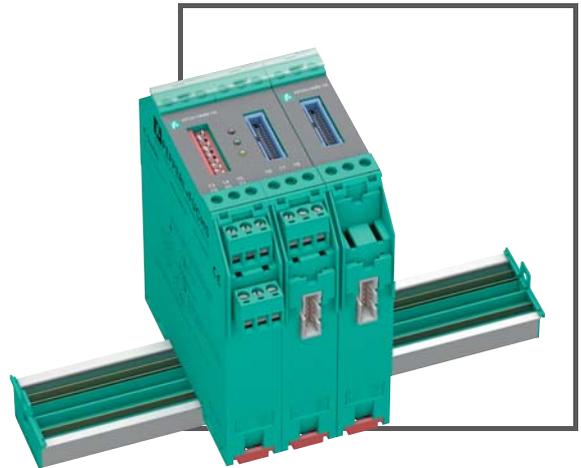


MANUAL

# HART Multiplexer System KFD\*-HM\*-16



**SIL 3**



With regard to the supply of products, the current issue of the following document is applicable: The General Terms of Delivery for Products and Services of the Electrical Industry, published by the Central Association of the Electrical Industry (Zentralverband Elektrotechnik und Elektroindustrie (ZVEI) e.V.) in its most recent version as well as the supplementary clause: "Expanded reservation of proprietorship"



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# 1 Introduction

## 1.1 Manufacturer

Pepperl+Fuchs GmbH Lilienthalstraße 200, 68307 Mannheim, Germany
Internet: <a href="http://www.pepperl-fuchs.com">www.pepperl-fuchs.com</a>

## 1.2 Content of this Document

This document contains information that you need in order to use your product throughout the applicable stages of the product life cycle. These can include the following:

- Product identification
- Delivery, transport, and storage
- Mounting and installation
- Commissioning and operation
- Maintenance and repair
- Troubleshooting
- Dismounting
- Disposal



**Note!**

This document does not substitute the instruction manual.



**Note!**

For full information on the product, refer to the instruction manual and further documentation on the Internet at [www.pepperl-fuchs.com](http://www.pepperl-fuchs.com).

The documentation consists of the following parts:

- Present document
- Instruction manual
- Datasheet

Additionally, the following parts may belong to the documentation, if applicable:

- EU-type examination certificate
- EU declaration of conformity
- Attestation of conformity
- Certificates
- Control drawings
- Additional documents



### 1.3 Target Group, Personnel

Responsibility for planning, assembly, commissioning, operation, maintenance, and dismantling lies with the plant operator.

Only appropriately trained and qualified personnel may carry out mounting, installation, commissioning, operation, maintenance, and dismantling of the product. The personnel must have read and understood the instruction manual and the further documentation.

Prior to using the product make yourself familiar with it. Read the document carefully.

### 1.4 Symbols Used

This document contains symbols for the identification of warning messages and of informative messages.

#### Warning Messages

You will find warning messages, whenever dangers may arise from your actions. It is mandatory that you observe these warning messages for your personal safety and in order to avoid property damage.

Depending on the risk level, the warning messages are displayed in descending order as follows:



#### ***Danger!***

This symbol indicates an imminent danger.

Non-observance will result in personal injury or death.



#### ***Warning!***

This symbol indicates a possible fault or danger.

Non-observance may cause personal injury or serious property damage.



#### ***Caution!***

This symbol indicates a possible fault.

Non-observance could interrupt the device and any connected systems and plants, or result in their complete failure.

#### Informative Symbols



#### ***Note!***

This symbol brings important information to your attention.



#### Action

This symbol indicates a paragraph with instructions. You are prompted to perform an action or a sequence of actions.

## 2 Product Specifications

### 2.1 Device Versions

This manual describes the following devices:

- HART multiplexer master KFD2-HMM-16, hereinafter referred to as the multiplexer master
- HART multiplexer slave KFD0-HMS-16, hereinafter referred to as the multiplexer slave

### 2.2 Function

The HART multiplexer system consists of one HART multiplexer master KFD2-HMM-16 and several HART multiplexer slaves KFD0-HMS-16. The HART multiplexer system is used to establish a HART connection to analog field devices and thereby maintain the conventional analog 4 mA to 20 mA circuits. The devices of the HART multiplexer system act as gateways between the field devices and the control side.

The devices of the HART multiplexer system can be used in the Zone 2 hazardous area or in the non-hazardous area. The devices are supplied with 24 VDC. The devices are connected to a maintenance station or the process control system via an RS-485 interface.

The supply, the analog signals, and the RS-485 interface are galvanically isolated from each other. The individual HART channels are decoupled. This does not affect the 4 mA to 20 mA signal.

Using the configuration software, you can search for available field devices automatically and query the HART variables of the field devices automatically.

### 2.2.1 HART Multiplexer Master KFD2-HMM-16

In addition to the master unit, the multiplexer master has an integrated slave unit. A maximum of 16 field devices can be connected to this slave unit. If more than 16 field devices have to be connected, a maximum of 15 additional HART multiplexer slaves KFD0-HMS-16 can be connected to the multiplexer master. This enables a maximum of 256 analog field devices to be connected to the HART multiplexer system.

The device is supplied with power via the Power Rail or via terminals.

The device is connected to a maintenance station via the RS-485 interface. You can connect additional participants via an additional RS-485 interface. The transfer rate is max. 57600 baud.

The device is connected to the multiplexer slaves via a 14-pin ribbon cable. The device has a 14-pin IDC socket on the bottom of the device for this purpose.

The device is connected to the termination board via a 26-pin ribbon cable. The device has a 26-pin IDC socket on the front of the device for this purpose.

The device can be used as a primary or secondary master.

The device address and the transfer rate are set via DIP switch.

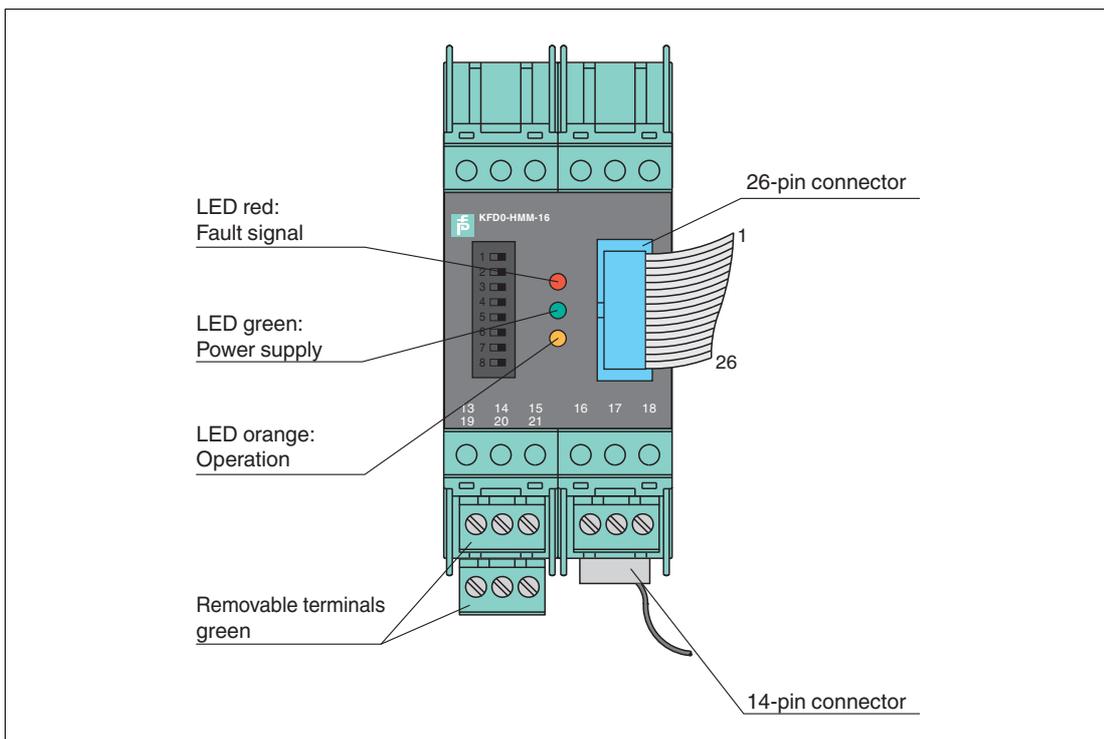


Figure 2.1 Assembly of the KFD2-HMM-16 HART multiplexer master

### 2.2.2 HART Multiplexer Slave KFD0-HMS-16

A maximum of 16 analog field devices can be connected to the multiplexer slave. The device can only be used in conjunction with the HART multiplexer master KFD2-HMM-16.

The device is supplied with power by the multiplexer master via the 14-pin ribbon cable.

The device is connected with the multiplexer master and additional multiplexer slaves via a 14-pin ribbon cable. The device has a 14-pin IDC socket on the bottom of the device for this purpose.

The device is connected to the termination board via a 26-pin ribbon cable. The device has a 26-pin IDC socket on the front of the device for this purpose.

The device address is set using a rotary switch. You can assign addresses 1 to 15. The address 0 is reserved for the multiplexer master and may therefore not be used. If several multiplexer slaves are connected to the multiplexer master, different addresses must be assigned. The sequence is irrelevant.

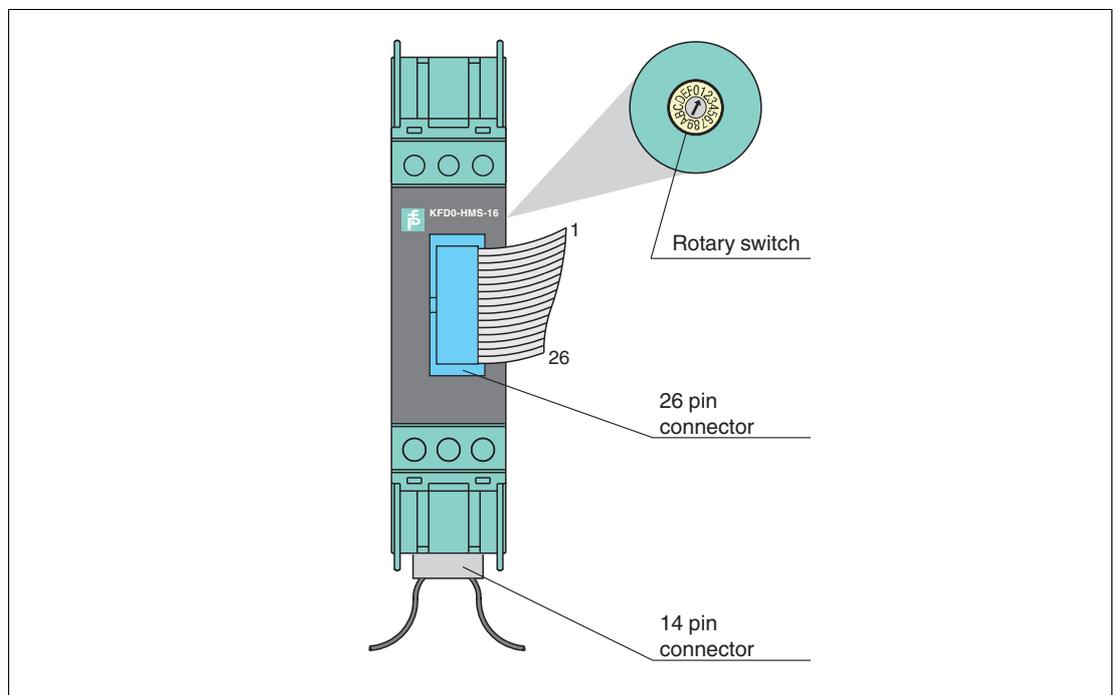


Figure 2.2 Assembly of the KFD0-HMS-16 HART multiplexer slave

### 3 System Description

#### 3.1 The Basic Principles of HART Communication

The HART protocol is supported by many conventional 4 mA to 20 mA field devices that use it to enable digital communication for configuration and maintenance purposes. Many of the device parameters, and the measured value itself, can be digitally transferred to and from the device. This digital communication runs in parallel to the 4 mA to 20 mA signal on the same line. This is enabled via current modulation, which is superimposed on the desired signal.

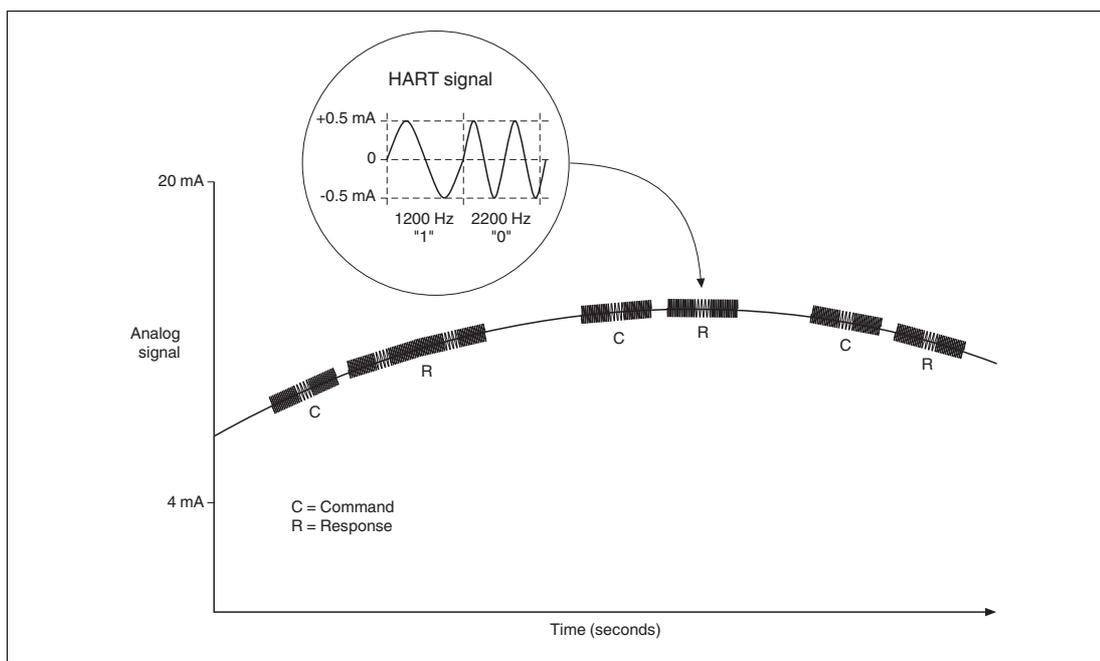


Figure 3.1

The high-frequency HART signal consists of the sine frequencies 1200 Hz and 2200 Hz. The average value of the signal is 0 and can therefore be filtered through the standard circuit of the analog input. This does not affect the analog signal.

The HART protocol is a master-slave protocol. This means that a field device responds only when it is addressed. Burst mode is an exception. The message duration is a few hundred milliseconds, meaning that two to three messages can be transferred per second.

The HART commands are divided into 3 groups:

- Universal commands  
These commands must be supported by all field devices.
- Common practice commands  
These commands correspond to common practice and are suitable for many field devices.
- Device-specific commands  
These commands are only suitable for certain field devices.

All three types of commands are used in the HART multiplexer system. This document includes a list of commands. See chapter 9.1.



**Note!**

Additional information can be found in /1/, /2/, /3/, see chapter 9.3.

## 3.2 Possible Applications

### General Applications

In process engineering plants, many field devices are distributed over a large area. The characteristic values of these field devices must be monitored and logged or adjusted if process variables are changed.

The HART multiplexer system from Pepperl+Fuchs enables communication between a computer or a process control system and field devices that support the HART protocol. The following figure shows the basic system structure.

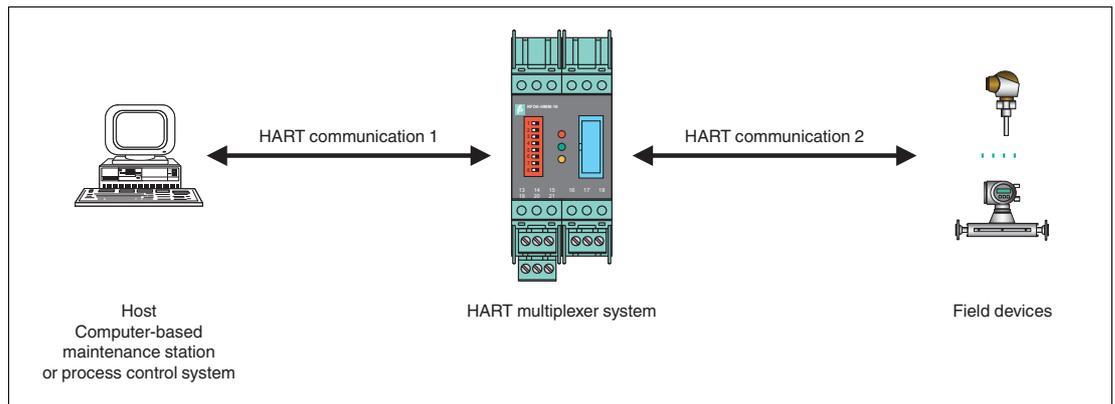


Figure 3.2 Basic structure

HART-compatible field devices allow information such as the measuring range and device address to be saved in the field device itself. Access to this data is usually achieved with a handheld. This means that a connection to the field device must be established manually for each value to be changed.

If certain data has to be logged as part of quality assurance processes, this increases the effort for the process control system. For example, the relevant data has to be requested cyclically and saved in a database by the system.

The HART multiplexer system establishes the connection between the computer and the HART-compatible field devices. All access to the field device takes place parallel to the transmission of the 4 mA to 20 mA signal and therefore has no effect on the processing of measured values by the process control system.

The system provides a subordinate service level. The HART multiplexer system can also detect measured values. For field devices that are mounted in hazardous areas, the connection takes place on the non-hazardous side of the control unit.

Pepperl+Fuchs offers corresponding control units, e. g., KCD2-STC-\*\*, KCD2-SCD-\*\*. The HART multiplexer system can also be connected to control units from other manufacturers. Existing plants can therefore be extended very easily, taking full advantage of the HART communication.

The system can consist of a maximum of 31 HART multiplexer devices that are connected to a computer via an RS-485 interface. Each multiplexer master can manage up to 15 multiplexer slaves. Each device, regardless of whether it is a multiplexer master or multiplexer slave, establishes the connection to 16 field devices. One computer can therefore be used to address up to a maximum of 7936 field devices.

Operation using a handheld is still possible, since the HART protocol accepts two masters in one system, i. e., a computer and a handheld.

## Maintenance Station

A computer is often used as a maintenance station to operate and maintain the HART multiplexer system. The computer is used to fulfill parameterization functions or logging functions independently of the process control system. For this computer, operating software that fulfills the required purpose is available from various manufacturers. See chapter 3.3.

However, in some cases, no computer is used as a maintenance station. Instead, the process control system communicates with the field devices directly via an RS-485 interface using the HART multiplexer system. The low speed of the HART communication imposes limitations on this method of operation.

## 3.3 Integration into Operating Software

The full functionality of the HART multiplexer system unfolds through the integration into modern asset management systems such as **PACTware** (open source), SIMATIC PDM (Siemens), AMS (Fisher-Rosemount), Cornerstone (Applied System Technologies), and Valve Manager (Neles Automation). These operating tools integrate the device functions of the devices in the multiplexer system into a standardized interface and convenient operation in the form of menu commands. However, the representation and designation of the functions in the individual operating tools may vary greatly. A representation that is valid generally is not possible at this point.

Information regarding the configuration, parameterization, operation, and diagnostic options of the HART multiplexer system can be found in the manual "Installation and Configuration Device Type Manager (DTM)".

## 3.4 System Structure

The field devices and the devices of the HART multiplexer system are connected to the process control system using termination boards. The following chapters describe three basic connection options. These connection options serve as examples as there are many other connection options.



### **Note!**

For further information about the connection layout of the termination boards used, see the corresponding datasheets.

The following accessories are available for the HART multiplexer system:

- 14-pin ribbon cable K-HM14 for connecting the multiplexer master with the multiplexer slaves.
- 26-pin ribbon cable K-HM26 for connecting the multiplexer master or the multiplexer slave with the termination board.
- Interface converter in different variants depending on the available interfaces
- Cordset for the connection between the termination board and the process control system. This cordset is available in different variants depending on the available interfaces and the control system manufacturer.



### **Note!**

Additional information you can find under [www.pepperl-fuchs.com](http://www.pepperl-fuchs.com).

### 3.4.1 External Mounting

The multiplexer master and multiplexer slaves are connected to a termination board. The termination board forwards the signals via screw terminals. The termination board establishes the connection to the connected multiplexer masters and multiplexer slaves in parallel or series. This type of mounting is independent of the process control system used and of any existing control units.

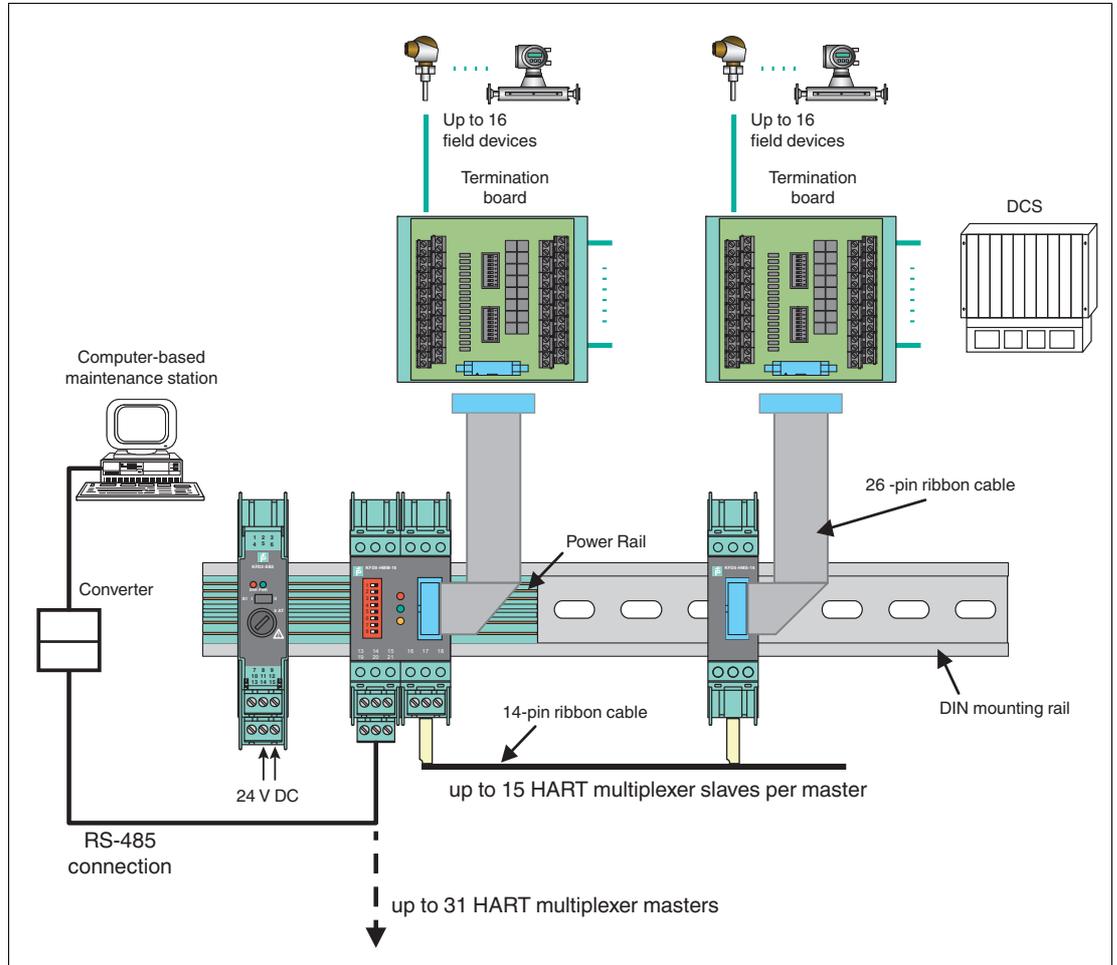


Figure 3.3

### 3.4.2 Mounting Integrated in the Process Control System

The multiplexer master and multiplexer slaves are connected to a termination board. The termination board forwards the signals to the process control system via screw terminals and system cables. The termination board establishes the connection to the connected multiplexer masters and multiplexer slaves in parallel or series. The termination boards are specifically tailored to the individual process control systems.

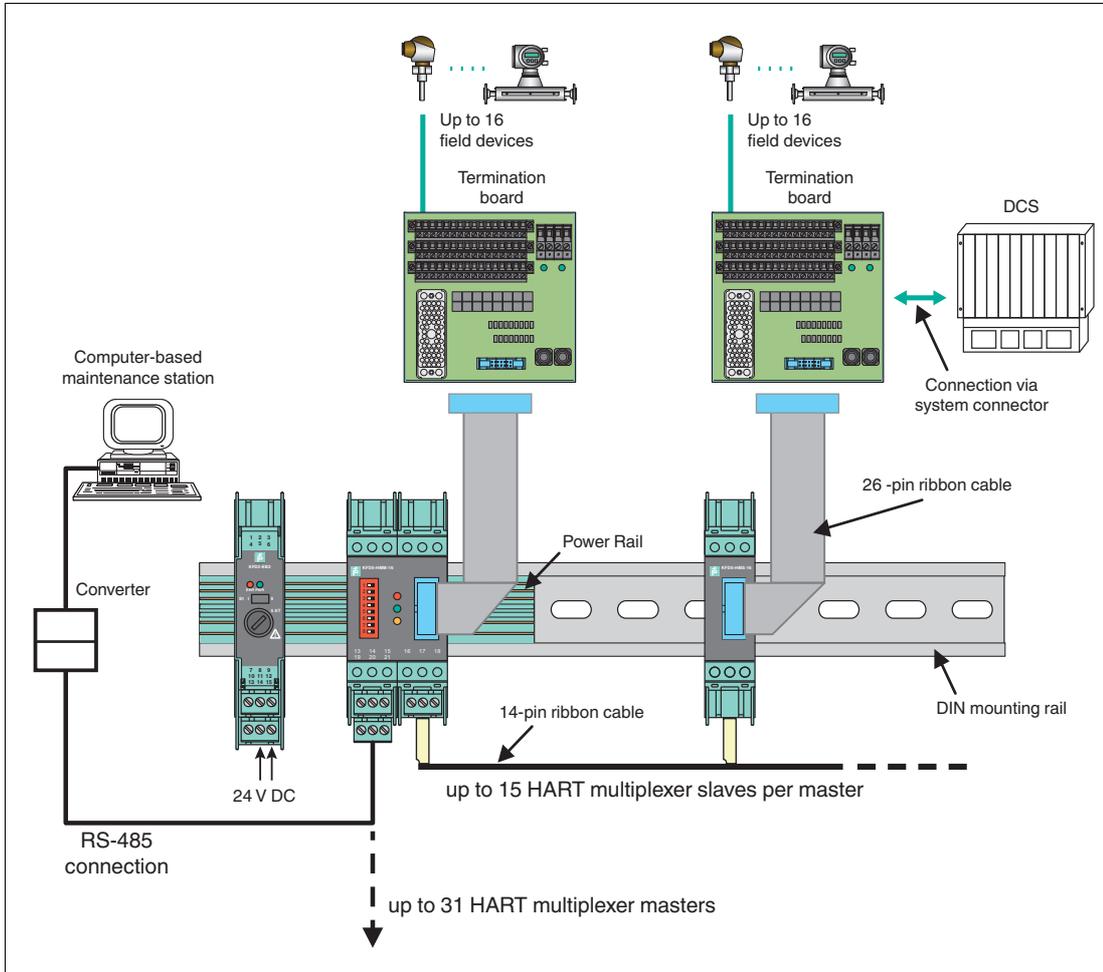


Figure 3.4

### 3.4.3 Mounting Integrated into the K-System

If you use this connection option, the signals can be transferred directly from the termination boards of the K-system to the multiplexer master and multiplexer slaves via a system connector.

