MANUAL

WHA-GW-F2D2-0-A*-Z2-ETH.EIP

WirelessHART® Gateway

WirelessHART®

PEPPERL+FUCHS

PROTECTING YOUR PROCESS

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 Safety

1.1 Introduction

1.1.1 Content of this Document

This document contains information required to use the product in the relevant phases of the product life cycle. This may include information on the following:

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

Note!

For full information on the product, refer to the further documentation on the Internet at www.pepperl-fuchs.com.

The documentation comprises the following parts:

- This document
- Datasheet

In addition, the documentation may comprise the following parts, if applicable:

- EU-type examination certificate
- EU declaration of conformity
- Attestation of conformity
- Certificates
- Control drawings
- Instruction manual
- Other documents

1.1.2 Manufacturer

Pepperl+Fuchs GmbH Lilienthalstraße 200, 68307 Mannheim, Germany
Internet: www.pepperl-fuchs.com

1.1.3 Target Group, Personnel

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

Only appropriately trained and qualified personnel may carry out mounting, installation, commissioning, operation, maintenance, and dismounting 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.

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1.1.4 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.

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2 Product Specifications

2.1 Functional Overview

The WirelessHART gateway is the interface between the WirelessHART network and the process control system. It supports WirelessHART networks with up to 250 network participants and provides an RS-485 interface as well as an Ethernet interface. Both interfaces transmit the HART or EtherNet/IP protocol. OPC connectivity can be realized via the HART OPC server. It can be configured via the device type manager (DTM) or device description (DD) in connection with a configuration software. Furthermore, it provides a web interface for direct access via a web browser.

Key Features

- Graphical network analysis
- Simple and automatic configuration options
- Ethernet and RS-485 interface
- HART protocol via both interfaces
- EtherNet/IP protocol via Ethernet interface
- Input WirelessHART wireless interface
- 24 V DC supply
- Redundant power supply connections

2.1.1 Network Management

The WirelessHART gateway contains a network manager. The network manager takes care of the wireless communication between the WirelessHART field devices. The network manager takes care of the creation and maintenance of the wireless mesh network to ensure proper communication between the WirelessHART field devices.
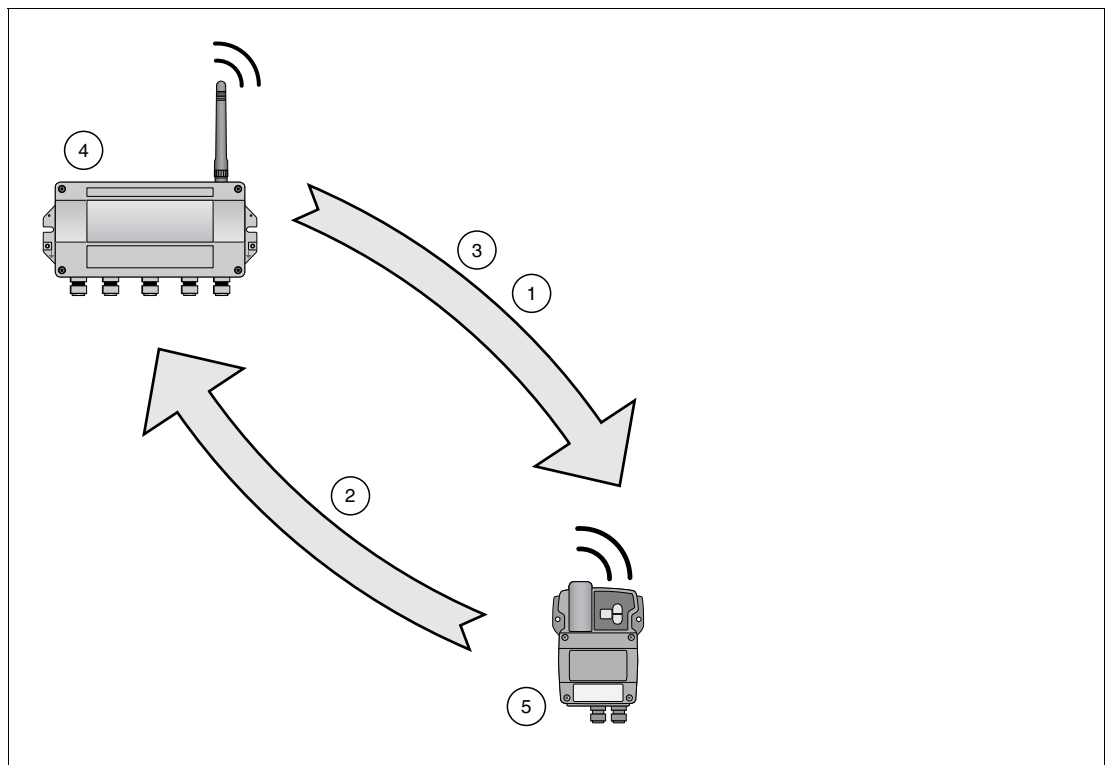

Figure 2.1   Network management

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1. Step 1: advertising

2. Step 2: joining

3. Step 3: scheduling

4. WirelessHART gateway

5. WirelessHART field device

First, the network manager sends advertising messages to announce the network's existence. When a WirelessHART field device receives such an advertising message, it tries to join the network. If the WirelessHART field device can identify itself with the same network ID and join key as stored in the WirelessHART gateway, the field device is allowed to join the network. Otherwise, the field device will be rejected.
The network manager can also instruct already joined devices to advertise on its behalf.

In the next step, the network manager sends scheduling information to the field device. The field device is told how to participate in the network and receives various information from the WirelessHART gateway:

- Number and identity of neighboring WirelessHART field devices,

- When to send messages and which channels to use,

- When to repeat messages for other WirelessHART field devices,

- The optimal communication path for messages as well as alternative communication paths in case of failure.

During this process, the field device may also apply to send messages in certain intervals and ask the network manager for the appropriate resources. The network manager then takes care that these resources are available. For example, the network manager informs other WirelessHART field devices when to repeat messages.

2.1.2 Security Management

The security manager is part of the WirelessHART gateway. To make communication safe, all messages are encrypted with industry-standard AES-128 block ciphers with symmetric keys. Therefore, messages are unreadable for external listeners.

The security manager distributes the encryption keys and changes them in certain (random) intervals, as an option.

2.1.3 Virtual Remote I/O system

The WirelessHART gateway makes wireless communication accessible to host systems capable of HART technology through the following principles.

WirelessHART devices and wired devices connected to a WirelessHART adapter are made available to host systems via a virtual HART I/O system. This I/O system contains one or multiple I/O cards. Each I/O card has up to 2 channels. To each channel, up to 6 wired field devices may be connected in multi-drop mode. → see Figure 2.2 on page 11

The WirelessHART gateway assigns a virtual I/O card to each WirelessHART device and stores card and channel values in a list. The I/O cards are assigned to the WirelessHART devices in chronological order (0 ... 249). New WirelessHART devices in the network are assigned to the next available I/O card.

WirelessHART devices are always assigned to channel 0 of an I/O card. All wired devices connected to a WirelessHART adapter are always assigned to channel 1 of the same I/O card as the adapter (multi-drop mode).

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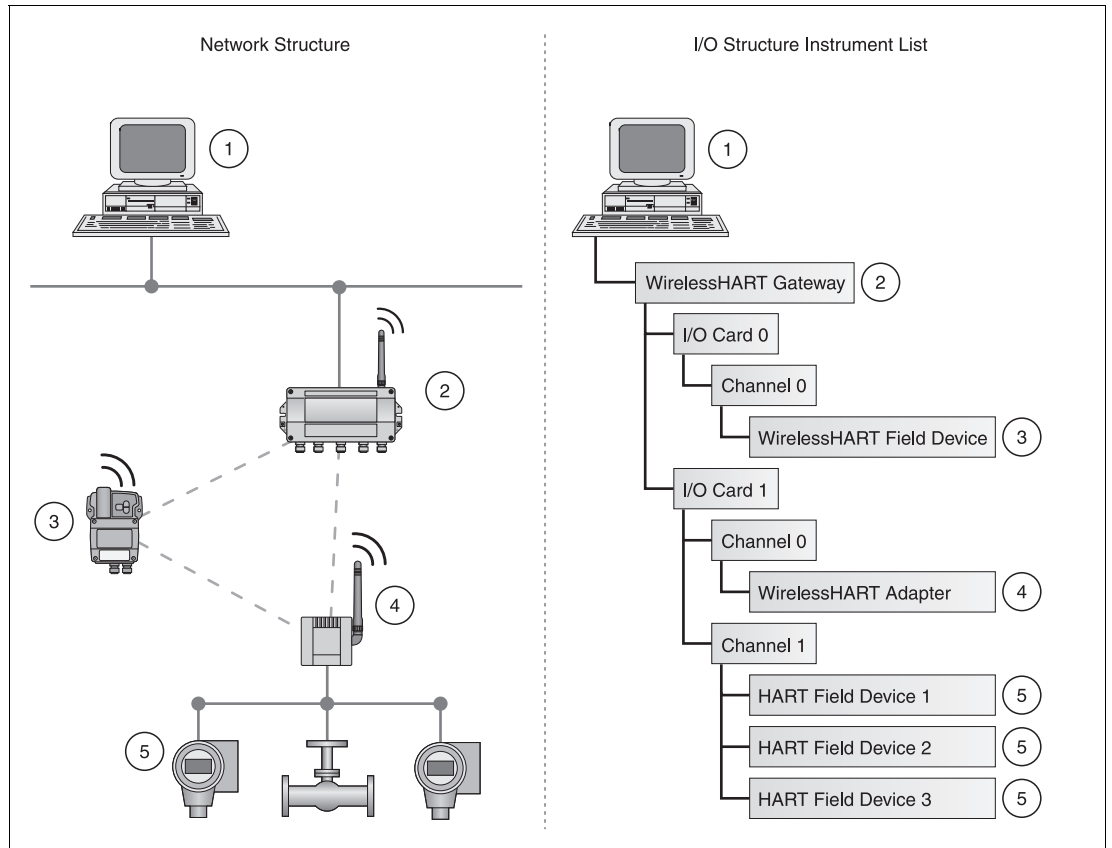
Figure 2.2   Network structure and corresponding I/O structure

1. Host application

2. WirelessHART gateway

3. WirelessHART field device (joined first): I/O card 0, channel 0

4. WirelessHART adapter (joined second): I/O card 1, channel 0

5. Wired devices 1...3 connected to WirelessHART adapter: I/O card 1, channel 1

If a WirelessHART device loses its connection to the WirelessHART gateway, it keeps its position in the list and stays assigned to the respective I/O card. If the connection to the WirelessHART gateway is re-established, the WirelessHART device has the same channel/card values that it had before.

The same principle applies to the field devices connected to the WirelessHART adapter. After communication to the WirelessHART gateway was lost, the field devices regain their previous position as soon as the connection is re-established.

Note!

This list is stored in a non-volatile memory of the WirelessHART gateway. The card and channel number assignment will remain the same after a restart of the WirelessHART gateway or software.

Long Tag Emulation

The WirelessHART communication protocol uses the long tag to address devices. However, long tags are only supported by HART 6 devices and newer devices (HART 6 = version 6 of the HART communication protocol; current version: HART 7). Older devices, for example HART 5 devices, have to be addressed by the "Message" field. If a HART 5 device is connected to the WirelessHART network using a WirelessHART adapter, the WirelessHART gateway emulates the long tag with the "Message" field.

2.1.4 Gateway Cache Management

The WirelessHART gateway caches parameters and dynamic values of the wireless and wired subdevices and makes them available to the host. Some commands are automatically cached by the WirelessHART gateway (upon read). Other commands, for example dynamic values, are only cached if the respective field device publishes them (upon publishing). See chapter 5.4.2 Burst Lists

The responses to the commands listed in the following table are cached in the WirelessHART gateway. Commands in the same row have an identical response frame and share the same cache memory. The write commands (17, 18, 22, 51) will never get an immediate answer, but their response will be cached (caching upon write-confirmation).

Information Cached by WirelessHART Gateway

Cache	Command	Description
Static configuration commands, cached upon read or upon write confirmation	0, 11, 21	Read unique identifier (associated with tag or long tag)
	12, (17)	Read (Write) Message
	13, (18)	Read (Write) Short Tag, Descriptor, Date
	20, (22)	Read (Write) Long Tag
	50, (51)	Read (Write) Dynamic Variable Assignments
Dynamic value commands, cached upon publishing only	1	Read Primary Variable
	2	Read Current and Percentage
	3	Read All Variables
	9	Read Device Variables and Status
	33	Read Device Variables
	93	Read Trend
	48	Read Additional Device Status

Status Information Caching

The WirelessHART gateway caches the device status byte separately for each wireless or wired device. The device status will be cached from any type of received message, no matter if from a wired or wireless device, or if it is a "published" or "normal" response.

The extended device status byte is cached in a similar way, but is available only for wireless devices.

2.2 Scope of Delivery

The scope of delivery comprises the following components

- Device WHA-GW-*
- Antenna W-ANT-2400-2DB-ROD (Part. No. 215520)
- 3 stopping plugs for unused cable glands
- Product documentation

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2.3 Operating Elements and Indicators

Inside the enclosure of the WirelessHART gateway there are LED indicators, DIP switches and buttons. The operating elements and indicators can be accessed when the enclosure is open.
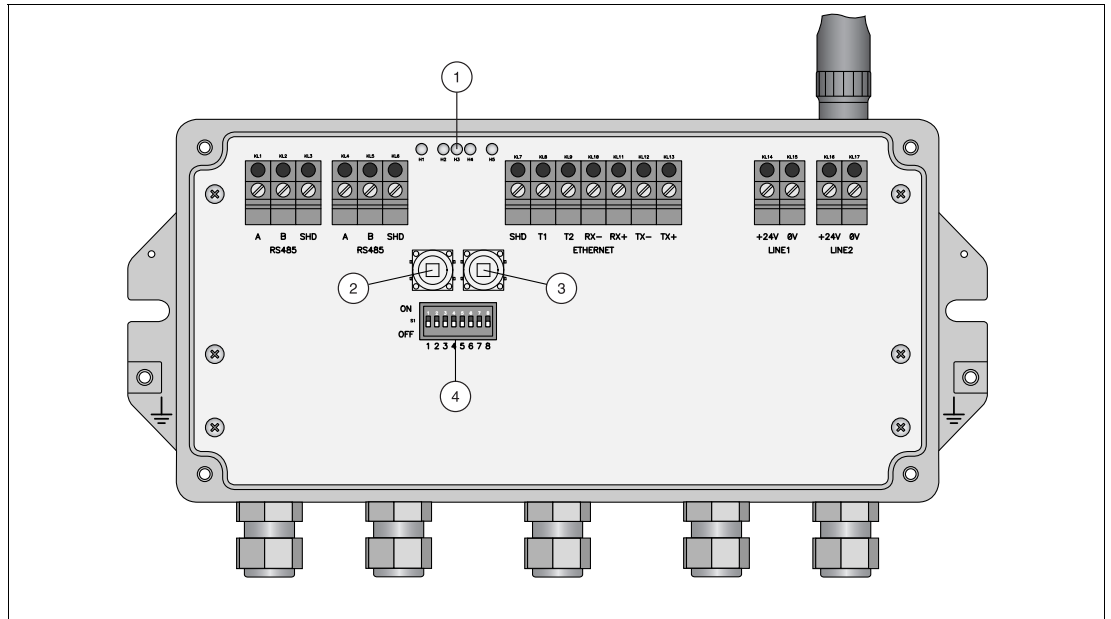

