Process Control

Ultrasonic Level Transmitter

Courseware Sample

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By the staff of Festo Didactic

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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	**DANGER** indicates a hazard with a high level of risk which, if not avoided, will result in death or serious injury.
⚠ WARNING	**WARNING** indicates a hazard with a medium level of risk which, if not avoided, could result in death or serious injury.
⚠ CAUTION	**CAUTION** indicates a hazard with a low level of risk which, if not avoided, could result in minor or moderate injury.
CAUTION	**CAUTION** used without the *Caution, risk of danger* 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. Consult the relevant user documentation.
	Caution, lifting hazard
	Caution, belt drive entanglement hazard
	Caution, chain drive entanglement hazard
	Caution, gear entanglement hazard
	Caution, hand crushing hazard
	Notice, non-ionizing radiation
	Consult the relevant user documentation.
	Direct current

Safety and Common Symbols

Symbol	Description
	Alternating current
	Both direct and alternating current
	Three-phase alternating current
	Earth (ground) terminal
	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

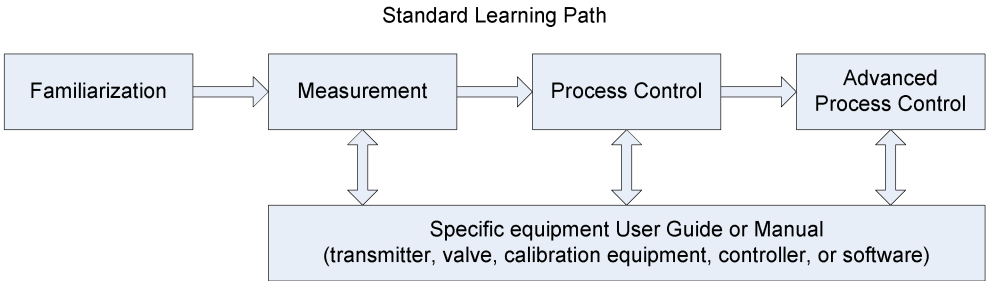
Automated process control offers so many advantages over manual control that the majority of today's industrial processes use it to some extent. Breweries, wastewater treatment plants, mining facilities, and the automotive industry are just a few industries that benefit from automated process control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

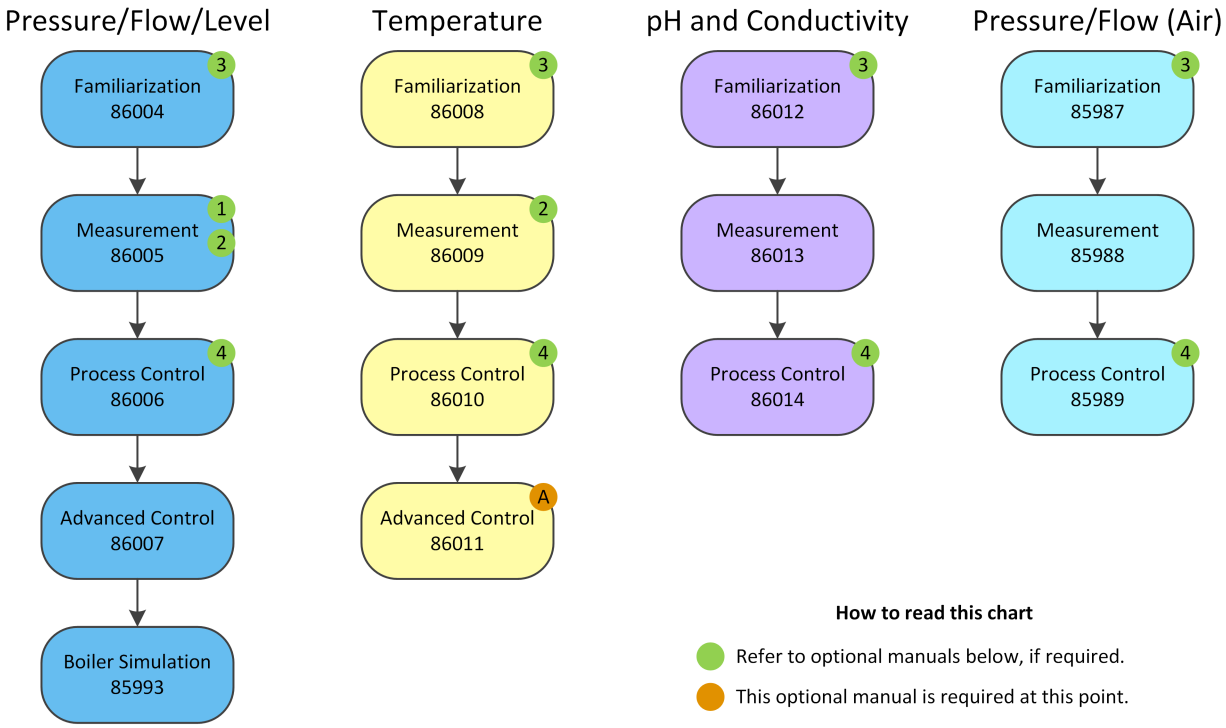
The Instrumentation and Process Control Training System, series 353X, is a state-of-the-art system that faithfully reproduces an industrial environment. Throughout this course, students develop skills in the installation and operation of equipment used in the process control field. The use of modern,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