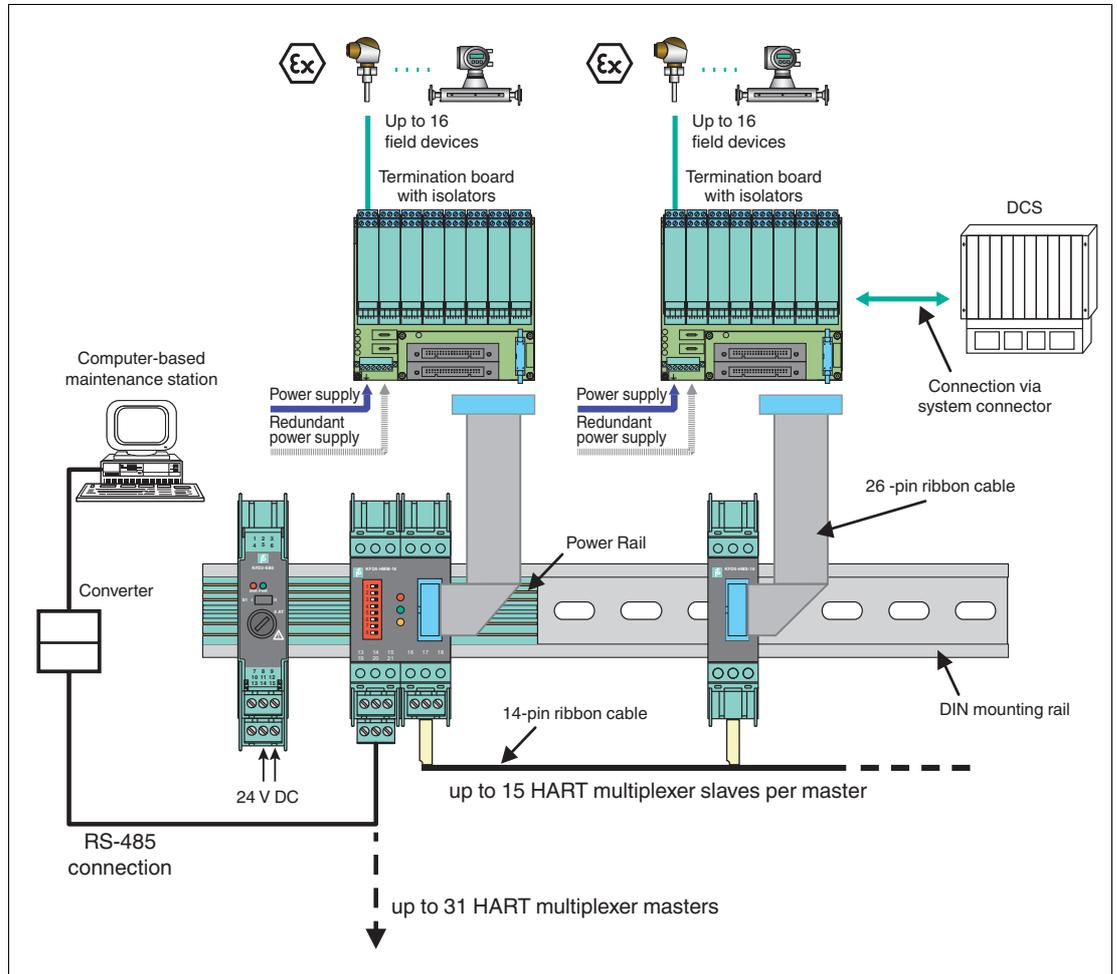


Figure 3.5

## 4 Mounting and Installation



### **Danger!**

Explosion hazard from damaged electronic components

Premature wear of electronic components in a device that was previously used in a general electrical installation can cause sparks that can ignite the surrounding potentially explosive atmosphere.

Never install devices that have already been operated in general electrical installations in electrical installations used in combination with hazardous areas!



### **Danger!**

Explosion hazard from pollution

An excessively polluted surface of the device can become conductive and consequently ignite a surrounding potentially explosive atmosphere.

Ensure that you install the device only in environments with a pollution degree 2 or better according to IEC/EN 60664-1.

### 4.1 DIN Mounting Rail

The devices are mounted on a 35 mm DIN mounting rail according to EN 60715.

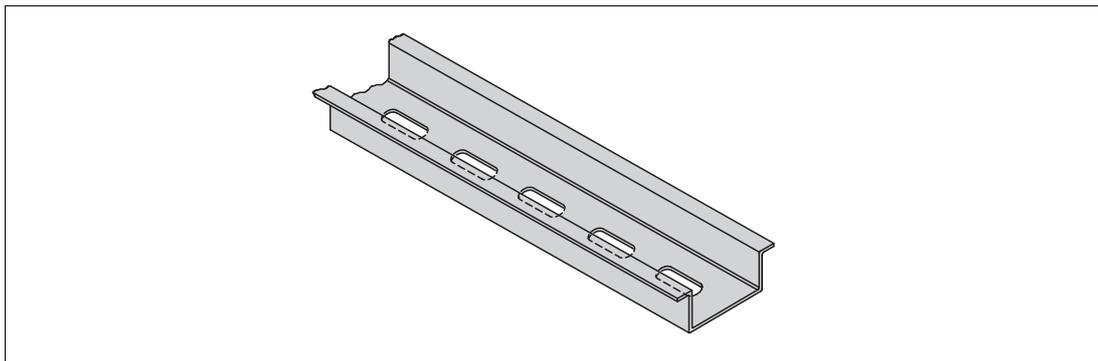


Figure 4.1 Example: DIN mounting rail UPR-MR (35 mm x 15 mm)

## 4.2 Power Rail

To reduce wiring and installation costs, Power Rail is the optimum solution. The Power Rail is a DIN mounting rail with plastic insert, that delivers power to the devices (24 V DC) and transfers bus signals and a collective error message.

The Power Rail is factory-equipped with cover and end caps. These parts cover empty and open segments of the Power Rail. Thus, the Power Rail is protected from contamination. Additionally the cover and end caps prevent that electrically conductive parts come in contact with the Power Rail.

### Power Rail UPR-03

The Power Rail UPR-03 has 3 conductors.

- 2 conductors for power
- 1 conductor for collective error messaging

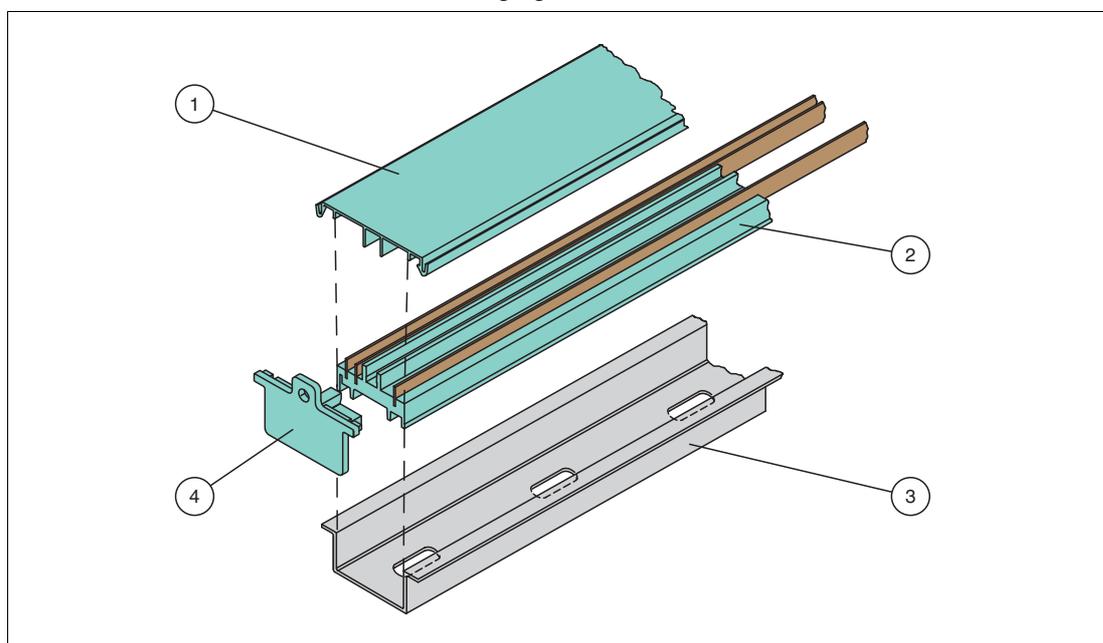


Figure 4.2 Example: Power Rail UPR-03

- 1 Cover UPR-COVER
- 2 Insert UPR-INS-03
- 3 DIN mounting rail UPR-MR (35 mm x 15 mm)
- 4 End cap UPR-E



### 4.3 Mounting

#### Mounting in a Non-Hazardous Area



##### Mounting the Device

Snap the device onto the DIN mounting rail from **above**. See the next figure.

#### Mounting in Areas that Require Equipment Protection Level Gc



##### **Danger!**

Explosion hazard from wrong mounting

The device safety can be impaired by external environmental influences and by mechanical stress. That can lead to sparking that can ignite a surrounding potentially explosive atmosphere.

Mount the device in a surrounding enclosure that complies with IEC/EN 60079-0 and that is rated with the degree of protection IP54 according to IEC/EN 60529.



##### Mounting the Device

Snap the device onto the DIN mounting rail from **above**. See the figure below.

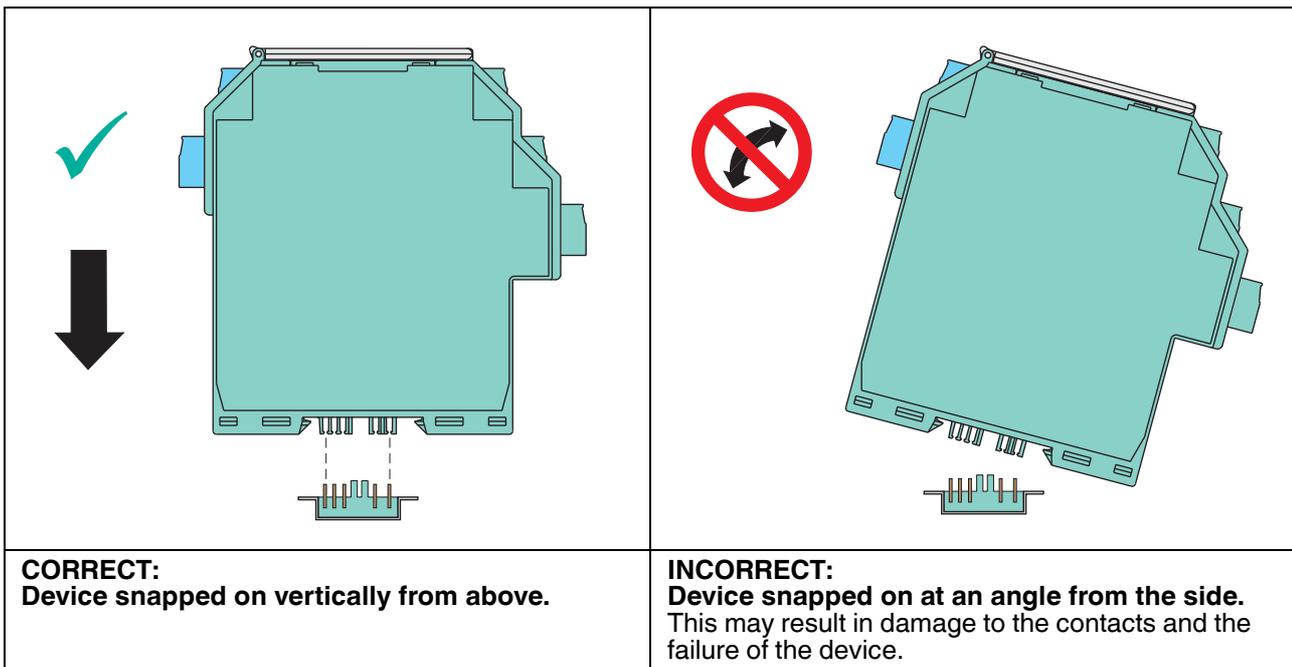


Figure 4.3



##### Mounting Terminal Blocks

Attach the terminal blocks or remove the terminal blocks.

## 4.4 Connecting the Multiplexer Master



### **Danger!**

Explosion hazard from using of non-intrinsically safe circuits in intrinsically safe circuits

Using non-intrinsically safe devices in intrinsically safe circuits suspends the type of protection. This can ignite the surrounding potentially explosive atmosphere.

Do not use HART multiplexer devices and HART termination boards in intrinsically safe circuits.



### **Danger!**

Explosion hazard from live wiring of circuits

If you connect or disconnect energized circuits in a potentially explosive atmosphere, sparks can ignite the surrounding atmosphere.

Only connect or disconnect energized circuits in the absence of a potentially explosive atmosphere.

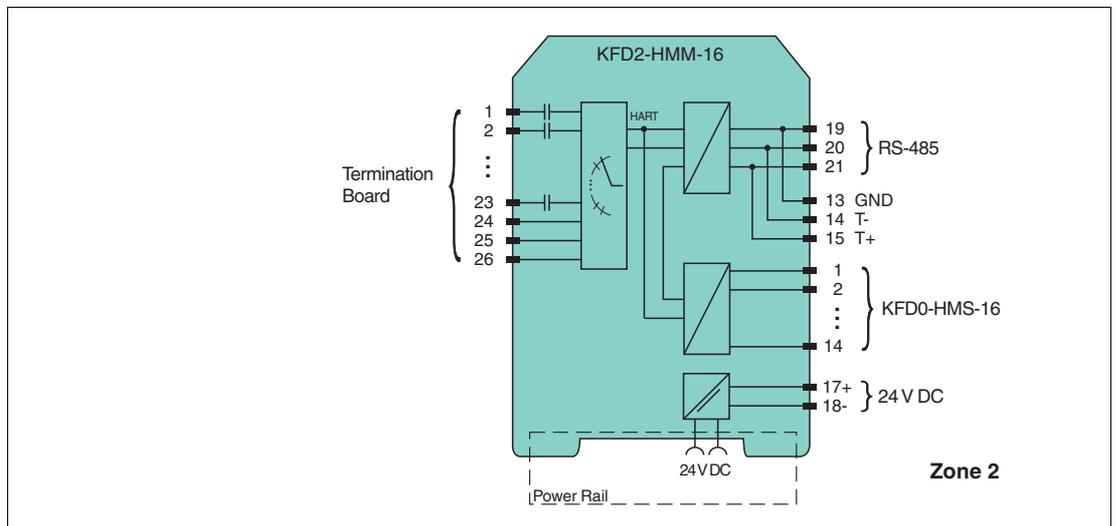


Figure 4.4 Connection of the KFD2-HMM-16 HART multiplexer master



#### 4.4.1 Supplying the Multiplexer Master with Power without Power Rail



**Danger!**

Danger to life from electric shock

Absent or insufficient insulation can result in electric shock.

Only connect supplies that provide protection against electric shock (e. g. SELV or PELV).

You can use the terminals to supply the multiplexer master with 24 VDC.



#### Connecting the Multiplexer Master Power Supply

Connect the power supply to terminals 17 and 18.

Observe the tightening torque for the terminal screws. The tightening torque is 0.5 Nm to 0.6 Nm.

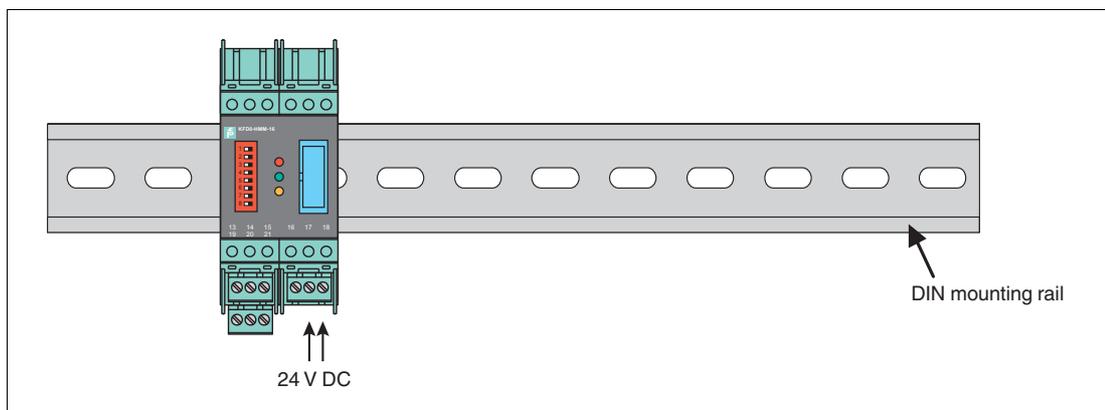


Figure 4.5

#### 4.4.2 Supplying the Multiplexer Master with Power with Power Rail



**Danger!**

Danger to life from electric shock

Absent or insufficient insulation can result in electric shock.

Only connect supplies that provide protection against electric shock to power feed modules (e. g. SELV or PELV).



**Caution!**

Property damage from use of isolators for Power Rail supply

Using the isolators for Power Rail supply can damage the isolators and make the Power Rail fail.

Do not supply the Power Rail via isolators.

You can use the Power Rail to supply the multiplexer master with 24 VDC. The supply is provided using the KFA6-STR-1.24.500 power supply, for example.



#### Connecting the Multiplexer Master Power Supply

Connect the power supply via Power Rail.

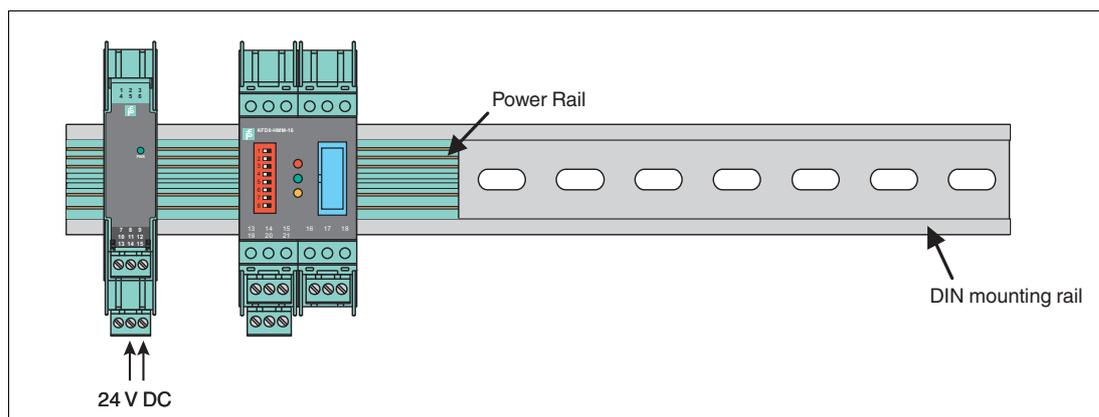


Figure 4.6

### 4.4.3 Connecting the Multiplexer Master to a Computer

The multiplexer master is connected to the computer via an RS-485 interface.

Terminal	Designation	Meaning
13, 19	Shield	Cable shielding
14, 20	RxD/TxD - (RS-485 B-)	RS-485 differential signal
15, 21	RxD/TxD + (RS-485 B+)	

Table 4.1 Connector assignment for removable terminals



#### **Caution!**

Risk of electric shock or property damage due to inadequate grounding

If the cable shield is not connected to the protective earth correctly, this may result in potential equalization currents. These currents may injure operating personnel or cause property damage.

Ground the cable shield at only one end of the line. Observe the applicable laws, standards, and directives for the operating location.



#### **Note!**

To connect the multiplexer master and computer, you need an interface converter. Different interface converters are required depending on the connection on your computer. We recommend the following converters:

- Interface converter from RS-485 to RS-232: Telebyte model 285, from Telebyte
- Interface converter from RS-485 to RJ45, Com-Server++, from W&T
- Interface converter from RS-485 to USB: I-7561-CR, from ICP



### Connecting the Multiplexer Master to a Computer

1. Connect a computer or a process control system to terminals 13, 14, and 15. Observe the tightening torque for the terminal screws. The tightening torque is 0.5 Nm to 0.6 Nm. Do not exceed a maximum cable length of 1200 m. Use a shielded, twisted, two-core cable.
2. In the case of long cable lengths and high baud rates, install a terminator at each end of the RS-485 line. Use terminators of 120 Ω to 220 Ω. If the RS-485 line ends at the multiplexer master and is not routed to other devices, use the second RS-485 connection at terminals 20 and 21 to connect a terminator. If you use an interface converter, install a terminator on the interface converter and an interface converter at the other end of the line.
 

↳ In the case of short cable lengths and low baud rates, no terminators are required. Observe the RS-485 specifications.
3. Connect additional participants to terminals 19, 20, and 21. Observe the tightening torque for the terminal screws. The tightening torque is 0.5 Nm to 0.6 Nm. Do not exceed a cable length of 1200 m. Use a shielded, twisted, two-core cable.

#### 4.4.4 Connecting the Multiplexer Devices to the Termination Board

The device is connected to the termination board via a 26-pin ribbon cable. The device has a 26-pin IDC socket on the front of the device for this purpose. 16 cables are intended for the HART signal of the analog measuring circuits of the field devices. The remaining 10 cables are connected to ground. For the assignment of the IDC socket, see chapter 9.2.

Pepperl+Fuchs provides special termination boards. Various connection options are available for these termination boards.



**Danger!**

Explosion hazard from exposed conductors

Exposed conductors of inadequately attached cables can cause sparks that can ignite the surrounding potentially explosive atmosphere.

When installing the device ensure that the cables are adequately attached.



#### Connecting Multiplexer Devices, Field Devices, and the Termination Board

Connect the multiplexer device to the termination board via the 26-pin ribbon cable K-HM26. See chapter 3.4.

#### 4.5 Connecting the Multiplexer Slaves



**Danger!**

Explosion hazard from using of non-intrinsically safe circuits in intrinsically safe circuits

Using non-intrinsically safe devices in intrinsically safe circuits suspends the type of protection. This can ignite the surrounding potentially explosive atmosphere.

Do not use HART multiplexer devices and HART termination boards in intrinsically safe circuits.



**Danger!**

Explosion hazard from live wiring of circuits

If you connect or disconnect energized circuits in a potentially explosive atmosphere, sparks can ignite the surrounding atmosphere.

Only connect or disconnect energized circuits in the absence of a potentially explosive atmosphere.



**Danger!**

Explosion hazard from exposed conductors

Exposed conductors of inadequately attached cables can cause sparks that can ignite the surrounding potentially explosive atmosphere.

When installing the device ensure that the cables are adequately attached.



### Connecting the Device

1. Connect the termination board via the 26-pin ribbon cable K-HM26.
2. Connect the multiplexer master and additional multiplexer slaves via the 14-pin ribbon cable K-HM14.

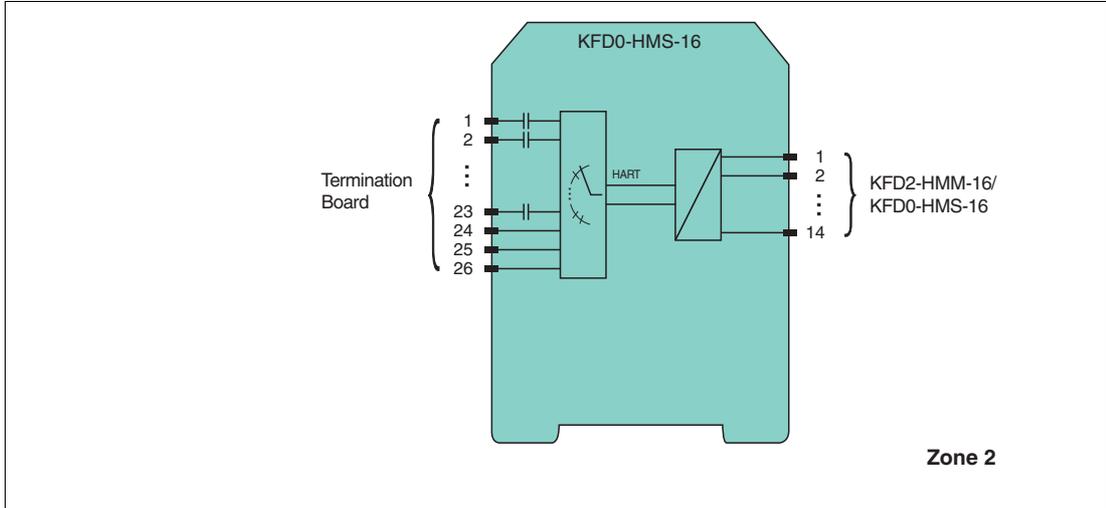


Figure 4.7 Connection of the KFD0-HMS-16 HART multiplexer slave

### 4.5.1

### Supplying the Multiplexer Slaves

The multiplexer slaves are supplied with power from the multiplexer master via the 14-pin ribbon cable.



### Connecting the Multiplexer Slave Power Supply

Connect the multiplexer slave to the multiplexer master via the 14-pin ribbon cable K-HM14.