Figure 2.3   WHA-GW with open enclosure

1. LEDs
2. Button A
3. Button B
4. DIP switches

2.3.1 LEDs
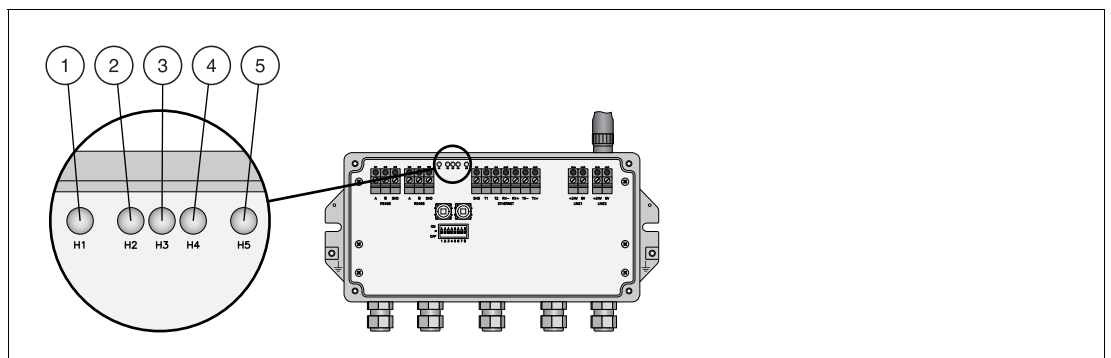
Figure 2.4   LED indicators

1. RS-485 communication status (yellow LED)
2. Power supply (green LED)
3. WirelessHART communication status (yellow LED)
4. Fault (red LED)
5. Ethernet communication status (yellow LED)

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LED Indicators

LED indicators	
RS-485 communication status (yellow LED)	
LED flashes	A message is received by the WirelessHART gateway via the serial interface. The LED does not flash if the message is not addressed to the WirelessHART gateway or if a communication error was detected within the message.
LED off	No serial communication at present.
Power supply (green LED)	
LED on	Power connected. The WirelessHART gateway ready.
LED flashes	Power connected, but the WirelessHART gateway is not yet ready to send wireless commands, for example, right after power-up or after a device reset.
LED off	Power disconnected. The LED may remain off for up to 40 seconds after connection to power (system boot-up).
WirelessHART communication status (yellow LED)	
LED flashes	A WirelessHART message is received by the WirelessHART gateway via the wireless interface (including published commands and excluding published events and notifications).
LED off	No wireless communication at present.
Fault (red LED)	
LED on	Hardware fault which makes normal operation of the WirelessHART gateway impossible.
LED flashes	Under certain conditions the LED flashes while the WirelessHART gateway application tries to eliminate the fault.
LED off	No hardware fault.
Ethernet communication status (yellow LED)	
LED flashes	A message is received by the WirelessHART gateway via the Ethernet interface. The LED does not flash if the message is not addressed to the WirelessHART gateway or if a communication error was detected within the message.
LED off	No Ethernet communication at present.

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2.3.2 Buttons and DIP Switches
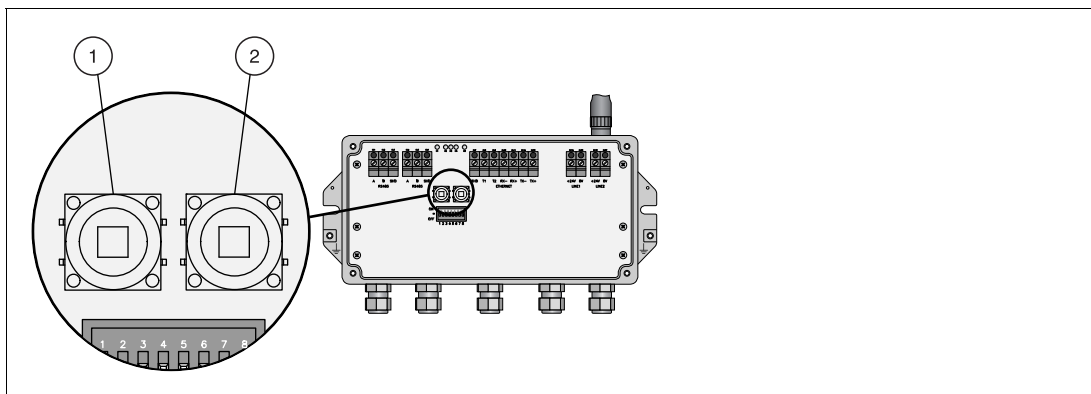
Figure 2.5   Buttons inside the enclosure of the WirelessHART gateway

1. Button A
2. Button B

Time pressed	Function
Function of button A	
> 3 seconds	**Configuration reset**: This button resets all parameters to the factory default values, except the parameters set by button B and button A + B. After 3 seconds, all LEDs light up to confirm the reset.
Function of button B	
> 3 seconds	**Communication reset**: This button resets all parameters related to the wired communication channels to the factory default values. After 3 seconds, all LEDs light up to confirm the reset.
Function of button [A + B] (security mode **disabled**)	
> 3 seconds	**Password reset**: When pressed while the Security Mode is disabled (→ see Figure 2.6 on page 16), the buttons reset the password of the web interface (HTTPS password) to the factory default value. The factory default password for the web interface (HTTPS) is "admin". After 3 seconds, all LEDs light up to confirm the reset.
Function of button [A + B] (security mode **enabled**)	
> 3 seconds	**Network manager reset**: When pressed while the Security Mode is enabled (→ see Figure 2.6 on page 16), the buttons reset the join key, network ID, radio power and access mode to the factory default values. After 3 seconds, all LEDs light up to confirm the reset.

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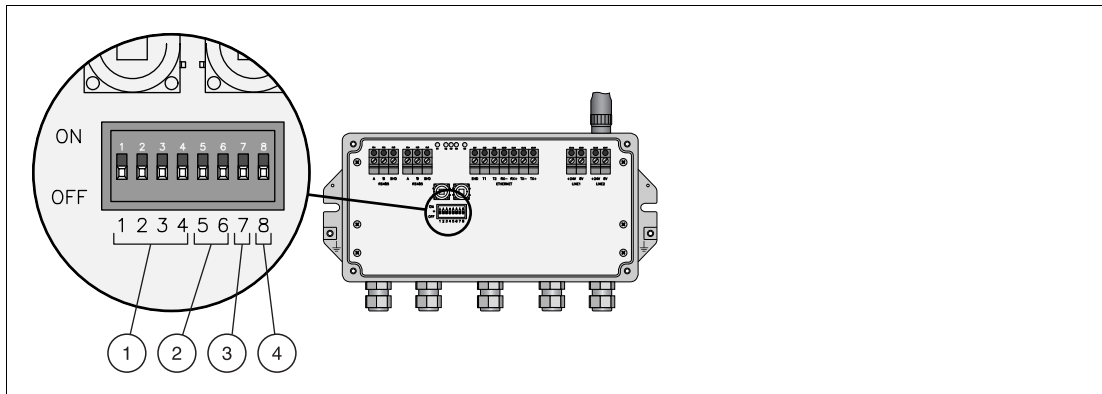
Figure 2.6   DIP switches

1   Switches 1 - 4: Polling address

2   Switches 5 - 6: Baud rate

3   Switch 7: RS-485 termination

4   Switch 8: Security mode

Note!

When using the DIP switches 1 ... 4 for setting the polling address of the WirelessHART gateway, you can set addresses ranging from 0 ... 15 only. Alternatively you can set the polling address using the configuration software. See chapter 5.3.3
If using the configuration software, you can set addresses ranging from 0 ... 63 (HART).

DIP switches 1 ... 4				
SW1	SW2	SW3	SW4	Polling address
OFF	OFF	OFF	OFF	0
ON	OFF	OFF	OFF	1
OFF	**ON**	OFF	OFF	2
ON	**ON**	OFF	OFF	3
OFF	OFF	**ON**	OFF	4
ON	OFF	**ON**	OFF	5
OFF	**ON**	**ON**	OFF	6
ON	**ON**	**ON**	OFF	7
OFF	OFF	OFF	**ON**	8
ON	OFF	OFF	**ON**	9
OFF	**ON**	OFF	**ON**	10
ON	**ON**	OFF	**ON**	11
OFF	OFF	**ON**	**ON**	12
ON	OFF	**ON**	**ON**	13
OFF	**ON**	**ON**	**ON**	14
ON	**ON**	**ON**	**ON**	15

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Note!

When using the DIP switches 5 ... 6 for setting the baud rate, this baud rate applies for the HART protocol. Alternatively you can set the baud rate using the configuration software. See chapter 5.3.3

If using the configuration software you can set individual baud rates for the HART protocol.

DIP switches 5 ... 6		
SW5	SW6	Baud rate
OFF	OFF	9600
ON	OFF	19200
OFF	**ON**	38400
ON	**ON**	57600

Note!

The security mode has to be enabled (DIP switch 8) to change the join key using the DTM or web interface or to reset the join key and network ID using the buttons inside the enclosure of the WirelessHART gateway.

Caution!

Network security risk

Do not to use the security mode connection as a normal communication channel.
After the join key has been changed, disable the security mode (DIP switch 8 = OFF).

DIP switches 7 + 8			
SW7	RS-485 termination	SW8	Security mode
ON	Connected	**ON**	Enabled
OFF	Disconnected	OFF	Disabled

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3 Installation

3.1 Mounting Considerations

3.1.1 Positioning the WirelessHART Gateway

Install the WirelessHART gateway first, before installing other WirelessHART devices. This way you can check for proper operation of new devices as they are installed. Nevertheless, consider the location of future WirelessHART devices that will be routed through the WirelessHART gateway to ensure good connectivity.

Guidelines for Planning a WirelessHART Network

- A line-of-sight between communication partners always is desirable. If a line-of-sight is not possible, the obstacles should not be massive and the partners should be more to the edge of an obstacle to allow the wave to "bend" around it (diffraction effect).

- Consider moving objects that could affect the device's antenna range.

- Install wireless devices at least 1 m above the ground.

- Make sure that the device's antenna is aligned vertically for best results.

- Make sure that a minimum of 2 other WirelessHART devices are well within the antenna range of the device.

- Do not position WirelessHART devices directly below or above each other. They would be outside each other's antenna range.

- Install WirelessHART devices at least 1 m away from each other.

- Antennas must be at least 6 cm away from any wall or any metallic material running parallel to it.

- Position the device as far away as possible from metal surfaces or walls containing metal. There should be as little metal close to the device as possible.

- Do not position other 2.4 GHz devices like cordless phone bases or WLAN routers near WirelessHART devices. Keep in mind other wireless networks using the same frequency spectrum (WLAN, Bluetooth, etc.). Wireless technologies used in an industrial environment must be able to coexist without disrupting each other. If multiple networks operate in one plant, a frequency management should be applied as part of administration.

If it is not possible to mount the WirelessHART gateway outdoors, you can also connect a remote antenna to the WirelessHART gateway and mount the remote antenna outdoors.

3.1.2 Antenna Characteristics

The included antenna W-ANT-2400-2DB-ROD (Part. No. 215520) is an omnidirectional dipole antenna. If you point the antenna upwards, the signal radiates horizontally with an angle of approx. 45 degrees above and below the horizontal (donut shaped). Almost no signal will be radiated directly above and below the antenna. Consider this when planning a WirelessHART network. The height differences between wireless devices in a network should not be too big.

This is valid only for an antenna, which is placed outdoors with no metal surfaces in immediate vicinity. The radiation pattern changes significantly when metal surfaces are close to the antenna.

The following diagrams show the antenna gain in two different planes.

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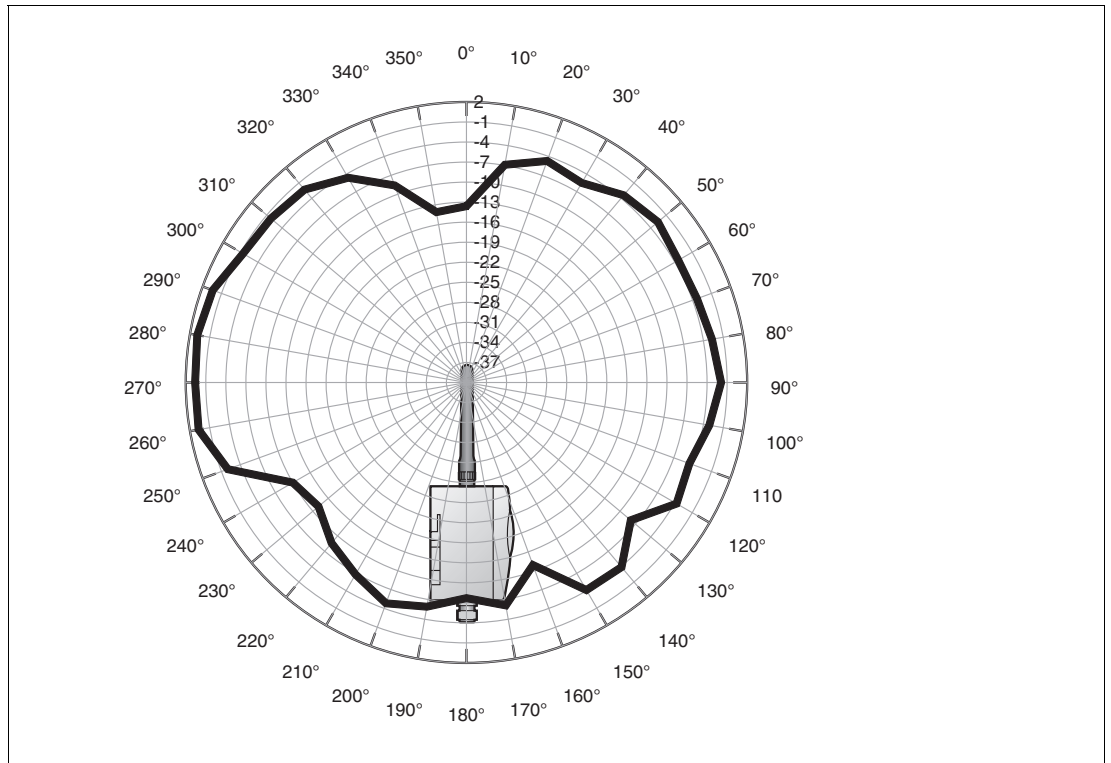
Figure 3.1   Antenna gain (side view, 2450 MHz, dBi)
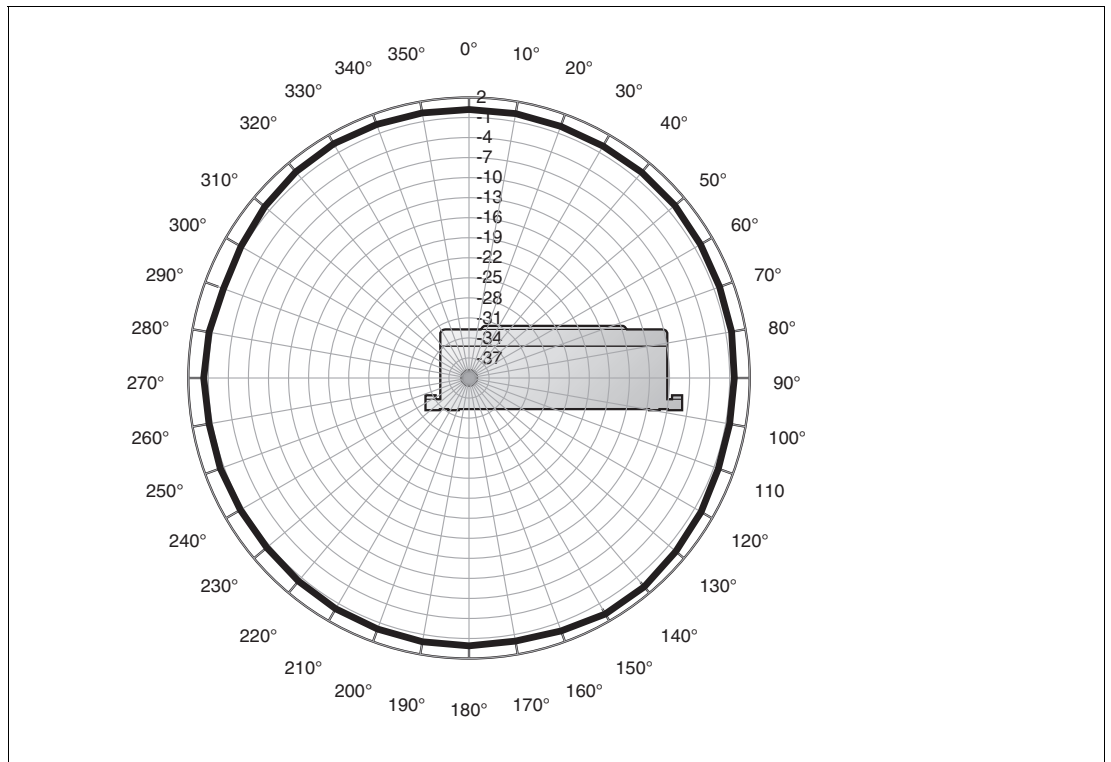
Figure 3.2   Antenna gain (top view, 2450 MHz, dBi)

