Process Control

HART Device Configuration

Courseware Sample

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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
	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

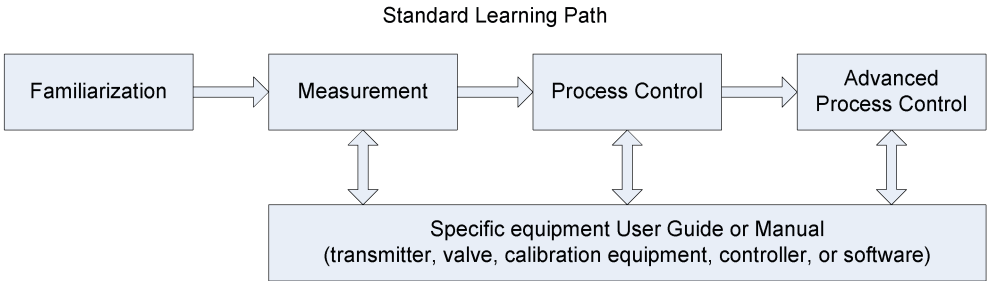
Automated process control offers so many advantages over manual control that the majority of today's industrial processes use it to some extent. Breweries, wastewater treatment plants, mining facilities, and the automotive industry are just a few industries that benefit from automated process control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

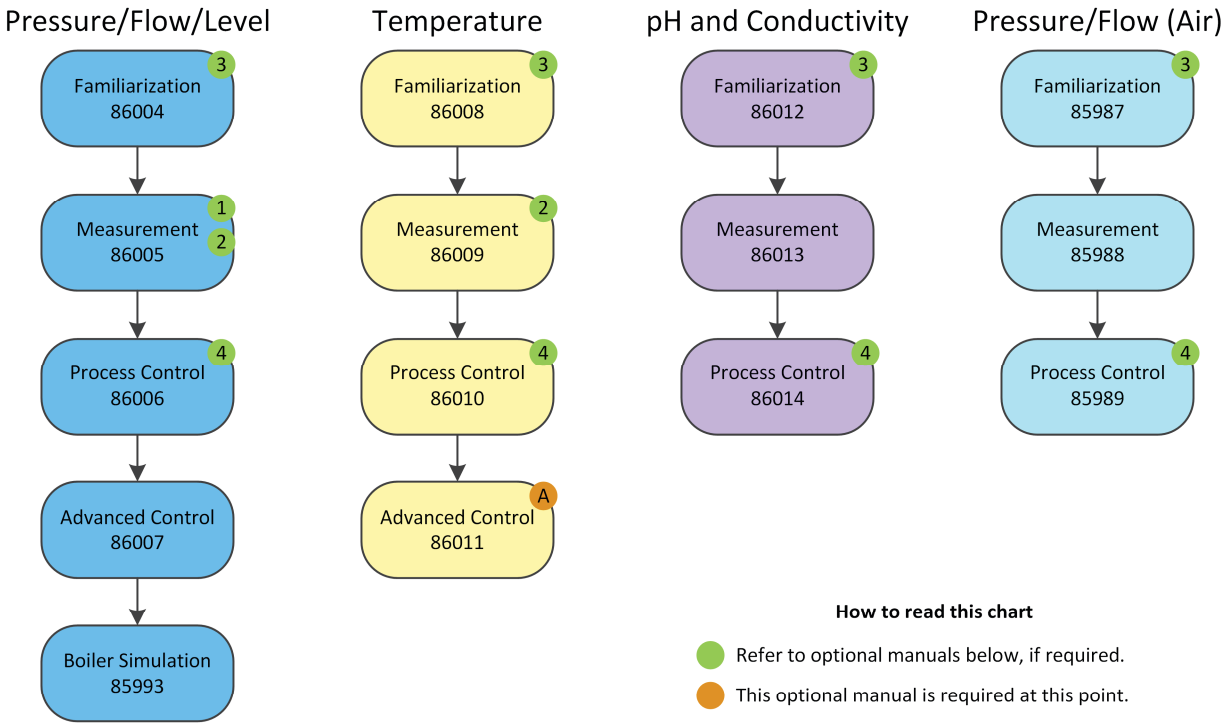
The Instrumentation and Process Control Training System, series 353X, is a state-of-the-art system that faithfully reproduces an industrial environment. Throughout this course, students develop skills in the installation and operation of equipment used in the process control field. The use of modern,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