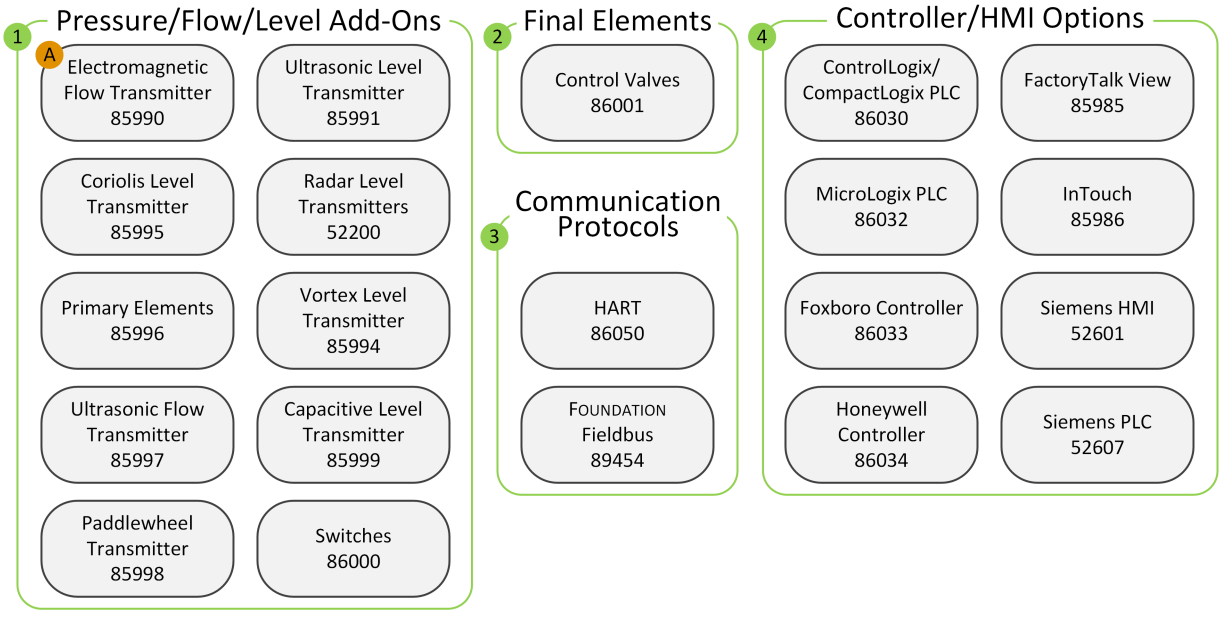
The modularity of the system allows the instructor to select the equipment required to meet the objectives of a specific course. Two mobile workstations, on which all of the equipment is installed, form the basis of the system. Several optional components used in pressure, flow, level, temperature, and 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.



Manuals of the 353X Series





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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

Safety considerations

Safety symbols that may be used in this manual and on the equipment are listed in the Safety and Common Symbols table at the beginning of the manual.

Safety procedures related to the tasks that you will be asked to perform are indicated in each exercise.

Make sure that you are wearing appropriate protective equipment when performing the tasks. You should never perform a task if you have any reason to think that a manipulation could be dangerous for you or your teammates.

Systems of units

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

To the Instructor

You will find in this Instructor Guide all the elements included in the Student Manual together with the answers to all questions, results of measurements, graphs, explanations, suggestions, and, in some cases, instructions to help you guide the students through their learning process. All the information that applies to you is placed between markers and appears in red.

Accuracy of measurements

The numerical results of the hands-on exercises may differ from one student to another. For this reason, the results and answers given in this manual should be considered as a guide. Students who correctly performed the exercises should expect to demonstrate the principles involved and make observations and measurements similar to those given as answers.

Sample Exercise
Extracted from
the Student Manual
and the Instructor Guide

Troubleshooting

EXERCISE OBJECTIVE

Face a troubleshooting situation involving an ultrasonic level transmitter.

DISCUSSION OUTLINE

The Discussion of this exercise covers the following points:

- Non-guided troubleshooting

DISCUSSION

Non-guided troubleshooting

Refer to Unit 3 of the Process Control *student manual for general troubleshooting guidelines.*

In this exercise, you take one of the setups from Exercise 2 and troubleshoot it without further indications. The difficulty of this exercise depends of the fault(s) that your instructor inserts in the control loop. Ask assistance or further instructions from your instructor if required.

Keeping a structured approach and following the troubleshooting guidelines should help to troubleshoot your process loop.

PROCEDURE OUTLINE

The Procedure is divided into the following sections:

- Installation procedure
- Set up and connections
- Troubleshooting

PROCEDURE

Installation procedure

1. Arrange the process workstation in the basic setup configuration as described in the *Familiarization with the Instrumentation and Process Control Training System* manual. Make sure the column is empty, the power is off, and the hand valves are closed.

Set up and connections

2. Your instructor will ask you to make a setup from exercise 2. Follow all the instructions and the piping and instrumentation diagram (P&ID).

3. Do not forget to ask your instructor to check and approve your setup.

4. Power up the electrical unit and configure the transmitter as specified in the exercise.

5. Stop the system and leave the room while your instructor inserts one (or more) fault(s) in your control loop.

The lists of available faults are given below.

Ultrasonic Level Transmitter faults (HART).

Fault	Faults descriptions
1	Power input open circuit
2	Current output open circuit
3	N.O. contact open circuit
4	Ultrasonic probe open circuit

Ultrasonic Level Transmitter faults (FOUNDATION Fieldbus).

Fault	Faults descriptions
1	Power input open circuit

Troubleshooting

6. Use the troubleshooting sequence presented in *Unit 3* of the *Process Control* manual to troubleshoot your control loop. Once you have identified a fault, report to your instructor. He will remove the fault and allow you to resume your troubleshooting sequence if any fault remains.

   Explain in detail your approach in isolating the problem(s).

CONCLUSION

After this exercise, you will be able to identify some common faults in a process that involves an ultrasonic level transmitter.

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