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3.1.3 Examples for Good and Poor Positioning

Figure 3.3   Wave propagation, schematic representation (alpha = approx. 45°, may vary considerably)

1   Weaker signal above and below; almost no signal directly above and below

2   Stronger signal sideways

Figure 3.4   Good positioning: Devices are within each other's antenna range

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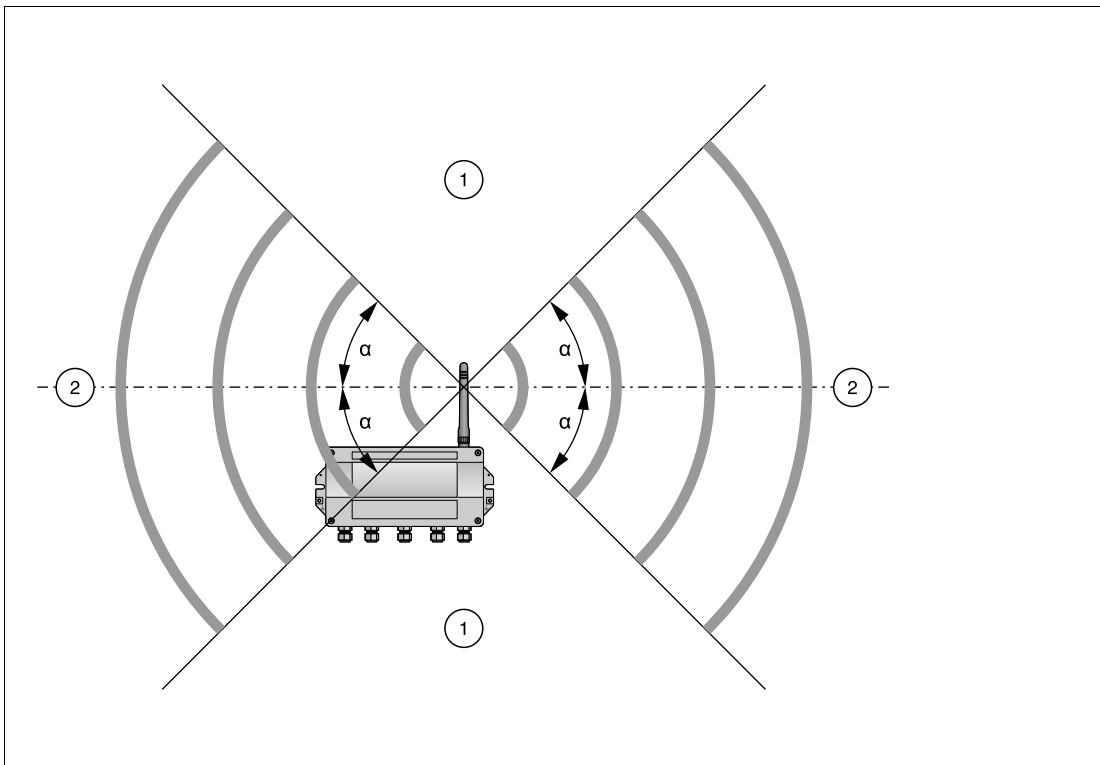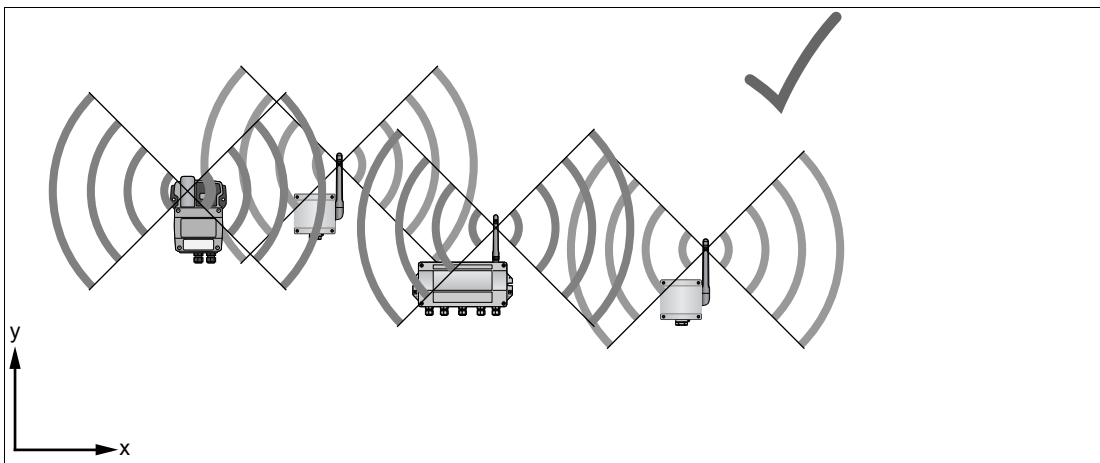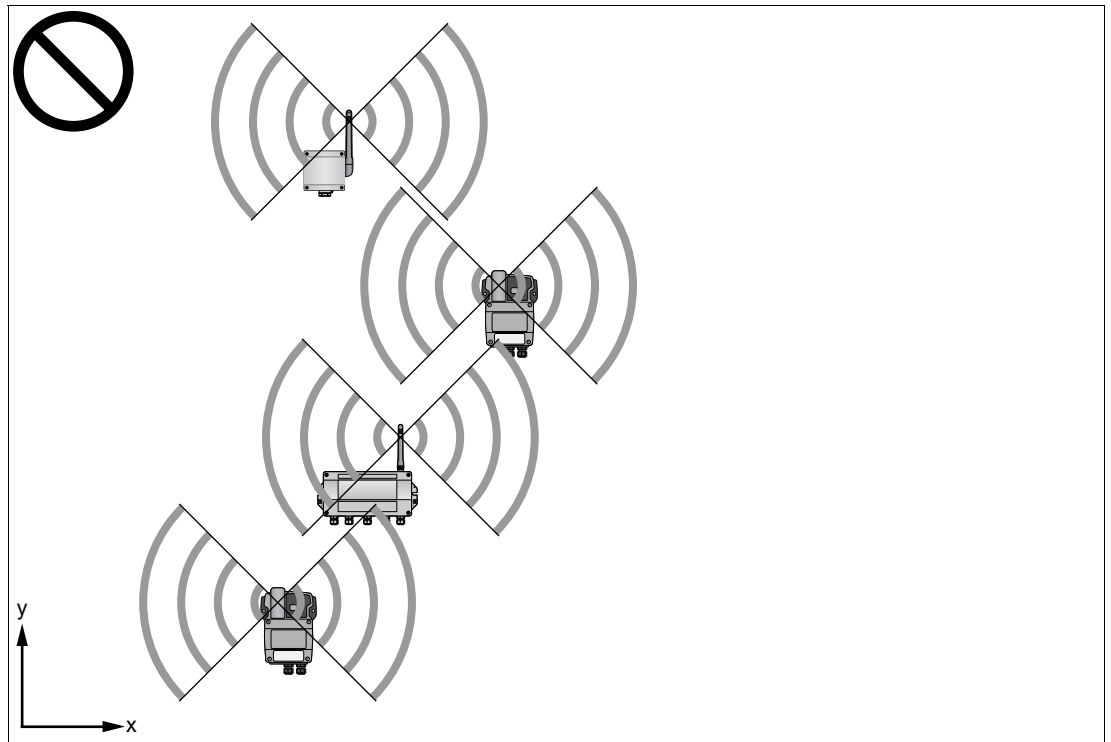Figure 3.5   Poor positioning: Devices are not within each other's antenna range

3.2   Installing the Antenna

Danger!

Explosion hazard from connection or disconnection activities

Connection and disconnection of cables or antennas may cause a spark that can ignite a potentially explosive atmosphere.

Connect or disconnect cables or antennas only in the absence of a potentially explosive atmosphere.

Note!

Avoid radio wave deflections

In order to ensure full functionality of the device antenna, the antenna must have a minimum distance of 20 cm from any surrounding personnel or items when the device is in operation.

Connecting the Standard Antenna (W-ANT-2400-2-ROD)

Firmly screw the antenna to the antenna terminal of the WirelessHART gateway.

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3.3 Installing a Remote Antenna

If the WirelessHART gateway is mounted indoors, or if there are many metal obstacles in the immediate surroundings, you can also connect a remote antenna to the WirelessHART gateway. Note that the use of a different antenna or the use of an antenna with a different antenna gain is subject to legal restrictions.
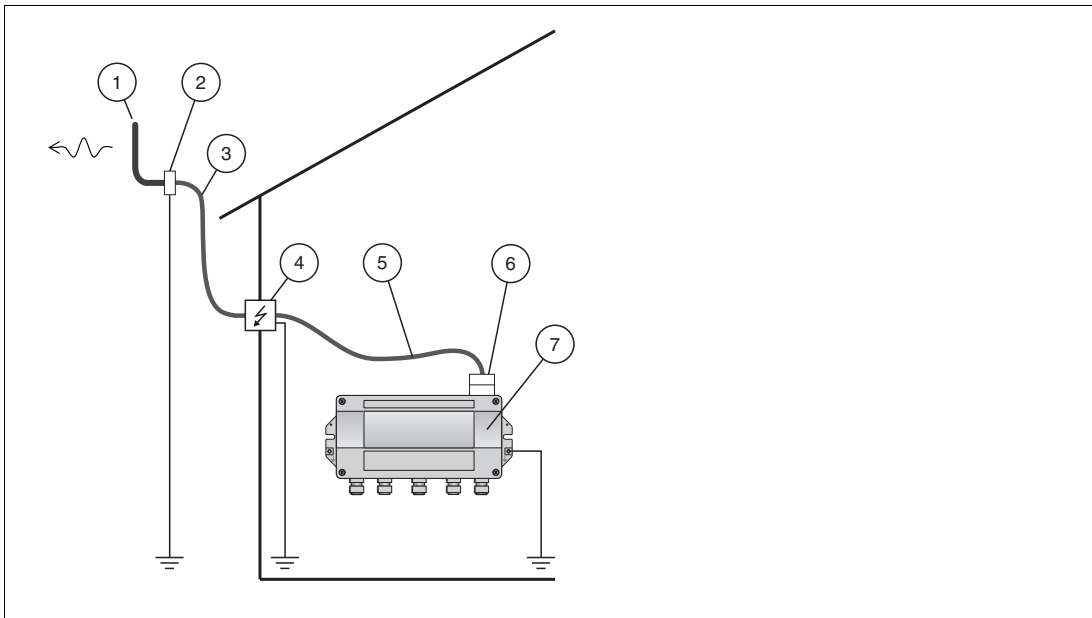
Installation Diagram

Figure 3.6   Installation diagram

1. External antenna (omnidirectional or directional antenna)
2. Coaxial adapter
3. Coaxial cable
4. λ/4 surge protector
5. Coaxial cable
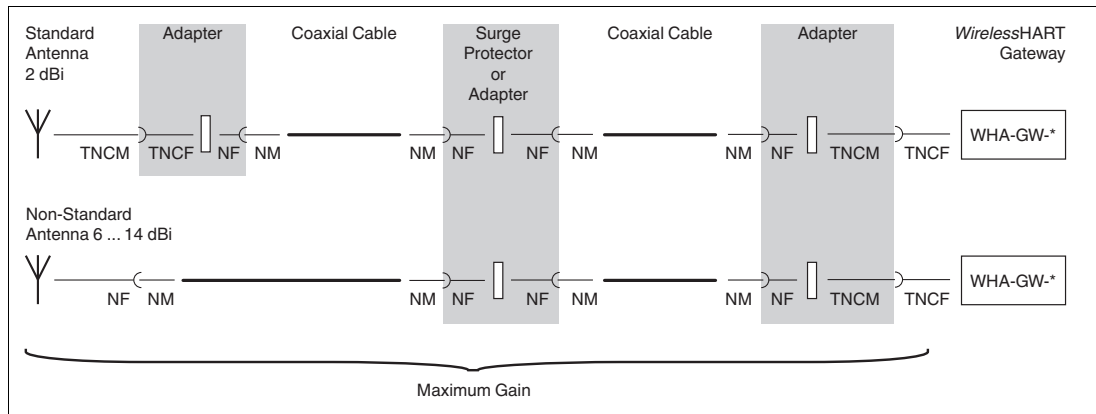6. Coaxial adapter
7. WirelessHART gateway

Connection Diagram

Figure 3.7   Connection diagram for standard and non-standard antennas

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Installation Examples

Antenna	WirelessHART gateway radio power [1]	Cable configurations for coaxial cable W-ACC-CA-NM-NM-*	
		EU	**US & Canada**
W-ANT-2400-2-ROD Omnidirectional rod antenna 2 dBi	10 dBm	■ 1 m ■ 1 m + 1 m ■ 2 m	■ 1 m ■ 1 m + 1 m ■ 2 m
W-ANT-2400-6dB-ROD-NF Omnidirectional rod antenna 6 dBi	10 dBm	■ 2 m + 2 m ■ 5 m ■ 5 m + 1 m ■ 5 m + 2 m	The use of alternative antennas is not allowed.
W-ANT-2400-8dB-PAN-NF Directional panel antenna 8.5 dBi	10 dBm	■ 5 m + 2 m ■ 5 m + 5 m ■ 10 m	The use of alternative antennas is not allowed.
W-ANT-2400-14dB-PAN-NF Directional panel antenna 14 dBi	10 dBm	■ 5 m + 10 m	The use of alternative antennas is not allowed.
	0 dBm	■ 1 m ■ 1 m + 1 m ■ 2 m ■ 2 m + 1 m ■ 2 m + 2 m	

[1] The power level of the WirelessHART gateway can be configured using the **Wireless Communication Parameters**. See chapter 5.2

Danger!

Explosion hazard or loss of radio approval through unsuitable accessories

The use of unsuitable or unapproved accessories may void the Ex certification or radio approval of the device and present an explosion hazard or violate the national radio regulations.

Only use suitable, certified remote antennas and accessories that are listed in the installation examples or that respect the limits mentioned below. If in doubt, consult your national regulations expert.

Remote antennas and accessories must respect the following limits:

■ Antenna must comply with the laws for usage of 2400 MHz equipment of the country of installation.

■ Radio frequency ≤ 50 µJ

■ Radio frequency power ≤ 2 W

■ Antenna gain ≤ 20 dBi
Furthermore, the allowed antenna gain depends on the laws for usage of 2400 MHz equipment of the country of installation.

■ Maximum gain for EU ≤ 4 dBi
Maximum gain for US & Canada ≤ 2 dBi
The maximum gain consists of the antenna gain minus the loss of all other components, such as, cables, adapters, etc.

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STOP

Danger!

Danger to life from electric shock through transients and lightning in outdoor installations

Outdoor installations can be subject to lightning.

- Install a surge protector to protect the installation against transients or damage caused by lightning.

- Refrain from installation and maintenance activities during thunderstorms.

STOP

Danger!

Explosion hazard from connection or disconnection activities

Connection and disconnection of cables or antennas may cause a spark that can ignite a potentially explosive atmosphere.

