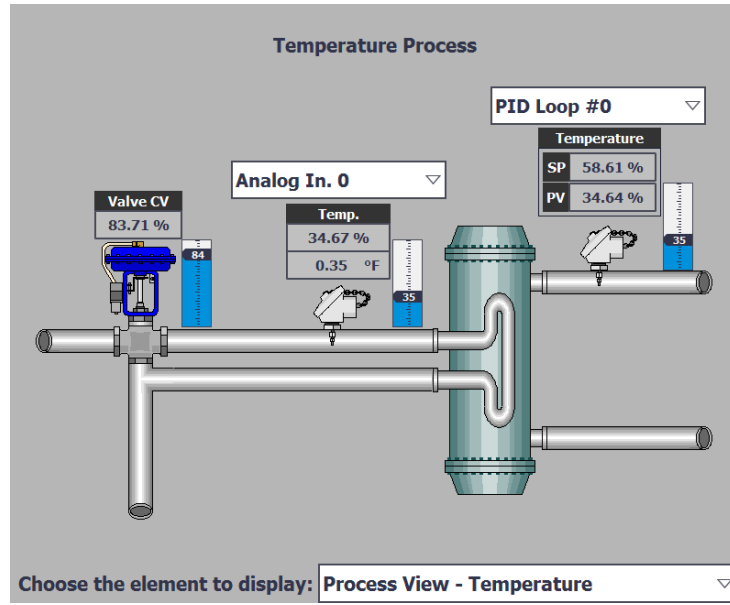


Figure 18. Process control visualization – temperature process.

Accessing PLC inputs and outputs

The [Access PLC I/O](#) button at the bottom of the [Home](#) screen opens the [PLC I/O](#) screen (Figure 19). This screen gives the current status of each of the controller inputs and outputs. The types of inputs and outputs available in this screen may vary depending on the type of PLC. For example, your PLC may or may not have HART inputs and outputs.

Digital inputs and outputs

The square beside a digital input label is green when it is actuated (logic 1) and grey otherwise (logic 0). You can actuate a digital output by pressing the button next to its output label. An actuated output is [ON](#) while a disabled output is [OFF](#).



Figure 19. PLC I/O.

Analog I/O

Press the button corresponding to an analog input or output to open a pop-up window showing its current status, scaling information, and raw data. In this window, you can adjust the minimum and maximum range for the engineering units of this input or output (Figure 20).

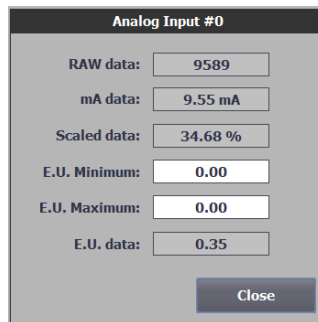


Figure 20. Analog input.

If your PLC has HART inputs and outputs, you have access to HART data for each of them, as shown in Figure 21.

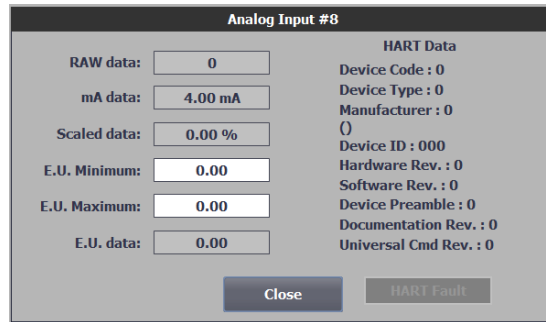


Figure 21. Hart input data.

Split range

Split range is a control scheme frequently used in the chemical industry. For example, a chemical reactor may have an upstream valve and a downstream valve that must open as a function of the pressure in the vessel.

The interface enables easy split-range configuration and visualization via the [Split Range](#) screen. To open this configuration screen, click on the [Split-Range](#) button at the bottom of the [Home](#) screen.

When using the split-range function, a single process-variable input influences two or three different analog outputs. Each analog output operates in a different range in its own PID loop.

Figure 22 shows a configuration for a split-range application with two loops. In this example, analog input 0 is the process variable (PV) and the set point is 50%. In the first control loop (Loop #0), analog output 0 varies from 0% to 100% (*CV Effective Range*) while the CV of the split-range scheme varies between 0% and 50% (*Split-Point Range*). When the value of the CV is above 50%, analog output 0 is topped at 100%. At this point, the second loop starts to operate. When the CV is between 50% and 100%, analog output 1 varies between 0% and 100%. Take note that the two loops need to be enabled, in automatic mode, and configured to work properly.

The [Split Range](#) screen has its own trend that monitors the process variables.

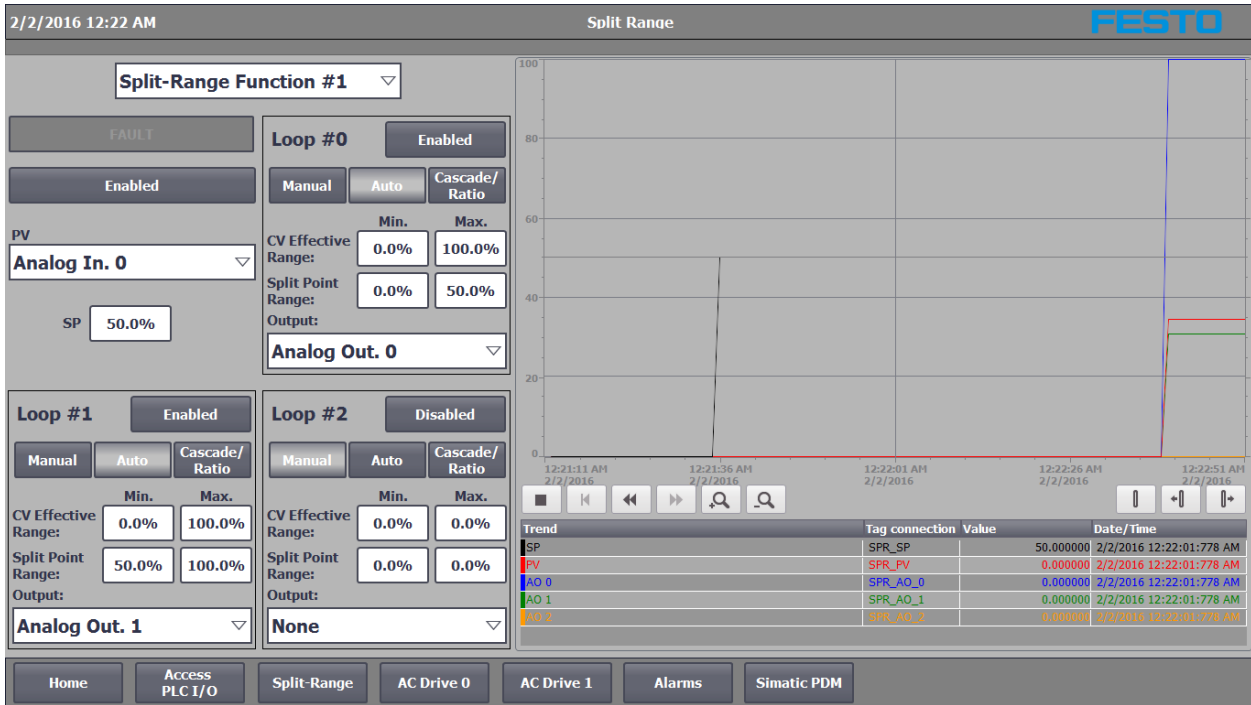


Figure 22. Split range.

AC drive control

Up to two Siemens drives can be controlled with the interface through the PROFINET protocol. To do this, the drive(s) must be connected and configured as described in Appendix A.

Press one of the ac drive buttons to open the corresponding drive pop-up window (Figure 23). This pop-up window shows the current status of the drive. To start the drive, set the desired speed set-point in the text box and press the **Start** button.

If one of the control loops has the drive as its CV output, the loop output can be used as an automatic set point for the drive. Click on the **Automatic SP** button to enable automatic control of the drive. Faults on the drive can be reset using the **Reset Faults** button.