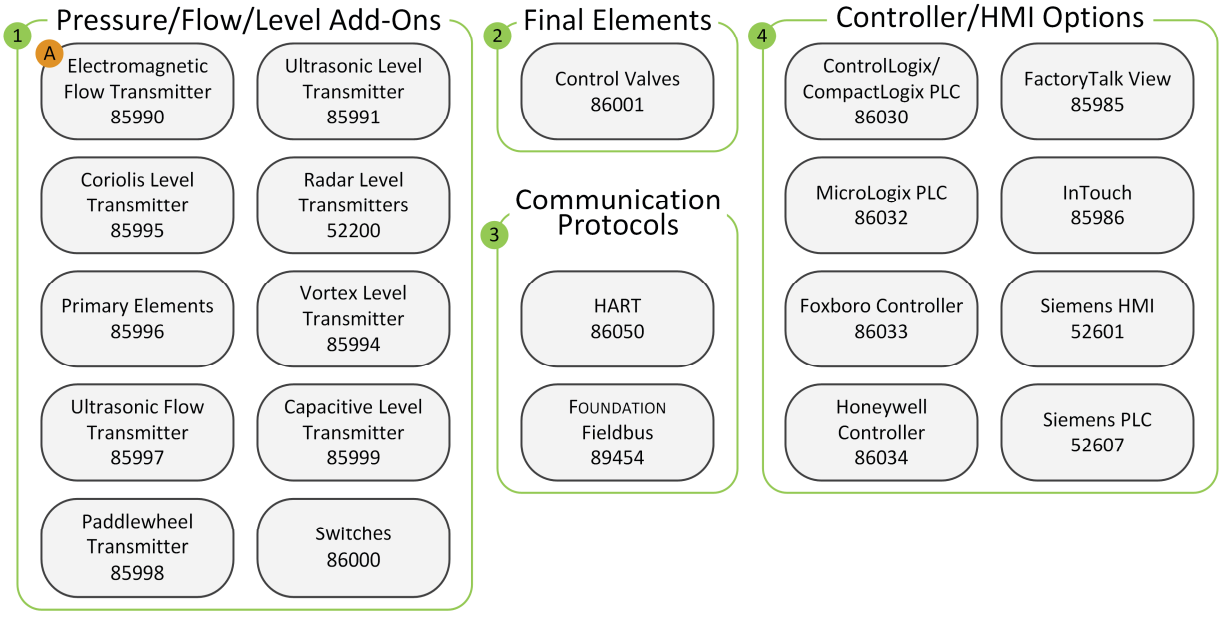
The modularity of the system allows the instructor to select the equipment required to meet the objectives of a specific course. Two mobile workstations, on which all of the equipment is installed, form the basis of the system. Several optional components used in pressure, flow, level, temperature, and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



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

Safety considerations

Safety symbols that may be used in this manual and on the equipment are listed in the Safety 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

HART Point-to-Point

UNIT OBJECTIVE

Become familiar with HART point-to-point network configuration.

DISCUSSION OUTLINE

The Discussion of Fundamentals covers the following points:

- General considerations
- Two-wire transmitters
- Four-wire transmitters
- Output devices

DISCUSSION OF FUNDAMENTALS

General considerations

As explained in Unit 1, point-to-point HART is the connection of a single field device to one or two master devices. In this mode, both the analog (4-20 mA) and the digital signals are transmitted.

The standard bus address for point-to-point communication is zero (0), which is also the default address of the field devices. While setting up your system, it is important to verify that the device address is not set to a different value (i.e., 1-15) and that no other device with address 0 is connected. Failure to do so may cause the field device to work inadequately in point-to-point mode. For example, some transmitters (e.g., the Electromagnetic Flow Transmitter, Model 46922) will block their current output to 4 mA when they are set to an address different than zero.

Two-wire transmitters

Two major types of transmitter connection are available in the industry: two-wire (loop-powered) and four-wire (active-source). Two-wire devices have only two connectors to transmit data and receive power from the current loop. Figure 2-1 shows the Differential-Pressure Transmitter, which is of the two-wire type.

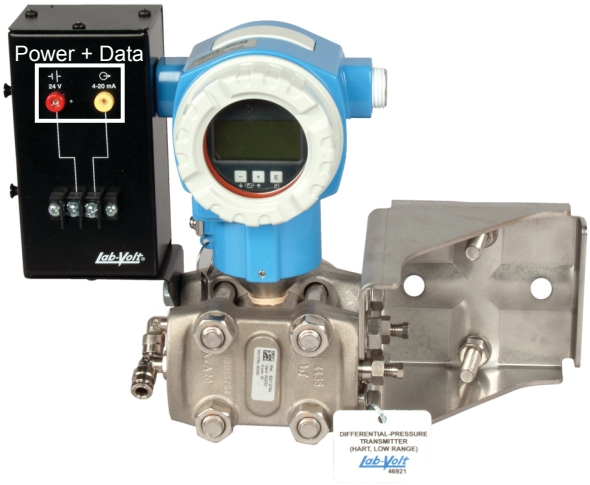


Figure 2-1. Two-wire device (Differential-Pressure Transmitter, Model 46921).

Figure 2-2, indicates how to connect two-wire devices for point-to-point operation using *FieldCare*.

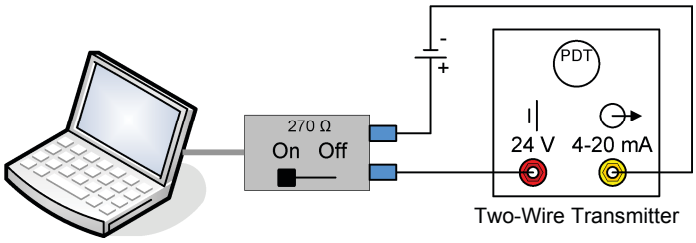


Figure 2-2. Two-wire point-to-point loop with *FieldCare*.