Connect or disconnect cables or antennas only in the absence of a potentially explosive atmosphere.

Caution!

Property damage through wrong installation

Wrong installation may impair the function of the WirelessHART network or cause damage to the WirelessHART gateway.

Ensure that only trained and qualified personnel carry out mounting and installation of the remote antenna and the related accessories such as cables, surge protectors, and adapters.

Connecting a Remote Antenna

1. Select an installation example that meets the legal requirements and restrictions of the country of installation. See table "Installation Examples" on page 23

2. Install the components according to the installation diagram. → see Figure 3.6 on page 22

3. Install the surge protector according to the instructions given by the manufacturer. If possible, the surge protector should be grounded directly to keep the ground connection as short as possible. Note that only a complete protection system according to IEC 62305-1 can protect your equipment and personnel.

4. Protect outdoor connections with weatherproof sealing tape to minimize corrosion and to improve long-term durability.

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3.4 Mounting the Gateway

> **STOP**
>
> *Danger!*
>
> Explosion hazard from live wiring of non-intrinsically safe circuits
>
> If you connect or disconnect energized non-intrinsically safe circuits in a potentially explosive atmosphere, sparks can ignite the surrounding atmosphere.
>
> Only connect or disconnect energized non-intrinsically safe circuits in the absence of a potentially explosive atmosphere.

> **STOP**
>
> *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.

> **STOP**
>
> *Danger!*
>
> Danger to life from electric shock through degree of protection violation
>
> Failing to ensure the degree of protection for the enclosure according to EN 60529 can result in severe or lethal electric shock.
>
> Ensure that the enclosure meets the required degree of protection during mounting and installation activities:
> - All seals must be undamaged and correctly fitted
> - All screws of the housing/housing cover must be tightened with the appropriate torque
> - Only cables of the appropriate size must be used in the cable glands
> - All cable glands must be tightened with the appropriate torque
> - All unused cable glands must be sealed or plugged with corresponding stopping plugs

> **STOP**
>
> *Danger!*
>
> Explosion hazard from overvoltage
>
> Using accessories or devices that are not suitable for the specified overvoltage category can lead to added voltages. This can result in a voltage flashover generating sparks. The sparks can ignite the surrounding potentially explosive atmosphere.
>
> Ensure that all circuits connected to the device comply with the overvoltage category II (or better) according to IEC/EN 60664-1.

> **STOP**
>
> *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.

The mounting location should be well accessible for mounting and electrical installation. Make sure that there is enough space to open the enclosure cover and to access the terminals, switches, and cable glands. Choose a mounting location that meets the requirements of the climatic limits specified in the technical data.

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The enclosure has a degree of protection of IP65 and is designed for wall mounting (mounting accessories and tools not included). See table "Installation torque for cable glands and enclosure cover" on page 31

Required tools:

■ 2 screws (M6)

■ Drill

■ Screwdriver

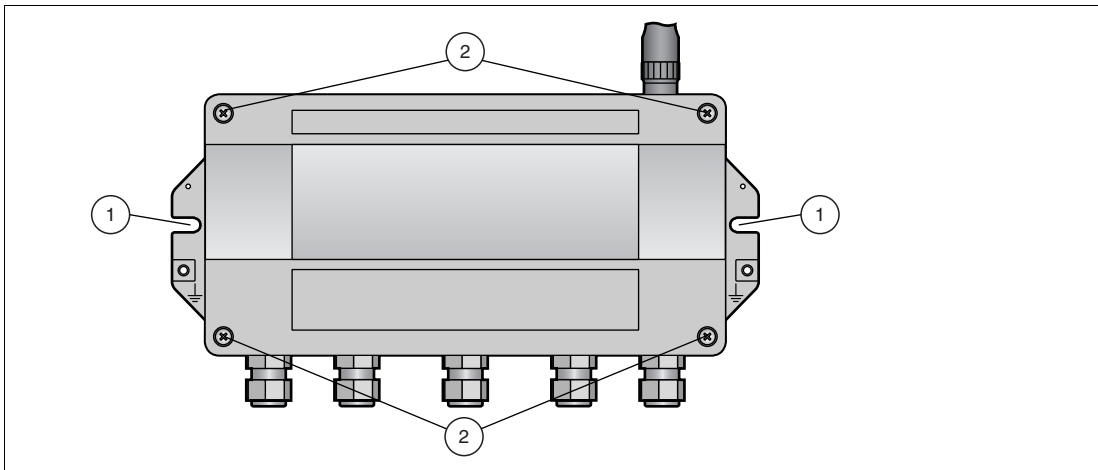Depending on the mounting surface, you may need additional mounting material.

Figure 3.8   Mounting holes and enclosure screws

1   Mounting holes for M6 screws

2   Enclosure screws

▶ Mounting the Gateway

1. Drill 2 holes into the mounting surface so that they match the holes of the enclosure.

2. Screw the device to the mounting surface using M6 screws.

3.5   Preparing Ethernet Connection

The WirelessHART gateway is equipped with a galvanically isolated Ethernet interface. Note that the maximum length of the cable running from the WirelessHART gateway to the Ethernet access point is 100 m or less, depending on the cable type and transfer rate. Ensure sufficient relief of tension on the cables during installation and note the minimum bending radii of the cables.

STOP

Danger!

Explosion hazard from connection or disconnection activities

Connection and disconnection of cables or antennas may cause a spark that can ignite a potentially explosive atmosphere.

Connect or disconnect cables or antennas only in the absence of a potentially explosive atmosphere.

▶ Wiring the Ethernet Interface

1. Unscrew the 4 screws of the enclosure cover and remove the cover.

2. Route the Ethernet cable through the cable gland in the middle of the enclosure of the WirelessHART gateway. The permissible cable diameter lies between 6 ... 10 mm.

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3. Connect the Ethernet cable to the Ethernet terminal block. Depending on the Ethernet access point, use straight-through or crossover wiring.
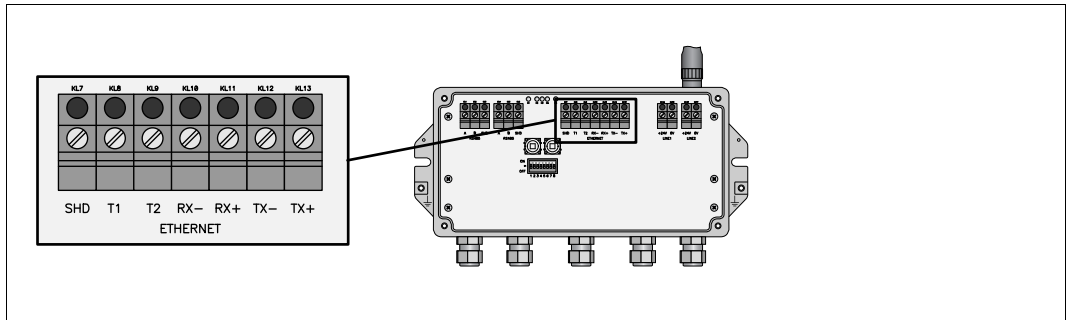

↳ The WirelessHART gateway is now connected to the Ethernet network. The yellow Ethernet communication status LED starts flashing when a correct HART or EtherNET/IP protocol message is received.

4. Tighten the cable glands with appropriate torque. See table "Installation torque for cable glands and enclosure cover" on page 31

5. Seal empty cable glands with the provided plugs.

6. Tighten the enclosure cover with appropriate torque. See table "Installation torque for cable glands and enclosure cover" on page 31

You do not need a RJ45 plug to connect the Ethernet cable to the WirelessHART gateway. However, you need a RJ45 plug at the other end of the cable to connect the cable to an Ethernet hub, switch, router, or PC.

Pinout of the RJ45 Plug

There are different standards for the RJ45 plug: **T568A** and **T568B**. The difference between both standards is that some wires are connected to different pins of the plug.
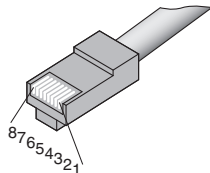
Signal	Pins	Wire color of **T568A** plug	Wire color of **T568B**plug
TX+	1	White/green stripe	White/orange stripe
TX-	2	Green	Orange
RX+	3	White/orange stripe	White/green stripe
	4	Blue	Blue
	5	White/blue stripe	White/blue stripe
RX-	6	Orange	Green
	7	White/brown stripe	White/brown stripe
	8	Brown	Brown

Straight-Through or Crossover Wiring

Depending on the network topology, use straight-through or crossover wiring to connect the WirelessHART gateway to an Ethernet access point. Note that newer Ethernet hubs, switches, and routers are able to detect whether straight-through wiring or crossover wiring has been used and adjust the pinout automatically if necessary.

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Wiring with a T568A Plug

Terminal block an WirelessHART gateway	Straight-through	Crossover
T1	Brown	Brown
	White/brown stripe	White/brown stripe
T2	Blue	Blue
	White/blue stripe	White/blue stripe
RX-	Orange	Green
RX+	White/orange stripe	White/green stripe
TX-	Green	Orange
TX+	White/green stripe	White/orange stripe
SHD	Cable shield	Cable shield

Witing with a T568B Plug

Terminal block an WirelessHART gateway	Straight-through	Crossover
T1	Brown	Brown
	White/brown stripe	White/brown stripe
T2	Blue	Blue
	White/blue stripe	White/blue stripe
RX-	Green	Orange
RX+	White/green stripe	White/orange stripe
TX-	Orange	Green
TX+	White/orange stripe	White/green stripe
SHD	Cable shield	Cable shield

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3.6 Preparing RS-485 Connection

The WirelessHART gateway is equipped with a fully galvanic isolated RS-485 interface. Note that the maximum length of the cable running from the WirelessHART gateway to the process control system is 1200 m or less, depending on the cable type and transfer rate. Use shielded twisted pair (STP) cables only. Ensure sufficient relief of tension on the cables during installation and note the minimum bending radii of the cables.

Note!

Terminator

The interface is daisy-chain capable through its duplicated RS-485 terminal block. If the RS-485 cable ends at the WirelessHART gateway and is not routed to other devices (no daisy-chain connection), activate the integrated terminator to ensure reliable RS-485 communication. The terminator can be switched on or off using the operating elements and indicators inside the enclosure (see chapter 2.3) or using the serial interface ().
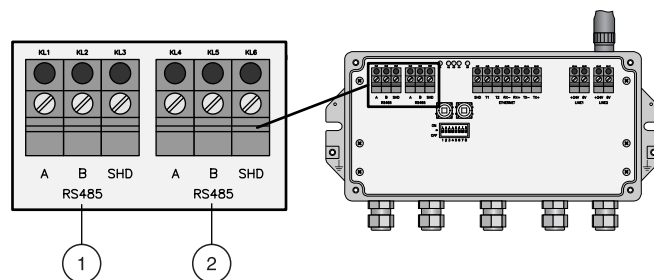

Figure 3.9   RS-485 interfaces

1. First RS-485 interface
2. Second RS-485 interface

Note!

Grounding

If the cable shield is grounded, the grounding should only be connected to one end of the cable, in order to avoid equipotential bonding currents.

Wiring the RS-485 Interfaces

1. Unscrew the 4 screws of the enclosure cover and remove the enclosure cover.
2. Route a shielded twisted pair cable through the first cable gland from the left on the bottom of the enclosure. The permissible cable diameter lies between 6 ... 10 mm.
3. Connect the shielded twisted pair cable to the first RS-485 terminal block.
4. For a daisy-chain connection, route the second shielded twisted pair cable through the second cable gland from the left on the bottom of the enclosure. Connect the second shielded twisted pair cable to the second RS-485 terminal block.
5. If the RS-485 bus ends at the WirelessHART gateway, set DIP switch number 7 to "ON" to activate the terminator.

   ↳ The WirelessHART gateway is now connected to the RS-485 network. The yellow RS-485 communication status LED starts flashing when a message is received.
6. Tighten the cable glands with appropriate torque. See table "Installation torque for cable glands and enclosure cover" on page 31
7. Seal empty cable glands with the provided plugs.
8. Tighten the enclosure cover with appropriate torque. See table "Installation torque for cable glands and enclosure cover" on page 31

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Gateway Wiring (RS-485 Connection)

Wire RS-485 cable	Terminal WHA-GW	Meaning
RxD/TxD - (RS-485 A)	A	RS-485 differential signal
RxD/TxD + (RS-485 B)	B	
Shield	SHD	Cable shielding

3.7 Connecting to Power Supply and Grounding

Danger!

Explosion hazard from premature powering

Powering parts of the system during installation or maintenance leads to added currents. This very likely results in a current flashover generating sparks. The sparks can ignite the surrounding potentially explosive atmosphere.

Prior to installation and maintenance activities, ensure that the device is disconnected from the power supply. Activate the power supply only after all the circuits required for operation have been fully assembled and connected

There are two 24 V DC power supply terminal blocks located inside the WirelessHART gateway, allowing for redundant power supply. Open the enclosure cover to access the terminal blocks.

Note!

Ensure sufficient relief of tension on the cables during installation and note the minimum bending radii of the cables.
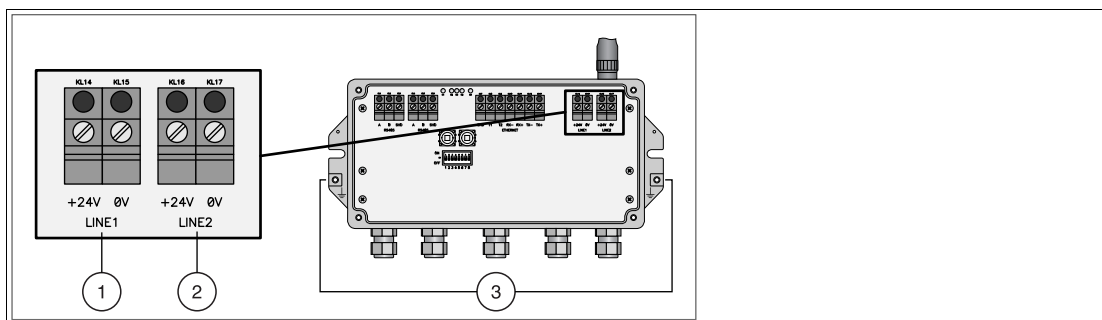

Figure 3.10   Power supply

1. First power supply connection
2. Second (redundant) power supply connection
3. Ground connection

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▶ Connecting to Power Supply and Grounding

1. Connect one of the grounding terminals to a ground wire. → see Figure 3.10 on page 30

2. Unscrew the 4 screws of the enclosure cover. → see Figure 3.8 on page 26

3. Remove the enclosure cover.

4. Ensure that appropriate power is supplied.

5. Draw the power cable through the second cable gland from right.
The permissible cable diameter lies between 6 ... 10 mm.

6. Connect the power cable to the first power supply connection "Line 1" observing polarity.
→ see Figure 3.10 on page 30

7. If you want to connect a redundant power supply (optional), draw the second power cable through the cable gland on the far right of the enclosure.

8. Connect the second power cable to the second power supply connection "Line 2" observing polarity.

↳ The WirelessHART gateway is connected to power supply.

9. Tighten the cable glands with appropriate torque. See table "Installation torque for cable glands and enclosure cover" on page 31

10. Seal empty cable glands with the provided plugs.

11. Tighten the enclosure cover with appropriate torque. See table "Installation torque for cable glands and enclosure cover" on page 31

Note!

The tightening torques of cable glands depend on what type of cable is used and must therefore be determined by the user. The cap nuts must be securely tightened. Tightening the cap nuts too tight can have a negative effect on the protection class. The following figures should be taken as rough guides only.

Installation torque for cable glands and enclosure cover

Installation torque cable glands	Type of cable glands
2.5 Nm	Plastic
4.11 Nm	Nickel plated brass
4.11 Nm	Stainless steel
Installation torque enclosure cover	
2.5 Nm	

Table 3.1 Installation torque for cable glands and enclosure cover

4 Commissioning

4.1 Important Steps to Getting Started

Connection and configuration can be performed in two different ways:

- DTM software
- Web interface

▶ Configuration via DTM Software

1. Install the DTM software and related components (if required): Microsoft® .NET Framework, PACTware® Framework, DTM Collection, HART Communication DTM.