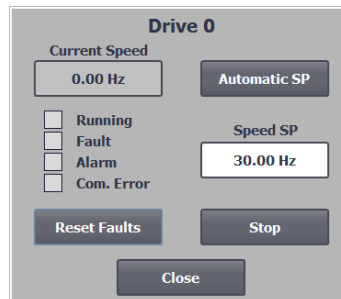
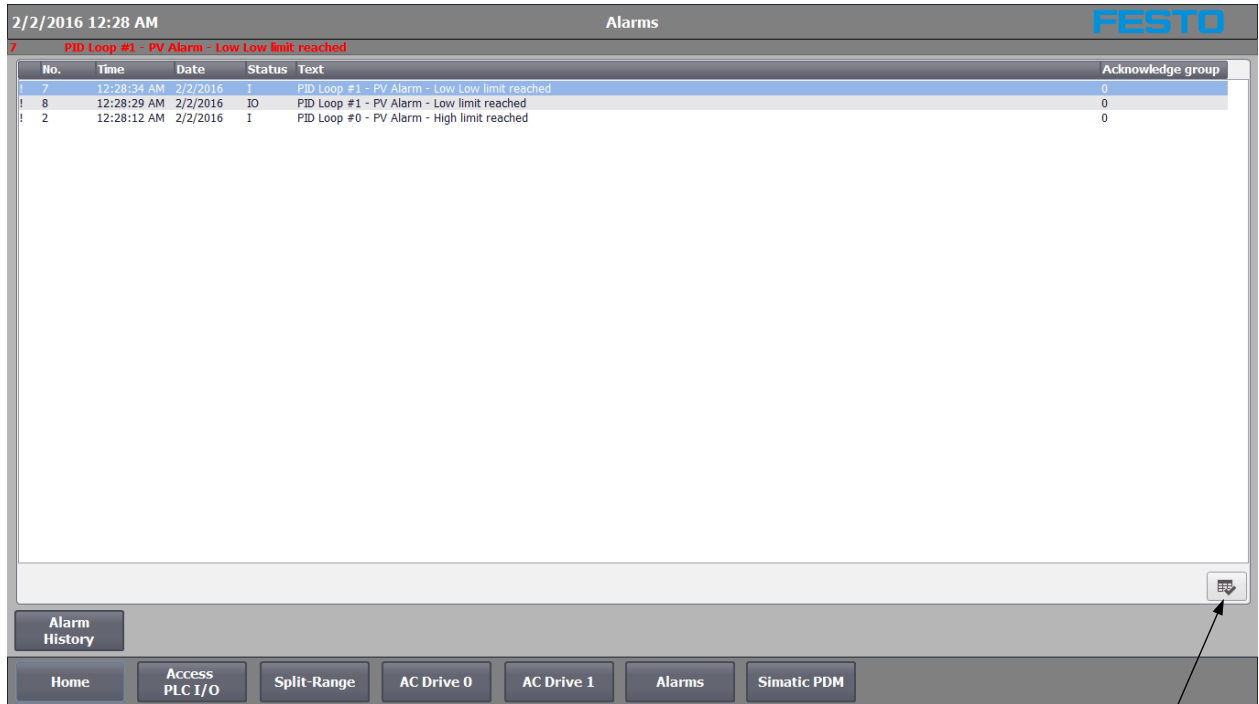


Figure 23. AC drive control.

Alarms

Click on the [Alarms](#) button to open the [Alarms](#) screen (Figure 24). This screen shows the active alarms. To acknowledge an alarm, click on the checkmark icon in the lower-right corner of the screen. The letter “A” in the [Status](#) column of an alarm indicates that it has been acknowledged.

Once an alarm is resolved, it disappears from the [Alarms](#) screen. However, all current and past alarms are logged in the [Alarms History](#) window, which you can access by pressing the button in the lower-left corner of the screen (Figure 25).



Acknowledge an alarm

Figure 24. Alarm status.

2/2/2016 12:28 AM		Alarms History		FESTO	
7 PID Loop #1 - PV Alarm - Low Low limit reached					
No.	Time	Date	Status	Text	Acknowledge group
!	8	12:28:34 AM	IO	PID Loop #1 - PV Alarm - Low limit reached	0
!	7	12:28:34 AM	I	PID Loop #1 - PV Alarm - Low Low limit reached	0
!	8	12:28:29 AM	I	PID Loop #1 - PV Alarm - Low limit reached	0
!	2	12:28:12 AM	I	PID Loop #0 - PV Alarm - High limit reached	0
\$	140000	11:54:05 PM	I	Connection established: HMI_Connection_1, Station 10.10.11.10, Rack 0, Slot 1.	0
\$	110001	11:54:02 PM	I	Change to operating mode 'online'.	0
!	8	2:13:11 AM	I	PID Loop #1 - PV Alarm - Low limit reached	0
!	4	2:13:11 AM	I	PID Loop #0 - PV Alarm - Low limit reached	0
\$	140000	2:13:11 AM	I	Connection established: HMI_Connection_1, Station 10.10.11.10, Rack 0, Slot 1.	0
\$	110001	2:13:08 AM	I	Change to operating mode 'online'.	0
!	8	2:12:57 AM	I	PID Loop #1 - PV Alarm - Low limit reached	0
!	4	2:12:57 AM	I	PID Loop #0 - PV Alarm - Low limit reached	0
\$	140000	2:12:57 AM	I	Connection established: HMI_Connection_1, Station 10.10.11.10, Rack 0, Slot 1.	0
\$	110001	2:12:55 AM	I	Change to operating mode 'online'.	0
!	8	2:09:28 AM	I	PID Loop #1 - PV Alarm - Low limit reached	0
!	4	2:09:28 AM	I	PID Loop #0 - PV Alarm - Low limit reached	0
\$	140000	2:09:28 AM	I	Connection established: HMI_Connection_1, Station 10.10.11.10, Rack 0, Slot 1.	0
\$	110001	2:09:26 AM	I	Change to operating mode 'online'.	0
!	8	2:07:26 AM	I	PID Loop #1 - PV Alarm - Low limit reached	0
!	4	2:07:26 AM	I	PID Loop #0 - PV Alarm - Low limit reached	0
\$	140000	2:07:26 AM	I	Connection established: HMI_Connection_1, Station 10.10.11.10, Rack 0, Slot 1.	0
\$	110001	2:07:24 AM	I	Change to operating mode 'online'.	0
!	8	2:06:02 AM	I	PID Loop #1 - PV Alarm - Low limit reached	0
!	4	2:06:02 AM	I	PID Loop #0 - PV Alarm - Low limit reached	0
\$	140000	2:06:02 AM	I	Connection established: HMI_Connection_1, Station 10.10.11.10, Rack 0, Slot 1.	0
\$	110001	2:05:59 AM	I	Change to operating mode 'online'.	0
!	4	1:14:08 AM	IA	PID Loop #0 - PV Alarm - Low limit reached	0
!	8	1:14:07 AM	IA	PID Loop #1 - PV Alarm - Low limit reached	0
!	8	1:14:04 AM	I	PID Loop #1 - PV Alarm - Low limit reached	0
!	4	1:13:50 AM	I	PID Loop #0 - PV Alarm - Low limit reached	0
!	4	1:13:02 AM	IAO	PID Loop #0 - PV Alarm - Low limit reached	0
!	4	1:12:49 AM	IA	PID Loop #0 - PV Alarm - Low limit reached	0
!	4	1:12:45 AM	I	PID Loop #0 - PV Alarm - Low limit reached	0
!	4	1:12:13 AM	IAO	PID Loop #0 - PV Alarm - Low limit reached	0
\$	140000	11:11:56 AM	I	Connection established: HMI_Connection_1, Station 10.10.11.10, Rack 0, Slot 1.	0
\$	190004	1:11:45 AM	I	Tag CurrentScreen: PLC address error.	0
\$	190004	1:11:45 AM	I	Tag Config_P: PLC address error.	0
\$	190004	1:11:45 AM	I	Tag Config_TI: PLC address error.	0

Figure 25. Alarms history.

Data logging

The values recorded on the trends and the alarms are logged in files on the graphic terminal. To access the logs, exit the interface by pressing the *Quit* button in the *Home* screen.

In the Windows operating system, browse the hard drive structure and open the *c:\winCC_Logs* folder. This folder contains the trends log in CSV format. A subfolder contains the alarm history. Alarm history is stored in a SQLite relational database format (.RDB). Software that can display SQLite content is required to open .RDB files.

On-Off Control

On-off control

PLCs can be used to implement on-off control for a process. This basic type of control is efficient for slowly changing processes. In an on-off control scheme, an analog input and an analog output are used for the process variable (PV) and control variable (CV) respectively. Three parameters must be set according to the requirements of the process: the set point, the deadband, and the loop action.

Connecting the PLC to the process loop

1. Connect the controller to the process as shown in Figure 26.

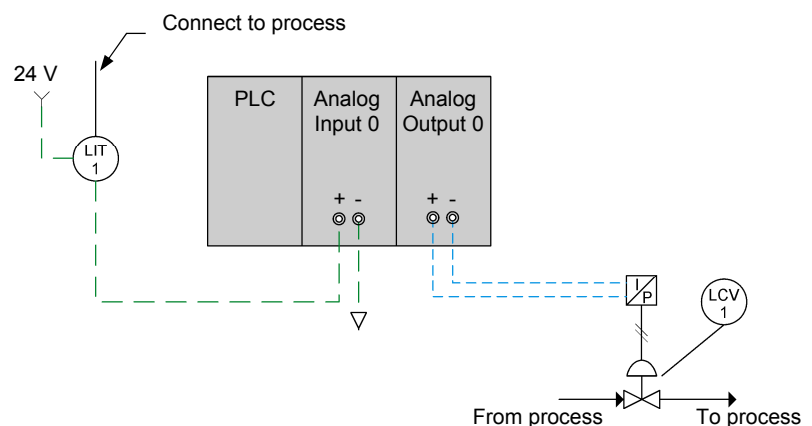


Figure 26. Typical connection for on-off control.