Four-wire transmitters

Four-wire devices have two connectors dedicated to power and two others are connected to the current loop for data transmission. Examples of four-wire devices are magnetic flow transmitters, level sensors, and analyzers. Figure 2-3 shows the Electromagnetic Flow Transmitter, which is of the four-wire type.

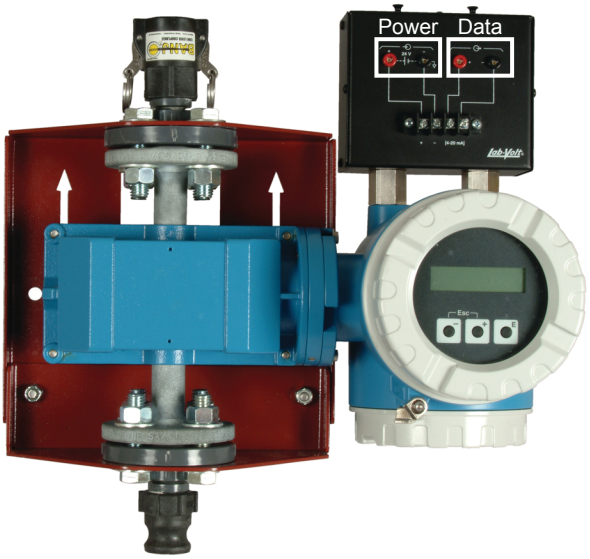


Figure 2-3. Four-wire device (Electromagnetic Flow Transmitter, Model 46922).

Figure 2-4 indicates how to connect four-wire devices for point-to-point operation using *FieldCare*.

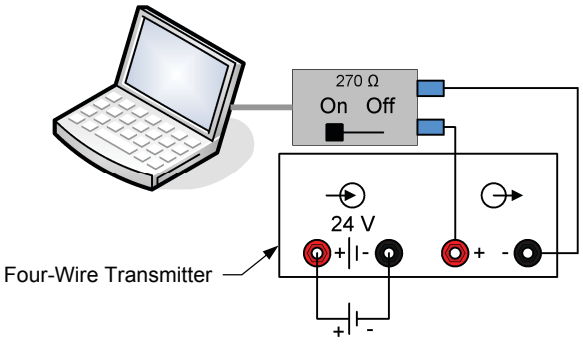


Figure 2-4. Four-wire point-to-point loop with *FieldCare*.

Output devices

Output devices, such as a valve positioner (Figure 2-5), require an input of 4-20 mA to operate correctly. A calibrator can be used to provide this type of signal for commissioning in point-to-point operation.

Figure 2-5. Output device (Pneumatic Control Valve with Digital Positioner, Model 46950-00).

Figure 2-6 indicates how to connect output devices for point-to-point operation using *FieldCare*.

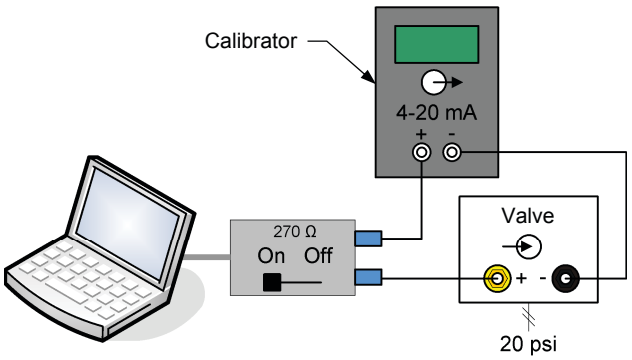


Figure 2-6. Output Device point-to-point loop with *FieldCare*.

Two-Wire Transmitter

EXERCISE OBJECTIVE

Become familiar with HART point-to-point connection of a two-wire transmitter.

DISCUSSION OUTLINE

The Discussion of this exercise covers the following points:

- Differential-pressure transmitter

DISCUSSION

Differential-pressure transmitter

The low-range and high-range differential pressure transmitters are part of the basic instrumentation and process control system. They are two-wire HART transmitters, meaning that they are powered by the current loop. In the following exercise, you will establish HART point-to-point communication between these transmitters and *FieldCare*. You will then change some basic parameters from within *FieldCare*.

PROCEDURE OUTLINE

The Procedure is divided into the following sections:

- Set up and connections
- Communication with FieldCare

PROCEDURE

Set up and connections

1. Connect the Differential-Pressure Transmitter and the Commubox according to Figure 2-7. The resistor of the Commubox must be switched on.

Table 2-1. Material needed.

Name	Model
HART Software Configurator	46982
Differential-Pressure Transmitter (High Range or Low Range)	46920 or 46921
Electrical Unit	46970
Accessories	46993

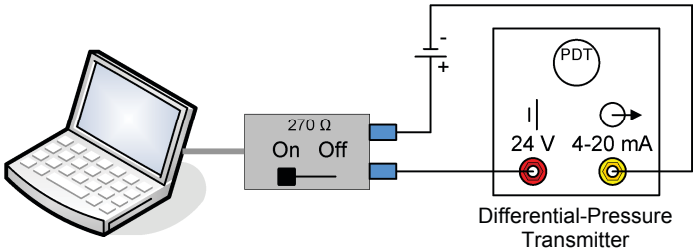


Figure 2-7. Differential-Pressure Transmitter connection.