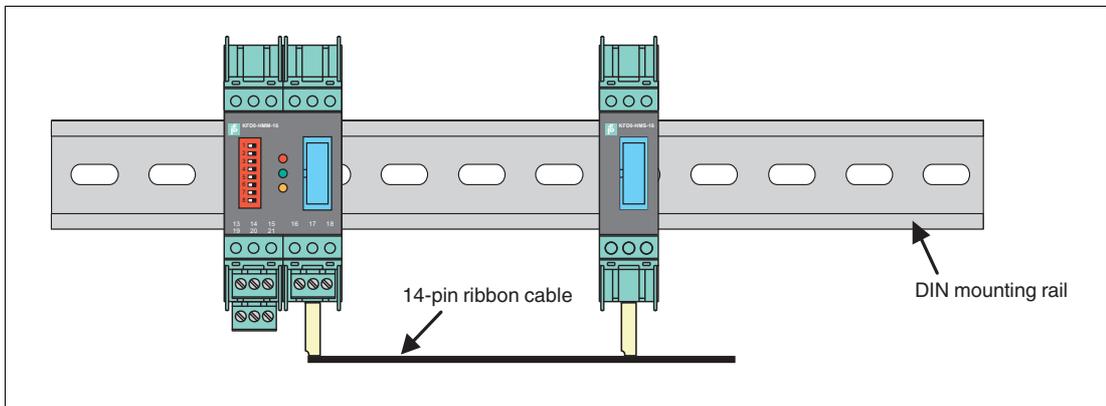


Figure 4.8

#### 4.5.2 Connection between Multiplexer Master and Multiplexer Slaves

The multiplexer slaves are connected to the multiplexer master via the 14-pin ribbon cable.



##### Connecting Multiplexer Master and Multiplexer Slaves

Connect the multiplexer master and the multiplexer slaves via the 14-pin ribbon cable K-HM14.

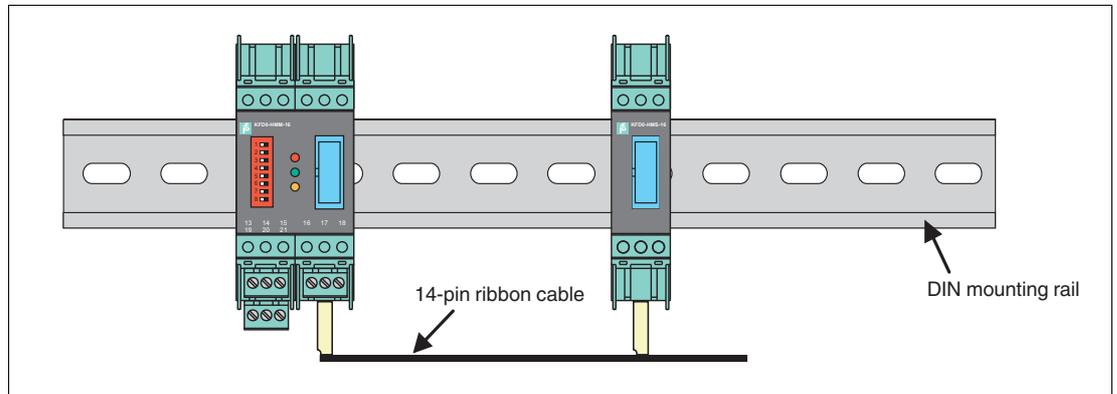


Figure 4.9

#### 4.5.3 Connecting the Multiplexer Devices to the Termination Board

The device is connected to the termination board via a 26-pin ribbon cable. The device has a 26-pin IDC socket on the front of the device for this purpose. 16 cables are intended for the HART signal of the analog measuring circuits of the field devices. The remaining 10 cables are connected to ground. For the assignment of the IDC socket, see chapter 9.2.

Pepperl+Fuchs provides special termination boards. Various connection options are available for these termination boards.



##### **Danger!**

Explosion hazard from exposed conductors

Exposed conductors of inadequately attached cables can cause sparks that can ignite the surrounding potentially explosive atmosphere.

When installing the device ensure that the cables are adequately attached.



##### Connecting Multiplexer Devices, Field Devices, and the Termination Board

Connect the multiplexer device to the termination board via the 26-pin ribbon cable K-HM26. See chapter 3.4.



## 4.6 Connecting the Termination Board



### ***Danger!***

Explosion hazard from using of non-intrinsically safe circuits in intrinsically safe circuits

Using non-intrinsically safe devices in intrinsically safe circuits suspends the type of protection. This can ignite the surrounding potentially explosive atmosphere.

Do not use HART multiplexer devices and HART termination boards in intrinsically safe circuits.



### ***Danger!***

Explosion hazard from live wiring of circuits

If you connect or disconnect energized circuits in a potentially explosive atmosphere, sparks can ignite the surrounding atmosphere.

Only connect or disconnect energized circuits in the absence of a potentially explosive atmosphere.



### ***Danger!***

Danger to life from electric shock

Absent or insufficient insulation can result in electric shock.

Only connect supplies that provide protection against electric shock to power feed modules (e. g. SELV or PELV).



### ***Danger!***

Danger to life from electric shock

Absent or insufficient insulation can result in electric shock.

- Maintain sufficient distance between the connection lines, terminals, housing, and the environment.
- Insulate connection lines, terminals, and the housing from the environment.



### ***Danger!***

Danger to life from incorrect installation

Incorrect installation of cables and connection lines can compromise the function and the electrical safety of the device.

- Observe the permissible core cross section of the conductor.
- When using stranded conductors, crimp wire end ferrules on the conductor ends.
- Use only one conductor per terminal.
- When installing the conductors the insulation must reach up to the terminal.
- Observe the tightening torque of the terminal screws.

#### 4.6.1 Connecting Field Devices to the Termination Board

Pepperl+Fuchs provides special termination boards. Various connection options are available for these termination boards. See the manual "K-System – Isolators and Termination Boards."



##### Connecting the Termination Board and Field Devices

1. Connect the HART-compatible field devices to the termination board using screw terminals or spring terminals. See chapter 3.4.1 and 3.4.2.  
Observe the tightening torque for the terminal screws. The tightening torque is 0.5 Nm to 0.6 Nm.  
or
2. Control units are mounted on the termination board. Connect the field devices to the control unit using screw terminals or spring terminals. See chapter 3.4.3.  
Observe the tightening torque for the terminal screws. The tightening torque is 0.5 Nm to 0.6 Nm.

#### 4.6.2 Connecting the Process Control System to the Termination Board

Pepperl+Fuchs provides special termination boards. Various connection options are available for these termination boards.



##### Connecting the Termination Board and Process Control System

1. Connect the process control system to the termination board using screw terminals or spring terminals. See chapter 3.4.1.  
Observe the tightening torque for the terminal screws. The tightening torque is 0.5 Nm to 0.6 Nm.  
or
2. Connect the process control system to the termination board via a manufacturer-specific system connector. See chapter 3.4.2 and 3.4.3.

#### 4.7 Information Regarding Electromagnetic Compatibility

The device is intended for use in electrically conductive and grounded switch cabinets.



##### Shielding Cables

1. Shield cables that are leaded into the switch cabinet.
2. Connect the switch cabinet and shield directly in the cable gland.
3. Lead unshielded cables (e. g. supply lines) into the switch cabinet via filter.

## 5 Commissioning

### Checklist for Commissioning

The commissioning of the multiplexer master is summarized in the following checklist. The steps required for commissioning the multiplexer master refer to the chapters where the respective procedure is described.

1. Installation of field devices
2. Selection and connection of the termination boards, see chapter 3.4
3. Selection and connection of the control units
4. Connection of the process control system
5. Connection of the multiplexer master, see chapter 4.4
6. Connection of the maintenance station.  
If necessary, use interface converters, see chapter 4.4.3.  
Observe the polarity of the RS-485 connection, see chapter 4.4.3.  
Specify the RS-485 address and the baud rate.
7. Wait for the switch-on process, see chapter 5.2.4.
8. Perform parameterization, see chapter 5.2.5.
9. Specify the multiplexer devices used in the module table, see chapter 7.1.2.
10. Build signal loops, see chapter 7.1.5.
11. If desired, activate the scan function, see chapter 7.1.6.

### 5.1 Data Access to the Connected Field Devices

The operating tool used determines how data on the connected field devices is accessed.

The field devices are generally found in a project tree beneath the multiplexer slaves. The multiplexer master integrates the slave unit with slave address 0. Device data, device parameters, and device diagnoses can be accessed via the project tree. For the structure of a project tree, see chapter 6.8.

The data, parameter, and diagnostic windows display the data of the underlying HART commands that differ according to the field device. Only universal commands and common practice commands have the same function for all devices. The information about the devices themselves, the process values, and some diagnostic information can thus be represented in a uniform manner.

### 5.2 Configuration of the Multiplexer Master

#### 5.2.1 Connection to the Maintenance Station or to the Process Control System

The connection to the maintenance station or to the process control system is via a multidrop-enabled RS-485 interface, see chapter 4.4.3. The baud rate for this interface can be set via the DIP switch. The device address for communication via RS-485 is also set via the DIP switch.

When setting the address, make sure that no address is assigned more than once, as otherwise this may lead to communication faults and even communication failure. The baud rate set must match that of the maintenance station.

## 5.2.2 DIP Switch Settings



### **Danger!**

Explosion hazard from sparking when using operating elements

Using operating elements in a potentially explosive atmosphere can cause sparks that can ignite the surrounding atmosphere.

Only use operating elements (e. g., switch, slider, button, etc.) in the absence of a potentially explosive atmosphere.

The device is equipped with 8 DIP switches on the front.

DIP switch 1 is used for device testing by the manufacturer and must therefore always be in the **off** position.

DIP switch	1	Meaning
Position	Off	Normal state

Table 5.1

DIP switches 2 and 3 determine the baud rate of the RS-485 interface.

DIP switch	2	3	Meaning
Position	Off	Off	9600 baud
	Off	On	19200 baud
	On	Off	38400 baud
	On	On	57600 baud

Table 5.2

DIP switches 4 to 8 define the RS-485 address. A value assigned to each of the DIP switches. The address is calculated from the sum of the values.

DIP switch	4	5	6	7	8	Meaning
Position	On	Off	Off	Off	Off	Value 16
	Off	On	Off	Off	Off	Value 8
	Off	Off	On	Off	Off	Value 4
	Off	Off	Off	On	Off	Value 2
	Off	Off	Off	Off	On	Value 1
Example	Off	On	On	Off	On	Address = 8 + 4 + 1 = 13

Table 5.3



### **Note!**

Briefly disconnect the device from the power supply to apply the values set using the DIP switches.

## Factory Setting

DIP switch	1	2	3	4	5	6	7	8	Meaning
Position	Off	Manufacturer test disabled, baud rate 9600 baud RS-485 address 0							

Table 5.4



### Note!

In the factory setting, the address 0 is set. Ensure that you do not assign any addresses more than once.

## 5.2.3

### LED Indication

The device is equipped with three LEDs which are located on the front of the housing. The LEDs have the following meanings:

Color	Meaning
Red	Fault indication, detected during the initialization process
Green	Operating indication
Orange	HART communication with a field device

Table 5.5

LED indication during the initialization process

Color	Status	Meaning
Red	Off	Initialization process
Green	Flashes	
Orange	Off	

Table 5.6

LED indication during the scanning process

Color	Status	Meaning
Red	Off	Scanning process
Green	Lit	
Orange	Flashes	

Table 5.7



### Note!

For further information about the scanning process, see chapter 5.2.4.

Faulty LED indication during commissioning

Color	Status	Meaning
Red	Flashes	If all three LEDs flash one after the other, DIP switch 1 (test) is in the on position. Turn the switch to off and repeat commissioning.
Green	Flashes	
Orange	Flashes	

Table 5.8

## 5.2.4 Switch-On Behavior

When the power supply has been switched on, the multiplexer master performs an initialization process with a self-test. The process is indicated by a flashing green LED. Any faults detected are indicated by a red LED. The multiplexer devices defined in the multiplexer table (command 157) are then scanned for any available HART-compatible field devices. This process is indicated by the flashing orange LED.

Once the multiplexer master has completed the scan process, a list of the field devices connected is saved in the device.



### **Note!**

If a field device is connected to the multiplexer device during operation, a scan must be performed afterwards so that the field device can be addressed via HART. This scanning process is triggered automatically when the multiplexer device is switched on, see chapter 7.1.5. The process can also be started manually in the maintenance station, see chapter 7.2.1. The duration of the scanning process is dependent

- on the number of connected multiplexer slaves,
- on the number of connected HART-compatible field devices,
- on the loop search type, see chapter 9.1, command 153,
- on the number of message repeats in the case of a fault, or
- on whether the query has been answered.

The factory setting for the number of message repeats is set to 2. The search duration is between approximately 30 seconds and several minutes in the case of maximum configuration. On completion of this phase, the orange LED goes out. Volatile data is set to its default setting. Data stored in non-volatile memory is retained.



### **Note!**

#### **Scanning Process with Several Interconnected Multiplexer Devices**

If several multiplexer devices are interconnected through a shared RS-485 line and a field device is replaced between the multiplexer devices, a scan must be performed on **both** multiplexer devices. Otherwise, no communication with the affected field device is possible.

## 5.2.5 Device Parameters, Parameterization



### **Caution!**

Potential device malfunction from change of device function

Changes in the device function can lead to device malfunction. The function of the device is no longer guaranteed.

Before transferring the new device function, make sure that the changed device function does not cause a danger to the device and the plant.

For the identification and parameterization of the multiplexer master, just like other HART field devices, the multiplexer master contains certain parameters that are saved in the non-volatile memory. The following list shows these parameters and how the parameterization must be performed.

- Unique device identification, see commands 0 and 11  
The device identification provides information about the device (type, type ID, serial number, revision numbers) and the manufacturer and cannot be changed.
- Message, see commands 12 and 17  
Under this parameter, any text of up to 32 characters can be stored in the device.
- Tag, description, and date, see commands 13 and 18  
A tag (8 characters), a measuring point description (16 characters), and a date can be stored under these parameters.
- Number of preambles in message responses, see command 59  
This parameter is used to define the number of preambles inserted in the message responses. The default setting is 4, the adjustment range is 2 to 20.
- Number of message repeats, see commands 144 and 145  
The number of message repeats can be set separately for repeats in the event of communication faults and in the event of response code **Busy**. The adjustment range is 0 to 11 repeats in each case. In the event of communication faults, the default setting is 2. For response code **Busy**, the default setting is 0.
- Scan command, see chapter 7.1.7 and commands 146 and 147  
Of the existing scan parameters, only the scan command is stored in non-volatile memory. The command indicates which HART command (1, 2, or 3) is to be a scan command to the field devices.
- Master type (primary or secondary master), see command 151  
This sets the priority for access to the HART field device. A primary master always initiates a connection to a field device. A secondary master initiates a connection to a field device only if the primary master does not access the field device. The default setting for the multiplexer master is primary master. A typical example of a secondary master is a handheld.
- Loop search type, see command 153  
The multiplexer master currently does not support multidrop with HART, i. e., only one HART field device is connected to each HART channel. During construction of the signal loop (scanning process, see chapter 7.1.5), the connected field devices are either always searched for polling address 0 (**single analog**) or for polling addresses 0 to 15 in preparation for multidrop operation. In multidrop operation, the first polling address found is addressed (**single unknown**).
- Module table, see chapter 7.1.2 and command 157

This document includes a list of commands. See chapter 9.1.

## 6 Configuration



### **Caution!**

Potential device malfunction from change of device function

Changes in the device function can lead to device malfunction. The function of the device is no longer guaranteed.

Before transferring the new device function, make sure that the changed device function does not cause a danger to the device and the plant.



### **Note!**

The steps are described using the FDT framework program **PACTware 4.1** as an example.

## 6.1 Introduction to PACTware Operating Software

### FDT Concept

The FDT concept (FDT – **F**ield **D**evice **T**ool) created a standard that can be used to integrate devices in various user interfaces (framework applications such as **PACTware**).

The FDT concept enables open and continuous device operation from the control level to the field, regardless of the bus systems used. The FDT concept specifies the data exchange between the device-specific driver and the framework application. Every communicating device has a device-specific driver (DTM) that is integrated in the framework application.

### PACTware™ Operating Software

**PACTware** (**PACTware** – **P**rocess **A**utomation **C**onfiguration **T**ool) is a manufacturer-independent operating software for devices. In the past, it was often necessary to use multiple manufacturer-specific programs to be able to operate different devices.

**PACTware** enables you to operate any number of devices with just this software. **PACTware** is not only a configuration tool, it also offers an interface to HART-compatible field devices as well as to bus systems such as PROFIBUS, MODBUS, and ControlNet. **PACTware** offers many features that allow users to simplify the plant documentation, to create trend curves, and to monitor signals using HART data.

### Device and Communication DTM

The DTM (DTM – **D**evice **T**ype **M**anager) contains all the data and functions of a device. Every DTM contains its own user interface optimized for the device. The device and communication DTMs can be integrated in any FDT frame application, such as **PACTware**.

The DTM offers almost no restriction with regard to display and user guidance. This means that all available device functions can be operated according to the user's needs. Operation is supported by graphics. The DTM technology enables consistent operation of a device in all FDT systems.

Pepperl+Fuchs generates DTMs for HART-compatible devices by converting the device description (DD) of these devices for use with **PACTware**.

Essentially, there are two different types of DTM:

- **Device DTMs**  
Device DTMs are DTMs for configuring field devices such as transmitter power supplies, signal converters, and trip amplifiers.
- **Communication DTMs**  
Communication DTMs are required for communication with a device via a point-to-point connection or via any network structures. The communication DTMs are available for various interfaces, such as an RS-232 interface or a USB interface.

## 6.2 Software Components

To configure the device with a user program, you need the following software components:

- **Microsoft® .NET Framework 3.5 or higher**
- **PACTware 4.1 or higher**  
In accordance with FDT Specification 1.2, **PACTware** is used as a framework application for DTMs supplied by manufacturers of the field devices as configuration software.
- **HART Multiplexer DTM**  
The DTM collection comprises all device DTMs required for the parameterization of multiplexer devices. The DTMs are used to establish communication with the field devices using communication protocols such as the HART protocol or PROFIBUS protocol.
- **DTM HART Comm**  
This package contains the HART communication DTM, which is necessary for communication between the host and the HART multiplexer DTM.
- **DTMs of the field devices**  
The manufacturers of field devices provide specific DTMs which allow access to all functions of the respective devices and therefore allow detailed parameterization. For further information, please contact the manufacturer of the field devices used.
- **Generic HART DTM**  
The Generic HART DTM provides the basic HART functionalities of the field devices. If no matching device DTM is available, the Generic HART DTM is used for basic parameterization. Therefore, we recommend that this DTM is always available.

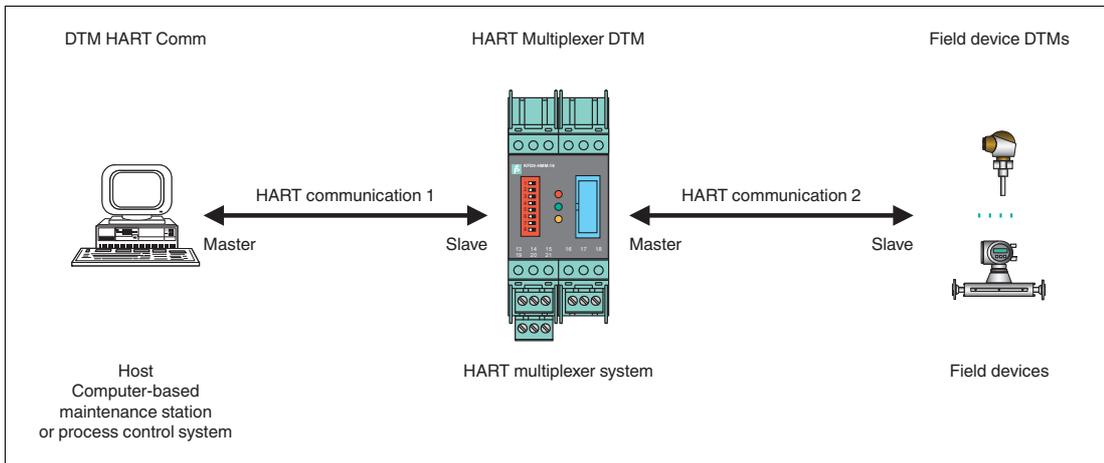


Figure 6.1 Software components



**Note!**

The latest software components can be found online at [www.pepperl-fuchs.com](http://www.pepperl-fuchs.com) in the product selector under **Products > Software**.



## Installing Software Components

1. Install **Microsoft®** .NET Framework.
2. Install **PACTware**.
3. Install the **HART multiplexer DTM**.
4. Install the **DTM HART Comm**.
5. Install the field device-specific **DTMs** from the manufacturer of the field devices.
6. Install the **DTM Generic HART** if necessary.



### **Note!**

The cross-device properties of the software are described in the manual "Installation and Configuration Device Type Manager (DTM)." You can download this manual free of charge from our website [www.pepperl-fuchs.com](http://www.pepperl-fuchs.com) in the product selector under **Products > Software > PACTware > Product list > PACTware 4.1 > Documents**.

The following section describes only the device-specific settings for the HART multiplexer master **KFD2-HMM-16**.

## 6.3 PACTware Main Window

The main window is divided into the project window and the editing window.

- Project window** In the project window, you build the current project tree of your system by adding the various components. In the project window, select the device you want to edit, monitor, diagnose, or simulate. The selected object is highlighted in a different color.
- Editing window** In the editing window, various windows required for editing your system are opened. In the first processing step, the selection window with the drivers and devices or the device catalog for the structure of the system is shown. For the configuration and parameterization, the corresponding windows for the drivers and devices are opened in the editing window. For subsequent operation, the menus for diagnosis, measured value, trend, or simulation are opened in the editing window. In addition, the communication monitor for the communication protocol can be opened.
- Menu bar** The menu bar contains the following drop-down menus:
- **File:** Here you can create a new project, save the current project, or load an existing project.
  - **Edit:** Contains the copy, cut, and paste functions.
  - **View:** Here you can display or hide various symbol and status bars, as well as the device catalog, fault monitoring, etc.
  - **Project:** Contains the basic project functions, such as loading device(s), writing to device(s), reading the device status.
  - **Device:** Contains the functions for editing the device data of the device currently selected in the project tree. Here you can also establish or disconnect the connection to the selected device.
  - **Extras:** Here you can manage the device catalog, the users, the options, and the add-ins.
  - **Window:** Here you can open the various current view windows.
  - **Help:** The **PACTware** help is called up.
- Command bar** The command bar is located below the menu bar and contains buttons for all important functions for adding, removing, and editing components within the project. You can also read the device status, edit the device data, and establish or disconnect the connection to the system.

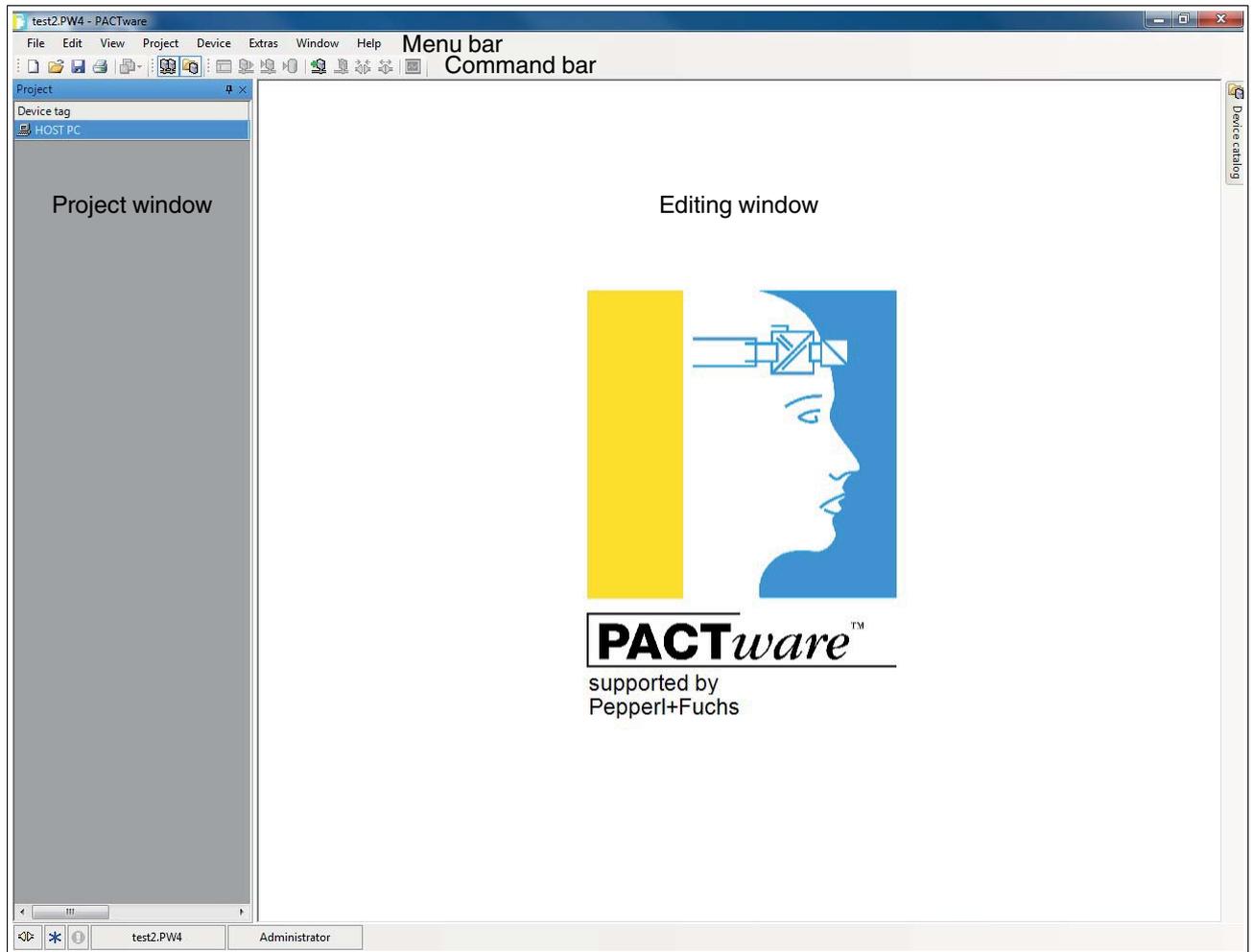


Figure 6.2 PACTware main window



**Note!**

Additional information on **PACTware** can be found in the manual "Installation and Configuration Device Type Manager (DTM)."