HMI configuration for on-off control

2. Make sure the PLC and the HMI are set up as explained in Appendix A.
3. This project requires you to connect an emergency button for increased safety. If the PLC digital input 0 is not powered, all processes are shut down. Connect digital input 0 of your PLC to a 24 V dc switched output source on the electrical unit of the Instrumentation and Process Control Training System. The switched output jacks become unpowered when the emergency button is pressed.

Configuring on-off control

4. Set the [PID Configuration](#) for on-off control as shown in Figure 27.

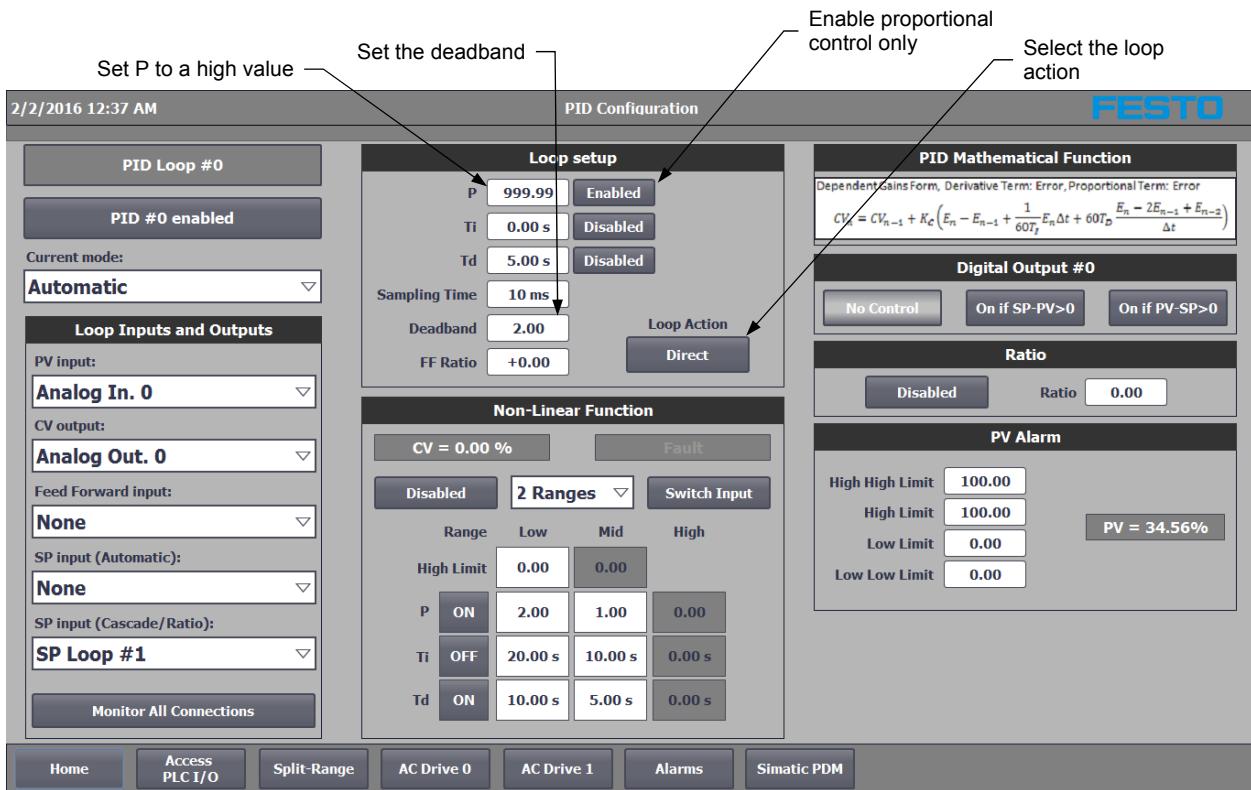


Figure 27. On-off control configuration.

Running on-off control

5. Verify your setup and adjust the set point to an appropriate value using the slider in the PID loop display. You are now ready to start your process. Make sure that the PLC mode is set to *Auto* so that the loop performs on-off control.

PID Control

PID control

PLC controllers can be used to implement PID control, which is a common process control scheme in the industry. In such a scheme, an analog input and an analog output are used for the process variable (PV) and control variable (CV) respectively. A series of parameters must be set according to the requirements of the process and the type of control (P, PI, PD, or PID).

Connecting the PLC to the process loop

1. Connect the PLC to the process as shown in Figure 28.

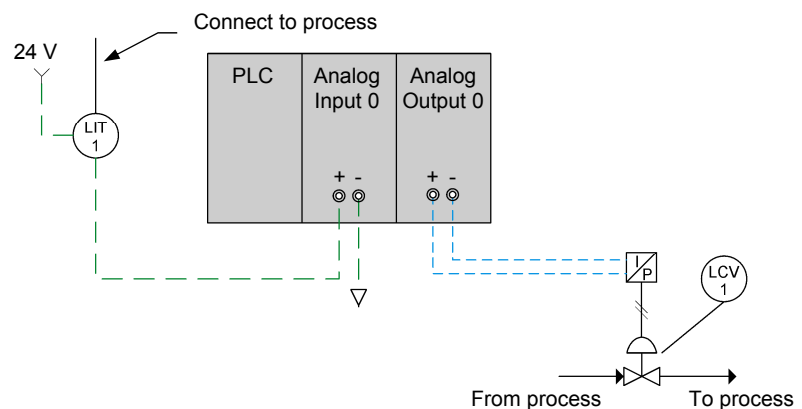


Figure 28. Typical connection for PID control.

HMI configuration for PID control

2. Make sure the PLC and the HMI are set up as explained in Appendix A.
3. This project requires you to connect an emergency button for increased safety. If the PLC digital input 0 is not powered, all processes are shut down. Connect digital input 0 of your PLC to a 24 V dc switched output source on the electrical unit of the Instrumentation and Process Control Training System. The switched output jacks become unpowered when the emergency button is pressed.

Configuring on-off control

4. Set the [PID Configuration](#) for PID control as shown in Figure 29.

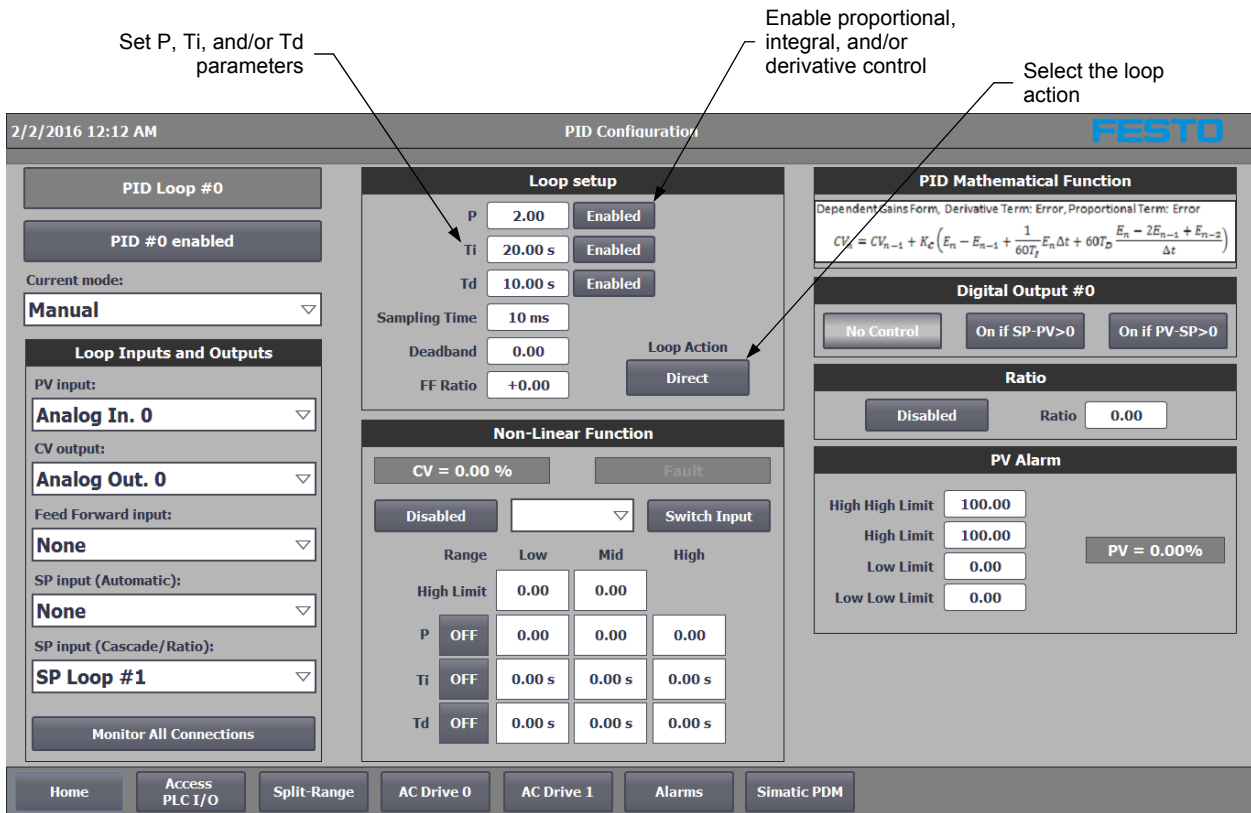


Figure 29. PID control configuration.