CAUTION

Do not put 24 V dc to the terminals of the Commubox when the integrated resistor is operational (i.e., with the switch in the ON position). This could permanently damage the Commubox.

2. Turn on the Electrical Unit. Reset the Differential-Pressure Transmitter to return the device to its default parameters. This procedure is detailed in the *Familiarization with the Instrumentation and Process Control Training System* manual.

Communication with FieldCare

3. Verify what COM port the Commubox is connected to. You can do that by using *Windows Device Manager* or the *ComPort Finder* utility provided on the Commubox driver CD (Figure 2-8).

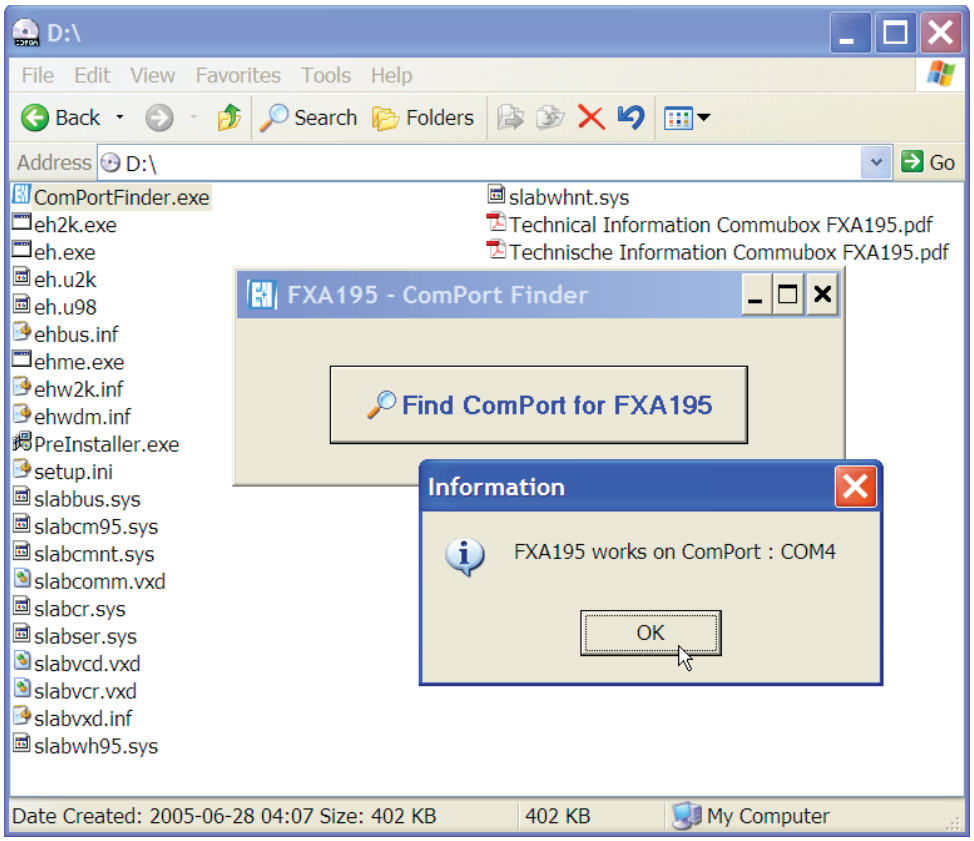


Figure 2-8. *ComPort Finder* utility.

The default *FieldCare* User Name is *Administrator*. The default password is *Admin*.

4. Open and log into *FieldCare*.

5. In the new dialog window, right-click on *HART (Point-to-Point)* and select *Edit* (see Figure 2-9).

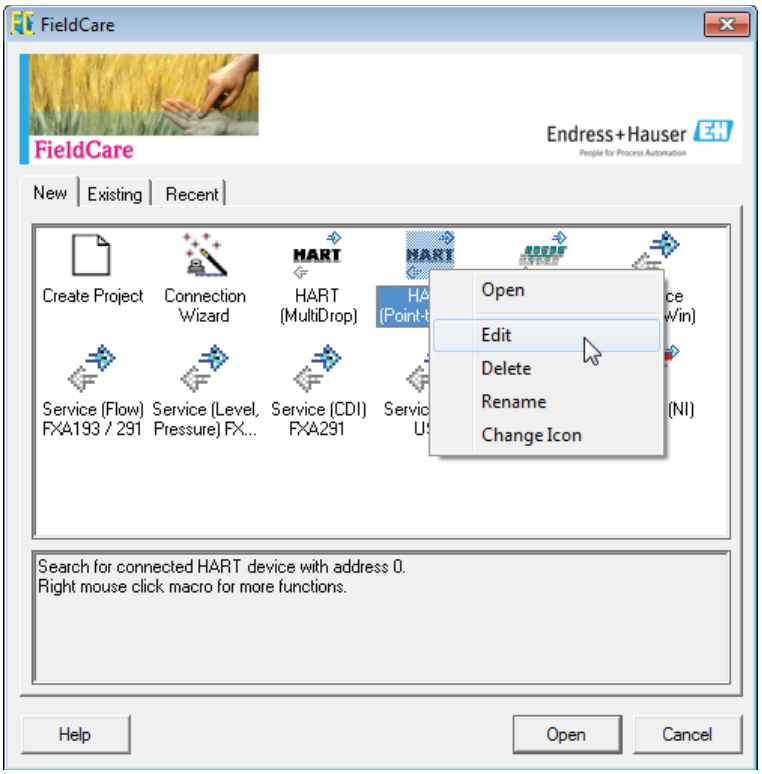


Figure 2-9. Edit Point-to-Point macro.