2. Connect to the WirelessHART Gateway via RS485 or Ethernet.

3. Create a new PACTware® project.

4. Configure the WirelessHART Gateway using the PACTware® or a similar framework application.

▶ Configuration via Web Interface

1. Download and install a web browser (if required).

2. Connect to the WirelessHART Gateway via Ethernet.

3. Configure the WirelessHART Gateway using the web interface.

4.2 DTM Software

4.2.1 Downloading DTM Software Components

Required software:

- Microsoft® .NET Framework

- PACTware® Framework

- WirelessHART DTM
  The DTM collection including WirelessHART device DTMs and Ethernet communication DTM.

- HART CommDTM
  The HART CommDTM has to be installed separately if serial HART communication via the RS-485 interface of the WirelessHART Gateway is required. The HART CommDTM supports both FSK (i.e. HART modem) and RS-485 interfaces.

Note!
If one of the software components is already installed on your system, the installation may be omitted.

▶ Download Software

1. Go to www.pepperl-fuchs.com and scroll down to the bottom of the page until you see the area **Pepperl+Fuchs International site links**.

2. Click **Process Automation**.

3. Click **Software** in the **Process Automation Products** menu on the left.

4. Click **Download Software** to download the following components:
   Microsoft® .NET Framework, **PACTware®**, **WirelessHART DTM** and, if required, the **HART CommDTM**. You might need to scroll down the page to find the required component.

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4.2.2   Installing the DTM Software Components

Your computer must meet the following requirements in order to run PACTware[TM] and the device DTM:

- Operating system: Windows® 2000 Service Pack 4, Windows® XP Service Pack 1/2/3 or Windows® Vista

- Software: Microsoft® .NET Framework Release 1.1 Service Pack 1

- Processor: 500 MHz or faster

- Memory: 256 MB RAM or more

- Disk space: 200 MB or more

- Graphics resolution: 1024 x 768 or higher

- Administrator privileges to enable software installation

Install the DTM Software Components

1. Install the Microsoft® .NET Framework by starting the corresponding setup.exe file and following the installation instructions given on the screen.

2. Install PACTware[TM] by starting the corresponding setup.exe file and following the installation instructions given on the screen.

3. Install the WirelessHART DTM collection by starting the corresponding setup.exe file and following the installation instructions given on the screen.

4. Install the HART CommDTM by starting the corresponding setup.exe file and following the installation instructions given on the screen.

   ↳ You have installed the required software.

4.2.3   Updating the DTM Catalog

Once you have installed the FDT base application and the Device Type Manager (DTM) on the computer, the FDT base application's DTM catalog must be updated. The PACTware[TM] DTM catalog is called "Device Catalog" and is normally automatically updated when PACTware[TM] is launched.

If PACTware[TM] does not update the device catalog automatically, proceed as follows.

Updating the Device Catalog

1. Start PACTware[TM].

2. Select **View > Device Catalog** or click **Device Catalog** in the icon bar.

   ↳ The **Device Catalog** window opens.

3. Click **Update Device Catalog** to update the device catalog.

4. Click **Yes** to continue.

   ↳ The updated device catalog appears.

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4.3 Discovery and Configuration Tool

4.3.1 Download Discovery and Configuration Tool

Note!

If the Discovery and Configuration Tool is already installed on your system, the installation may be omitted.

▶ Download Software

1. Go to www.pepperl-fuchs.com and scroll down to the bottom of the page until you see the area **Pepperl+Fuchs International site links**.
2. Click **Process Automation**.
3. Click **Software** in the **Process Automation Products** menu on the left.
4. Click **Download Software** to download the Discovery and Configuration Tool for the WirelessHART Gateway. You might need to scroll down the page to find the required software.

4.3.2 Install the Discovery and Configuration Tool

▶ Install the Discovery and Configuration Tool

1. Go to the directory that includes the installation file and start the installation wizard.
2. Follow the instructions of the installation dialog.
3. Choose **Finish** to leave the installation wizard.

   ↳ The Discovery and Configuration Tool has been installed and is ready for use.

4.3.3 Detect IP Address of the WirelessHART Gateway

By default, the IP address of the WirelessHART Gateway is automatically assigned via DHCP. The Discovery and Configuration Tool enables you to scan the Ethernet network and detect the current IP address of the WirelessHART Gateway. Furthermore, you can use the Discovery and Configuration Tool to resolve an improper network configuration, for example, if an IP address collision has been detected.

Tip

Note that the WirelessHART Gateway is always accessible via the Discovery and Configuration Tool, even in case of errors.

▶ Detect IP Address and Update Network Configuration

1. Make sure your PC is connected to the Ethernet network that the WirelessHART Gateway is connected with.
2. Start the Discovery and Configuration Tool.
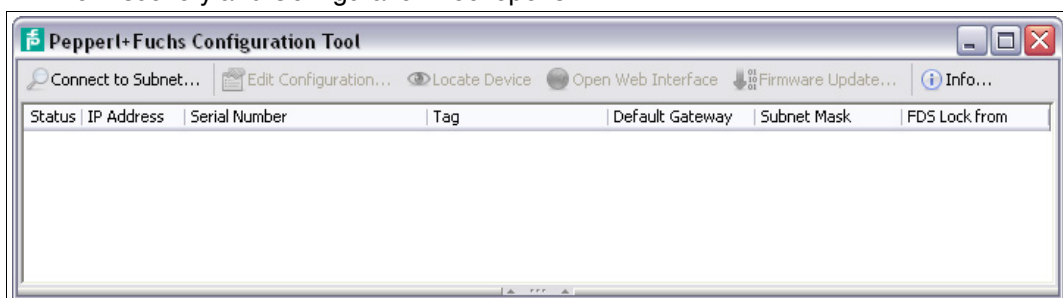
   ↳ The Discovery and Configuration Tool opens.

Figure 4.1   Pepperl+Fuchs Configuration Tool

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3. The Discovery and Configuration Tool automatically scans the Ethernet network.

↳ If the WirelessHART Gateway is located in the same subnet, the Discovery and Configuration Tool displays the current IP address of the WirelessHART Gateway in the **IP Address** column.

4. If the WirelessHART Gateway is not located in the same subnet, click **Connect to Subnet...** and enter the IP address of a gateway in the subnet, which then acts as a proxy for all gateways in the subnet.

↳ The Discovery and Configuration Tool displays the current IP address of the WirelessHART Gateway in the **IP Address** column.

5. To change the configuration of the WirelessHART Gateway, select the WirelessHART Gateway from the list and click **Edit Configuration**.

↳ The **Edit Configuration** window enables you to update the network connection.

4.4 Connecting via RS-485

Once the WirelessHART gateway has been connected to the RS-485 bus, you can connect the RS-485 bus to your PC. This can be done by using an RS-485 to RS-232 converter or using an RS-485 to USB converter.

Note!

The usage of an approved RS-485 converter is recommended for faster configuration and more reliable high-speed operation. In addition, the usage of a galvanically isolated RS-485 converter is strongly recommended for permanent installations.

Connect the RS-485 Bus to your PC

1. Connect the RS-485 to RS-232 converter or the RS-485 to USB converter to your PC.

2. To find out to which COM port the converter is connected, open the Windows® device manager. Click **Windows Icon > Control Panel > System > Device Manager**.

3. Under **Ports (COM & LPT)** you see the converter and its COM port. Make a note of the COM port number. You will need the COM port number when setting up the communication DTM for the RS-485 connection.
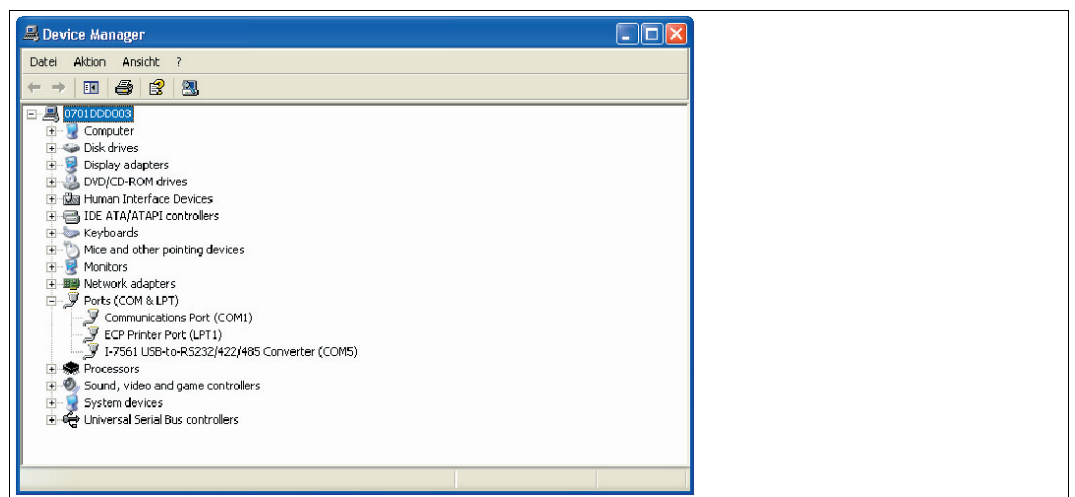
Figure 4.2   USB converter in device manager

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4.5 Connecting via Ethernet

By default, the IP address of the WirelessHART Gateway is automatically assigned via DHCP. Depending on whether a DHCP server is available or not, you have two options to connect your PC to the WirelessHART Gateway via Ethernet:

■ **DHCP server available**
If the WirelessHART Gateway and your PC are connected to an Ethernet network, use the Discovery and Configuration Tool to scan the Ethernet network and detect the current IP address of the WirelessHART Gateway. See chapter 4.3.3
Using this IP address, you can connect to the WirelessHART Gateway via Ethernet.

■ **No DHCP server available**
If the WirelessHART Gateway is directly connected to your PC, use the Discovery and Configuration Tool to define a static IP address and subnet mask for the WirelessHART Gateway that matches the local area network settings of your PC. See chapter 4.3.3
Using the static IP address of the WirelessHART Gateway, you can connect to the WirelessHART Gateway via Ethernet.

4.6 Creating a new Project in PACTware^{TM}

4.6.1 Creating a New Project

Creating a new project in PACTware^{TM}?

Select **File > New** or click ⬜ **Create New Project**.

↳ A new, unnamed project appears in the main window. The project initially consists of the entry **HOST PC**.

4.6.2 Adding the Communication DTM

A communication DTM is an interface between the FDT frame application and the device DTM. The communication DTM enables communication between the device DTM and the device connected to the PC.

Depending on how your PC is connected to the WirelessHART Gateway (via RS485 or Ethernet), you need to add a corresponding communication DTM to your PACTware project. The RS485 communication DTM is the **HART Communication** DTM, and the Ethernet communication DTM is called **HART IP Communication**.

Adding HART Communication DTM

Note!
The HART Communication DTM is not included in the WirelessHART DTM Collection. It can be downloaded separately from www.pepperl-fuchs.com.

1. Select **HOST PC** in the project view.

2. Choose **Device > Add device** or click **Add device** .

3. Select the entry **HART Communication** and click **OK**.

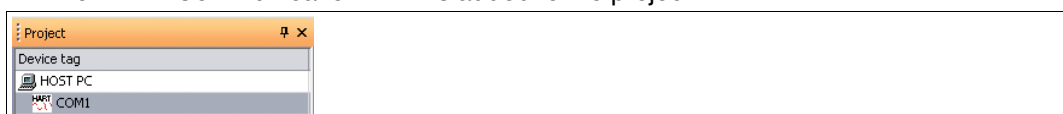   ↳ The HART Communication DTM is added to the project.

Figure 4.3   HART Communication DTM in project view

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4. To edit the parameters, right-click the HART communication DTM and select **Properties**.

5. Set the parameters according to the following table.

6. Click **OK** to save the changes and to close the parameter window.

Parameter	Description	Default
Communication interface	Set this parameter to **HART multiplexer**.	HART modem
Port	Set this parameter to the COM port your RS485–RS232 converter or your RS485–USB converter is connected to. See chapter 4.4	COM1
Baudrate	Set the baudrate according to the settings of the baud rate of the WirelessHART Gateway. The baud rate of the WirelessHART Gateway can be adjusted via the DIP switches inside the housing or via software. See chapter 2.3	19200
RTS Control	Depending on the RS485–RS232 converter used, it may be necessary to switch on or off the request-to-send control in order to be able to switch over correctly between reception and transmitting mode	Toggle
Master	Specify if you want the WirelessHART Gateway to be the primary or the secondary master. If, for example, there already is a primary master connected, you have to choose **Secondary master**.	Primary Master
Preamble	Number of preambles for HART communication.	5
Number of communication retries	The number of retries for HART communication in case of an error.	3
Start address	Here the address range is set, in which the HART Communication DTM is to search for HART Multiplexers connected to the RS-485 bus.	0
End address		15

▶ Adding HART IP Communication DTM

1. Select **HOST PC** in the project view.

2. Choose **Device > Add device** or click ⊞ **Add device**.

3. Select the entry **HART IP Communication**.

4. Click **OK**.

   ↳ The HART IP Communication DTM is added to the project.

Figure 4.4   HART IP Communication DTM in project view

5. To edit the parameters, right-click **HART IP Communication** and select **Properties**.

6. Set the parameters according to your preferences. In most cases, the default values should be fine.

7. Click **OK** to save the changes and to close the **Properties** window.

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▶ Edit DTM Addresses of the Ethernet Communication DTM

1. Right-click **HART IP Communication**.

2. Choose **Additional Functions > Set DTM addresses**.

↳ The **Set DTM addresses** window is displayed.
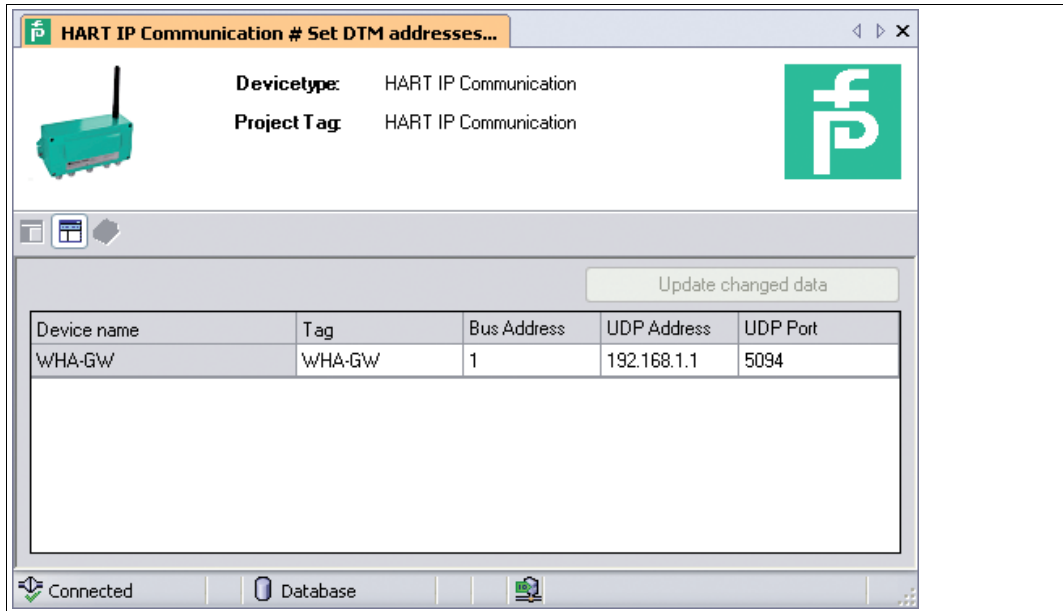

Figure 4.5   **Set DTM address** window

3. Change the parameters as required (see following table).

4. Click **Update changed data** to apply the new settings.

5. Disconnect and re-establish the connection between the DTM and the WirelessHART gateway to activate the new settings.

HART IP communication DTM			WirelessHART gateway	
Parameter	Explanation	Default	Parameter	Default
Tag	Gateway name in the **Project** view of PACTware. Any name may be entered (not relevant for connection to the WirelessHART gateway)	WHA-GW	–	–
Bus Address	Gateway polling address Must match the settings of the WirelessHART gateway.	1	**Parameterization > Wired Communication > Protocols > HART > Bus Address**	1
UDP Address	Gateway IP address Must match the settings of the WirelessHART gateway.	192.168.0 01.001	**Parameterization > Wired Communication > Interfaces > Ethernet > IP Address**	192.168.0 01.001
UDP Port	Gateway port number (HART over UDP) Must match the settings of the WirelessHART gateway.	5094	**Parameterization > Wired Communication > Protocols > HART > Port Number**	5094

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4.6.3   Devices

After you have added a communication DTM, add the devices for the WirelessHART gateway.