Tuning the control loop

5. Verify your setup and perform the tuning of your PID loop by either adjusting the tuning parameters while in *Auto* mode (trial-and-error or ultimate-cycle method) or by performing a step change in *Manual* mode and proceeding with the Ziegler-Nichols calculations. In any case, fine-tune your process until it meets your control expectations.

Cascade Control

Cascade control

Cascade control can be very useful when a fast-changing secondary process variable yields information about the behavior of the primary variable. The added information results in tighter control and the ensuing cascade scheme typically yields better overall performances. This type of control can be implemented on a PLC simply by combining two PID control instructions.

Two analog inputs and one analog output are used for the two process variables (PV) and for the control variable (CV) respectively. A series of parameters must be set according to the needs of the process.

It is essential that you become familiar with PID control before using cascade control. Refer to Section 4 if necessary.

Connecting the PLC to the process loop

1. Connect the PLC to the process as shown in Figure 30.

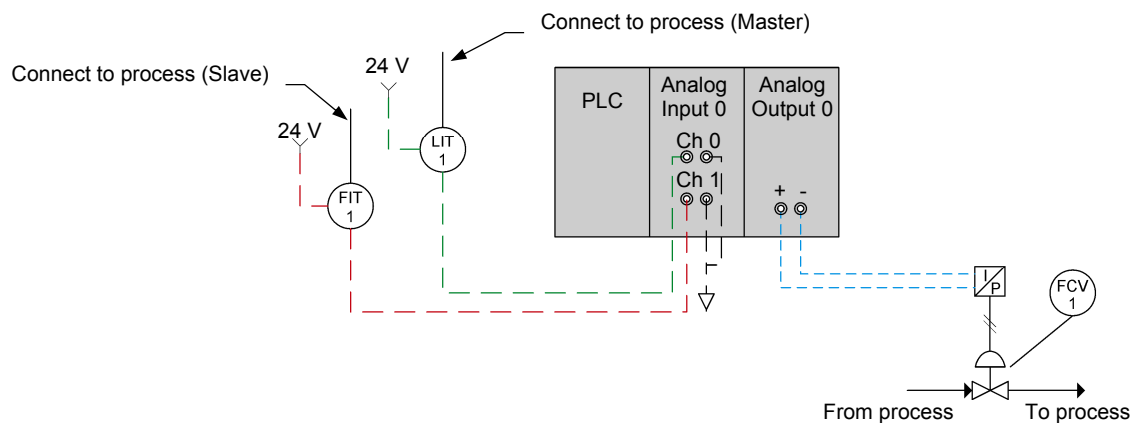


Figure 30. Typical connection for cascade control.

HMI configuration for cascade control

2. Make sure the PLC and the HMI are set up as explained in Appendix A.
3. This project requires you to connect an emergency button for increased safety. If the PLC digital input 0 is not powered, all processes are shut down. Connect digital input 0 of your PLC to a 24 V dc switched output source on the electrical unit of the Instrumentation and Process Control Training

System. The switched output jacks become unpowered when the emergency button is pressed.

Configuring cascade control

- Set the **PID Configuration** of two control loops for cascade control as shown in the following figures. Figure 31 shows the master loop configuration; it uses analog input 0 to read the process level. The second loop is the slave loop; its configuration is shown in Figure 32 and it uses analog input 1 to read the process flow while analog output 0 is connected to the control valve. The master and slave loops should both be in *Manual* mode for now.

The output of the master loop will be used (when in cascade mode) as the set point of the slave loop. This output does not have any other use and is simply ignored when the cascade mode is inactive.

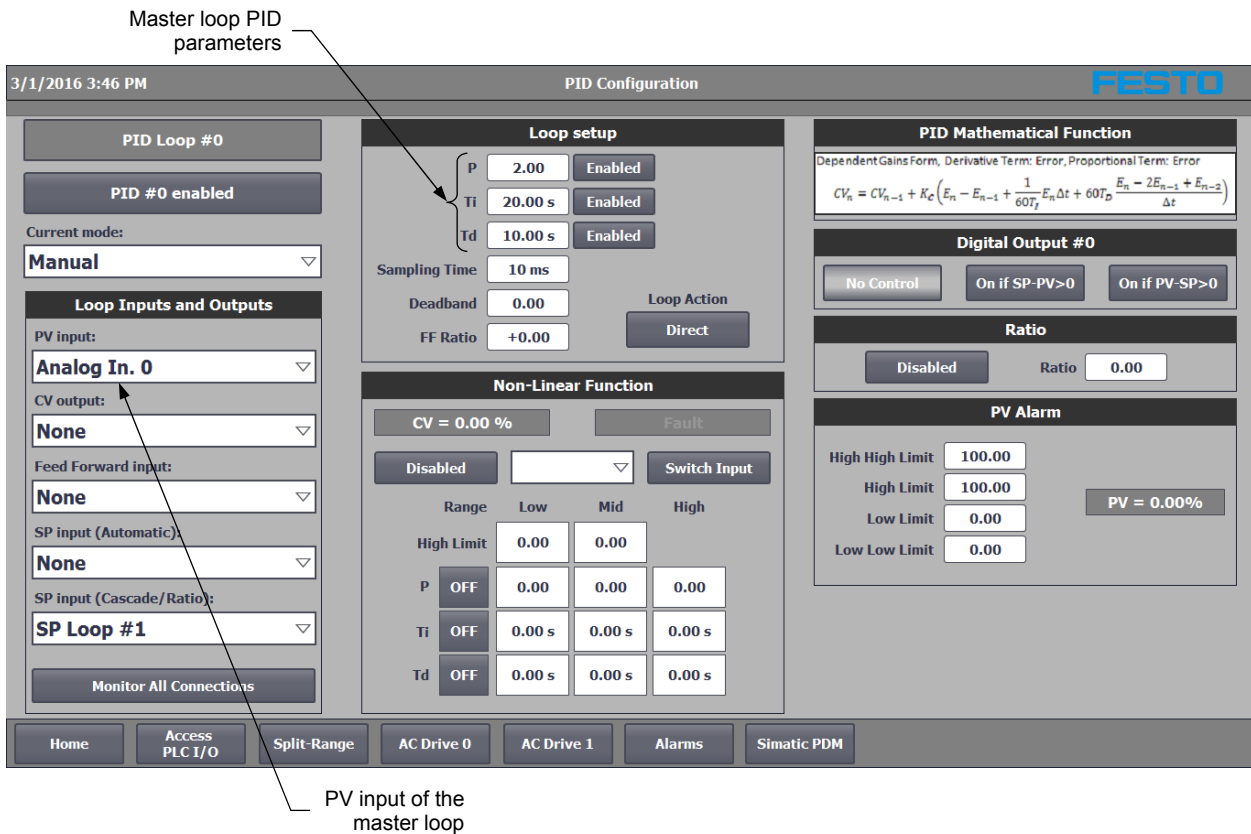


Figure 31. Master loop configuration (loop #0).