6. In the point-to-point macro configuration window, make sure that your parameters are those of Figure 2-10, except for the COM port, which can be different.

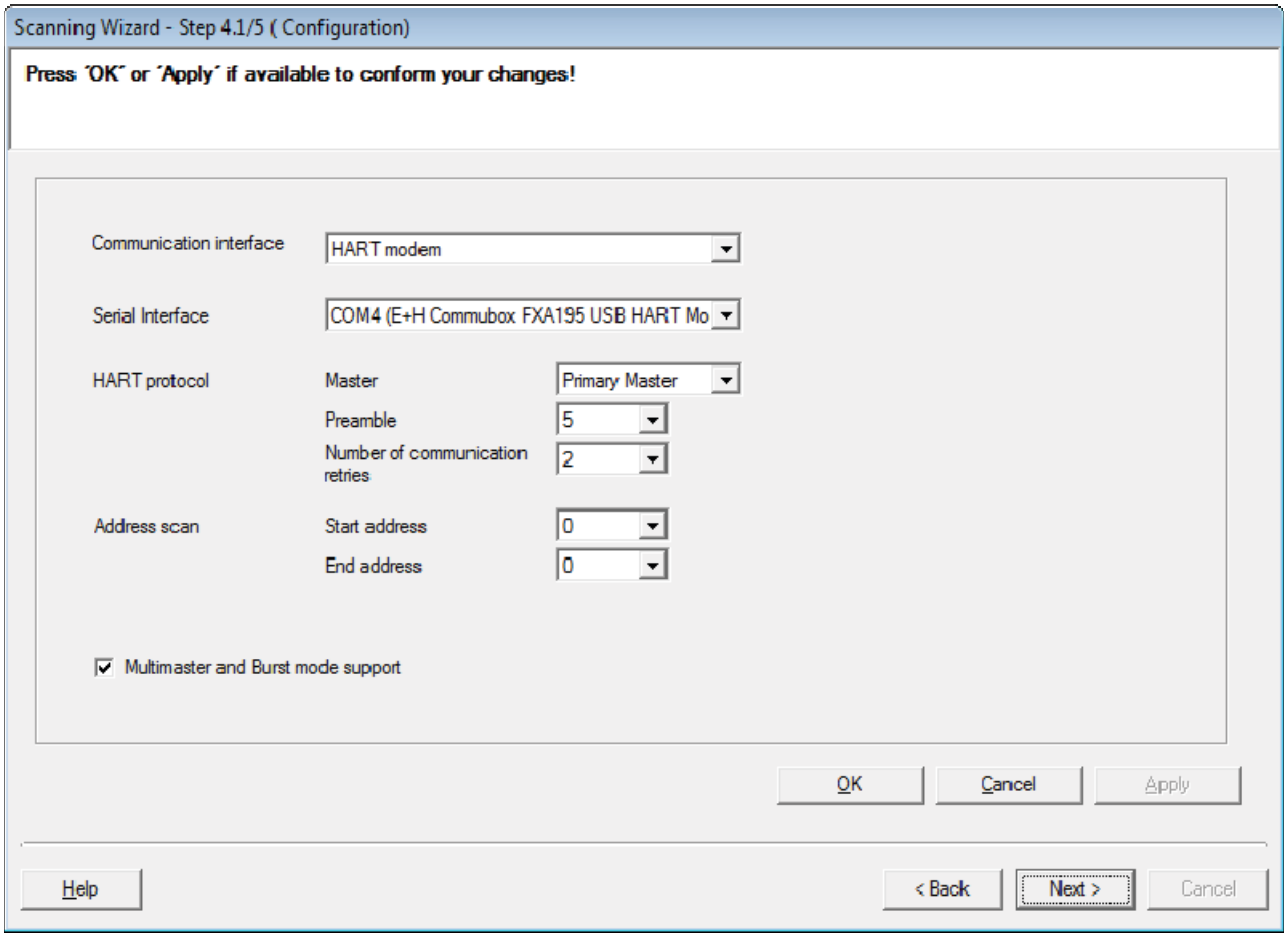


Figure 2-10. Point-to-point configuration Window.

7. Click *OK* and *Finish*. Your scanning macro *HART (Point-to-Point)* is ready to use. Double-click on the icon or press *Open*. When asked if you want to execute the scanning macro, click *Yes*.

   A window should appear stating that scanning is in progress. Wait for the device to be detected.

8. After the device has been detected, *FieldCare* opens the DTM pertaining to the Differential-Pressure Transmitter. Note the presence of the parameters tree at the left of the screen. Clicking on the plus (+) and minus (-) signs opens or closes the different menu levels.

   Go to *MEASURING MODE*.

9. Pressure is the default measuring mode. In the *MEASURING MODE* drop-down menu, select *Level*, as shown in Figure 2-11. Press *Enter* to confirm the command.