## 6.4 Connecting with the Device



### Connecting the Computer to the Device

1. Mount the device. See chapter 4.
2. Connect the device to the power supply.
3. Connect the computer and the device via an interface converter. See chapter 4.4.3.
4. Start **PACTware** as described in the manual "Installation and Configuration Device Type Manager (DTM)".

↳ The **PACTware** main window is displayed. See chapter 6.3.



### Enabling Memory-Optimized Operation

In combination with the DTMs for the multiplexer master, we recommend enabling the **Memory-optimized operation** option.

1. Open the menu **Extras > Options**.
2. Enable **Use memory-optimized project management**.
3. Confirm your selection with **OK**.

↳ You have enabled the memory-optimized operation.

## 6.5 Inserting the Communication DTM

In a **PACTware** project, the multiplexer master can only be addressed via the communication DTM **HART communication**. Information detailing how to create and edit a project can be found in the "Installation and Configuration Device Type Manager (DTM)" manual.

If there is no communication DTM in your project, add a communication DTM from the device catalog.



### Note!

Do not use the communication DTM **HART Driver FDT**. This communication DTM is an obsolete IDL-DTM.



### Adding Communication DTMs

1. In the project window, select **HOST PC** using the right mouse button.
2. In the context menu, select **Add device**.
3. Select the DTM **HART communication** from the list.
4. Confirm your selection with **OK**.

↳ The communication DTM is included in the project. In the project tree, the communication DTM bears the name of the COM port on which the device is physically connected with the computer (e. g. **COM8**).

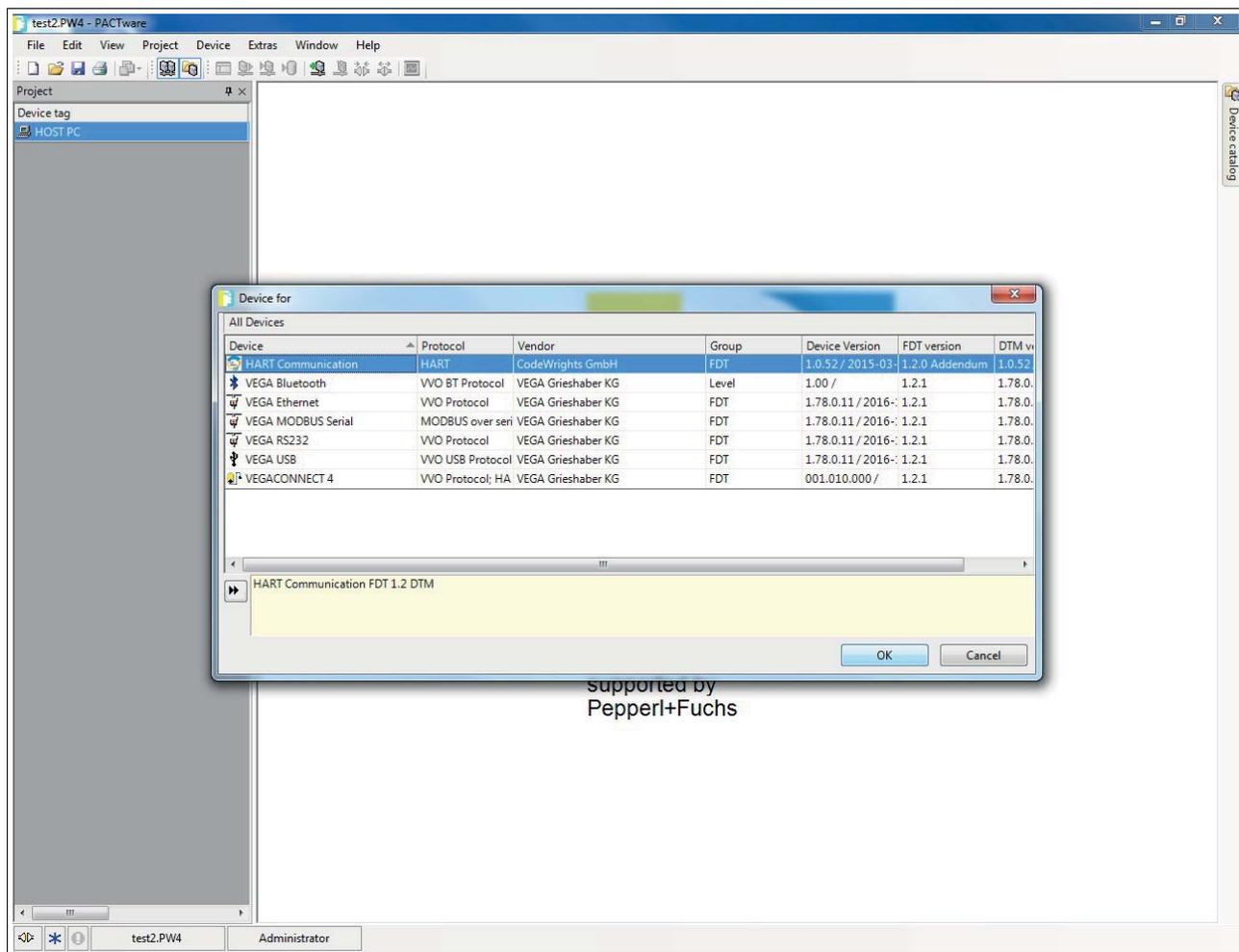


Figure 6.3 Device catalog

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## Setting Parameters

1. In the project window, double-click the communication DTM. It bears the name of the COM port on which the device is physically connected with the computer (e. g. **COM8**).
2. Close the **Parameters** window by clicking the **OK** button.

↳ If you have made changes to parameters, these changes will be saved.

The following parameters are adjustable:

- **Communication interface:**  
Select the option **HART multiplexer** as the interface.
- **Serial interface:**  
Select the COM port to which the multiplexer master is connected.
- **Baud rate:**  
Select the baud rate according to the settings of the DIP switches on the multiplexer master, see chapter 5.2.2.
- **RTS control:**  
Depending on the type of interface converter used, switching the request-to-send control on or off may be necessary to switch cleanly between receive and transmit mode.
- **HART protocol:**  
**Master:** 2 HART masters may be connected to a HART signal loop, whereby the parameterization must differentiate between the primary master and the secondary master. This setting is defined here.  
**Preamble:** In accordance with the HART standard, a corresponding number of FF characters must be sent in advance as a preamble. The number of characters is defined here.  
**Number of communication retries:** Number of repeated attempts to make contact in the event of an fault.
- **Address scan: start address and end address:**  
Here you can set the address range in which the HART communication DTM should search for the multiplexer devices connected to the RS-485 interface.
- **Communication timeout:**  
Here you can set how long the HART communication DTM should search for the multiplexer devices connected to the RS-485 interface.

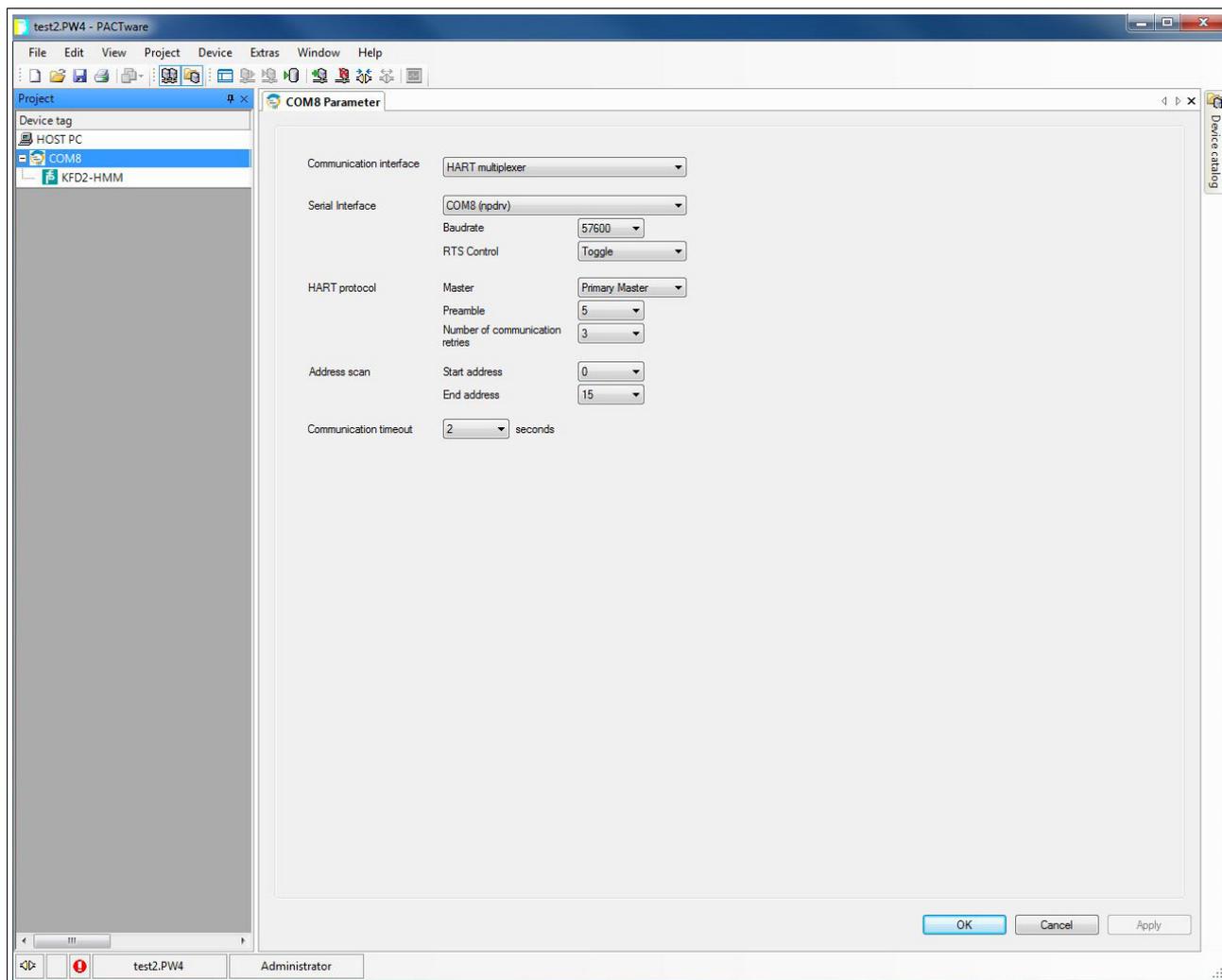


Figure 6.4 HART communication parameter window

## 6.6 Inserting the Multiplexer Devices

The connected multiplexer devices can be scanned in the communication DTM via the **Additional functions > Scanlist** function.



### Updating the Scan List

1. In the project window, right-click to select the HART communication DTM (e. g. **COM8**).
2. In the context menu select **Additional functions**.
3. Select **Scanlist**.
4. Start the scan by clicking **Update**.

↳ The scan list is updated and displayed.

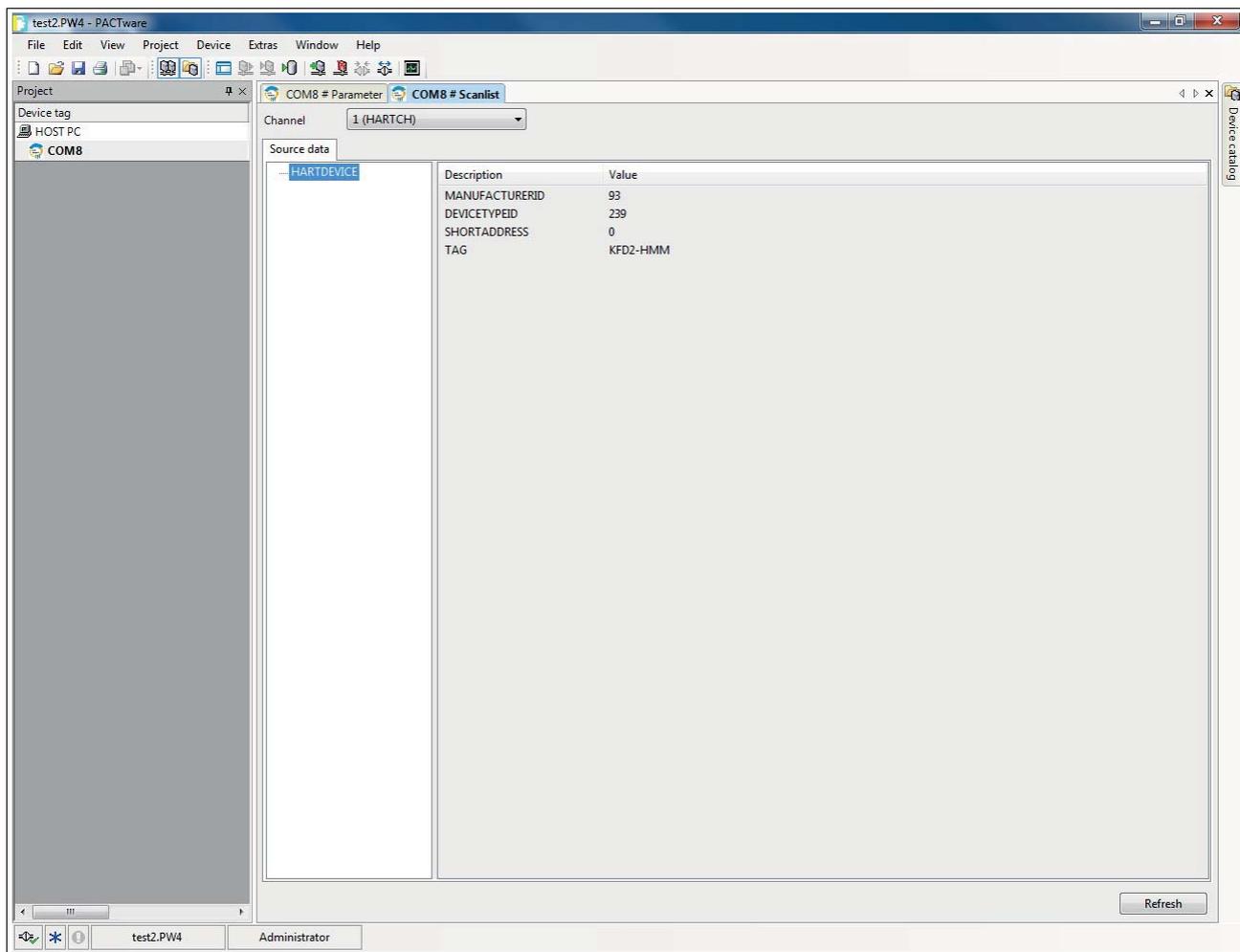


Figure 6.5 HART communication window, scan list

The multiplexer devices must be added to the project manually.



#### Inserting Multiplexer Devices via Device Catalog

1. Open the device catalog by clicking **View > Device catalog**
2. Use drag-and-drop to move the **KFD2-HMM-16** DTM from the device catalog to the HART communication DTM (e. g. **COM8**) in the project tree.

↳ The **KFD2-HMM-16** DTM is added to the project.



#### Inserting Multiplexer Devices via Context Menu

1. In the project window, right-click to select the HART communication DTM (e. g. **COM8**).
2. In the context menu, select **Add device**.
3. Select the **KFD2-HMM-16** DTM from the list and confirm by clicking **OK**.

↳ The **KFD2-HMM-16** DTM is added to the project.



#### **Note!**

To establish the connection to a device in the project tree or to disconnect the connection, right-click to select the corresponding device in the project window. In the context menu, select **Connect** or **Disconnect**.

Alternatively, you can select the device in the project window and click the corresponding field in the command bar.

## 6.7 Displaying Device Information and Setting Parameters

### 6.7.1 Loading Device Data



#### Loading Data and Establishing a Connection

1. In the project window, right-click to select multiplexer master **KFD2-HMM-16**.
2. Select **Load from device** in the context menu.
3. If no connection has been established previously, a window opens and you are asked whether you want to establish the connection to the device. Select **Yes**.

↳ The connection to the multiplexer master is established and the device data can be read.

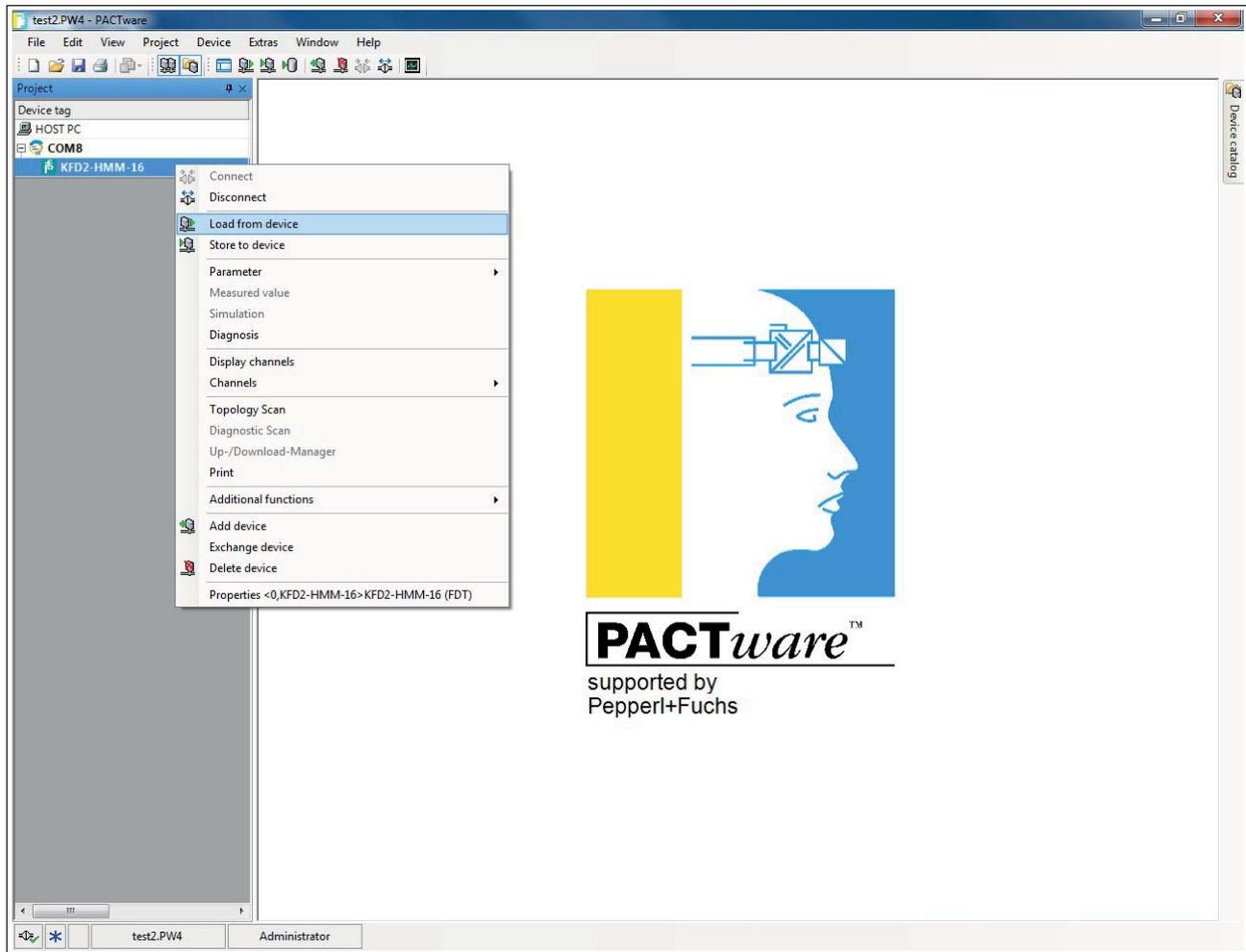


Figure 6.6 Load data from device

## 6.7.2 Device Information

General information about the device is displayed in the **General** menu:



### Displaying Device Information

1. Use the mouse to double-click the multiplexer master **KFD2-HMM-16** in the project window.
2. In the editing window, open the **Configuration > General** menu.  
↳ The **General** window is displayed.
3. Click **Apply** to confirm your selection.
4. Select **Revert** to reset your selection.

### Information

General, unchangeable information about the device is displayed in the **Information** section:

- **Manufacturer:** Manufacturer of the multiplexer device (Pepperl+Fuchs).
- **Device ID:** Type designation of the device.
- **Device type ID:** This number identifies the type of device and is unique depending on the manufacturer. Together with the manufacturer ID, the device type ID can be used to identify the device type uniquely.
- **Serial number:** The serial number of the device.
- **Hardware revision:** Hardware revision of the multiplexer master.
- **Software revision:** Software revision of the multiplexer master.
- **Device revision:** The revision of the devices supported.
- **Date:** The date on which the device parameters were last changed.
- **Configuration changed:** Indicates whether a parameter has been changed in the configuration of the device, see chapter 7.2.4.

### Identification

Identification information is displayed in the **Identification** section. This information can be changed and saved by the user.

- **Tag:** Tag for the identification of the multiplexer master.
- **Descriptor:** Description for the multiplexer master.
- **Message:** Communication without any special function which can be used freely by the user (e. g. for identification).

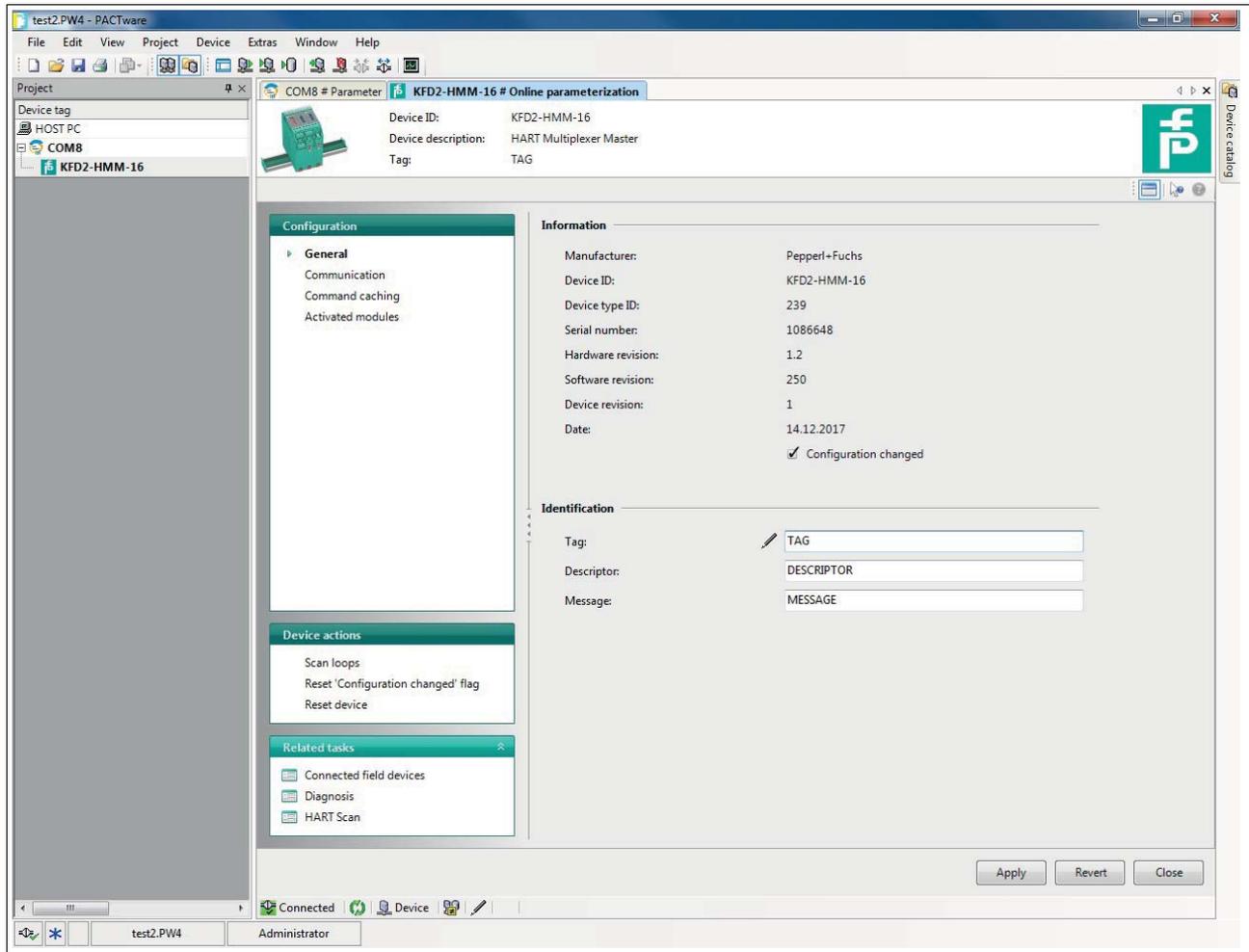


Figure 6.7 General window (device information)

### 6.7.3 Parameterizing Communication



#### Displaying Communication Parameters

1. Use the mouse to double-click the multiplexer master **KFD2-HMM-16** in the project window.
2. In the editing window, open the **Configuration > Communication** menu.  
↳ The **Communication** window is displayed.
3. Click **Apply** to confirm your selection.
4. Select **Revert** to reset your selection.

The communication parameters between the host, HART multiplexer system, and field device are displayed and set in the **Communication** menu:

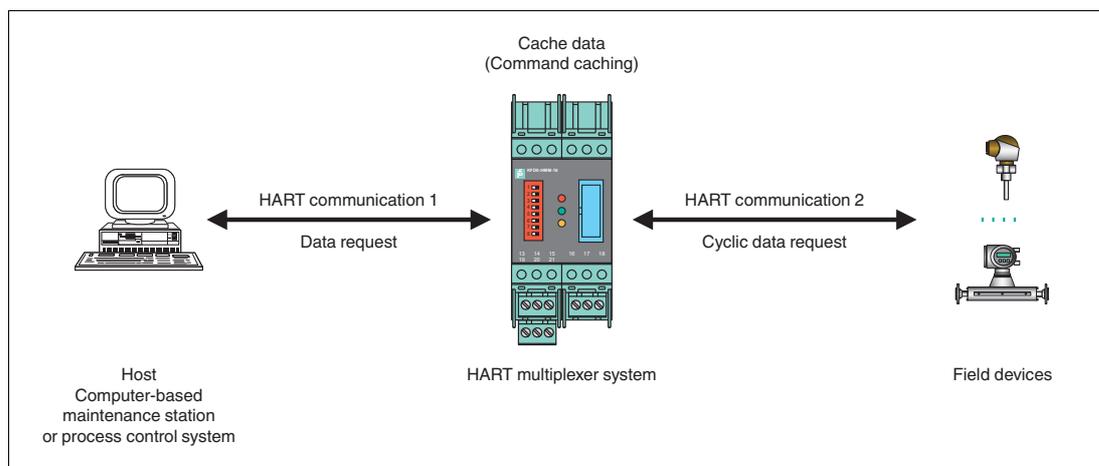


Figure 6.8

#### Communication with the Multiplexer Master

In this case, the communication between the host and the HART multiplexer system (HART communication 1) is described.