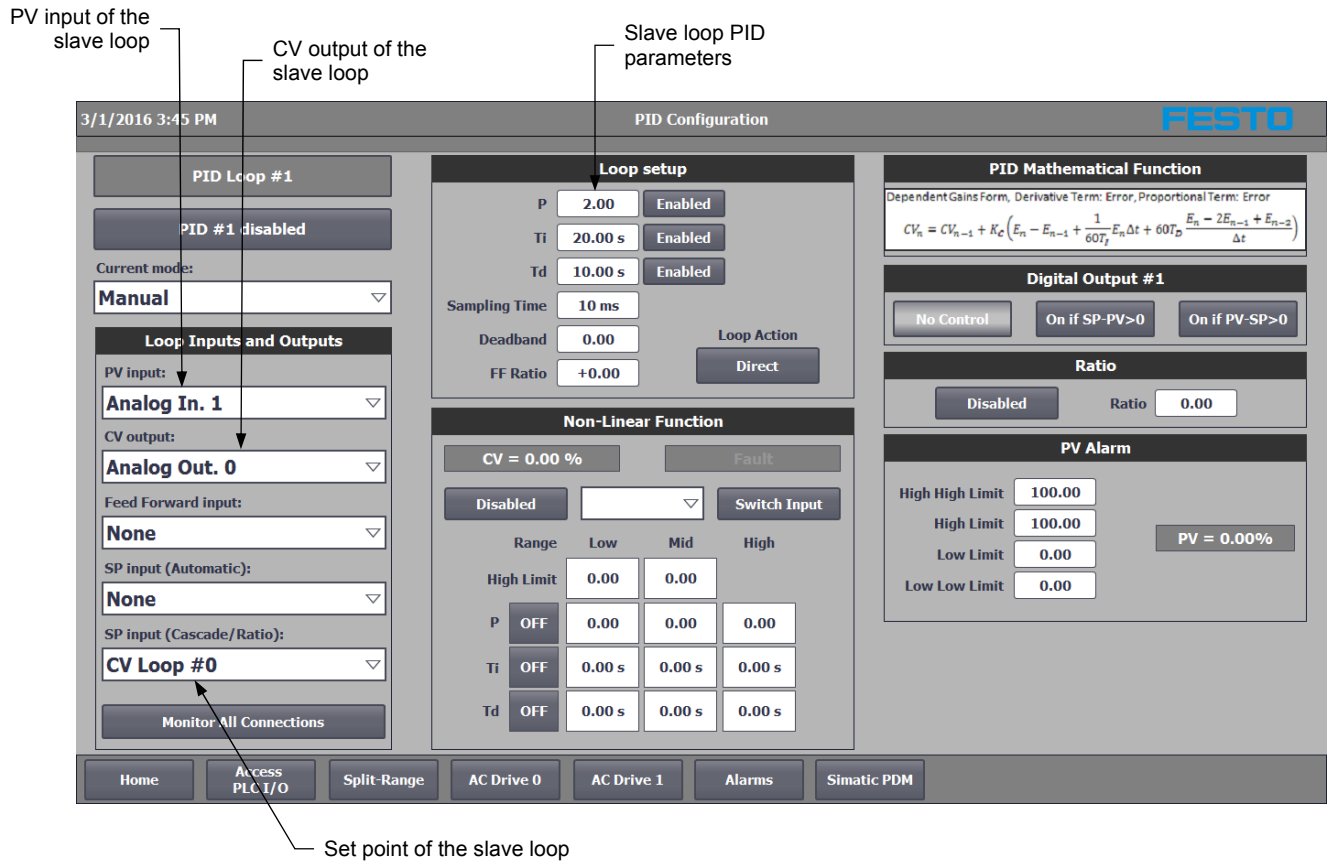


Figure 32. Slave loop configuration (loop #1).

Tuning the control loops

Tuning the slave loop

5. Perform the tuning of the PID slave loop by either adjusting the tuning parameters while in *Auto* mode, or by performing a step change in *Manual* mode and proceeding with the Ziegler-Nichols calculations. In any case, fine-tune your process until it meets your control expectations.

Keep in mind that the slave and the master loops work on different variables. In the archetypal example, the slave loop controls the flow going into a tank while the master loop controls the level in the tank.

Once the slave loop is tuned, press the *Cascade/Ratio* button to activate the cascade mode.

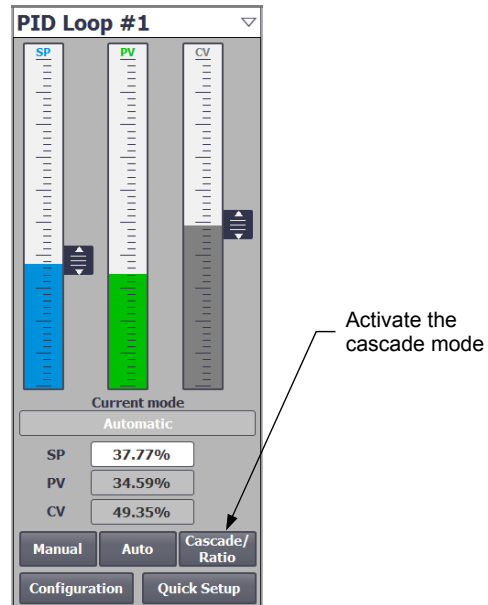


Figure 33. Activating cascade mode for the slave loop.

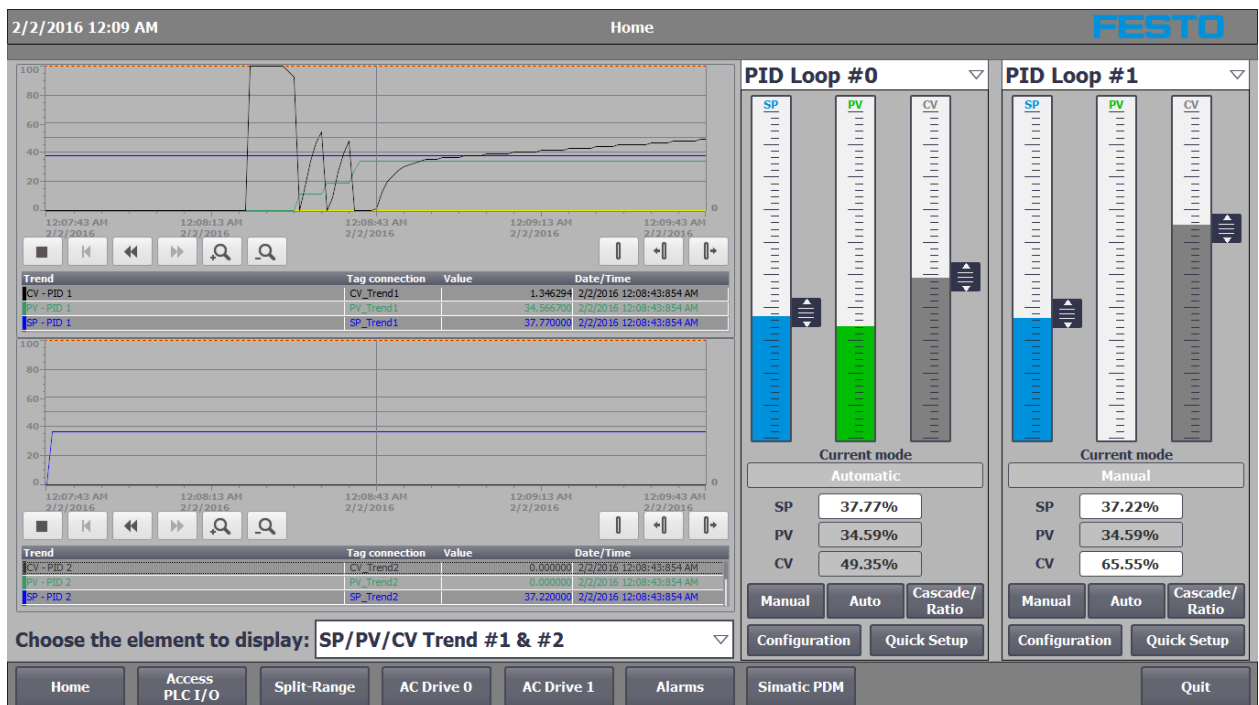
Tuning the master loop

6. Perform the tuning of the PID master loop by either adjusting the tuning parameters while in *Auto* mode, or by performing a step change in *Manual* mode and proceeding with the Ziegler-Nichols calculations. In any case, fine-tune your process until it meets your control expectations.
7. Leave the master loop in *Auto* mode. The PLC is now controlling your process in cascade.

Process Device Manager

Managing devices

SIMATIC Process Device Manager (PDM) is a complete tool to configure and commission HART devices. You can open this software using the *SIMATIC PDM* button at the bottom of the interface.



Open the SIMATIC PDM

Figure 34. Click the SIMATIC PDM button to open the SIMATIC Process Device Manager.

The interface of the SIMATIC Process Device Manager is shown in Figure 35. The PDM version installed on the HMI is preconfigured to communicate with three types of transmitters. This section describes how you can add or remove devices from the PDM, as well as how to use the PDM to monitor and configure your devices.

As shown in Figure 35, each preconfigured transmitter (TMT162, PDM75 HR, and PDM75 LR) is associated to a channel. Each channel corresponds to a HART input on the distributed I/O module. For example, to use the default PDM configuration to configure and monitor a temperature transmitter (TMT162), you must connect it to input 0 of the distributed I/O module.