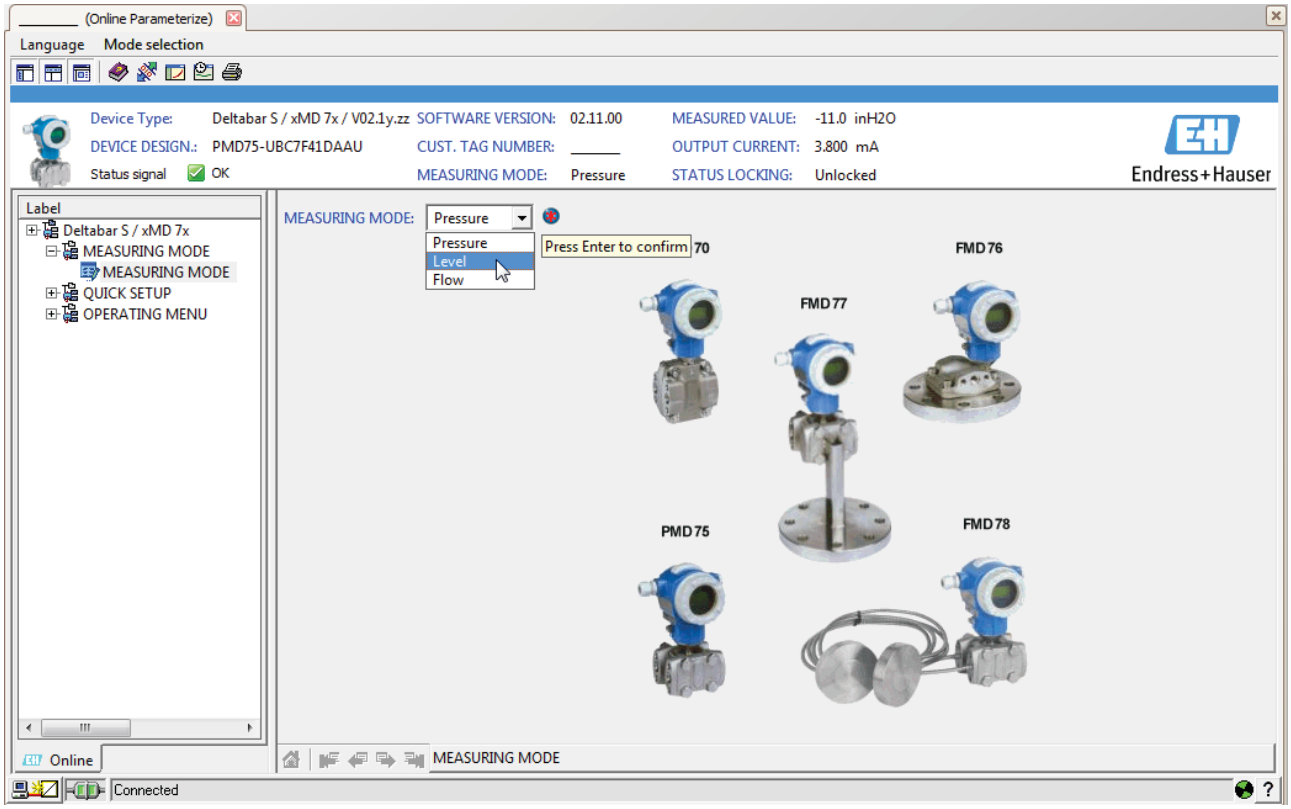


Figure 2-11. Level measurement.

At the bottom of the screen, you can see the state of execution of the command. The *MEASURING MODE* is changed to *Level* after a few seconds.

10. Next, go to *OPERATING MENU* ▶ *SETTINGS* ▶ *BASIC SETUP* and modify the unit from inH2O to kPa. In the *PRESS. ENG. UNIT* drop-down menu, select *kPa* (Figure 2-12). Then, press *Enter* to confirm the command.