The **Communication to host HART master (as field device)** section displays the following information about the device:

- **Address:** The RS-485 address of the multiplexer master is displayed here.
- **Unique identifier:** The unique, non-variable long address of the multiplexer master.
- **HART revision:** HART revision under which the multiplexer master is operated.
- **Minimum number of preambles:** Minimum number of preambles.

## Communication with the Field Devices

In this case, the communication between the HART multiplexer system and the field devices (HART communication 2) is described.

The **Communication to field devices (as HART master)** section displays the following information. This information can be changed and saved by the user.

- **Master type:** 2 HART masters may be connected to a HART signal loop, whereby the parameterization must differentiate between the primary master and the secondary master. The setting at this point indicates whether the multiplexer master addresses the field devices as primary or secondary HART master.
- **Retries on "Busy":** Number of repeat attempts to establish communication with the field device if the field device reports **Busy**.
- **Retries on error:** Number of repeat attempts to establish communication with the field device if a fault occurs.
- **Loop scan address range:** This defines the address range in which the field devices on the individual signal loops are searched for, see chapter 6.7.4:
  - **Scan address 0 only:** The multiplexer master uses only address 0 to search for connected devices.
  - **Scan addresses 0 to 15:** The multiplexer master searches for all polling addresses between 0 and 15 and identifies the first device to respond.

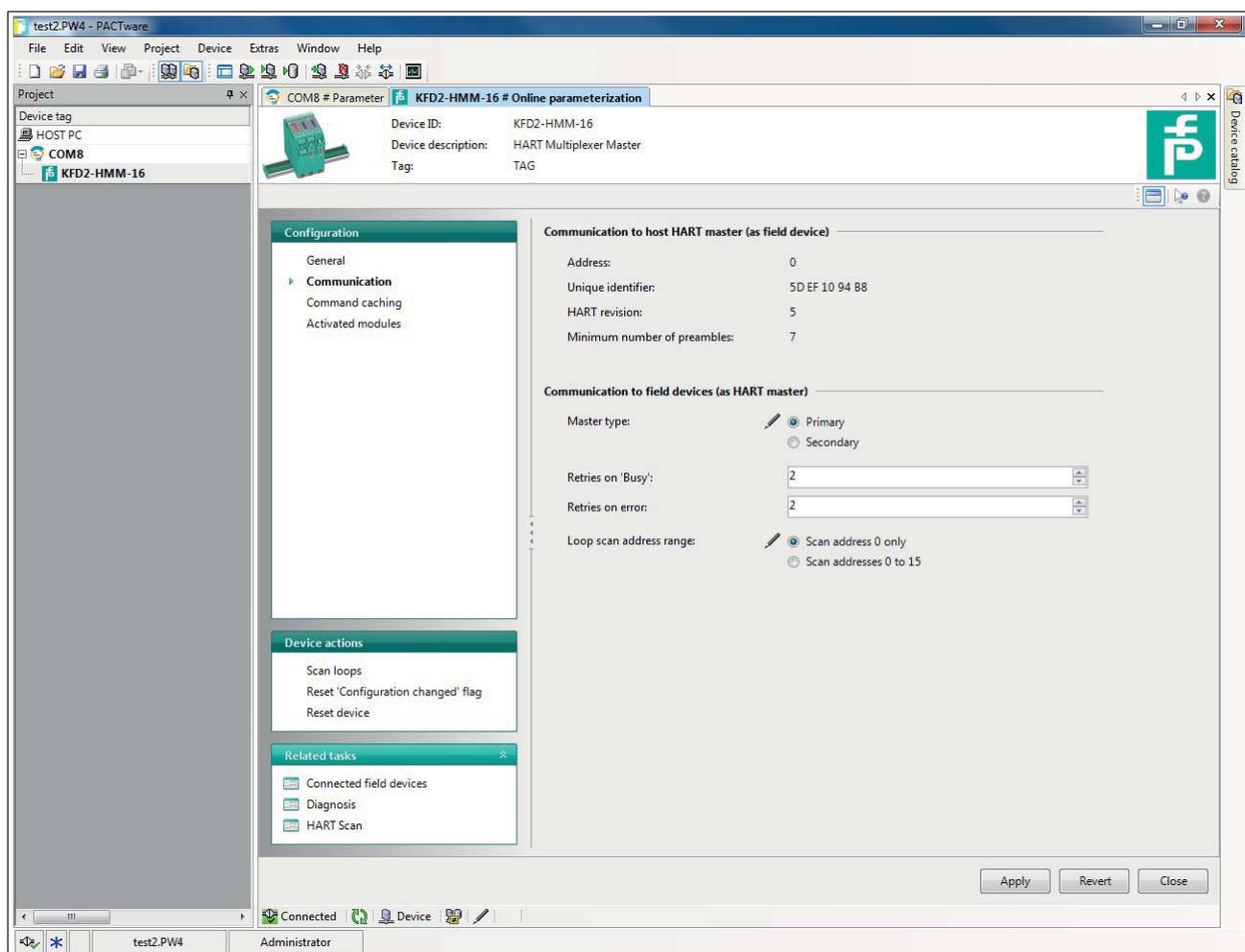


Figure 6.9 Communication window

## 6.7.4 Command Caching Function

### Cyclical Data Retrieval

With cyclical data retrieval, the HART multiplexer master periodically retrieves data from the connected field devices and stores the data in its internal memory. If the process control system queries the data of the field devices, this data can be forwarded more quickly. The data is no longer read directly from the field device. Instead, it is read directly from the memory of the multiplexer master. See chapter 6.7.3.



### Displaying the Command Caching Function Settings

1. Use the mouse to double-click the multiplexer master **KFD2-HMM-16** in the project window.
2. In the editing window, open the **Configuration > Command caching** menu.  
↳ The **Command caching** window is displayed.
3. Click **Apply** to confirm your selection.
4. Select **Revert** to reset your selection.

The command parameters for the multiplexer master are displayed and set in the **Command caching** menu:

- **Mode:** This switches the **Command caching** function on or off.
  - **Disabled:** The function is switched off.
  - **Default caching:** The function is switched on. This is the default setting. The commands selected are cached, see below.
- **HART command:** Here you can use a drop-down menu to select which values are to be read out from the field devices:
  - **Command 1 - Read Primary Variable:** Only the primary variable of the field device is read out.
  - **Command 2 - Read Loop Current and Percent Of Range:** The current value in mA is read out.
  - **Command 3 - Read Dynamic Variables and Loop Current:** All variables of the field device are read out.

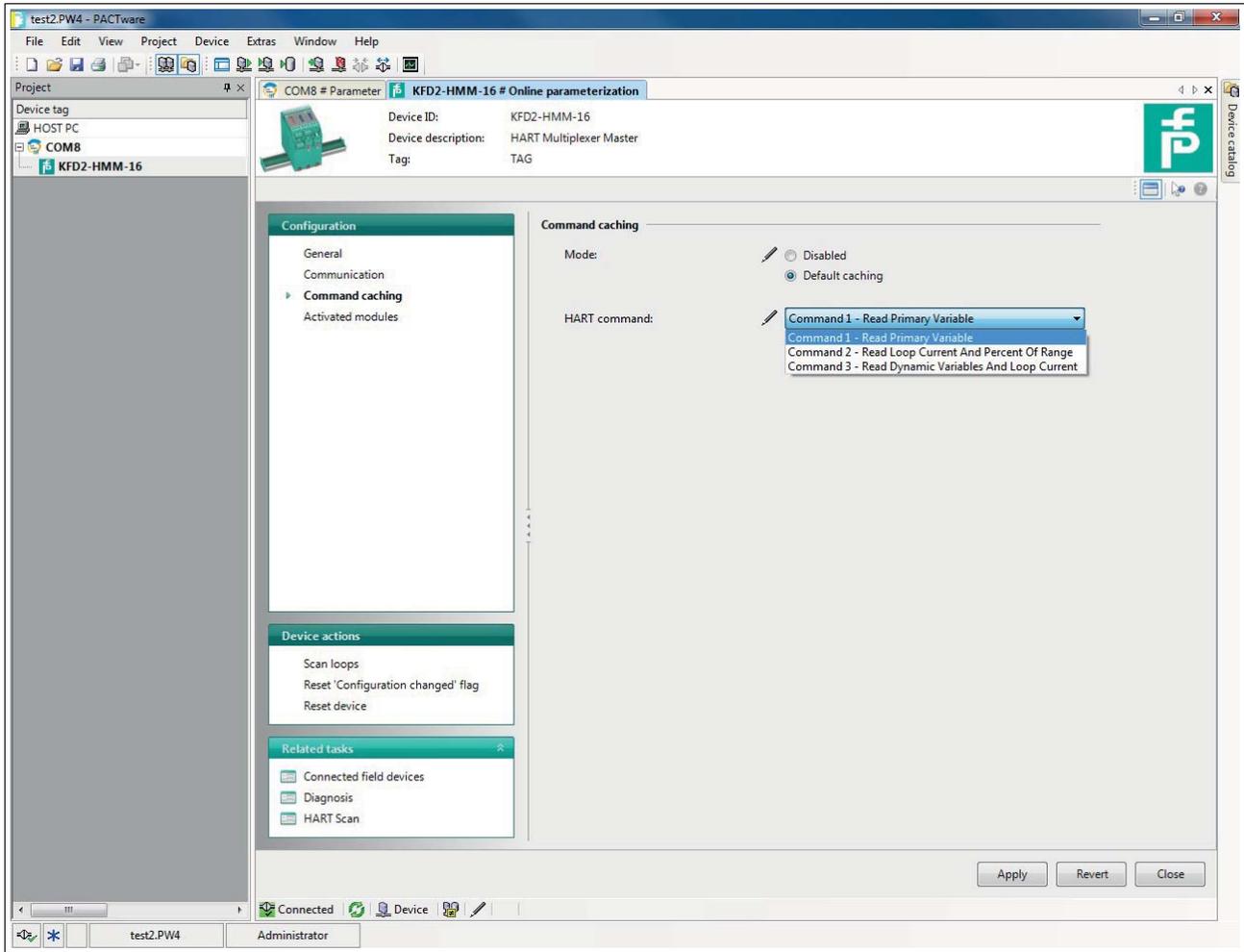


Figure 6.10 Command caching window

## 6.7.5 Active Multiplexer Devices



### Selecting Active Multiplexer Devices

1. Use the mouse to double-click the multiplexer master **KFD2-HMM-16** in the project window.
2. In the editing window, open the **Configuration > Activated modules** menu.  
↳ The **Activated modules** window is displayed.
3. Click **Apply** to confirm your selection.
4. Select **Revert** to reset your selection.

In the **Activated modules** window, select the active multiplexer slaves for each multiplexer master. By default, only the master is activated. Select the connected multiplexer slaves depending on the expansion level.

- Click **Select all** to select all multiplexer devices.
- Click **Select none** to select no multiplexer devices.
- With a single click, you can place or remove individual checkmarks in the list. The checkmarks specify the active multiplexer devices.



#### Note!

Connected field devices are only accessible to the multiplexer master if their assigned multiplexer slave is marked as active in this list.

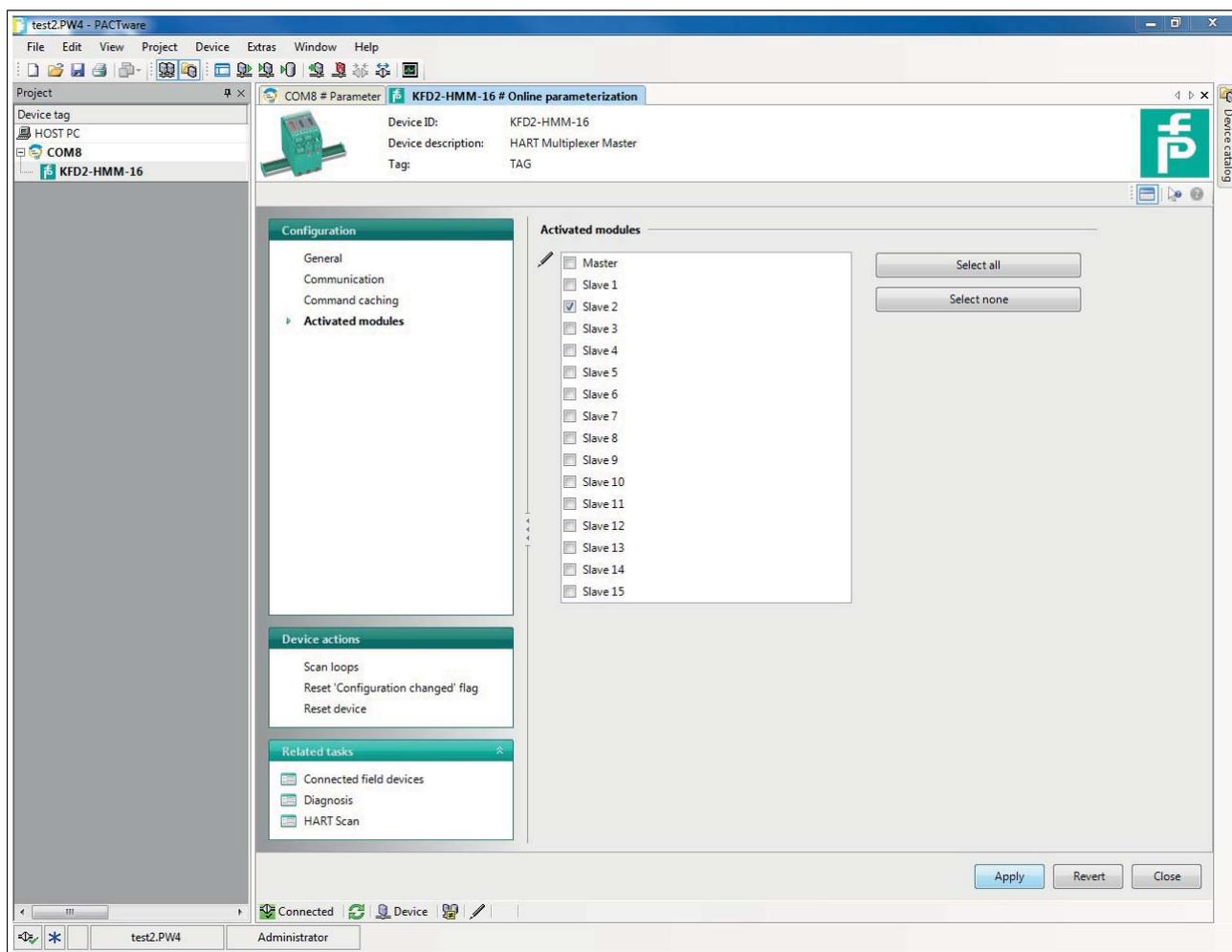


Figure 6.11 Activated modules window

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## 6.8 HART Scan

### 6.8.1 Starting the HART Scan Function

The HART scan function can read in the entire project structure connected to the serial interface: multiplexer master, multiplexer slaves, field devices.



#### Starting the HART Scan Function via Menu

1. Use the mouse to double-click the multiplexer master **KFD2-HMM-16** in the project window.
2. In the editing window, open the **Related tasks > HART Scan** menu.
  - ↳ The **HART Scan** window is displayed.



#### Starting the HART Scan Function via Context Menu

1. In the project window, right-click to select multiplexer master **KFD2-HMM-16**.
2. In the context menu, select **Additional functions**.
3. In the dropdown list, select **HART Scan**.
  - ↳ The **HART Scan** window is displayed.

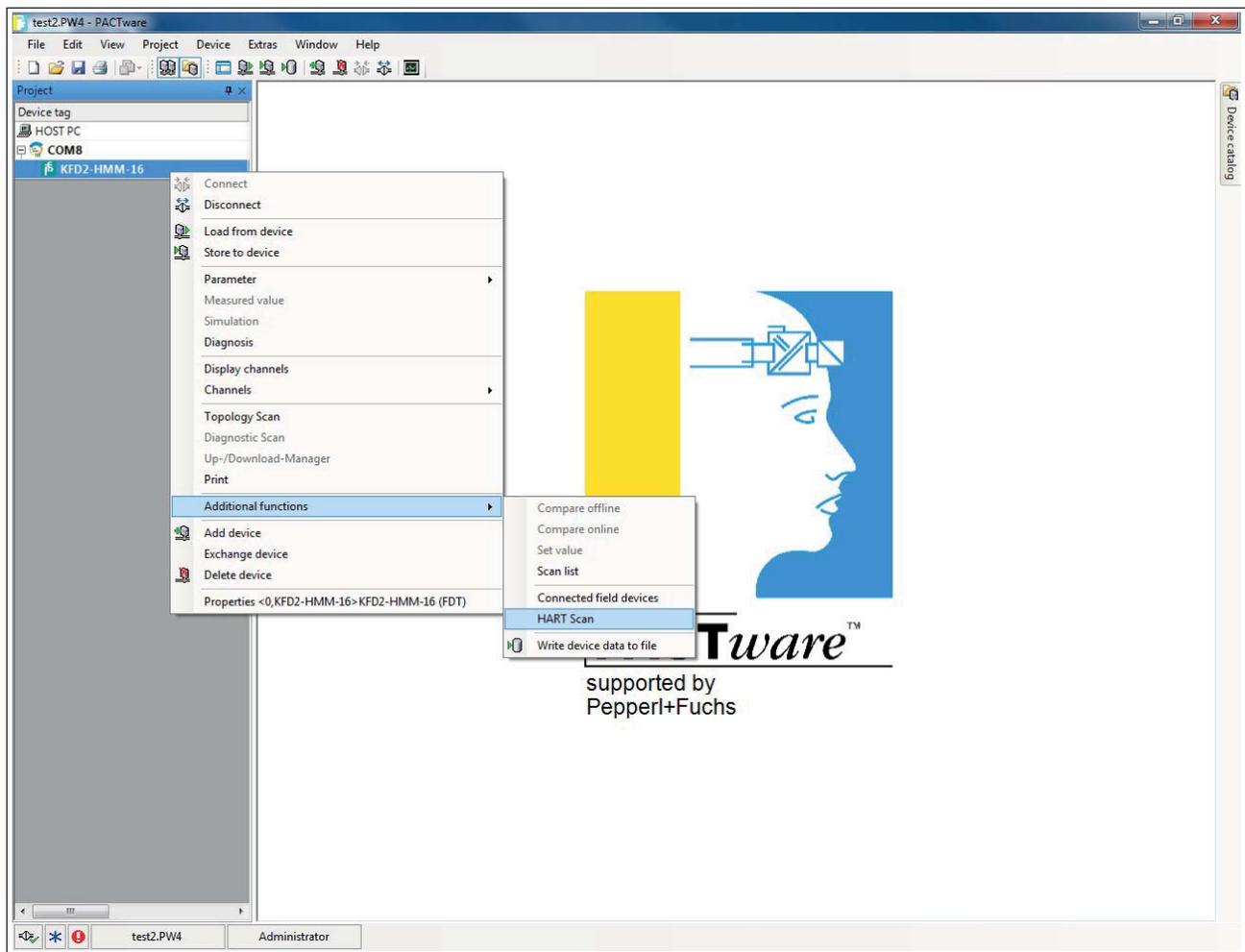


Figure 6.12 HART Scan function



**Note!**

Under certain circumstances, the HART scan function is not supported by all framework applications or is subject to restrictions.

## 6.8.2

### Executing the HART Scan Function



#### Performing a HART Scan

1. In the **HART scan wizard** section in the **HART scan** window, select one of the following options, see Figure 6.13:
  - **First commissioning:** Select this option to create a complete basic setup of the FDT project. Devices included in the FDT project, such as the multiplexer master, multiplexer slaves, and field devices, including the communication settings, are recorded and analyzed. If you select this option, you have to define additional settings in the next steps, see Figure 6.14:
    - **Primary or secondary:** 2 HART masters may be connected to a HART signal loop, whereby the parameterization must differentiate between the primary master and the secondary master. Select one of the options.
    - **Scan address 0 only:** Select this option if you want the multiplexer master to use only the address 0 to search for connected devices.
    - **Scan addresses 0 to 15:** Select this option if you want the multiplexer master to search for all connected devices with polling addresses between 0 and 15.
    - **Retries on "Busy":** Number of repeat attempts to establish communication with the field device if the field device reports **Busy**.
    - **Retries on error:** Number of repeat attempts to establish communication with the field device if a fault occurs.
  - **Update modules:** Select this option if a module has been removed or added.
  - **Update field devices:** Select this option if field devices have been removed or added.
  - **Update FDT project:** Select this option to adapt the FDT project to the current HART topology.



**Note!**

Depending on the selected settings and the number of field devices, a complete HART scan may take up to several hours because additional addresses are queried and the individual channels are addressed multiple times.

**Recommendation:**

Initially, select **Scan address 0 only** and keep the number of **Retries on "Busy"** and the number of **Retries on error** as low as possible. If field devices are missing after the HART scan, amend the settings and scan again.

2. Click **Next** to confirm and continue with the HART scan.
  - ↳ Before the HART scan starts, you can select which active multiplexer devices are to be searched, see chapter 6.7.5.
  - If you select the option **Automatic**, all multiplexer devices to which field devices are connected are automatically detected and activated.
  - If you select the option **Manual**, you can enable/disable the check boxes to determine which active multiplexer devices are to be searched.
3. Confirm your selection by clicking **Next** to start the HART scan.
  - ↳ The HART scan is executed. Depending on the selected settings and the number of field devices, a complete HART scan may take from a few seconds to several hours.

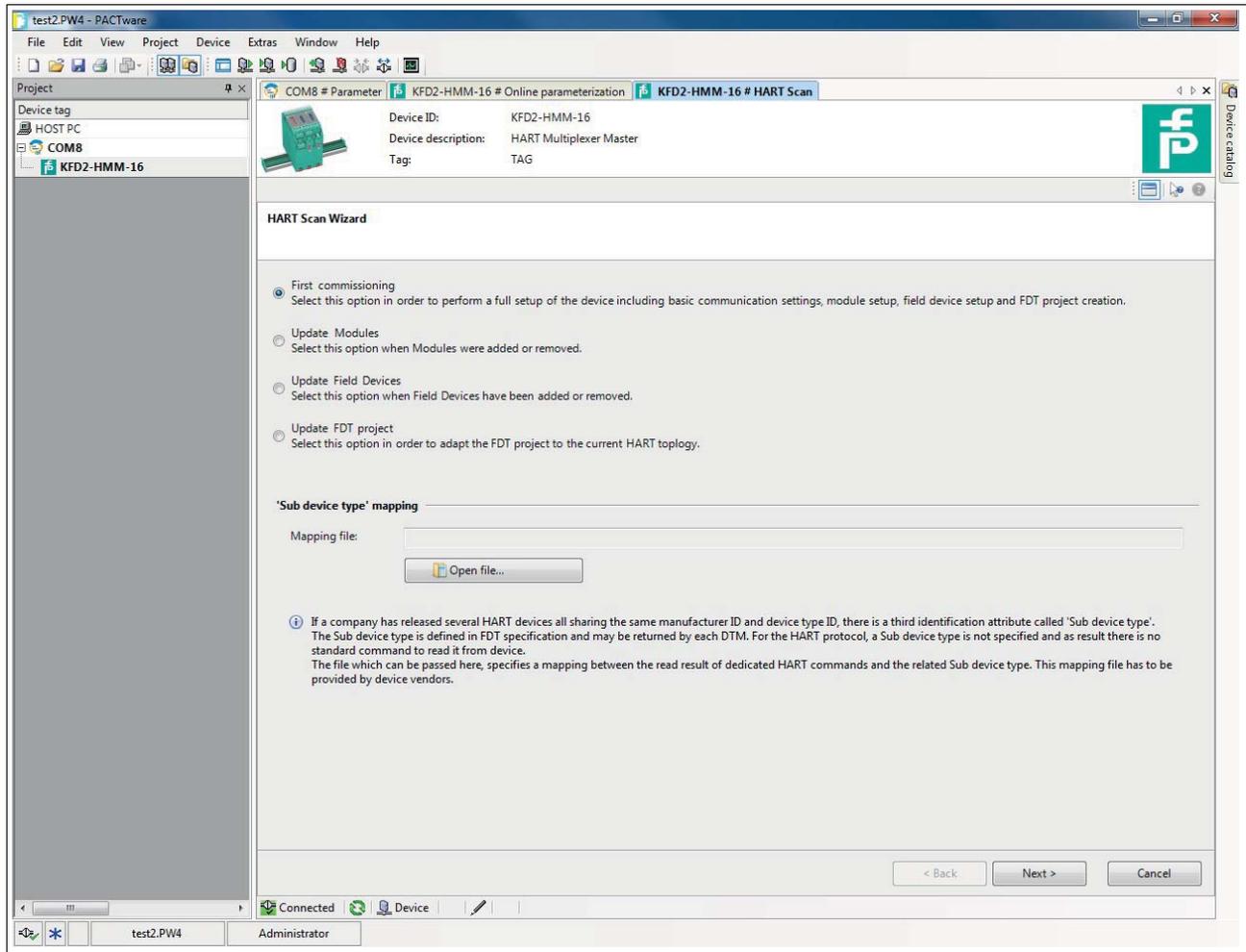


Figure 6.13 HART Scan wizard

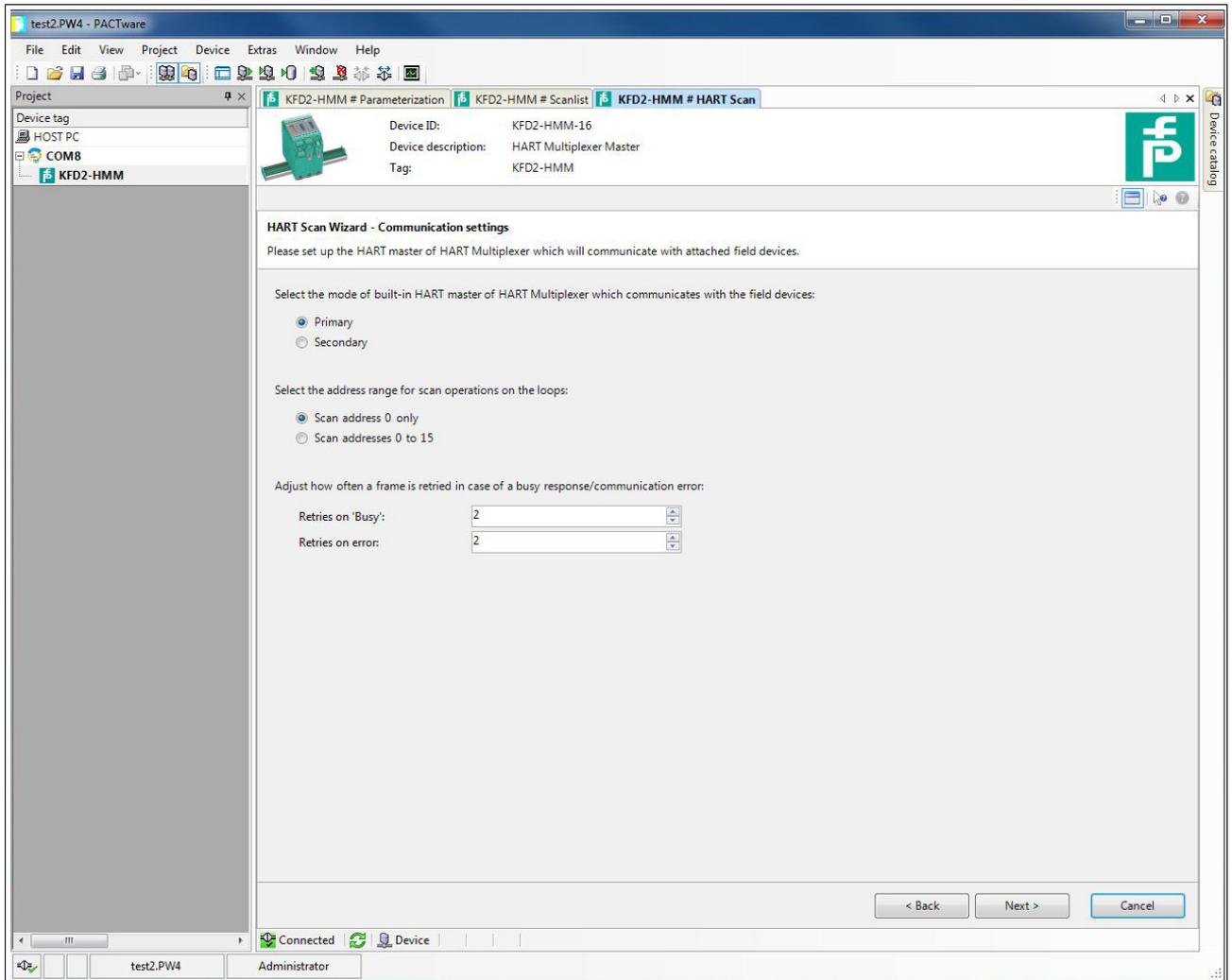


Figure 6.14 HART Scan Wizard, communication options



## Reading In the XML File for Detection of the Sub Device Type

If a manufacturer has released several devices that have the same manufacturer ID and device type ID, a third identification attribute is required for unique identification. This attribute is referred to as a **sub device type**. The attribute is defined in the FDT specification and can be detected by any DTM. However, the identification attribute is not defined in the HART protocol and is not recognized in device communication. The file that is read at this point converts the identification attribute so that this information can be read in the DTM. This file must be provided by the device manufacturer.