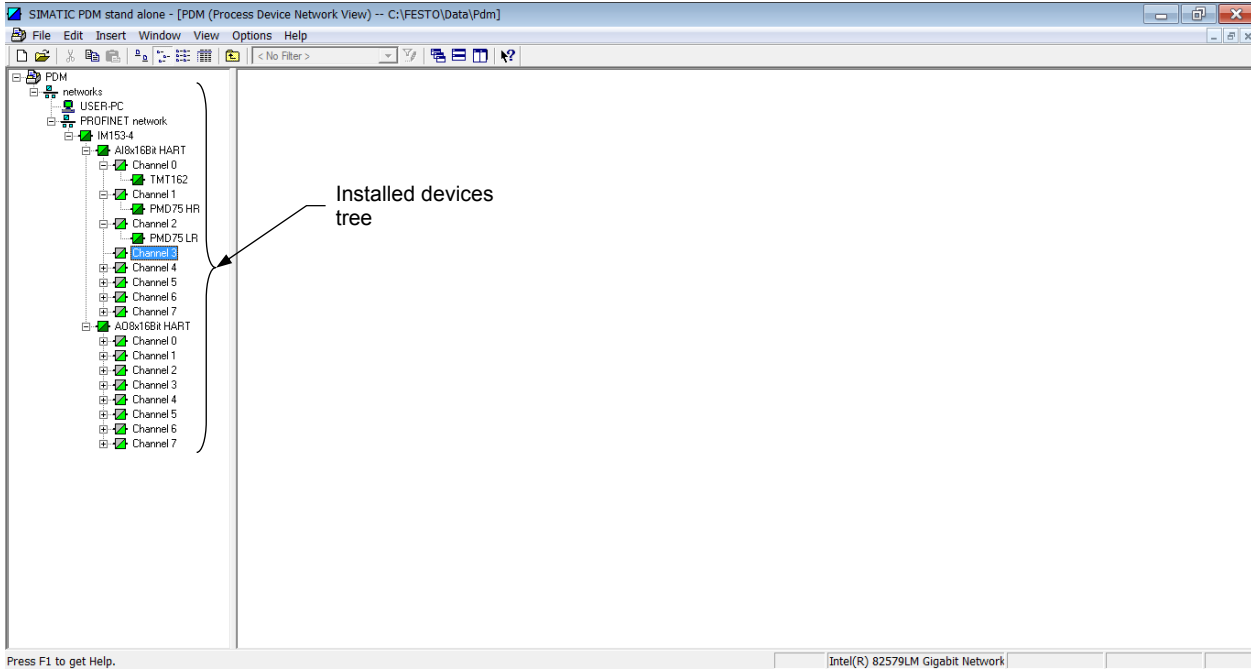


Figure 35. Process Device Manager interface.

Accessing a preconfigured device

To connect to a device via PDM, first make sure it is in the devices tree and connect the transmitter output to the I/O module. Use the HART input corresponding to the channel number in the PDM.

To open a device configuration, right click on the device name and select *Open Object* as shown in Figure 36.

This opens the device configuration as shown in Figure 37. In this window, you can monitor and commission the device. You have access to the full menu hierarchy of the device and you can modify its parameters.

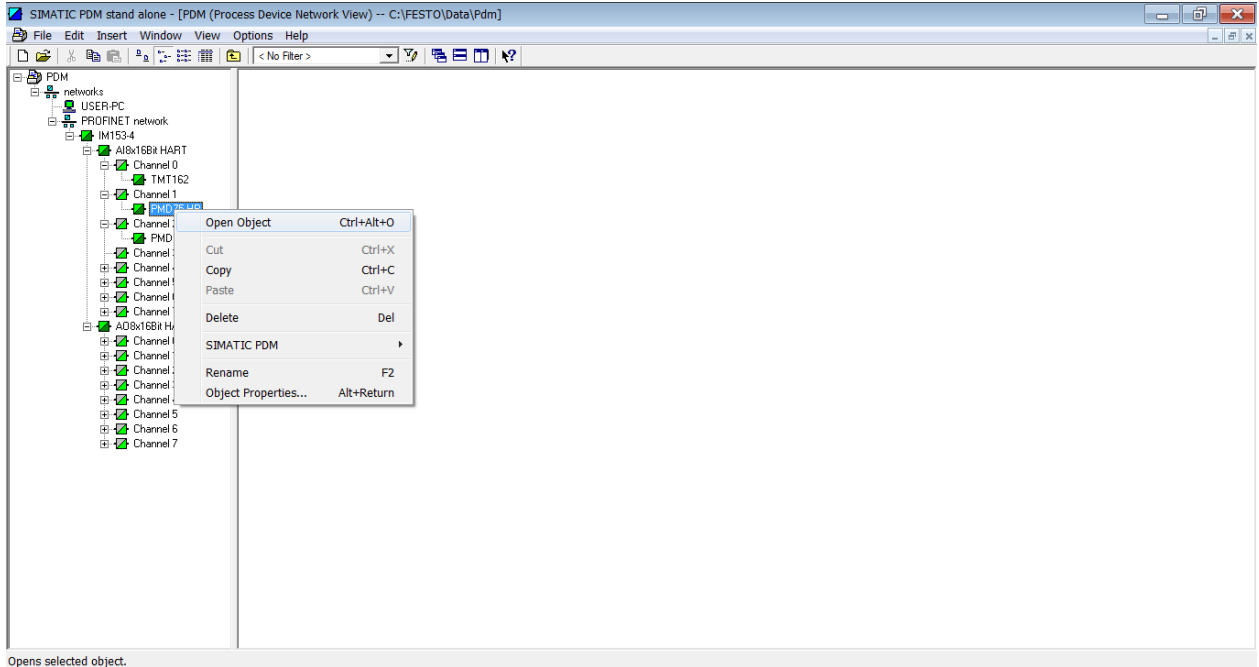


Figure 36. Opening a device configuration.

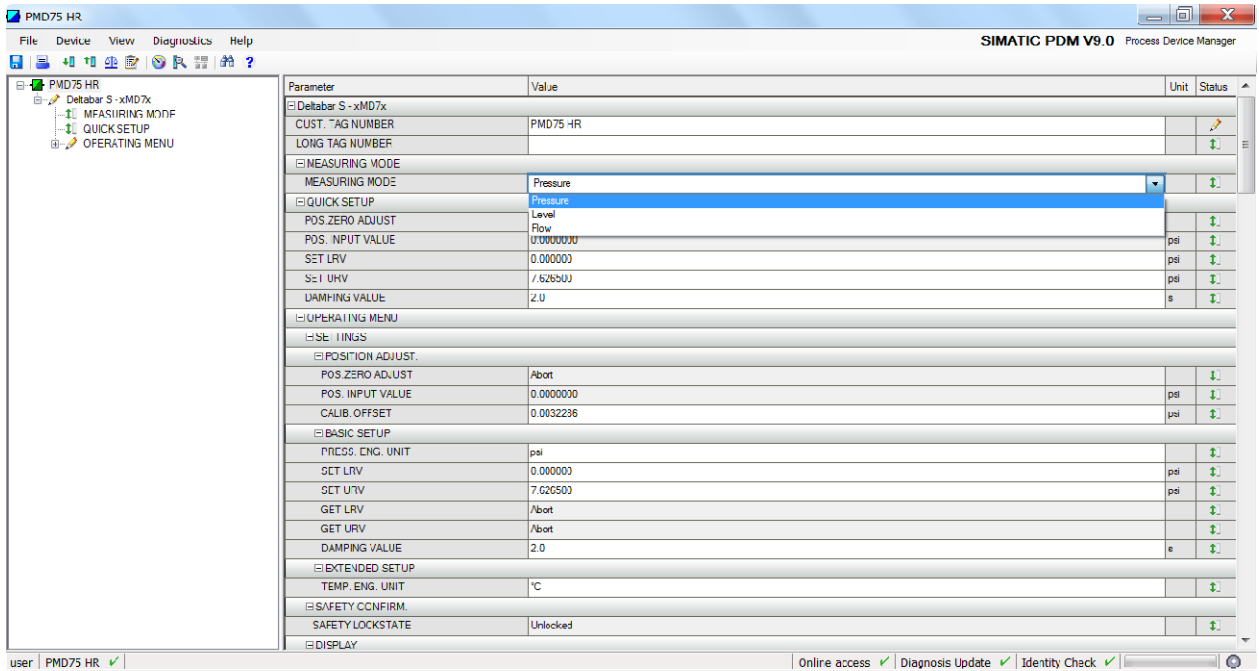




Figure 37. Device configuration.

If parameters have been changed either directly on the device or in the local PDM configuration, you can download the PDM configuration to the device (Figure 38) or upload information from the device to the computer using the buttons  and  in the software menu.