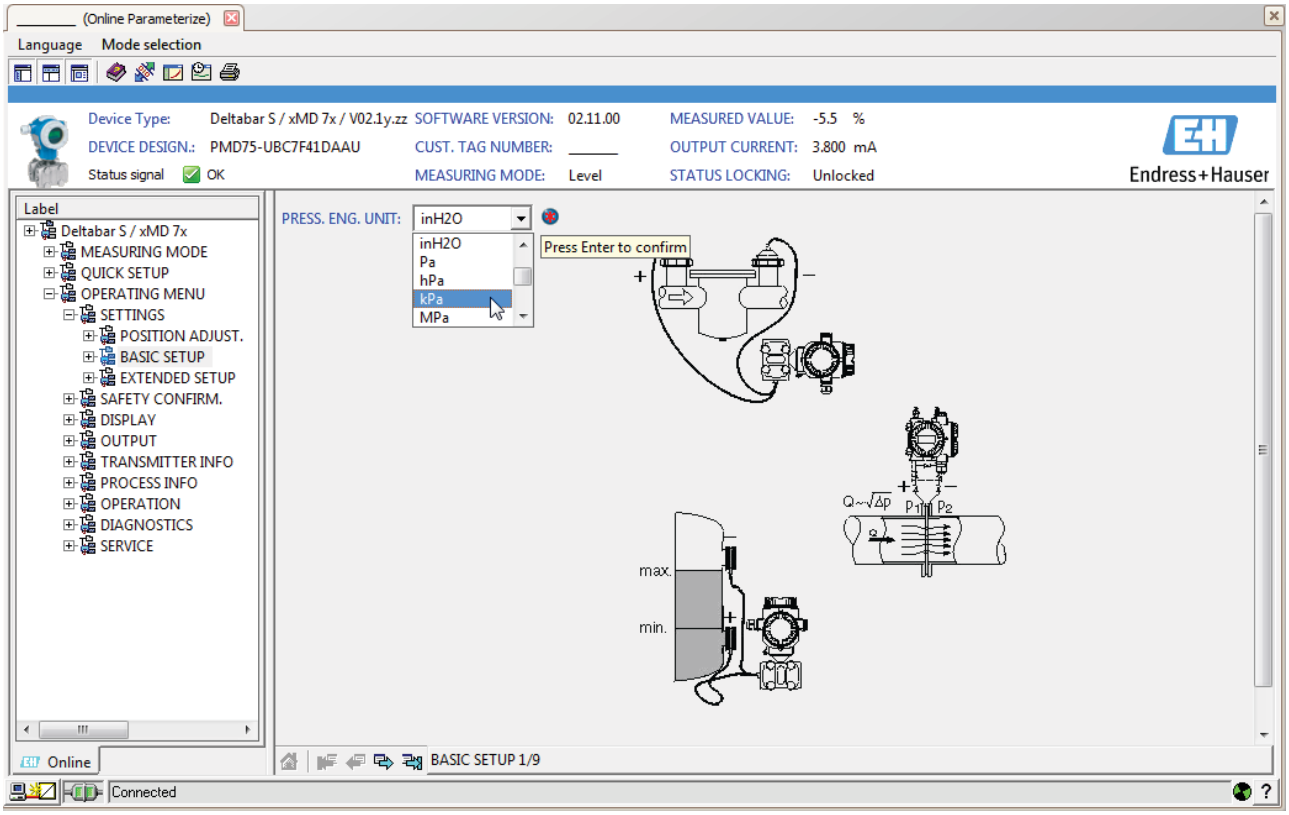


Figure 2-12. Pressure Unit.

11. A greater damping value reduces the oscillation amplitude of the measured value. Go to *OPERATING MENU ► SETTINGS ► BASIC SETUP ► DAMPING VALUE.* Modify the damping value from to 1.0 s. Press *Enter* to confirm the command (Figure 2-13).

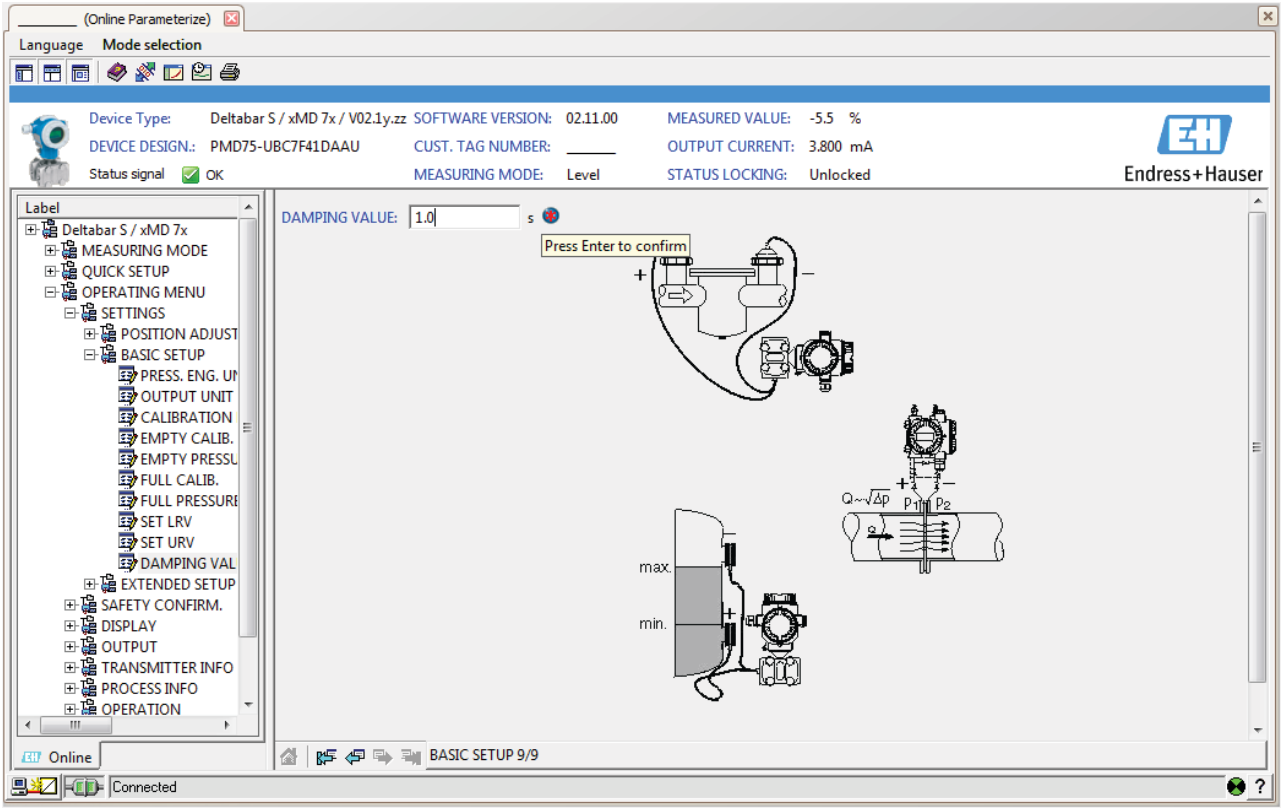


Figure 2-13. Damping value.