1. Open the Explorer by clicking **Open file** under the **Mapping file** field.
2. Select the required XML file.  
↳ The file path of the XML file is displayed in the **Mapping file** field.
3. Alternatively, you can enter the file path of the XML file in the **Mapping file** field directly.

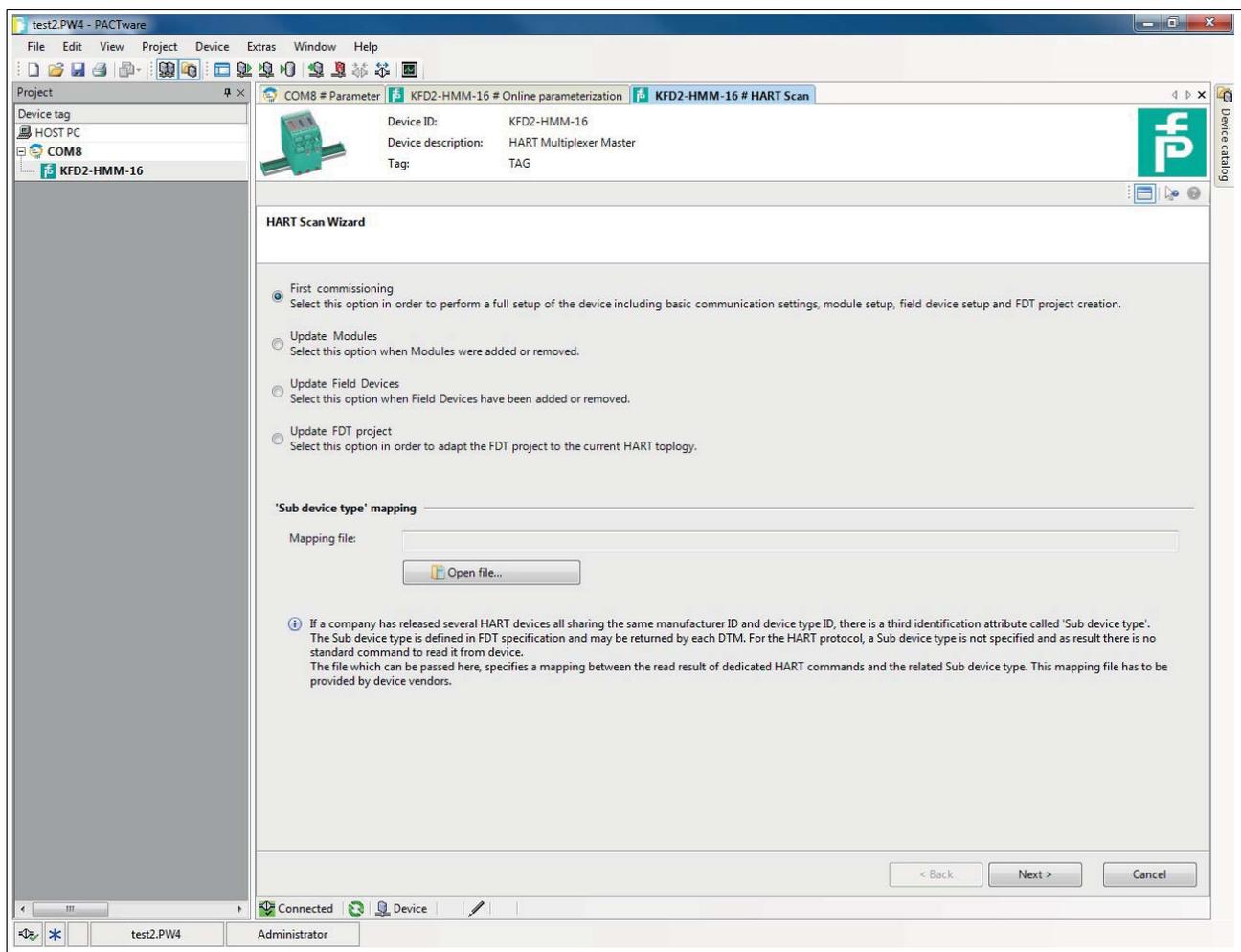


Figure 6.15 HART Scan wizard

### 6.8.3 Results of the HART Scan

As the result of the HART scan, a table is output containing the following information about the field devices found:

Loop	Device data	Match result	Assigned DTM	DTM action	Apply
Slave and loop address of the field device	Name and data of the field device	Specifies whether the HART scan wizard has found a suitable DTM	Suggested DTM	Specifies what the HART scan wizard will do with the selected DTM	Select this check box to apply the changes for this field device

Table 6.1 Results table for the HART scan

Match result	Explanation
Single green checkmark	The assigned DTM matches the device exactly.
Two green checkmarks	There are several DTMs, that match the field device data.
Individual gray checkmark	The Generic HART DTM has been assigned to the device as no device-specific DTM has been found.
Yellow warning triangle	The assigned DTM does not match the device.

Table 6.2 Explanation of the match result

DTM action	Explanation
Yellow star	No DTM has been assigned to the field device yet. A new DTM will be created in the project tree.
Pen	The DTM previously assigned to the device will be replaced by the new DTM selected.
Red cross	The field device for this DTM that exists in the project is missing. The DTM will be removed from the project tree.

Table 6.3 Explanation of the DTM action

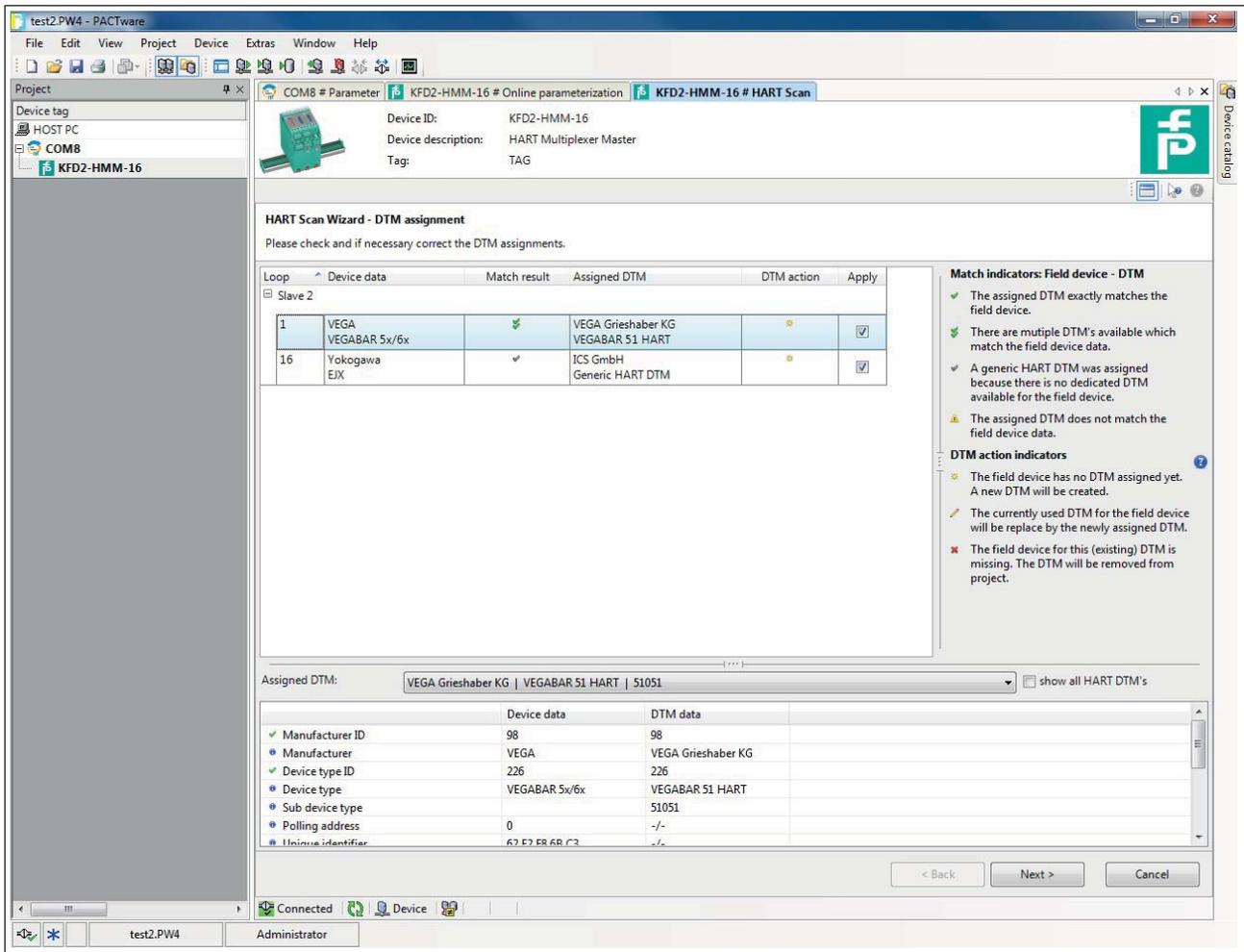


Figure 6.16 HART Scan result

Click on a row in the table to select the corresponding field device and to display additional options in the lower section of the editing window:

In the **Assigned DTM** dropdown list, you can manually select which DTM is to be used for the field device:

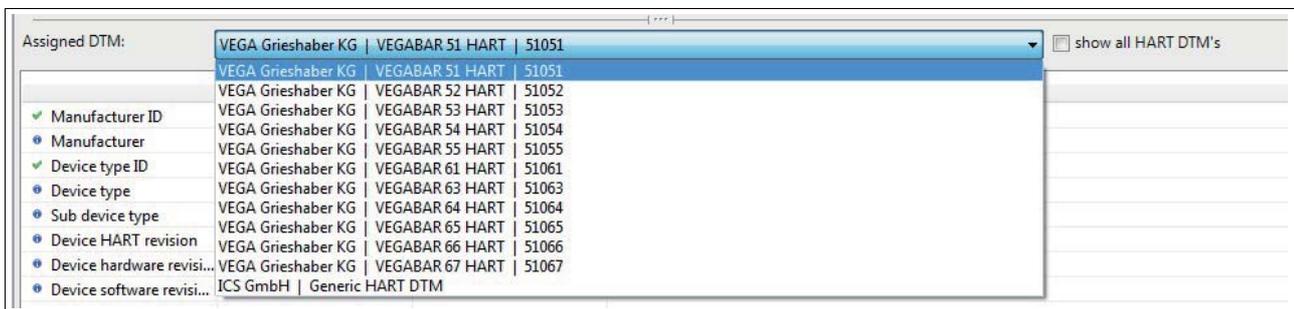


Figure 6.17

In the table below, the data read out from the field device and the data contained in the selected DTM is compared. This allows a comparison between the field device data and the DTM:

Assigned DTM: VEGA Grieshaber KG   VEGABAR 51 HART   51051 <span style="float: right;">show all HART DTM's</span>			
	Device data	DTM data	
✓ Manufacturer ID	98	98	
• Manufacturer	VEGA	VEGA Grieshaber KG	
✓ Device type ID	226	226	
• Device type	VEGABAR 5x/6x	VEGABAR 51 HART	
• Sub device type		51051	
• Polling address	0	-/-	
• Unique identifier	62 E2 F8 6B C3	-/-	
• Device HART revision	5	-/-	
• Device hardware revision	1	-/-	
• Device software revision	1	-/-	
• Device device revision	1	-/-	
• DTM description	-/-	Pressure transmitter wit...	
• DTM version	-/-	3.50	

Figure 6.18

Confirm your selection by clicking **Next** to complete the HART scan. The HART topology determined in the HART scan can then be added to the device tree in the project window. You will be prompted to save the project to store the modified HART topology.



**Note!**

Some manufacturers have different DTMs for the same device family. In this case, you have to select the correct DTM from the dropdown list.



**Note!**

Some DTMS do not make this information available, meaning that automatic assignment is not possible.

After completion of the HART scan, the devices are added to the device tree in the project window.

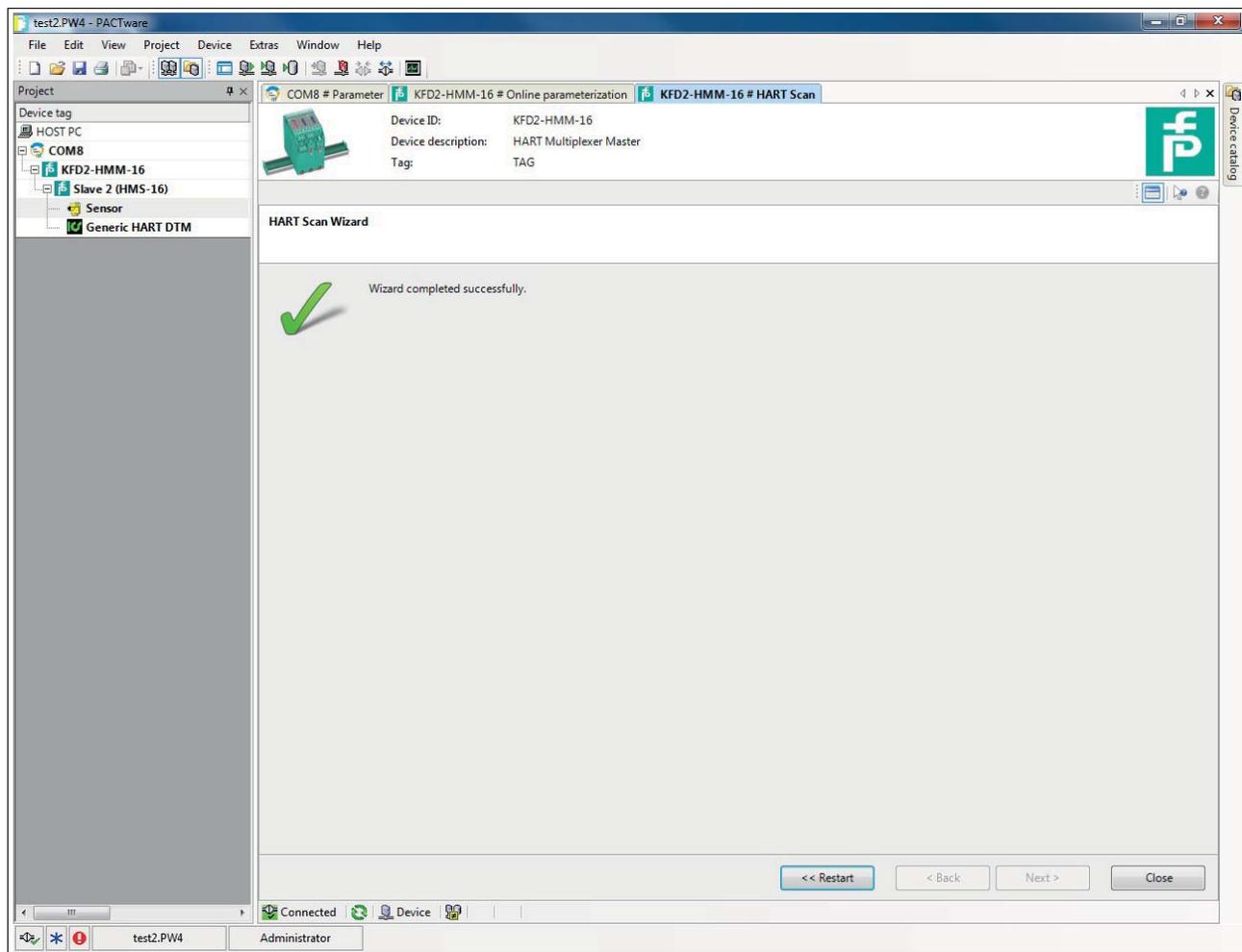


Figure 6.19

## 6.9 Adding DTMs Manually

For known field devices, you can also add the device-specific DTMs in the project tree manually. Proceed as follows:



### Adding a Device-Specific DTM Manually via Device Catalog

Use drag-and-drop to move the device-specific DTM from the device catalog to the DTM of the multiplexer slave that the device is to be assigned to.

↳ The device-specific DTM is then added to the project.



### Adding a Device-Specific DTM Manually via Context Menu

1. In the project window, right-click to select the DTM of the multiplexer slave that the device should be assigned to.
2. In the context menu, select **Add device**.
3. Select the device-specific DTM from the list and confirm with **OK**.
4. Select the signal loop that the device is to be connected to and confirm with **OK**.

↳ The device-specific DTM is then added to the project.

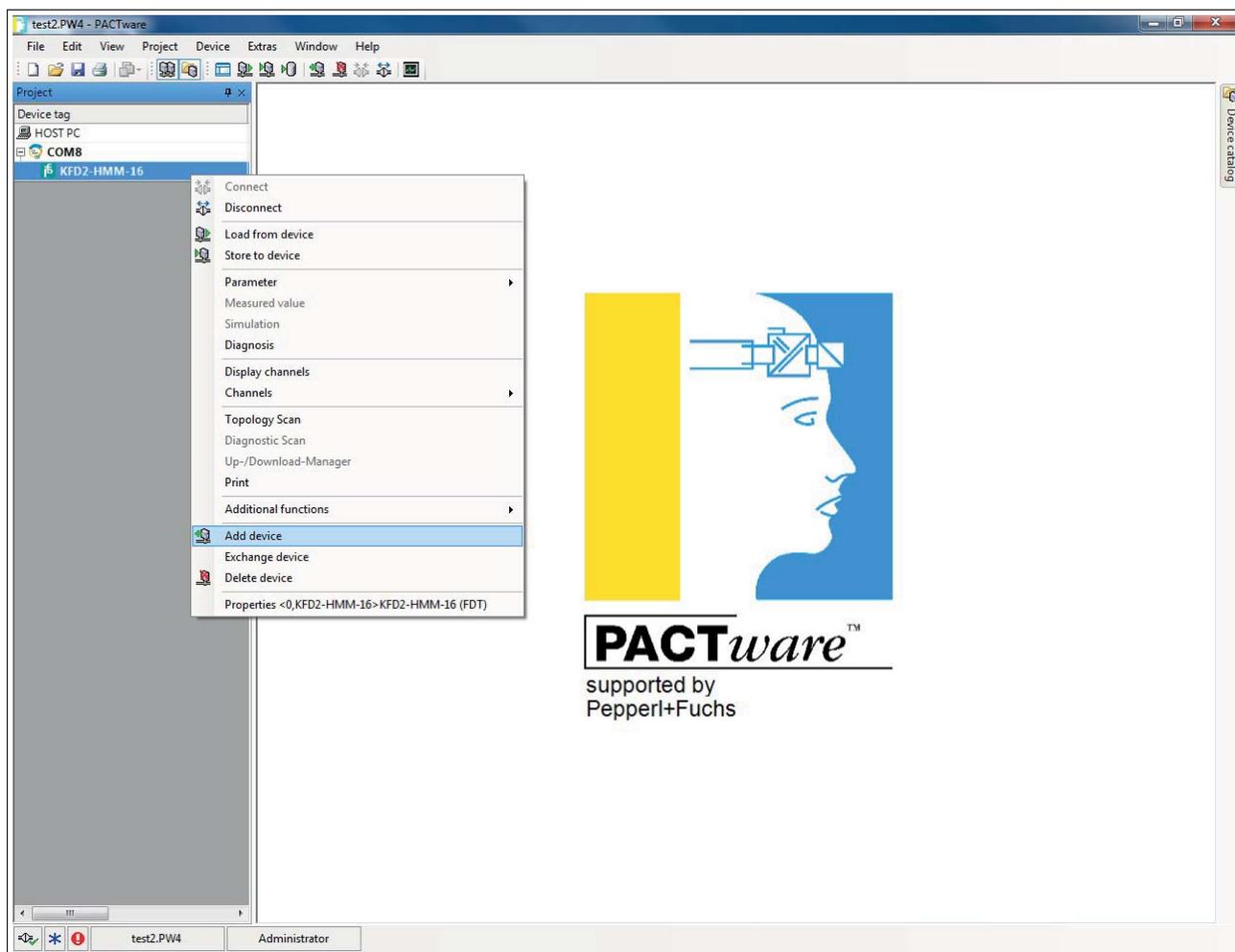


Figure 6.20 Manual insertion of a DTM

## 7 Operation



### **Danger!**

Explosion hazard from live wiring of circuits

If you connect or disconnect energized circuits in a potentially explosive atmosphere, sparks can ignite the surrounding atmosphere.

Only connect or disconnect energized circuits in the absence of a potentially explosive atmosphere.



### **Danger!**

Explosion hazard from sparking when using operating elements

Using operating elements in a potentially explosive atmosphere can cause sparks that can ignite the surrounding atmosphere.

Only use operating elements (e. g., switch, slider, button, etc.) in the absence of a potentially explosive atmosphere.

## 7.1 Device Functions

The software functions described in this chapter are usually integrated in the operating software of the process control system, i. e., the software functions are generally **not** enabled or disabled via the described HART commands. Instead, they exist in the functions (menu commands) of the operating software that take on these processes. Nevertheless, the underlying HART commands are described because the functions may have different names in the individual user interfaces and the underlying basic functions may not always be apparent from the name. For a list of the commands supported see chapter 9.1.

### All Functions at a Glance

The following list shows all the functions of the multiplexer master at a glance:

- 16 channels, expandable up to 256 channels by connecting up to 15 multiplexer slaves
- Up to 7936 signal loops per RS-485 interface
- Automatic search of all existing HART-compatible field devices (scan)
- Switchable, independent, cyclical querying of the HART variables (command caching)
- Acts as the primary or secondary multiplexer master
- Fast RS-485 interface (multidrop) with up to 56700 baud
- Integrated modem
- Removable terminals
- Power supply via Power Rail
- Approved for Zone 2

### 7.1.1 Number of Channels

The multiplexer master provides 16 channels for connecting field devices or control units that support digital communication according to the HART specification. A maximum of 15 additional multiplexer slaves can be connected. These multiplexer slaves in turn support 16 channels. With just one multiplexer master, 256 channels can therefore be reached in maximum configuration.

### 7.1.2 Multiplexer Table (Module Table)

The multiplexer master and the connected multiplexer slaves must be labeled as present in a multiplexer table, see chapter 9.1 command 157. Only modules defined as present in this table are included in communication. The multiplexer table consists of 16 bit, 1 bit for each multiplexer address. The default is module 0 (multiplexer master) and 1 activated.

### 7.1.3 Interface

The multiplexer master acts as a transparent gateway between the maintenance station and the field devices. The maintenance station is typically a computer with appropriate software, see chapter 3.2. The maintenance station can address up to 31 multiplexer masters via a RS-485 connection of up to 57600 baud. Since each multiplexer master can address up to 256 field devices, each RS-485 interface communicates with up to 7936 field devices.

### 7.1.4 HART Communication

As a digital communication system for maintenance and configuration purposes, the HART protocol is supported by many field devices with conventional analog 4 mA to 20 mA circuits. The HART signal is modulated to the analog current as an FSK signal, see chapter 3.1. The modulator/demodulator circuit (modem) required is integrated in the multiplexer device. Only one HART-compatible field device can be connected to each HART connection of the multiplexer device – there is no multidrop functionality.