▶ Adding Devices

1. In the project view, right-click on the entry of the communication DTM.

2. To add a device to the project, choose **Add device**.

3. Select the entry **WHA-GW**.

4. Click **OK**.

   ↪ The device for the WirelessHART gateway is added to the project.

Figure 4.6   New device below HART IP Communication DTM in project tree

ⓘ Tip

After you have added the device for the WirelessHART gateway, you can easily add other WirelessHART devices by performing a topology scan. To do so, right-click the WirelessHART gateway and select **Connect**. When you have an active connection to the WirelessHART gateway, right-click the WirelessHART gateway and select **Topology Scan**.

Topology Scan

The DTM provides a topology scan wizard to detect and store the device structure of the scanned network in an FDT project. The scan is performed independently on each level for the communication DTM, the WirelessHART gateway, and the devices.

ⓘ Note!

Note on Hardware Version

Automatic topology scanning is possible with the WirelessHART gateway, revision 3 or higher.

▶ Topology Scan: Creating the Project Tree Online

You can create the complete project tree for communication DTMs using the topology scan. The following example shows how to create a project tree for the HART IP Communication DTM. Ensure that you have added HART IP Communication DTM to the project tree. Ensure that the HART IP Communication DTM remains active, and proceed as follows:

1. Right-click on the **HART IP Communication DTM**, and go to **Topology Scan**.

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↳ The topology scan wizard opens.

2. Optionally, you can make settings for the HART IP communication DTM: In the Scan Tree, right-click onto the **HART IP Communication DTM**. From the context menu that opens, select **DTM Functions > Parameter**. In the Settings section on the right, for the HART IP Communication DTM enter a suitable project tag, determine the communication timeout, and the number of retries.

Figure 4.7   Parameter > DTM Functions for HART IP Communication DTM

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3. In order to start the topology scan, click on the blue single arrow (1) in the lower left section of the wizard dialog.
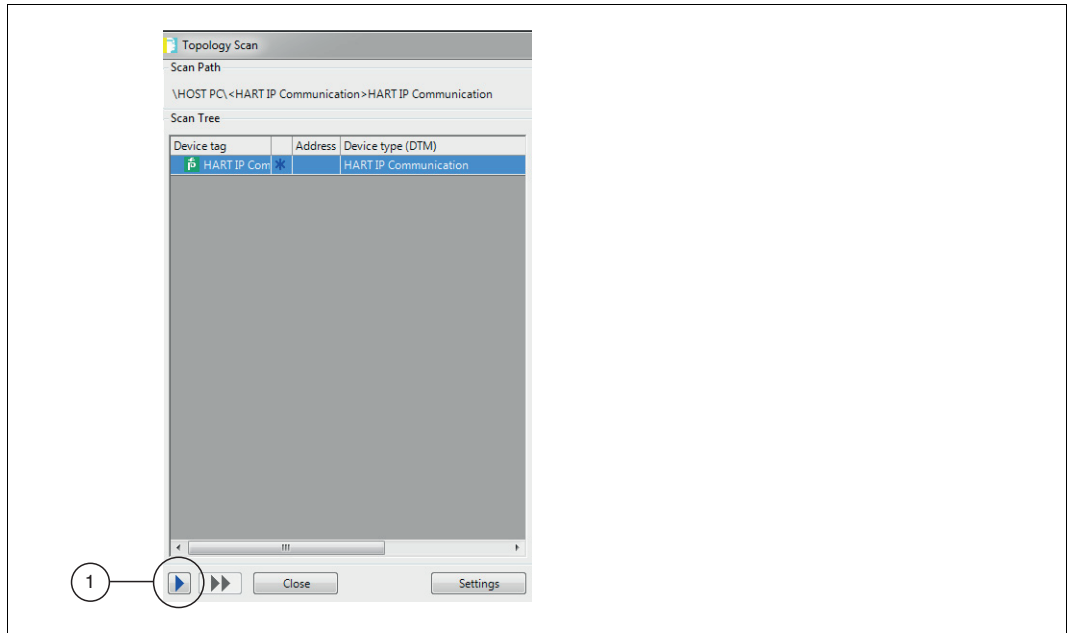
↳ Scanning is indicated by a status bar. All gateways on the network are listed. All devices that are connected to the gateways are listed. As scanning takes place, the Scan Tree section fills with all the detected participants of network, at the same time the project tree is updated.
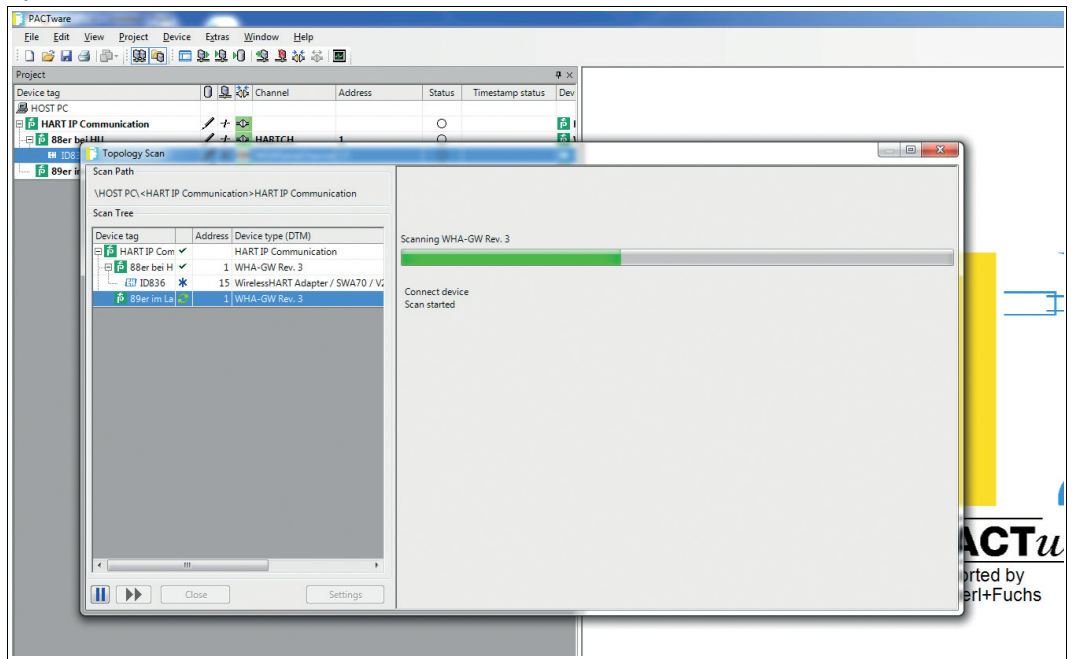
Figure 4.8　　　　Topology scan: Filling up project tree while scanning

4. Close the topology scan wizard.

↳ Your FDT project tree is complete.

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Rescanning in Case of Failed Device Detection

In case the topology scan cannot detect any connected devices, ensure that all devices are switched on. Then you can manually rescan the topology as follows:

1. Manually rescan the WirelessHART adapter. Assign a device type and a semantic ID manually. Confirm by clicking on **Apply**.
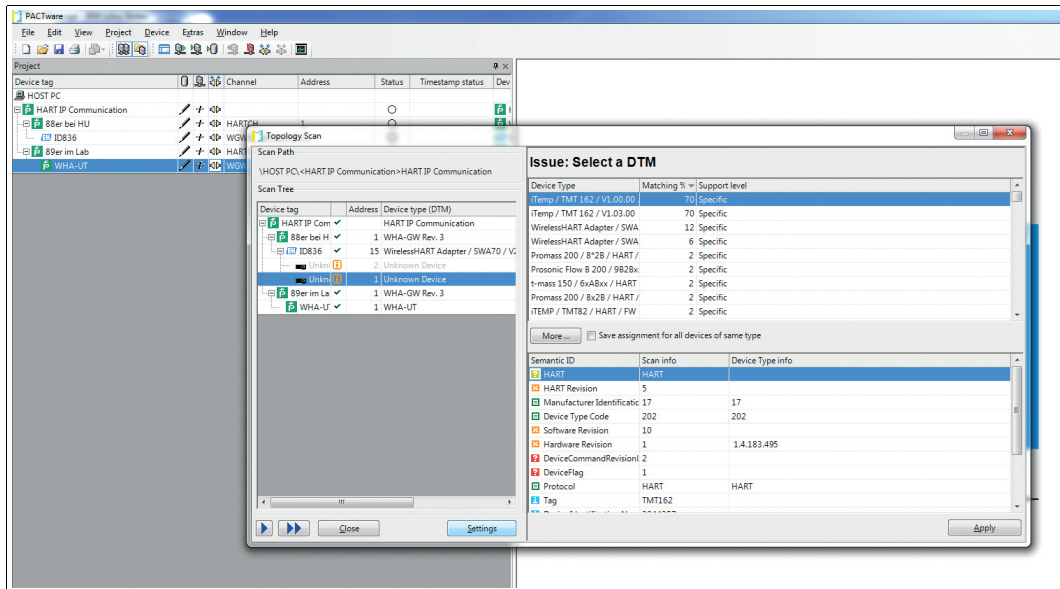
Figure 4.9   Topology scan wizard: Issues after completing the scan, in general unkown devices on the network

2. Close the topology scan wizard.

↪ Your FDT project tree is complete.

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5 Configuration via Web Interface

When configuring the WirelessHART gateway via the web interface, the WirelessHART gateway must be connected to your PC via Ethernet.

Log in to the Web Interface

1. Start your web browser.

2. If your web browser uses a proxy, deactivate the proxy.

3. Type the IP address of the WirelessHART gateway into the address field. The default IP address is `192.168.001.001`. If you changed the IP address of the WirelessHART gateway, type in the new IP address.

↳ Depending on the security settings of your web browser, you may see a security warning. In this case, click OK and proceed to the login screen.

Figure 5.1　　　Entering login data for secure connection

4. Either log in as user/operator or as administrator. Enter your user name and password. The default user is `admin` and the default password is `admin`.

5. Click **OK**.

5.1 Identification Parameters

The identification parameters provide various information about the device and identify the device within the network.

Figure 5.2　　　Parameter > Identification

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Identification Parameters

Parameter	Description	Default
Device Long Tag	Identifies the device in a WirelessHART network. Enter up to 32 characters.	–
Device Tag	Identifies the field device within the process plant. Enter up to 8 characters.	–
Descriptor	Further description of the device. Enter up to 16 characters.	–
Date	User-defined date (e.g. last parameter change). Format: DD.MM.YYYY The **Date** parameter is not modified by the WirelessHART gateway. It must be set by the user or a host application.	–
Message	User-defined message. Enter up to 32 characters.	–
Country Code	Select the country code of the country in which the device is operated from this drop-down list.	–

Table 5.1   Identification Parameters

5.2   Wireless Communication Parameters

5.2.1   Setup

The setup parameters contain the necessary information for establishing and maintaining a WirelessHART network.

Figure 5.3   Parameter > Wireless Communication > Setup

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▶ **Changing the Join Key throughout the Network**

Note!

Prerequisites

In order to change the join key network password parameter, activate the security mode with a DIP switch inside the enclosure of the WirelessHART gateway. Set the DIP switch 8 to ON. →
see Figure 2.6 on page 16
In the security mode, the CMD 768 HART command can be used to set the join key of the WirelessHART gateway as required.

1. In the web interface, go to **Wireless Communication > Setup**.

Figure 5.4   Wireless Communication > Setup

2. In order to change join key on all devices throughout the network: Use the **Join Key Part 1 ... 4 of 4 (HEX)** fields.
   Use the double arrow buttons to **Write the Join Information**.

   ↳ A status message will inform you whether the procedure was successful. If a problem occurred a NE 107 maintenance symbol will be displayed in the lower status bar. Clicking on the symbol will provide you with information on the problem. For more information on the NE 107 symbols, see chapter 5.2.2

Tip

Re-Joining Devices with Issues

For an overview of all devices in the network go to **Wireless Communication > Operating Modes**. NE 107 status information symbols inform on the status of each device in the network.

In order to access a device that is temporarily out of operation or needs maintenance, use the join key that was previously used when this device was active in the network. The old join key allows the device to re-join the network without having to change it.

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> **Caution!**
>
> Network security risk
>
> For security reasons do not use the security mode connection as a normal communication channel. After having changed the join key, disable the security mode using the DIP switch (DIP switch 8 = OFF).

> **Caution!**
>
> Possible loss of connection when changing **Network ID**
>
> If you change the **Network ID** parameter of an already operating WirelessHART network, the WirelessHART gateway stores the new network ID and applies the network ID the next time the network is reformed (note that reforming the network can take a long time). When the new network ID becomes active, the connection to other WirelessHART devices can get lost.
>
> When changing the network ID in the WirelessHART gateway, write the new network ID to each wireless device in the network using either the wired or the wireless connection. Again, the new network ID is stored in the device and is applied the next time the network is reformed.

Setup Parameters

Parameter	Description	Default
Network Tag	Identifies the device in a WirelessHART network. Enter up to 32 characters.	–
Network ID	Each wireless device needs to store a network ID to identify the WirelessHART gateway it is expected to connect to. Enter up to 5 digits. The network ID may range from 0 ... 65535. Press **Write Join Information** to store the new network ID to the WirelessHART gateway. Remember to change the network ID of the other wireless devices in the network, too. The network has to be reformed before the new network ID takes effect. To reform the network, choose **Reform Network** in the **Additional Functions > Reset** menu.	1945
Join Key Part 1 ... 4	The join key is a common network password. Each wireless device needs this join key to be allowed to join the network. The join key consists of up to 32 hexadecimal characters (0 ... 9, a ... f). There are 4 text fields. Enter up to 8 hexadecimal characters into each text field. Each text field must contain the same number of characters (e.g., 5 each). Press **Write Join Information** to store the new join key to the **Wireless**HART gateway. This parameter can only be edited if the security mode is activated by means of a DIP switch. ⟶ see Figure 2.6 on page 16 In order to change the join key, in the gateway web interface go to **Wireless Communication > Setup** and change the join key in the **Join Key Part 1 ... 4 of 4 (HEX)** fields. A status message will inform you whether the procedure was successful. If the join key is changed, the currently joined wireless devices will remain connected with the network. However, no device will be allowed to join unless it stores the new join key. Available only **online**.	E090D6E2 DADECE94 C7E9C8D1 E781D5ED
Write Join Information	Stores the **Network ID** and **Join Key** to the WirelessHART gateway. Please read the information related to the network ID and join key in this section including the security notes. Available only **online**.	
RTC Date	Real-time clock (RTC) date setting for the network. Enter a date in the following format: DD:MM:YYYY. Available only **online**.	–

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Parameter	Description	Default
RTC Time	Real-time clock (RTC) time setting for the network. Enter a time in the following format: hh:mm:ss. Available only **online**.	–
Network start date	Shows the date at which the network was (re)started. Available only **online**.	–
Network start time	Shows the time at which the network was (re)started. Available only **online**.	–
Allow new Devices	Specify if new devices are allowed to join the WirelessHART network.	all
Radio Power	Power level of the radio transmitter of the WirelessHART gateway, which should normally be set to 10 dBm. Observe local restrictions for 2400 MHz equipment.	10 dBm
Bandwidth Profile	This option allows you to increase network performance by reducing the latency, which increases the energy consumption and reduces battery life of the network components. We recommend that you use the medium and high performance profiles if latency reduction is more important than battery life. The network has to be reformed for the new bandwidth profile to become active. To reform the network, choose **Reform Network** in the **Additional Functions > Reset** menu.	Normal Bandwidth Profile
Global Advertising Timeout	If **Global Advertising** is activated, the WirelessHART gateway and the network components will send a series of identification messages at a frequency higher than normal to identify new wireless devices and to reduce the network join time. The messages are sent until the **Global Advertising Timeout** is reached. Enter the timeout in minutes. The timeout may range from 1 ... 255 minutes.	–
Activate Global Advertising	If activated, the network manager sends advertising messages to announce the network's existence. When a WirelessHART field device receives such an advertising message, it tries to join the network. Enabling **Global Advertising** increases energy consumption of the network components. Therefore we recommend that you use this features only if needed, for example if you expect new devices to join the network. Note that you can activate **Global Advertising** without reforming the network.	