Finally, reset the Differential-Pressure Transmitter. Go to *OPERATING MENU ▶ OPERATION*.

Enter the reset code 7864 and press enter to confirm. The display on the transmitter will soon show the start-up screen.

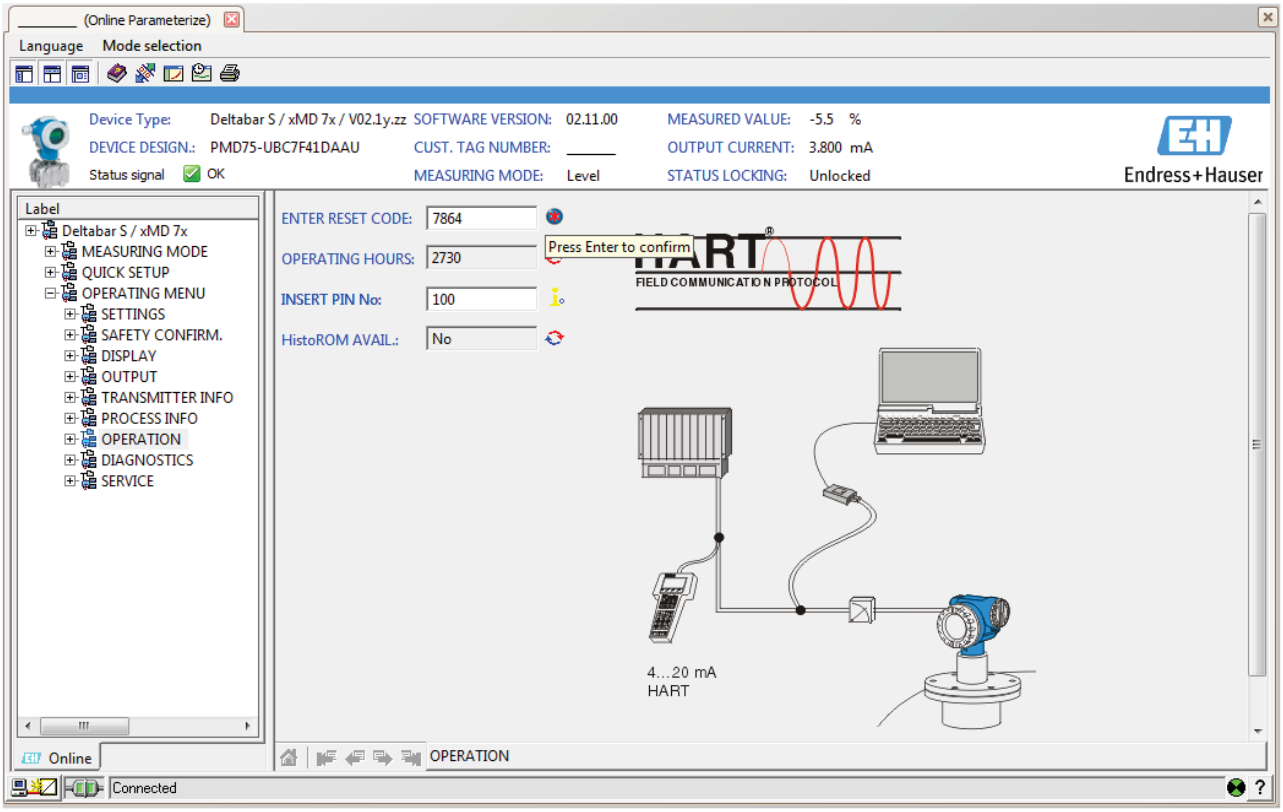


Figure 2-14. Reset the DP.

12. Use the main switch to power off the Instrumentation and Process Control Training System.

CONCLUSION

In this exercise, you have configured selected parameters of the two-wire Differential-Pressure Transmitter using the HART software configurator.

REVIEW QUESTIONS

1. How many cables are connected to the Differential-Pressure Transmitter?

2

2. What is the Commubox resistor switch position for point-to-point communication?

On (270 Ω)

3. How can you permanently damage the Commubox?

By putting 24 V dc to the terminals of the Commubox when the integrated resistor is operational.

4. What is the name of the utility software from *Endress+Hauser* used to know the COM port pertaining to the Commubox?

ComPort Finder

5. What happens when the damping value of a transmitter is reduced?

The measured value oscillations are greater.

Bibliography

HART FIELD COMMUNICATION PROTOCOL APPLICATION GUIDE (HCF LIT 34), HART Communication Foundation, 1999.