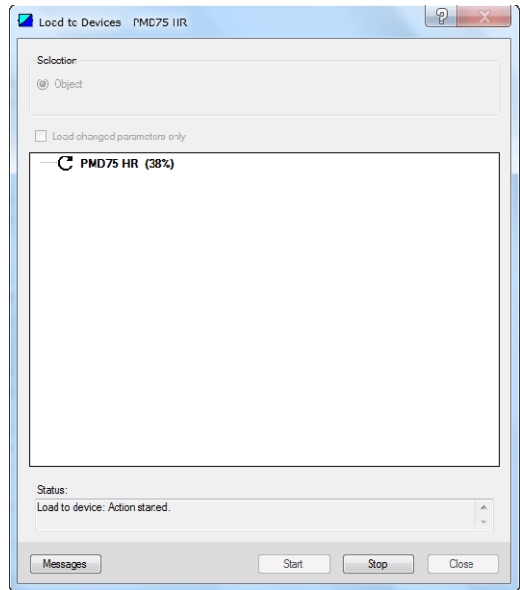


Figure 38. Downloading configuration to device.

To refresh the information from the device, right click on the device name and select *Update Diagnostics* (Figure 39).

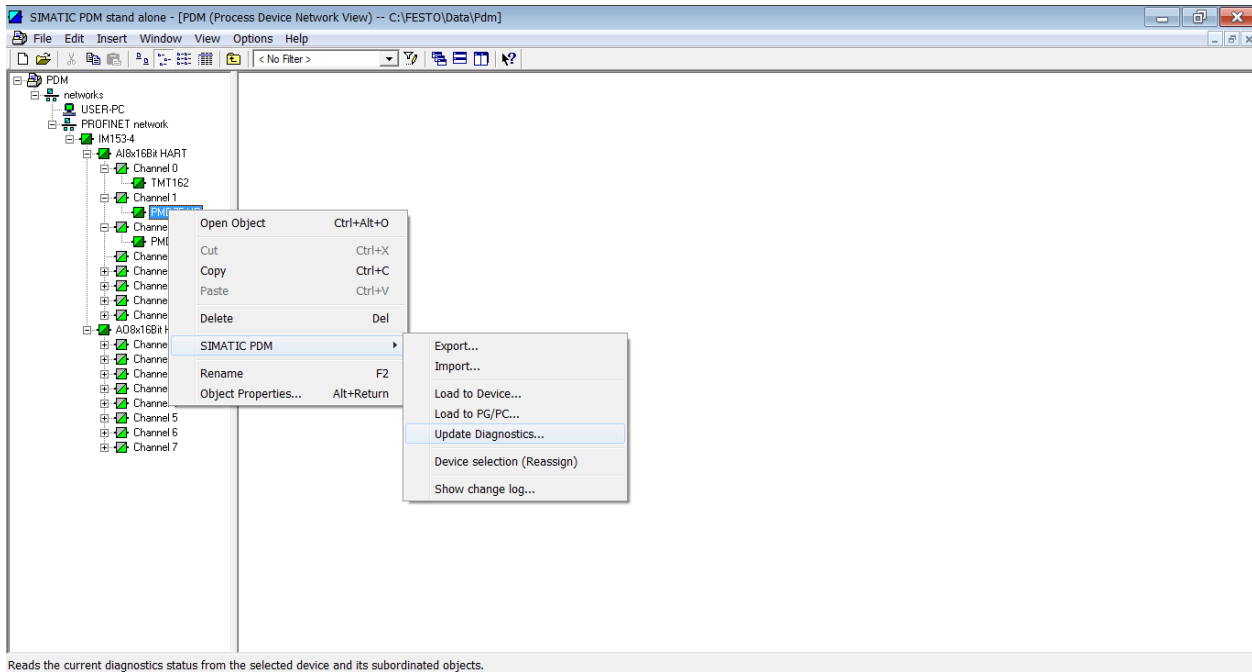


Figure 39. Refresh the information from the device.

Adding a device

Only some of the devices are preconfigured on the PDM. To add a new device, proceed as follows.

First, select the channel to which you want to link the device under the *A18x16Bit HART* item in the PDM devices tree. Right click on this channel and select *Insert New Object ► Object* (Figure 40).

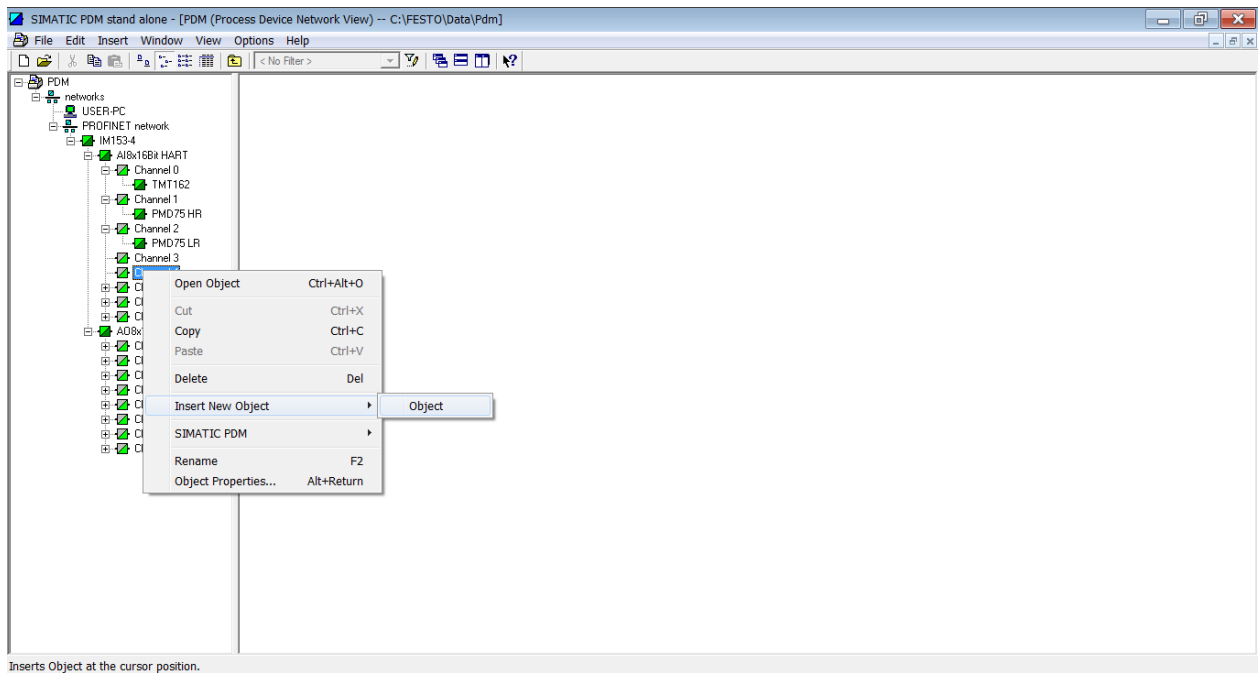


Figure 40. Adding a new device.

This opens the *Insert Object* window for the selected channel (Figure 41).

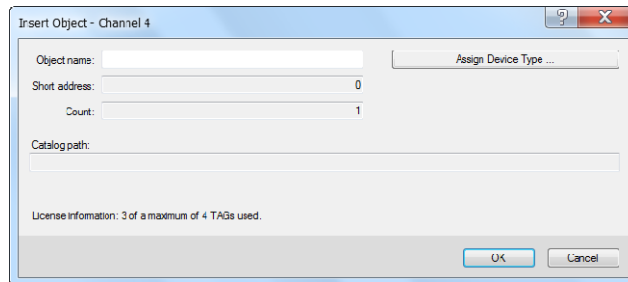


Figure 41. Inserting a new object.

To access the available devices list, click on the *Assign Device Type* button. This opens a new window with a tree-type devices list. Devices from several manufacturers are available. Select the device type that corresponds to your equipment; make sure to select the right revision version. Confirm the revision version on the device, if necessary. Click *OK* to confirm.

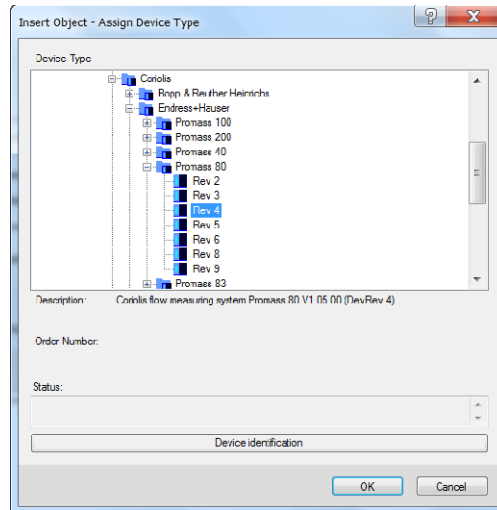


Figure 42. Inserting a new object.

Removing/reassigning a device

Devices can also be removed or reassigned in the manager. To remove a device, right click on the device name and select *Delete*. To reassign a device, select *SIMATIC PDM ► Device selection (Reassign)* instead (Figure 43).