Special procedures with regard to the HART communication:

- On the host side (RS-485), the extended address is always used, except in the case of command 0.
- On the field device side, either the polling address or the extended address is used depending on the need.
- The **primary master** and **secondary master** operating modes and the corresponding time responses are supported on the field device side.
- On the host side, only the commands 0 to 3 and 11 to 13 are accepted from the secondary host. Other commands are not accepted or are ignored.
- Commands to connected field devices are only accepted from the primary host.
- Extended messages and messages in burst mode are detected and used but are not generated by the multiplexer device itself.
- A response buffer is available for a delayed response telegram. A message with an initiating command that requires a long execution time can be temporarily stored here.

### 7.1.5 Constructing the Signal Loop/Scan (Software Function)

When the power supply to the device is switched on, the device searches the multiplexer devices listed in the multiplexer table for the connected HART field devices (command 0 and 4 <sup>1</sup>) and in doing so generates the internally required access tables. This process can also be performed by the maintenance station connected as is necessary, for example, for communication with new HART-compatible field devices connected. The length of this process depends:

- on the number of multiplexer slaves connected,
- on the number of connected HART-compatible field devices,
- on the loop search type, see chapter 9.1, command 153,
- on the number of message repeats in the case of a fault, or
- on whether the query has been answered.

With 16 field devices the duration is between 15 s and 30 s (e. g., for use by only one multiplexer master without multiplexer slaves).



**Note!**

In the DTM, the parameters for the signal loop construction can be parameterized in the **Communication** menu in the **Communication to field devices (as HART master)** section. For a detailed description, see chapter 6.7.3.

During the scanning process, only certain read commands (commands 0, 1, 2, 3, 11, 12, 13, 48, 129) are accepted by the maintenance station. All other commands result in the response **Busy** until the scanning process is concluded.

### 7.1.6 Cyclical Data Retrieval/Command Caching (Software Function)

The multiplexer device can read cyclical data from up to 31 field devices. To do this, the scan option (command 137) must be set for the field device and the scan function in the multiplexer device must be activated (command 149, function 1). The **Scan command** option (command 147) defines which data is to be transferred, see chapter 9.1.



**Note!**

In the DTM, the scan function for cyclic data retrieval can be activated and parametrized in the **Command caching** menu. For a detailed description, see chapter 6.7.4.

If the scan function is activated, the field devices with the scan option activated are regularly checked for data. To do this, the scan command that reads one or more variables from the field device is executed. If a field device does not respond, it is designated as **Disappeared** (command 129) but it remains in the search list. This means that the field device will be searched for again during the next cycle. If a field device has disappeared but responds correctly with one of the next search commands, it is designated as **Appeared**. If another field device has responded instead, the **Mismatched** status appears.

<sup>1</sup> Command 4 is also used for field devices that support only older HART specifications up to command 4.

### 7.1.7 Variant of the Scan Function (Special Scan Function)

The special scan function (command 149, function 2) uses an additional parameter that defines the minimum length of expected data bytes. This parameter can be different for each signal loop but it must be set for each signal loop to be scanned.



**Note!**

The special scan function cannot be parameterized via the DTM. It can only be parameterized via HART commands from the host.

The scanning process itself takes place as described in the chapter above. However, the response of the field device is compared with the expected data length. If the length of the response is below the specified minimum data length, the response is rejected. If the minimum data length is 0, the response is always stored.

## 7.2 Software Functions

### 7.2.1 Field Device List



#### Scanning Signal Loops

1. Use the mouse to double-click the multiplexer master **KFD2-HMM-16** in the project window.
2. In the editing window, open the **Device actions > Scan loops** menu.  
↳ The **Scan loops for field devices** window is displayed.

In the **Scan loops for field devices** window, you can start a scan to identify all field devices connected to the multiplexer master. Proceed as follows:

- In the left-hand area, select the signal loops that you want to search. If you select a slave, all signal loops of the slaves are scanned.
- Selecting the **Scan selected loops** button starts the scan of the signal loops. The scan may take several minutes.

Once the signal loops have been scanned, you can find more information about the connected field devices in the field device list, see chapter 7.2.2.

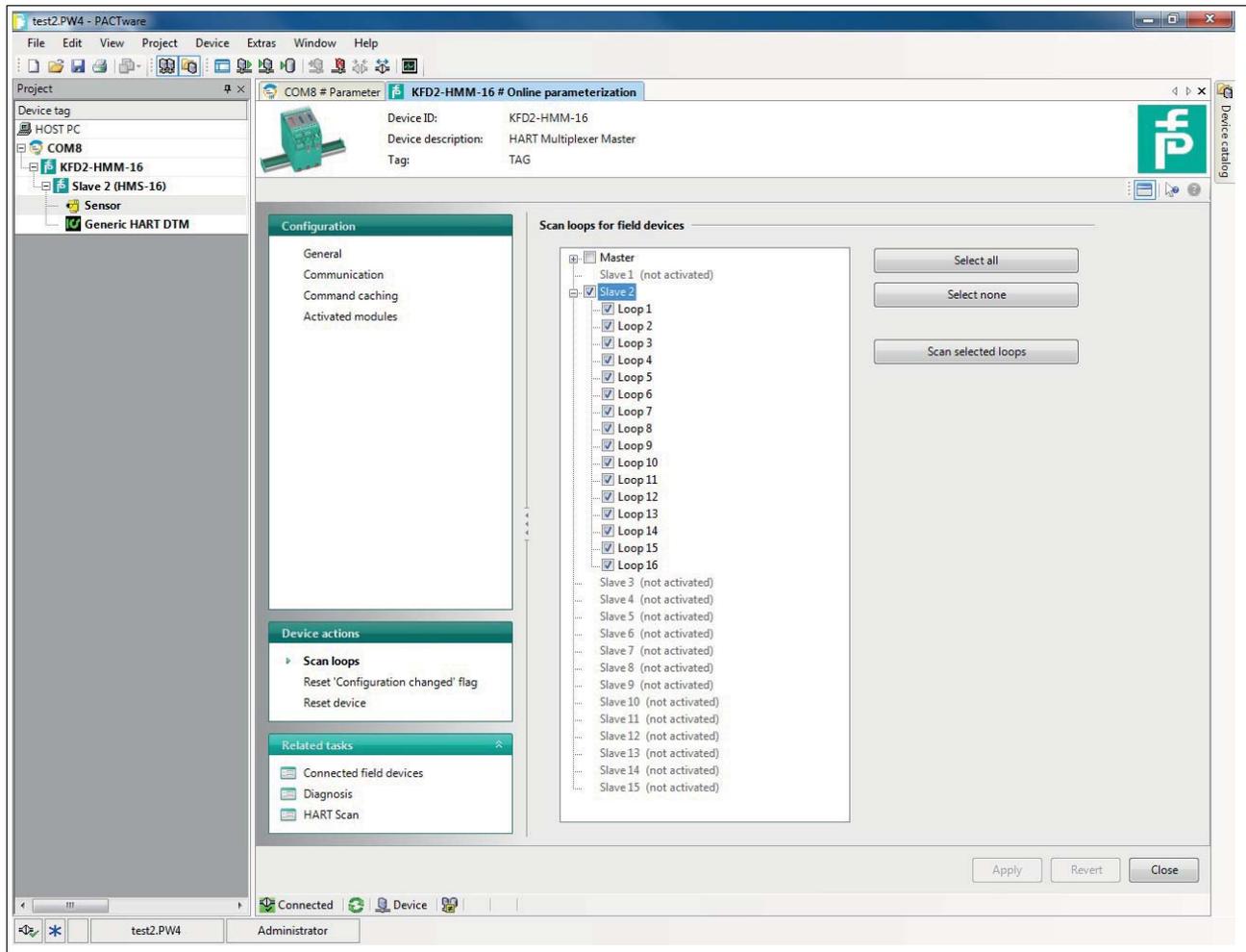


Figure 7.1 Scan loops window

## 7.2.2 Field Device List



### Selecting the Field Device List

1. Use the mouse to double-click the multiplexer master **KFD2-HMM-16** in the project window.
2. In the editing window, open the **Related tasks > Connected field devices** menu.  
↳ The **Connected field devices** window is displayed.

In the **Connected field devices** window, a table detailing information on the field devices connected to the multiplexer master is shown:

Table column	Explanation
Modules	Module to which the field device is connected
Loop	Signal loop in which the field device is connected
Polling address	Polling address of the field device
Unique ID	Unique, unchanging address of the field device
Device type	Device type
Manufacturer	Manufacturer of the field device
HART revision	HART revision under which the field device is operated
Long tag	Long device tag of the field device
Tag	Tag for identification of the field device
Descriptor	Description for the field device
Date	Date of the last change to the identification information
Message	Any user-created message/comment

Table 7.1 Explanation of the field device list

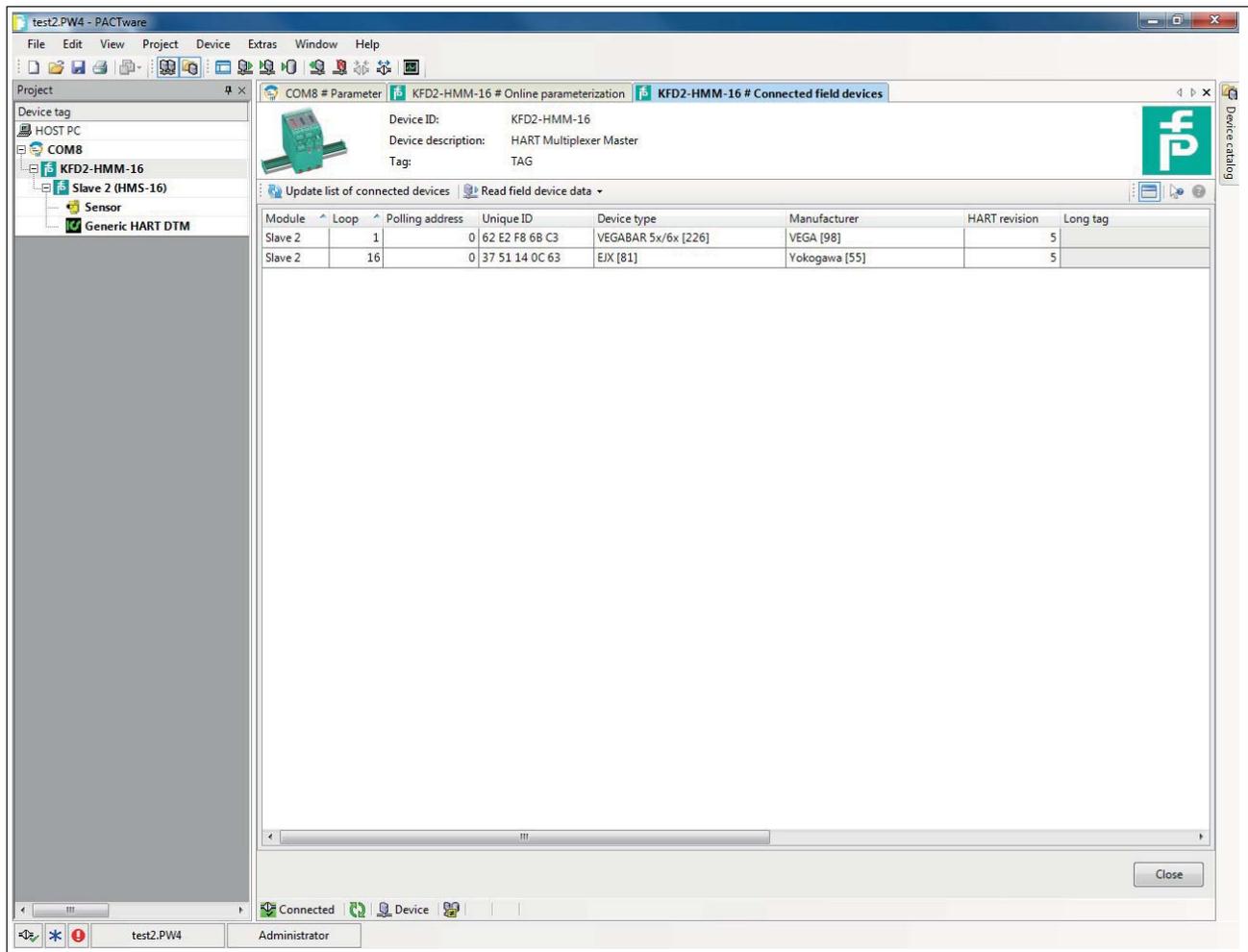


Figure 7.2 Connected field devices window

### 7.2.3 Device Diagnosis



#### Selecting a Diagnosis

1. Use the mouse to double-click the multiplexer master **KFD2-HMM-16** in the project window.
2. In the editing window, open the **Related tasks > Diagnosis** menu.
  - ↳ The **Diagnosis** window is displayed.

In the **Diagnosis** window, detailed diagnostic information regarding the multiplexer master and the field devices connected to it can be retrieved.

In the **System overview** section, the device tree is displayed on the left-hand side with the connected devices. Click on a device to select it.

The right-hand section displays device-specific, detailed diagnostic information.

Select the **Update diagnosis** button above the **System overview** section to update the diagnostic information.



#### Note!

For a precise explanation of the diagnostic information, see chapter 7.3.

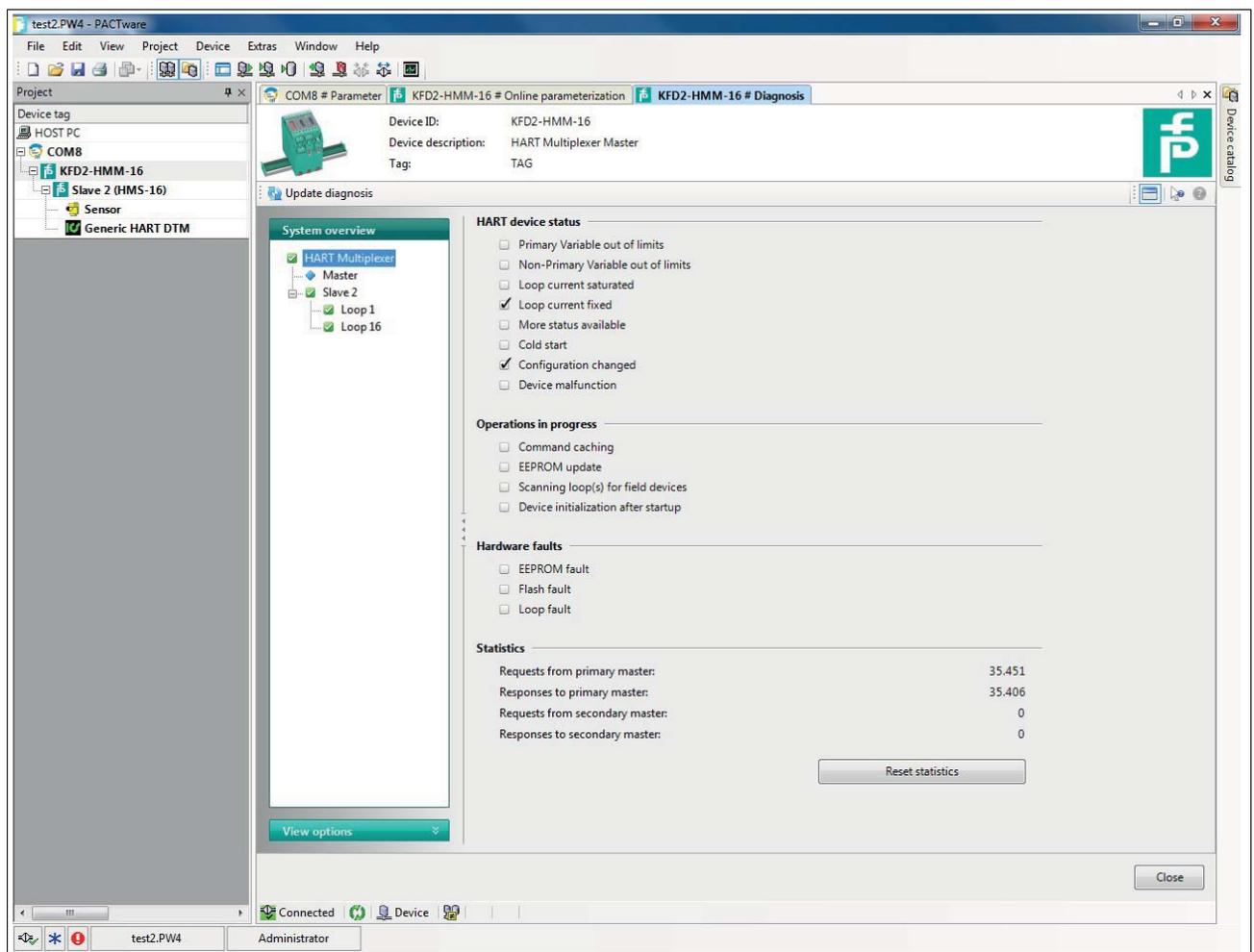


Figure 7.3 Diagnosis window

## 7.2.4 Resetting the Configuration Flag



### Resetting the Configuration Flag

1. Use the mouse to double-click the multiplexer master **KFD2-HMM-16** in the project window.
2. In the editing window, open the **Device actions > Reset "Configuration changed" flag** menu.
  - ↳ The **Reset "Configuration changed" flag** window is displayed.

The **"Configuration changed"** flag is a flag of the standard HART device status. It is always set when a parameter has been changed in the configuration of the device.

In the **Reset "Configuration changed" flag** window, you can reset the **"Configuration changed"** flag. To do this, select the **Reset "Configuration changed" flag** button.

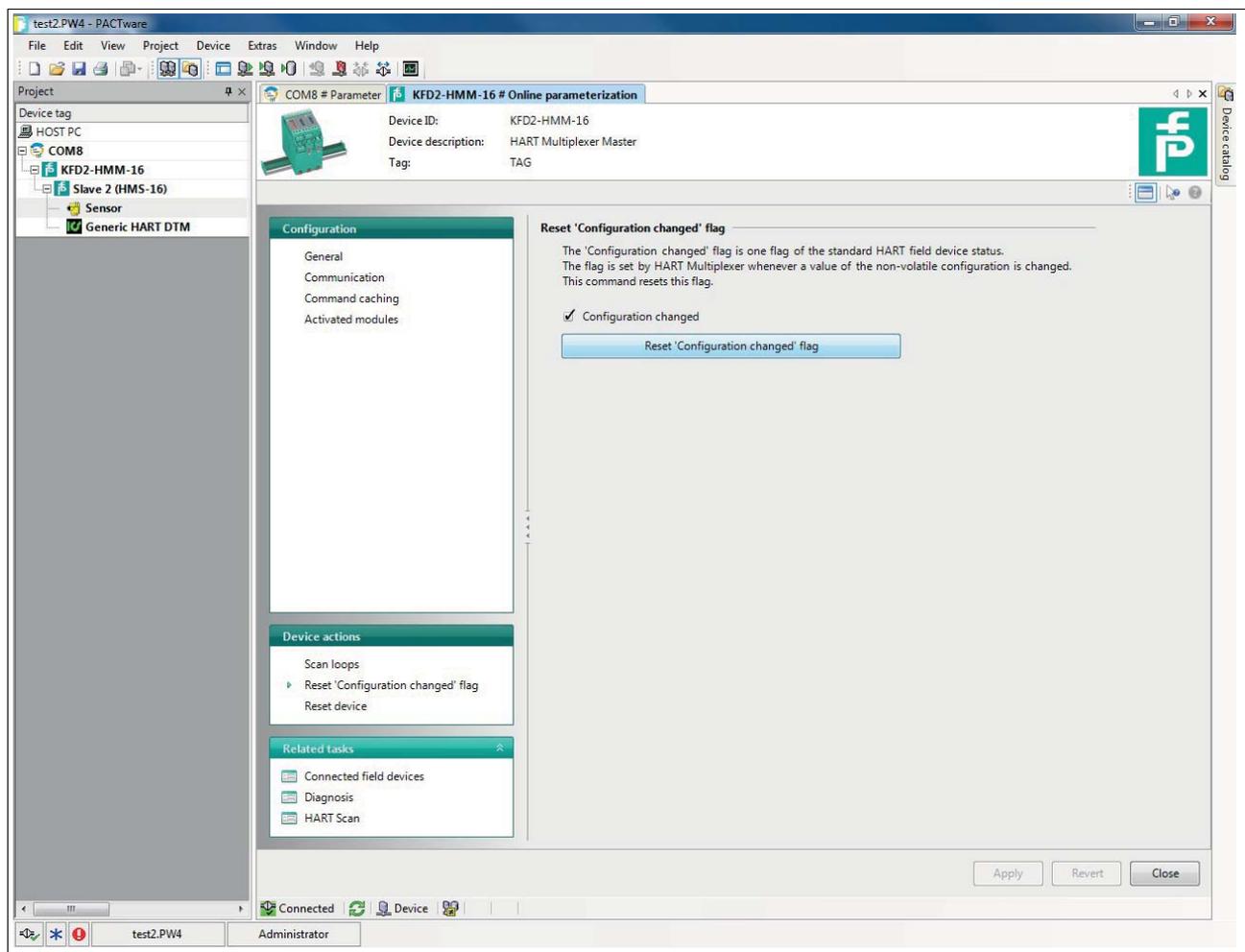


Figure 7.4 Reset "Configuration changed" flag window

## 7.2.5 Resetting the Device



### Resetting the Device

1. Use the mouse to double-click the multiplexer master **KFD2-HMM-16** in the project window.
2. In the editing window, open the **Device actions > Reset device** menu.
  - ↳ The **Reset device** window is displayed.

In the **Reset device** window, you can reset the multiplexer master. To do so, select the **Reset device** button.



#### Note!

Please ensure that the multiplexer master restarts after the reset. During the reset, communication to all connected field devices is initially interrupted. After the restart, all signal loops are scanned for any existing HART-compatible field devices. During this time, no communication with the field devices is possible.

For further information about the scanning process, see chapter 5.2.4 and 7.1.5.

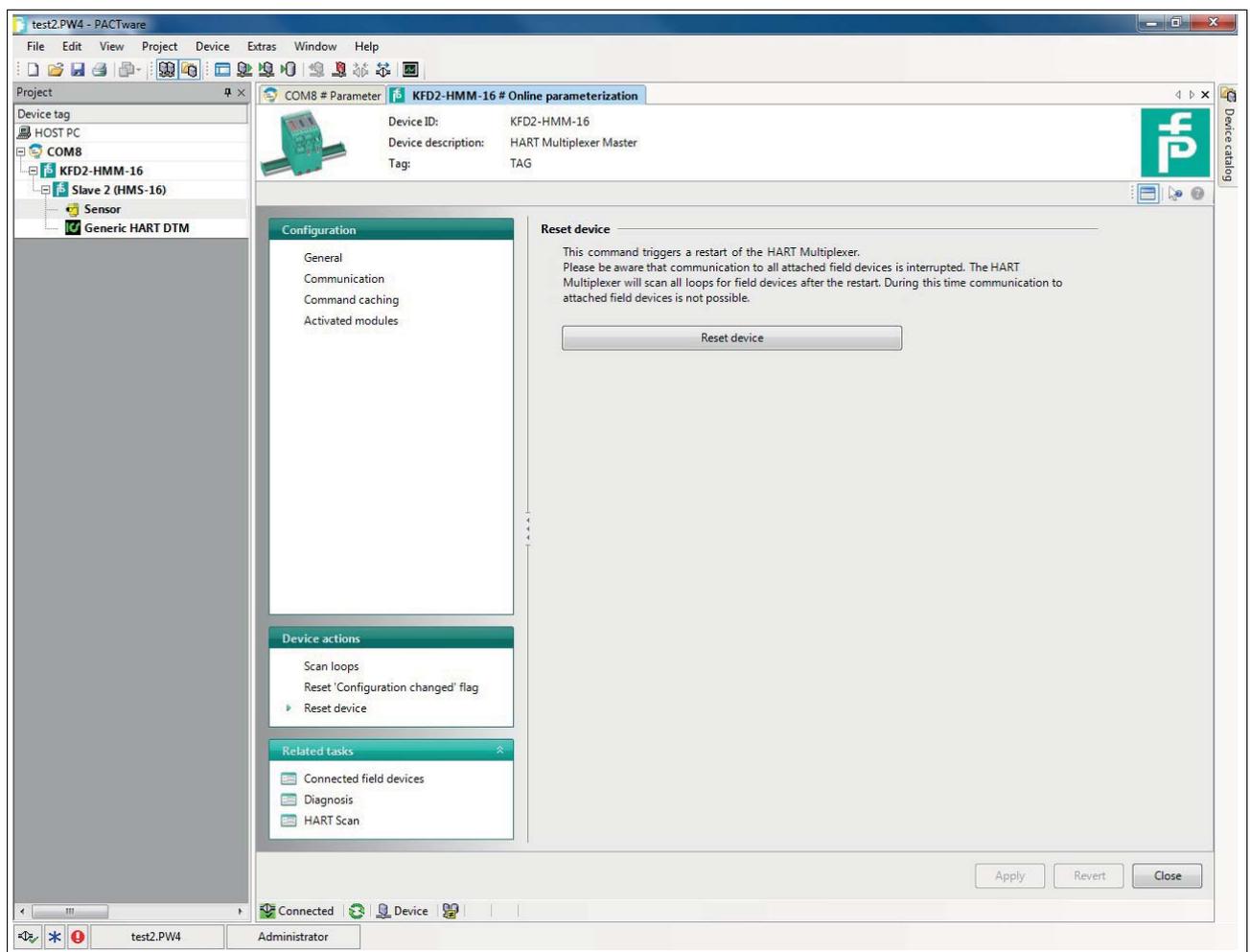


Figure 7.5 Reset device window

## 7.3 Diagnosis and Troubleshooting

This chapter provides operating instructions to be used if faults occur and describes the possible causes of such faults. Faults and failures are reported via the following means:

- LED indication, see chapter 7.3.1
- Status/response code, see chapter 7.3.2
- Extended device status, see chapter 7.3.3

### 7.3.1 LED Indication

After you have switched the device on, the following fault states can occur during the initialization process:

Red	Green	Orange	Cause	Corrective action
Off	Off	Off	<ul style="list-style-type: none"> <li>• No power supply present.</li> <li>• LED(s) faulty.</li> </ul>	<ul style="list-style-type: none"> <li>• Check the power supply.</li> <li>• Switch on DIP switch 1, briefly disconnect the power supply. LEDs flash one after the other.</li> </ul>
On	On	On	Device hardware fault (CPU, ROM)	Send the device to Pepperl+Fuchs for repair.
On	Off	Off	Device hardware fault (CPU, ROM)	Send the device to Pepperl+Fuchs for repair.
On	On	Off	<ul style="list-style-type: none"> <li>• Device hardware fault (CPU, ROM)</li> <li>• Device parameterization (command 161) faulty.</li> </ul>	<ul style="list-style-type: none"> <li>• Send the device to Pepperl+Fuchs for repair.</li> <li>• Parameterize the device again. If this is not successful, the device must be sent to Pepperl+Fuchs for repair.</li> </ul>

Table 7.2

### 7.3.2 Status/Response Code

Two status bytes, known as the **Response code**, are included in each field device message. These include three types of information:

- Communication faults
- Command responses
- Device status

Dependent on bit 7, the first two types are contained in the first byte of the status. The device status is always transferred in the second byte.