Table 5.2   Setup Parameters

You can use the **Channel Blacklist** to disable selected channels. If there are other wireless networks in the area where the WirelessHART network is located, you can make sure that channels are not used by multiple networks at a time.
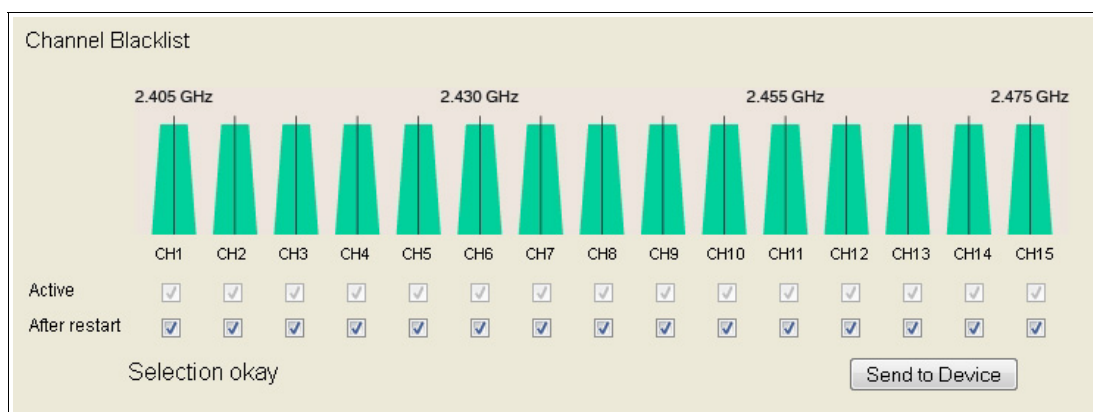
Figure 5.5   Channel Blacklist

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Create Channel Blacklist

1. To disable a channel, deactivate its check box in the **Channel Blacklist** area. Note that at least 5 channels must remain active.

2. Click **Send to Device** to transfer the updated blacklist settings to the WirelessHART gateway. Note that the WirelessHART gateway stores the updated blacklist but does not apply the updated settings unless the network is reformed.

3. Go to **Additional Functions > Reset** and click **Reform Network** to apply the updated channel blacklist.

Example!

Note that a WLAN channel based on the IEEE 802.11 standard is wider than a WirelessHART channel based on the IEEE 802.15.4 standard. If running a WirelessHART network in such an area, we recommend that you also disable adjacent channels. For example, if channel 5 is already occupied by a wireless network based on the IEEE 802.11 standard, we recommend that you disable the WirelessHART channels 4, 5, and 6.

Note!

In addition to the manual channel selection, the WirelessHART network adapts the channel usage dynamically to new situations, for example if a new wireless network is installed in the area where the WirelessHART network is located.

5.2.2 Operating Modes

The **Operating Modes** table displays all devices of the WirelessHART network and their operation modes. It represents the virtual I/O system of the WirelessHART gateway. See chapter 2.1.3

Whenever a wireless device joins the network, it is automatically inserted into the **Operating Modes** list if it is not already existing. Wired devices connected to a WirelessHART adapter will also be inserted.

Figure 5.6   Parameter > Wireless Communication > Operating Modes

If required, click **Refresh** to reload the operation mode parameters of all devices.

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Caution!

System failure

If you click **Refresh** right after the device was switched on or reset, the system may stop responding.

If the device was switched on or reset, wait about 1 minute until the boot process is complete before you click **Refresh**.

Note!

If using the DTM and PACTware to configure the WirelessHART gateway, the following data is available only during online parameterization.

General Data

Displayed Information	Description
Long Tag	Displays the long tag of the device. HART 5 devices and older devices do not support long tags. For those devices, the WirelessHART adapter uses the content of the **Message** field which will be displayed here instead.
I/O Card	Indicates the virtual I/O card number to which the device is mapped to. See chapter 2.1.3
Channel	Indicates the channel of the virtual I/O card that the device is mapped to. See chapter 2.1.3 The value 0 identifies a WirelessHART device or a WirelessHART adapter, while the value 1 identifies a wired device connected to a WirelessHART adapter.
Device Type	Displays the device type as registered at the HCF.
Status	The following communication statuses exist: communication not possible communication possible, device not identified (flashing) communication possible, identification ongoing device connected and identified
Dev. Status	Note that the device status displayed in the list may differ from the actual device status because the HART status bits may be interpreted differently. The following device statuses exist: maintenance required out of specification check function failure

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Operating Mode Parameters

Parameter	Description
Routing Device	Indicates whether the device is allowed to act a routing device. This option enables you to set up a star network, or to increase the battery life of certain devices. To deactivate the routing functionality, deactivate the corresponding check box in the **Routing Device** column. The network has to be reformed before the activated/deactivated routing functionality takes effect. To reform the network, choose **Reform Network** in the **Additional Functions > Reset** menu.
Fast Pipe	This option establishes a direct connection to a selected device. The fast pipe connection is about 4 times faster than a regular connection, which enables you to perform fast updates. To establish a direct connection to a selected device, activate the **Fast Pipe** check box. Note that you can activate the **Fast Pipe** option only for one device at a time.
Flush Cache	This option deletes the cache of the received HART commands. Note that the measured values will not be deleted to allow host applications to work with the last measured values.
Force Identification	This option forces a device to resend its identification, for example if a communication failure occurred. Note that this option is available only for devices that have not been identified yet.
Delete Device	To remove a device from the list, click the ☒ X-sign at the end of the row. Note that this option is available only for devices that have no connection to the network.

Table 5.3   Operating Mode Parameters

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5.3 Wired Communication Parameters

Note!

If you are connected to the WirelessHART gateway via Ethernet using the HART IP communication DTM, make sure to update the parameters of the HART IP communication DTM when changing the following parameters of the WirelessHART gateway.

- **Parameterization > Wired Communication > Interfaces > Ethernet > IP Address**
- **Parameterization > Wired Communication > Protocols > HART > Bus Address**
- **Parameterization > Wired Communication > Protocols > HART > Port Number**

5.3.1 Serial Interface

The WirelessHART gateway can connect to the host system via an Ethernet interface or a serial interface. This section describes the parameters for the serial interface.
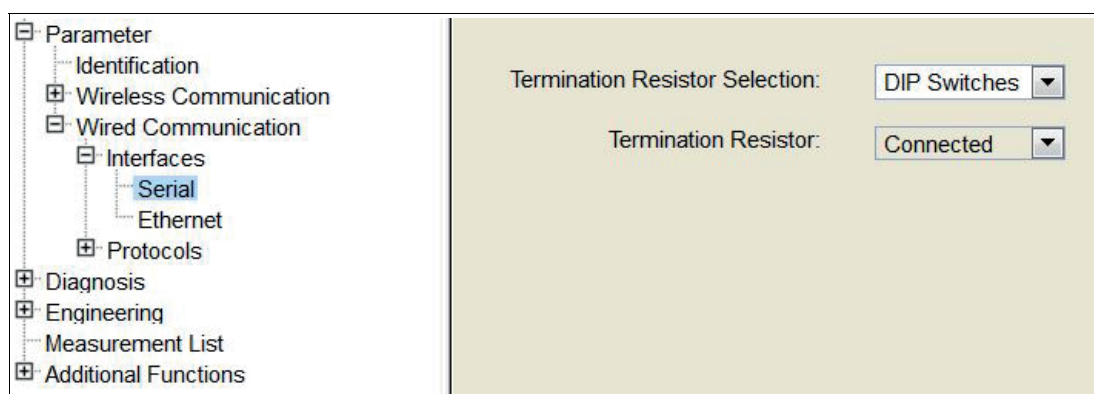
Figure 5.7   Parameter > Wired Communication > Interfaces > Serial

Serial Interface Parameters

Parameter	Description	Default
Termination Resistor Selection	Select if you prefer to activate the termination resistor of the WirelessHART gateway via the DIP switches inside the enclosure (see chapter 2.3) or via software.	DIP switches
Termination Resistor	Connect or disconnect the termination resistor of the WirelessHART gateway. This drop-down list depends on the value of **Termination Resistor Selection**. If the value of **Termination Resistor Selection** is "DIP switches", this checkbox is read only.	Disconnected

Table 5.4   Serial Interface Parameters

5.3.2 Ethernet Interface

The WirelessHART gateway can connect to the host system via an Ethernet interface or a serial interface. This section describes the parameters for the Ethernet interface.

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Figure 5.8   Parameter > Wired Communication > Interfaces > Ethernet

Caution!

Possible loss of Ethernet connection

After enabling DHCP using the **IP address assignment (DHCP)** parameter, the host can lose the Ethernet connection due to the new, automatically assigned IP address.

Ethernet Interface Parameters

Parameter	Description	Default
IP configuration mode (DHCP, DNS)	Select **Manually** to configure the IP address, gateway address, and Domain Name Server (DNS) manually, or select **Automatic** to enable automatic configuration via the Dynamic Host Configuration Protocol (DHCP) server. If you choose **Automatic**, all other input fields in the window will be grayed out (read only).	Manually
IP Address	If using manual configuration, enter the IP address of the WirelessHART gateway.	192.168.1.1
Netmask	If using manual configuration, enter the subnet mask.	255.255.255.0
Gateway address	If using manual configuration and if necessary, specify the IP address of the WirelessHART gateway in the IP network. Note that this is not the IP address of the WirelessHART gateway. If changing the **gateway address**, it can take up to 10 seconds for the changes to take effect.	0.0.0.0
DNS 1	If using manual configuration, enter the address of the first Domain Name Server (DNS 1).	0.0.0.0
DNS 2	If using manual configuration, enter the address of the second Domain Name Server (DNS 2).	0.0.0.0
MAC Address	Displays the MAC address of the WirelessHART gateway. Note that the MAC address is a characteristic of the device itself and cannot be changed. Each device has a unique MAC address.	
Write Ethernet Information	Applies the current Ethernet settings from above to the WirelessHART gateway.	

Table 5.5   Ethernet Interface Parameters

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5.3.3 HART Protocol

The protocol parameters configure the HART protocol that run over the serial interface or the Ethernet interface.
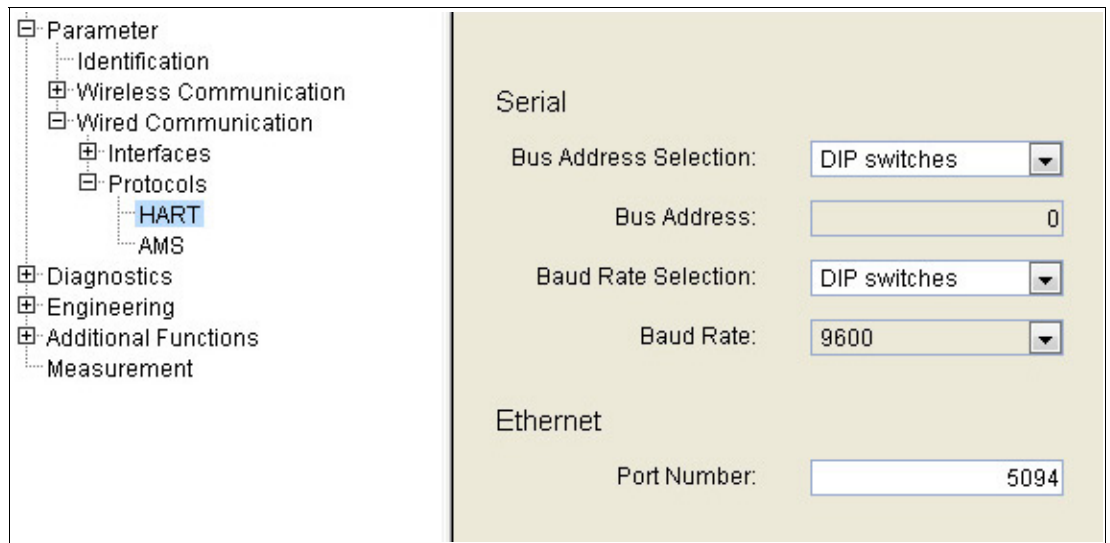
Figure 5.9 Parameter > Wired Communication > Protocols > HART

HART Parameters

Parameter	Description	Default
Serial		
Bus Address Selection	Select **DIP switches** to specify the polling address of the WirelessHART gateway using the DIP switches inside the enclosure (see chapter 2.3) or select **Software** to specify the polling address in the following field.	DIP switches
Bus Address	■ If **Bus Address Selection** is set to **DIP switches**, this is a read-only field. ■ If using the DTM and PACTware® for specifying the polling address, this field is a read-only field and you must enter the polling address in the **HART IP Communication DTM**. See chapter 6.1 ■ If using the web interface for specifying the polling address, enter the polling address for the WirelessHART gateway.	0
Baud Rate Selection	Select **DIP switches** to specify the baud rate of the WirelessHART gateway using the DIP switches inside the enclosure (see chapter 2.3) or select **Software** to specify the baud rate in the following field.	DIP switches
Baud Rate	If using the DTM or web interface for specifying the baud rate, select the baud rate for the WirelessHART gateway from the drop-down list. If **Baud Rate Selection** is set to **DIP switches**, this parameter is read only.	19200
Ethernet		
Port Number	Enter the port number of the WirelessHART gateway (HART over UDP, Ethernet Interface).	5094

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Tip

If you change the Ethernet port for the HART protocol, the default port remains open and active. Thus, you can communicate with the WirelessHART gateway over the default port (5094) and a user-defined port in parallel. Note that this behavior applies only for the HART protocol (not for the EtherNet/IP protocol).

5.3.4 Emerson AMS Integration

Integration in the Emerson AMS Suite is performed via Ethernet.
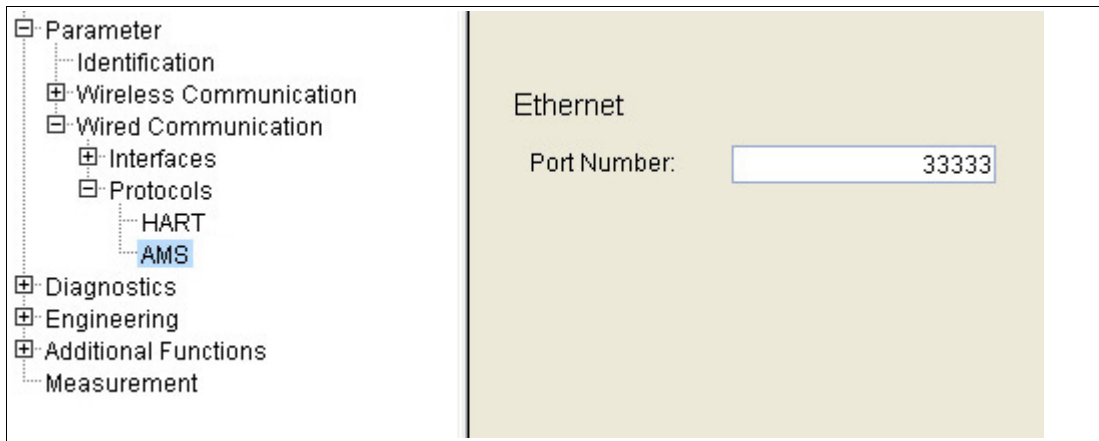
Figure 5.10   Parameter > Wired Communication > Protocols > AMS

AMS Parameters

Parameter	Description	Default
Port number	Enter the port number under which the AMS will address the WirelessHART gateway.	33333

5.3.5 Number of Clients on Ethernet Interface

You can access the WirelessHART Gateway with multiple clients in parallel, depending on the port configuration of the WirelessHART Gateway.
If you change the Ethernet port for the HART protocol, the default port remains open and active. Due to this behavior it is possible to communicate with the WirelessHART Gateway over the default port (5094) and a user-defined port in parallel.