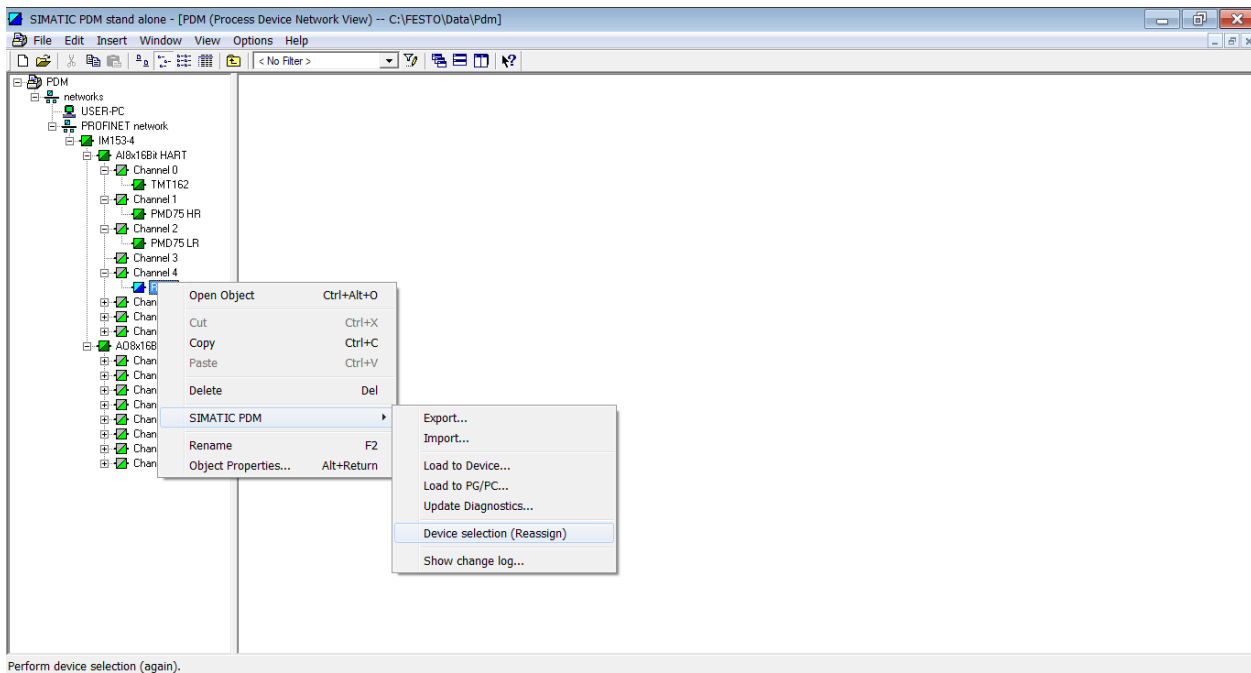


Figure 43. Reassigning a device.

Setting Up Siemens Equipment

Starting the HMI for the first time

1. The first time you start the Siemens HMI, you need to transfer the software licenses from the USB key provided with the system to the HMI (you only need to do it once).
2. First, connect the USB key containing the Siemens licenses to the HMI.
3. Close the interface, if it is active, then click on the *Automation License Manager* icon on the desktop.
4. This opens the application that manages Siemens software licenses. In this software, select the USB key from the drives list at the left. This displays the licenses available on the USB key.
5. Select all the available licenses.
6. From the *License Key* menu, select *Transfer* to open the *Transfer License Key* window.
7. In this window, select *C:* as the target drive from the drop-down menu and click *OK*.
8. The Siemens software licenses are now on the HMI hard drive; you should be able to run all licensed software without restrictions.

Connecting Siemens equipment

1. The HMI application must be able to communicate with other Siemens devices to work properly. First, make sure all Siemens devices are powered.
2. Additionally, input 0 of the PLC should be connected to a 24 V dc switched output source on the electrical unit of the Instrumentation and Process Control Training System. The switched output jacks become unpowered when the emergency button is pressed (see the training system and the PLC user guides for details).

3. Once all Siemens equipment is powered, connect each device to the Ethernet switch as shown in Figure 44.

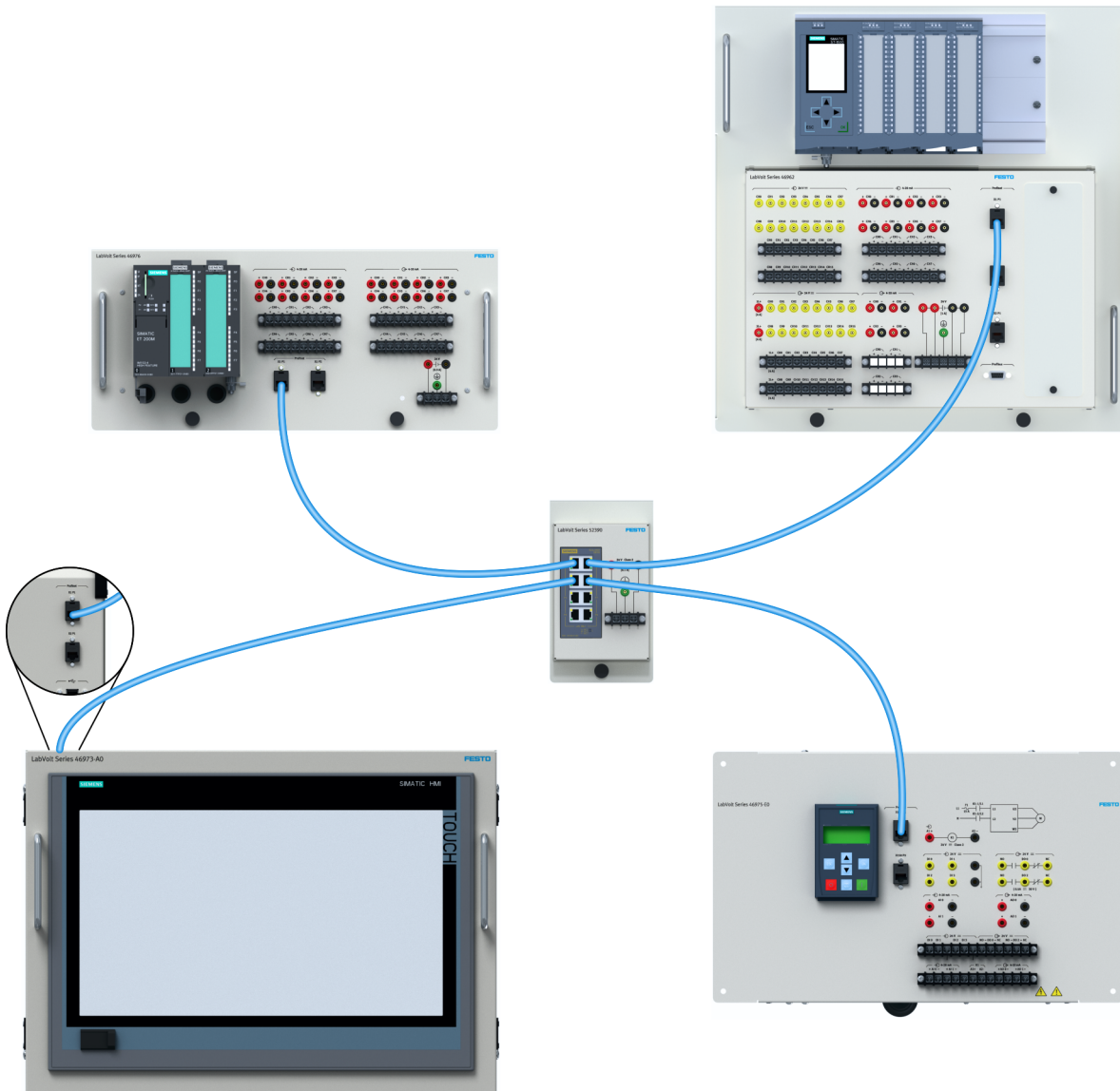


Figure 44. PROFINET network setup.

4. Another requirement to enable communication between the HMI and Siemens devices is that the IP address of each device must be set correctly. Make sure the IP address of each device is set as in Table 2. Refer to the user guide of each device for details.

Table 2. Siemens devices network settings.

Name	Model	IP address	Subnet mask
PLC X1	46962	10.10.11.10	255.255.0.0
PLC X2	46962	192.168.1.1	255.255.0.0
Distributed I/O	46976	10.10.11.11	255.255.0.0
Drive 1	46975-E	10.10.11.12	255.255.0.0
Drive 2	46975-E	10.10.11.13	255.255.0.0
HMI	46973-A	10.10.11.15	255.255.0.0
Other PC		10.10.11.16	255.255.0.0