#### Structure of the First Byte (Communication Fault)

If bit 7 is set (1), the first status byte contains a summary of communication faults. This information is coded bit by bit.

If bit 7 is deleted (0), the first status byte contains a summary of command responses. This information is numbered and not coded bit by bit.

#### Communication Faults

The byte contains information concerning the receipt of a message. The individual bits indicate a detected fault, which has resulted in the message not being accepted. It is therefore not possible to provide a response to the message. This problem can only be avoided by:

- Repeating the command,
- Checking the connection,
- Using terminators, or
- Reducing the baud rate.

Bit								Meaning
7	6	5	4	3	2	1	0	
1								Communication fault, if bit 7 = 1, coded bit by bit
1	1							Parity fault
1		1						Overflow fault
1			1					Message fault
1				1				Checksum fault
1					0			Always 0 (reserved)
1						1		Receive buffer overflow
1							1	(Undefined)

Table 7.3

## Command Responses

The first byte contains information regarding the execution of a command.  
The command-specific response code documents the execution of the command.

In contrast to the communication faults, the command responses are not coded bit by bit and are instead numbered from 0 to 127.

For command responses reported by multiplexer devices, two instances are warnings (codes 8 and 31). In these cases the processing of the command is continued. In other cases, there are faults indicating that the initiating command could not be correctly executed. The meaning of the codes is explained in the following table.

Code	Designation	Meaning	Can occur in the case of a command
2	Invalid selection	Invalid selection: The selected code/index is not permitted.	147, 149, 151, 153
3	Passed parameter too large	The parameter value was too large.	59, 129, 155
4	Passed parameter too small	The parameter value was too small.	59
5	Too few data bytes received	The message has no faults but contains fewer bytes than expected for the execution of the command.	17, 18, 59, 129 to 141, 145, 147, 149, 151, 153, 154, 155, 157
8	Warning	Here (132): Preamble length is not within the range of 5 to 20 and has been set to 5 or 20	132
9	1st parameter too large	The first of the two parameters is too large.	145
11	2nd parameter too large	The second of the two parameters is too large.	145
16	Access restricted	The command was ignored because the current state of the device does not permit the correct execution of the command.	6, 17, 18, 38, 41, 42, 48, 59, 106, 128 to 157
17	Too many items requested	Too many items have been requested.	131, 132, 133, 135 to 141, 154
31	Warning	Here (137): Scan value has not been changed as it is identical.	137
32	Busy	The device is executing a function that cannot be interrupted by this command.	6, 17, 18, 38, 41, 42, 59, 106, 128, 130 to 157
64	Command not implemented	Command does not exist and therefore cannot be executed. This fault message is also output if an fault occurs that cannot be specified more precisely by the device.	Almost all
65	Not specified	Parameter is not within the permissible range.	132, 137

Table 7.4



**Note!**

Additional information can be found in /1/, see chapter 9.3.

### Structure of the Second Byte (Device Status)

If a communication fault is reported in the first byte (bit 7 = 1), the second byte described here has no significance (always 0). Otherwise it contains the overall status of the field device, i. e., regardless of the commands. The individual bits have the following meanings:

Bit	Designation	Meaning	Action
7	Malfunction of the field device	Hardware fault. The extended device status may provide further information, see chapter 7.3.3.	<ul style="list-style-type: none"> <li>• Read extended device status, see chapter 7.3.3.</li> <li>• Check LEDs, see chapter 7.3.1.</li> <li>• Parameterize device again.</li> </ul>
6	Configuration changed.	A write command has been executed.	This bit can be deleted using command 38.
5	Switch-on process is running.	The power supply has been switched on or a reset has been triggered. Volatile data is reset to the default setting.	Wait for the switch-on process and then parameterize the device.
4	Extended device status available.	Further status messages are available and can be called up, see chapter 7.3.3.	Read extended device status, see chapter 7.3.3.
3	Analog output current cannot be changed (primary variable).	The primary variable is set to the requested value and no longer follows the process.	Always 1 Has no function on the multiplexer device as there is no analog output.
2	Analog output current has reached its limit (primary variable).	The primary variable is outside its limit values and therefore no longer corresponds to the process value.	Always 0 Has no function on the multiplexer device.
1	Variable (not the primary) outside the range.	The data detected by the sensor – not the data for the primary variable – lies outside the operating range. The extended device status may provide further information, see chapter 7.3.3.	Always 0 Has no function on the multiplexer device.
0	Primary variable outside the range.	Primary variable outside the range. The measured value detected by the sensor is outside the operating range.	Always 0 Has no function on the multiplexer device.

Table 7.5



**Note!**

Additional information can be found in /1/, see chapter 9.3.

### 7.3.3 Extended Device Status

The extended device status can be retrieved using command 48. The command provides 5 byte of information which are arranged thematically:

#### First Byte

The operation is currently in progress

The byte indicates which operation is currently running. The information is coded bit by bit. The coding is shown in the following table:

Bit	Operation in progress	Meaning
7	Reset	Switch-on operation is running and must be completed.
6	Rebuild	Rebuild operation is running and must be completed.
5	Internal EEPROM write operation	Switching off the power supply may result in the loss of parameterization.
4	Scan	Scanning process is running and must be completed.
3	Self-test (command 41)	Performs the device self-test, such as when switching on the supply voltage. If no fault occurs, the status message <b>Malfunction</b> is deleted if the message has been set.
2 to 0	Reserved	Reserved.

Table 7.6

#### Second Byte

Hardware fault

The byte indicates which operation is currently running. The information is coded bit by bit. The coding is shown in the following table:

Bit	Detected hardware fault	Meaning/remedial action
7	Signal loop	OR link of all detected hardware faults in the signal loops. Check the field devices and their cabling, then run <b>Scan loops</b> , see chapter 7.2.1.
6	ROM fault	Send the device to Pepperl+Fuchs for repair.
5	EEPROM fault	Send the device to Pepperl+Fuchs for repair.
4 to 0	Reserved	Reserved.

Table 7.7

### Third Byte

#### Scan fault

The byte indicates an OR link for all the faults detected during the scanning process.

Example: If one field device is detected as **Disappeared** and another as **Mismatched**, these two bits are set at the same time. The bit by bit coded information is shown in the following table:

Bit	Status	Meaning	Action
7	Reserved	Reserved.	
6	Searching	Field device is searched for due to the <b>Disappeared</b> report.	<ul style="list-style-type: none"> <li>• Check the cabling.</li> <li>• Check the field device.</li> </ul>
5	Disappeared	Field device is no longer responding.	
4	Appeared	Field device is responding again.	Check the cabling.
3	Mismatched	Another field device has responded instead.	Field device was replaced with another field device. Check the field device, rebuild signal loops.
2 to 0	Reserved	Reserved.	

Table 7.8



**Note!**

Additional information can be found in /1/, see chapter 9.3.

## 8 Dismounting, Maintenance, and Repair



### **Danger!**

Explosion hazard from live wiring of circuits

If you connect or disconnect energized circuits in a potentially explosive atmosphere, sparks can ignite the surrounding atmosphere.

Only connect or disconnect energized circuits in the absence of a potentially explosive atmosphere.



### **Danger!**

Danger to life from using damaged or repaired devices.

Using a defective or repaired device can compromise its function and its electrical safety.

- Do not use a damaged or polluted device.
- The device must not be repaired, changed or manipulated.
- If there is a defect, always replace the device with an original device from Pepperl+Fuchs.



### Disconnecting the Device from the Circuit

1. Disconnect the power supply.
2. Disconnect the connection to the maintenance station or the process control system.
3. Disconnect the connection to the termination board.
4. Disconnect the connection to the other devices of the HART multiplexer system.
5. Disconnect the connection to other participants.



### Disconnecting Circuits

1. Disconnect the field circuit.
2. Disconnect the control circuit.
3. Disconnect the power supply.



## Removing the Device

Use a suitable slot-head screwdriver for dismounting the device.

1. Insert the screwdriver (4) into the groove of the red mounting bracket (3).
2. Turn the screwdriver (4) in the groove until the red mounting bracket (3) springs back.
3. Repeat these steps on the other side of the device.
4. Remove the device (2) from the DIN mounting rail (1).

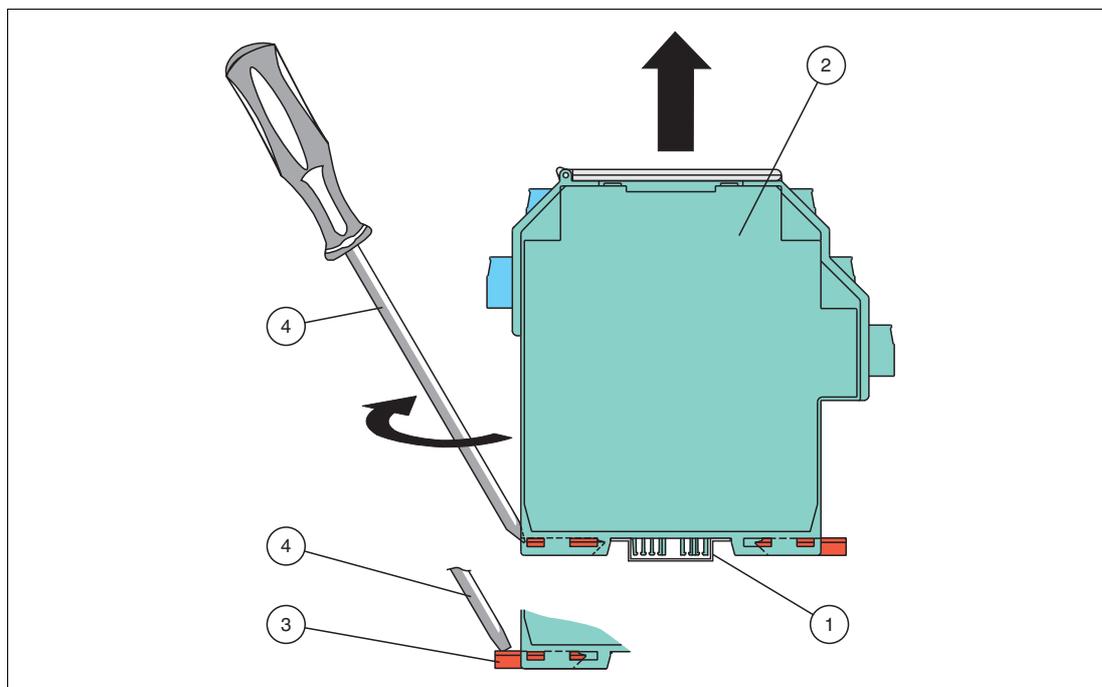


Figure 8.1 Dismounting the device from the DIN mounting rail

- 1 35 mm DIN mounting rail
- 2 Device
- 3 Mounting bracket
- 4 Slot-head screwdriver

## 9 Appendix

### 9.1 Supported HART Commands

The following tables show the HART commands supported by the HART multiplexer system. The HART commands are divided into 3 groups:

- Universal commands
- Common practice commands
- Device-specific commands



**Note!**

The universal commands and common practice commands are described in detail in /1/, see chapter 9.3. At this point, only the functions are explained, not the underlying data structures of the HART protocol.

#### 9.1.1 Universal Commands

Command	Action	Meaning
0	 Read unique device identification.	A 12 byte device identification is given in response.
1	 Read HART variables (data).	Commands are only supported by the HART multiplexer system for compatibility purposes and have no significance. However, in the field devices (e. g., scan function) they have the following meanings: <ul style="list-style-type: none"> <li>• 1: Read primary variable.</li> <li>• 2: Read primary variable as a current (mA) and percentage of the measuring range.</li> <li>• 3: Read primary variable as a current (mA) and four (pre-defined) dynamic variables.</li> </ul>
2		
3		
6	 Set polling address.	This command will not be accepted and the messages <b>Access restricted</b> or <b>Busy</b> will be returned.
11	 Read unique device identification using the tags.	A 12 byte device identification is given in response if the specified tag corresponds to the tag stored in the HART multiplexer system.
12	 Read message.	The 32-digit message is read, see also command 17.
13	 Read the tag, description, and date.	Read the 8-digit tag, the 16-digit description, and the date.
17	 Save message.	The 32-digit message is written, see also command 12.
18	 Save the tag, description, and date.	Save an 8-digit tag, a 16-digit description, and a date.

Table 9.1

### 9.1.2 Common Practice Commands

Command	Action	Meaning
38	 Reset the status <b>Configuration changed.</b>	Delete status message, see chapter 7.3.2.
41	 Perform device self-test.	Performs the device self-test, such as when switching on the power supply. If no fault occurs, the status message <b>Malfunction</b> is deleted if it has been set, see chapter 7.3.2.
42	 Perform device reset.	Immediately after the command confirmation, the device processor is reset.
48	 Read extended device status.	See chapter 7.3.3.
59	 Define the number of response preambles.	The number of preambles inserted in message responses can be set to between 2 and 20. The default setting is 4.
106	 Delete all delayed responses pending for the master.	The pending response messages are deleted. As only one response message buffer exists, the buffer is always deleted in accordance with the specification regardless of the requesting master.

Table 9.2

### 9.1.3 Device-Specific Commands

Command	Action	Meaning
128	 Read the parameters of the multiplexer device.	The current parameterization is read from the multiplexer device.
129	 Read the status of the signal loop.	This command can be used to query the status of each signal loop. The following information is provided: <ul style="list-style-type: none"> <li>Existing hardware faults</li> <li>Scan is in progress.</li> <li>Scan activated for this signal loop.</li> <li>Field device is being searched for due to the <b>Disappeared</b> designation.</li> <li>Field device is no longer responding (<b>Disappeared</b>).</li> <li>Field device responds again (<b>Appeared</b>).</li> <li>Another field device has responded instead (<b>Mismatched</b>).</li> </ul>
130	 Read field device list (maximum of 49 entries, starting with the specified index).	The extended addresses of up to 49 field devices are returned from the specified list entry.
131	 Read static data from up to 22 field devices.	For the specified extended addresses, the function returns the following field device data: <ul style="list-style-type: none"> <li>Number of the signal loop (0 to 15)</li> <li>Polling address</li> <li>Supported HART revision</li> <li>Required minimum number of preambles (5 to 20)</li> </ul>
132	 Write static data from up to 22 field devices.	Write the static data, see command 131. A preamble length outside the range of 5 to 20 is set to 5 or 20.
133	 Delete field devices from the field device list (max. 35 simultaneously).	Field devices with the specified extended address are deleted from the field device list (and the scan list).
134	 Read scan list (max. 49 entries, starting with the specified index).	The extended addresses of up to 49 field devices are returned from the specified list entry.

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Command	Action	Meaning
135	 Read dynamic data from up to 7 field devices.	For the specified extended addresses, the function returns the following data: <ul style="list-style-type: none"> <li>The specified scan command</li> <li>Extended address</li> <li>HART data</li> </ul>
136	 Read scan status of up to 31 field devices.	For the specified extended addresses, the function returns the scan status of the field device (0 = deactivated, 1 = activated).
137	 Write scan status of up to 31 field devices.	Set the scan status for the specified extended addresses (0 = deactivated, 1 = activated).
138	 Read fault overview of up to 27 field devices.	The fault overview provides an OR combination of communication faults and status bits.
139	 Delete fault overview of up to 35 field devices.	Fault overview is deleted.
140	 Read the number of command requests and command faults from up to 16 field devices.	Communication statistics on received or bad messages are returned.
141	 Delete the number of command requests and command faults from up to 16 field devices.	Communication statistics are deleted.
142	 Read all communications of the multiplexer devices.	The communication statistics concerning the multiplexer devices are returned.
143	 Delete all communications of the multiplexer devices.	The communication statistics concerning the multiplexer devices are deleted.
144	 Number of message repeats.	<ul style="list-style-type: none"> <li>Repetitions in the event of <b>Busy</b> report: 0 to 11, default setting is 0</li> <li>Repetitions in event of communication faults: 0 to 11, default setting is 2</li> </ul>
145	 Write the number of message repeats.	
146	 Read the specified scan command.	During the scan, the HART commands 1, 2, or 3 can be executed, see above.
147	 Specify scan command.	
148	 Read scan status.	This reads or specifies the status of the scan function, see chapter 7.3.3. <ul style="list-style-type: none"> <li>0: Scan function is deactivated, default setting after a device reset.</li> <li>1: Normal scan function is activated.</li> <li>2: Special scan function is activated, see command 158, 159.</li> </ul>
149	 Write scan status.	
150	 Read master type.	<ul style="list-style-type: none"> <li>1 = Primary master, default setting</li> <li>0 = Secondary master</li> </ul>
151	 Write master type.	
152	 Read loop search type.	The loop search type defines which polling address is used to search for a device that has not responded after repeated requests, (disappeared, see also command 129). <ul style="list-style-type: none"> <li>0: Single field device, 4 mA to 20 mA (single analog), only polling address 0, default setting</li> <li>1: Single field device, unknown (single unknown), first of the polling addresses 0 to 15<sup>1</sup></li> <li>2: Reserved for multidrop</li> </ul>
153	 Write loop search type.	

Command	Action	Meaning
154	 <b>Scan</b> up to 83 specified signal loops.	See chapter 7.1.5 and 7.2.1.
155	 Pass through host command to the device and response to the host.	This enables any command to be sent to a field device and its response evaluated by the multiplexer device without any changes.
156	 Read multiplexer table. (16 multiplexer devices)	Reads the specified multiplexer table, see command 157.
157	 Write multiplexer table. (16 multiplexer devices)	Determines which multiplexer devices (multiplexer master and up to 15 multiplexer slaves) are assigned (2 byte, coded bit by bit).
158	 Read special scan parameters.	The current special parameters and the field device data (if available) for the specified signal loop is provided. These include: <ul style="list-style-type: none"> <li>• Number of the signal loop</li> <li>• Fault flag (0 = OK, 1 = special scan is not active)</li> <li>• Polling address, always 0, as there is no multidrop</li> <li>• The minimum number of data bytes for the special scan</li> <li>• The scan command used</li> <li>• Extended address</li> <li>• Number of available data bytes</li> <li>• Data byte content</li> </ul>
159	 Write special scan parameters.	For the specified signal loop and the polling address (must always be 0), the minimum number of data bytes (0 to 62) and the scan command to be used can be written.
160	 Read delay period for channel change.	When changing the communication channel (0 to 255), the multiplexer can include a waiting period (0 ms to 300 ms) before HART commands are sent to the channel.
161	 Write delay period for channel change.	

Table 9.3

<sup>1</sup> The search process is 16 times longer with no field device connected, as all 16 polling addresses are checked.

## 9.2 Assignment of the 26-Pin IDC Socket with Analog HART Signals

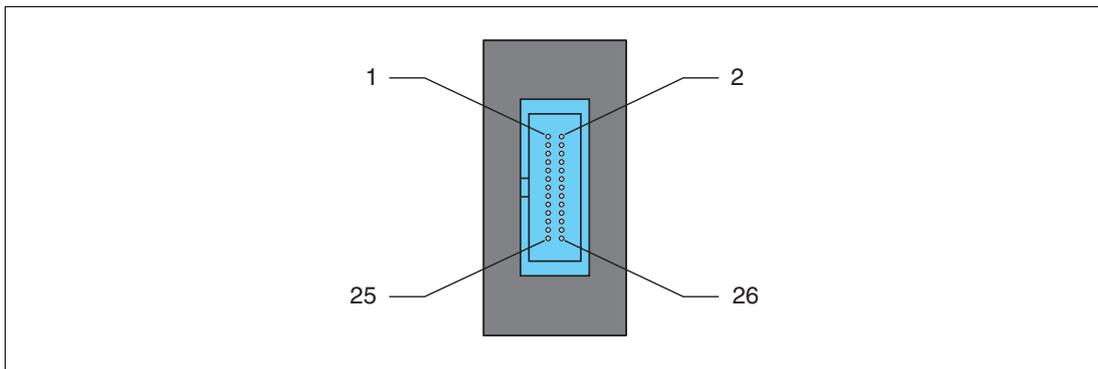


Figure 9.1

Pin	Signal	Pin	Signal
1	Analog ground	14	Analog ground
2	Analog ground	15	Analog ground
3	Analog ground	16	HART channel 9
4	Analog ground	17	HART channel 10
5	Analog ground	18	HART channel 11
6	HART channel 1	19	HART channel 12
7	HART channel 2	20	HART channel 13
8	HART channel 3	21	HART channel 14
9	HART channel 4	22	HART channel 15
10	HART channel 5	23	HART channel 16
11	HART channel 6	24	Analog ground
12	HART channel 7	25	Analog ground
13	HART channel 8	26	Analog ground

Table 9.4

### 9.3 Bibliography

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Romilly Bowden  
HART Field Communications Protocol: A Technical Overview, 2007  
Fisher-Rosemount

## 9.4 Glossary

### Address

In communication systems, an address is used to identify the device to which a message is addressed. HART uses two addressing modes: a polling address in the range 0 to 15 and the extended address consisting of 38 bit. The polling address 0 is reserved for 4 mA to 20 mA analog field devices in point-to-point connections. The polling addresses 1 to 15 are reserved for field devices in multidrop connections.

### Broadcast mode

See burst mode

### Burst mode

A communication mode in which the multiplexer master instructs field devices to continuously transmit process values – for example, the primary variable – to the multiplexer master without further instruction. The multiplexer master recognizes and supports this mode but does not put field devices in this mode itself.

### Extended address

See Address

### DTM

The DTM (DTM – **D**evice **T**ype **M**anager) contains all the data and functions of a device. Every DTM contains its own user interface optimized for the device. The device and communication DTMs can be integrated in any FDT frame application, such as **PACTware**.

The DTM offers almost no restriction with regard to display and user guidance. This means that all available device functions can be operated according to the user's needs. Operation is supported by graphics. The DTM technology enables consistent operation of a device in all FDT systems.

Pepperl+Fuchs generates DTMs for HART-compatible devices by converting the device description (DD) of these devices for use with **PACTware**.

Essentially, there are two different types of DTM:

- **Device DTMs**  
Device DTMs are DTMs for configuring field devices such as transmitter power supplies, signal converters, and trip amplifiers.
- **Communication DTMs**  
Communication DTMs are required for communication with a device via a point-to-point connection or via any network structures. The communication DTMs are available for various interfaces, such as an RS-232 interface or a USB interface.

## FDT

The FDT concept (FDT – **F**ield **D**evice **T**ool) created a standard that can be used to integrate devices in various user interfaces (framework applications such as **PACTware**). The FDT concept enables open and continuous device operation from the control level to the , regardless of the bus systems used. The FDT concept specifies the data exchange between the device-specific driver and the framework application. Every communicating device has a device-specific driver (DTM) that is integrated in the framework application.

## FSK

Abbreviation for **F**requency **S**hift **K**eyping. Method of encoding the digital information **0** or **1** with two different frequencies.

## HART

Abbreviation for **H**ighway **A**ddressable **R**emote **T**ransducer. Designation for communication according to the HART protocol. HART is a master-slave system.

## Host

Higher-level system, e. g., maintenance station, computer, or process control system.

## Polling address

See Address

## Master

A device – e. g., the control system – in a master-slave system which initiates all transmission requests and commands.

## Master-slave system

Communication system in which a master initiates all transmission requests and commands and a slave responds to the transmission requests and commands.

## Multidrop

In contrast to point-to-point connections, several (field) devices may be connected to one segment (core pair). To allow each device to be addressed individually, the device must have a unique address. As communication can only take place with one field device at a time, cycle times increase in proportion to the number of field devices. In HART multidrop operation, field devices fix their current consumption at 4 mA to enable parallel operation of up to 15 devices.

## Multi master

HART allows the connection of two masters, a primary master and a secondary master. The main station is configured as the primary master – this is generally the control system or the main control. A second station is configured as secondary master – this can be a handheld or a maintenance station. The difference between the primary and secondary masters is the priority of access, i. e., the primary master has a higher priority than the secondary master. Messages sent by the masters are characterized by a master bit so that the masters can assign the message responses to their own messages.

## PACTware™

**PACTware** (**PACTware** – **P**rocess **A**utomation **C**onfiguration **T**ool) is a manufacturer-independent operating software for devices. In the past, it was often necessary to use multiple manufacturer-specific programs to be able to operate different devices.

**PACTware** enables you to operate any number of devices with just this software. **PACTware** is not only a configuration tool, it also offers an interface to HART-compatible field devices as well as to bus systems such as PROFIBUS, MODBUS, and ControlNet. **PACTware** offers many features that allow users to simplify the plant documentation, to create trend curves, and to monitor signals using HART data.

## Point-to-point connection

In point-to-point connections, only two communication participants can be connected to one segment (core pair). A point-to-point connection is, for example, the master-slave connection of multiplexer device to field device.

## Primary variable

This variable is a process measured value of the field device. The unit differs according to the HART command (see commands 1, 2 and 3). The primary variable of a pressure transducer may be, for example, the measured process pressure in **bar**.

## Primary master

See Multi master

## Secondary variable

This variable is a further, additional process measured value of the field device. Up to 4 additional values are supported via HART. This variable can only be read using HART command 3.

## Secondary master

See Multi master

## Slave

A device in a master-slave system that receives commands from a master. A slave cannot initiate a transmission request.

## Smart field device

Intelligent, programmable field device with microprocessor and memory which is able to perform calculations, integrated diagnostics, and fault reports and can communicate with a remote control.

## Tag

Unique identifier of the C&I point (**C**ontrol and **I**nstrumentation technology) of the field device within a process plant.







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# PROCESS AUTOMATION – PROTECTING YOUR PROCESS



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