To change the Ethernet port for the HART protocol, .

Note!

Note that this behavior applies only to the Ethernet port for the HART protocol.

5.4 Diagnostics

The **Diagnostics** function provides detailed information about the device, wireless/wired communication and health status.

Note!

Available Only Online (DTM)

If using the configuration via DTM and PACTware the **Diagnostics** function is available only online. See chapter 6.4

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▶ **Accessing the Diagnostics Window**

1. If using the DTM and PACTware, right-click the device in the project tree and select **Diagnostics**.

2. If using the web interface, select **Diagnostics** in the navigation area on the left.

5.4.1 Identification

Here you find information about the WirelessHART gateway.

Figure 5.11   Diagnostics > Identification

Identification Information

Parameter	Description
Device Long Tag	Identifies the device in a WirelessHART network.
Device Tag	Identifies the field device within the process plant.
Descriptor	Further description of the device.
Date	User-defined date (e.g. last parameter change). Format: DD.MM.YYYY The **Date** parameter is not modified by the WirelessHART gateway. It must be set by the user or a host application.
Message	User-defined message.
Universal command revision	Revision of the universal commands of the device. Only available **online**.
Device Revision	Revision of the device-specific commands. Only available **online**.
Software Revision	Software revision of the device. Only available **online**.
Country Code	Country code of the country in which the device is operated (user-defined).
Assembly Number	The assembly number of the WirelessHART gateway. Only available **online**.

Table 5.6   Identification Information

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5.4.2 Wireless Communication

Overview

The overview screen provides information about the I/O interfaces of the wireless network as well as network statistics.

Figure 5.12   Diagnostics > Wireless Communication > Overview

Overview Information

Displayed Information	Description
I/O System Capabilities	
Max. Card Number	Displays maximum number of cards in the I/O system. This corresponds to the maximum number of wireless devices that can be connected to the WirelessHART gateway.
Max. Channel Number	Displays maximum number of channels. The WirelessHART gateway always returns the value 2.
Max. Sub Dev. Number	Displays maximum number of sub devices that can be connected to a specific WirelessHART adapter.
Number of Devices	Displays current number of sub devices. Every device counts as a sub device, no matter if it is a wireless device or a wired device connected to a WirelessHART adapter.
Lifetime Network Statistics	
Reliability	Percentage of data packets generated by wireless devices that were correctly received by the WirelessHART gateway.
Stability	Ratio of successful data packet transfers to the total number of data packet transfers on all wireless paths in the network.
Latency	Average time taken for data packets generated by the wireless devices to reach the WirelessHART gateway.
Lost upstream packages	Total number of data packets generated by the wireless devices that were lost when transferred over the network.

Table 5.7   Overview Information

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Details

The **Details** table displays all devices of the WirelessHART network including their diagnostic information of the last 15 minutes.

Note!

Diagnostic information is available only after a cycle of 15 minutes has been completed. During this time, some information is set to 0 or replaced by wildcard characters.

The diagnostic information represents the last 15 minutes only. Note that for connection paths with very low traffic, the validity of the diagnostic information can be poor.

Figure 5.13   Diagnostics > Wireless Communication > Details

To show/hide the index number of a device in the structure, deactivate/activate **Tree-View**. If **Tree-View** is deactivated, the devices are shown in the order they were added to the instrument list.

If required, click **Refresh** to reload the diagnostic details of all devices.

Caution!

System failure

If you click **Refresh** right after the device was switched on or reset, the system may stop responding.

If the device was switched on or reset, wait about 1 minute until the boot process is complete before you click **Refresh**.

Note!

If using the DTM and PACTware to configure the WirelessHART gateway, the following data is available only during online parameterization.

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General Data

Displayed Information	Description
Long Tag	Displays the long tag of the device. HART 5 devices and older devices do not support long tags. For those devices, the WirelessHART adapter uses the content of the **Message** field which will be displayed here instead.
I/O Card	Indicates the virtual I/O card number to which the device is mapped to. See chapter 2.1.3
Channel	Indicates the channel of the virtual I/O card that the device is mapped to. See chapter 2.1.3 The value 0 identifies a WirelessHART device or a WirelessHART adapter, while the value 1 identifies a wired device connected to a WirelessHART adapter.
Device Type	Displays the device type as registered at the HCF.
Status	The following communication statuses exist: ❌ communication not possible ⚠ communication possible, device not identified ⚠ (flashing) communication possible, identification ongoing ✅ device connected and identified
Dev. Status	Note that the device status displayed in the list may differ from the actual device status because the HART status bits may be interpreted differently. The following device statuses exist: 🔧 maintenance required ⚠ out of specification ⚠ check function ❌ failure

Diagnostic Information

Parameter	Description
Number of Joins	Number of times the device has joined the network.
Join Time	Date and time of the most recent join.
Reliability	Percentage of the data packets generated by the wireless devices that were correctly received by the WirelessHART gateway.
Latency	Average time taken for data packets generated by the wireless devices to reach the WirelessHART gateway.
+	To show/hide the list of neighboring devices, click the + sign in the **+** column.
Neighbors	Lists the neighboring WirelessHART devices in reach of the selected device.
RSSI	The RSSI (Received Signal Strength Indicator) indicates the power of the received signal for each neighboring device. Note that you must expand the list of neighboring devices in order to see the RSSI value for each device.
Stability	Ratio of successful data packet transfers to the total number of data packet transfers on all wireless paths in the network.

Table 5.8   Diagnostic Information

To export the diagnostic details to a CSV file, click **Export** (web interface) resp. **Export CSV** (DTM).

For more information on the structure of the CSV file, see chapter 12.

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Burst Lists

Normally, a HART slave device only responds when being polled by the host. Burst mode is a special communication mode in which a HART slave device sends data to a particular HART command without being polled by the host. When burst mode is used, a HART slave device can publish data (for example process values) autonomously to another device in regular intervals. Alternatively, data can be published if the value has changed by a significant amount, has reached a certain threshold level, or has not been updated within a default reporting time.

The WirelessHART gateway maintains a burst message list, which lists the specific commands that are being published by each device in the WirelessHART network. Note that the burst list is reset after power-up or network restart.

Note!

The WirelessHART gateway is able to cache up-to-date device status information only if at least one command is published in each wireless device. Up-to-date data is important for efficient device status monitoring. You can find the publishing parameters of most WirelessHART devices in the **Burst Mode** menu of the DTM.

Device Publishing Guidelines

- We recommended that you always publish **command 48** to ensure caching of the related status information. A publishing interval of approx. 1 minute is generally the best choice for wireless devices (not for wired devices).
  For example, when configuring WirelessHART adapters, **command 48** allows proper identification and management of changes in the sub-device list without intervention of the host.

- Publishing of at least one command on the wireless device level enables detection of configuration changes and automatic device cache invalidation without intervention of the host.

- Publishing of at least one command also ensures that the cached status information is updated for cached configuration commands.

- Short publishing intervals may impair battery life of wireless devices.

Figure 5.14   Diagnostics > Wireless Communication > Burst Lists

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To show/hide the index number of a device in the structure, deactivate/activate **Tree-View**. If **Tree-View** is deactivated, the devices are shown in the order they were added to the instrument list.

If required, click **Refresh** to reload the burst parameters of all devices.

Caution!

System failure

If you click **Refresh** right after the device was switched on or reset, the system may stop responding.

If the device was switched on or reset, wait about 1 minute until the boot process is complete before you click **Refresh**.

Note!

If using the DTM and PACTware to configure the WirelessHART gateway, the following data is available only during online parameterization.

General Data

Displayed Information	Description
Long Tag	Displays the long tag of the device. HART 5 devices and older devices do not support long tags. For those devices, the WirelessHART adapter uses the content of the **Message** field which will be displayed here instead.
I/O Card	Indicates the virtual I/O card number to which the device is mapped to. See chapter 2.1.3
Channel	Indicates the channel of the virtual I/O card that the device is mapped to. See chapter 2.1.3 The value 0 identifies a WirelessHART device or a WirelessHART adapter, while the value 1 identifies a wired device connected to a WirelessHART adapter.
Device Type	Displays the device type as registered at the HCF.
Status	The following communication statuses exist: ❌ communication not possible 🔧 communication possible, device not identified 🔧 (flashing) communication possible, identification ongoing ✅ device connected and identified
Dev. Status	Note that the device status displayed in the list may differ from the actual device status because the HART status bits may be interpreted differently. The following device statuses exist: 🔷 maintenance required ⚠ out of specification 🔧 check function ❌ failure

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Burst Parameters

Parameter	Description
+	To show/hide the list of burst messages for a device, click the + sign in the **+** column.
Burst Command	Displays the HART command number and its description.
Num. Packets	Number of burst messages the device has sent.

Table 5.9   Burst Parameters

Topology View

The topology view is a graphical overview of all wireless devices within your network, including their connection status and connection paths. To set up the topology view, go to **Engineering > Topology View**. See chapter 5.5.4

The lines between the devices represent the connection paths. The thickness of a connection path indicates the traffic for this path compared to the total traffic. The color of the connection path indicates the stability of the connection for this path.

The topology view also displays the path statistic. Move the mouse over a path in order to display an information box with the following details:

- Stability
- Radio signal strength intensity (RSSI)

Move the mouse over a field device in order to display an information box with the following details:

- Reliability
- Latency
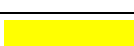
Note!
Traffic and stability data is available only after a statistics cycle of 15 minutes has been completed.

Note that the data that is displayed in the topology view represents a single cycle of 15 minutes only.

Traffic

Line Style	Description
_ _ _ _ _ _ _ _ _	Dotted lines represent unused paths.
——————	Thin lines represent paths with poor traffic (compared to the total traffic).
——————	Medium lines represent paths with medium traffic (compared to the total traffic).
——————	Thick lines represent important connection paths with heavy traffic (compared to the total traffic).

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Stability

Color	Successfully received messages in %
	0 - 10
	10 - 20
	20 - 30
	30 - 40
	40 - 50
	50 - 60
	60 - 70
	70 - 80
	80 - 90
	90 - 100

Note!

For paths indicated in black, there is no statistic information available.

Example!

In the following example you can see that the devices **WHA-ADP-CorrTran** and **Test_Dev_598** have no network connection (red status icon and no connection paths) and thus they are unavailable. Apart from these devices, all other devices are linked with unused connections (dotted lines), which means that if the main connection fails, the communication can easily be switched to an alternative, unused connection path.

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Figure 5.15   Diagnostics > Wireless Communication > Topology View

Use the slider to zoom in or out of the topology view. To reset the zoom to its default value, click **Reset Zoom**.

Click the devices in the topology view for more information on the device.

If required, click **Refresh** to reload the device information and rebuild the topology view. Note that rebuilding the topology view takes some time.

> ⚠ ***Caution!***
>
> System failure
>
> If you click **Refresh** right after the device was switched on or reset, the system may stop responding.
>
> If the device was switched on or reset, wait about 1 minute until the boot process is complete before you click **Refresh**.

Topology View Parameters

Parameter	Description
Horizontal image origin	Displays the horizontal respectively vertical alignment of the background image. See chapter 5.5.4
Vertical image origin	
Resolution	Displays the resolution of the background image. See chapter 5.5.4
Paths shown	Enables you to select the connection paths that are displayed in the topology view.

Table 5.10   Topology View Parameters

▶ Display connection paths for a single device

1. Select **Selected** in the **Paths shown** drop-down list.

2. Move the cursor over a device in the topology view.

↳ The connection paths are displayed for the select device.

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5.4.3 Wired Communication

The overview screen provides information the host connection of the WirelessHART gateway. The information is only available when online.
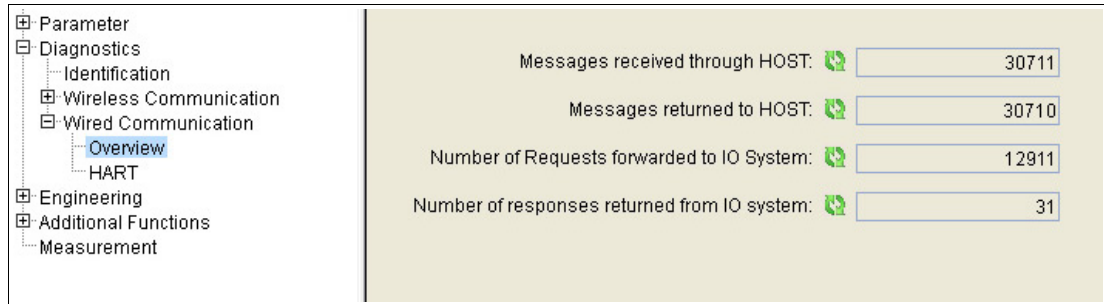
Figure 5.16   Diagnostics > Wired Communication > Overview

Overview Information

Displayed Information	Description
Messages received through HOST	Total bytes received by the host system.
Messages returned to HOST	Total bytes transmitted to the host system.
Number of Requests forwarded to the I/O system	
Number of responses returned from the I/O system	

Table 5.11   Overview Information

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Figure 5.17   Diagnostics > Wired Communication > HART

Note!

Not all parameters from the **Diagnostics > Wired Communication > HART** window are used by the WirelessHART gateway. In the following table, only the relevant parameters are described.

Most parameters are transient parameters, which means that they are automatically reset if the status does no longer apply. The following exceptions have to be reset by pressing **Reset Diagnostic Bits** in the **Additional Functions > Reset** menu.

- Active Device List changed

- More Status Available

- Configuration Changed

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HART Parameters

Parameter	Description
Extended Device Malfunction	
Manager fault	Non-recoverable hardware fault within the manager section of the WirelessHART gateway.
Non-Volatile Memory Defect	Non-recoverable hardware fault within a non-volatile memory area.
Volatile Memory Defect	Non-recoverable hardware fault within a volatile memory area.
Ethernet Communication Fault	Non-recoverable hardware fault within the communication controller associated with the Ethernet interface.
Electronic Defect	Non-recoverable hardware fault within the WirelessHART gateway different from the other faults in the "Extended Device Malfunction" category.
RS-485 Communication Fault	Non-recoverable hardware fault within the communication controller associated with the RS-485 interface.
Gateway Operation in Progress	
Block transfer	When the checkbox is activated, this shows that block-transfer activity is going on in the WirelessHART gateway.
Delayed answer	When the checkbox is activated, this shows that delayed-answer activity is going on in the WirelessHART gateway, which can be related either to a buffer of the WirelessHART gateway or to a buffer of a connected device.
Self-test	This bit is associated with a self-test activity triggered by CMD 41. The checkbox remains activated until the activity has been completed.
File update	If required, the WirelessHART gateway can write persistent (i.e. non-volatile) information to its local file system. The checkbox remains activated as long as information is being written to the file system.
Start-up phase	At each power-up or software restart / reset (triggered by CMD 42 & 141), the WirelessHART gateway polls all devices within the Instrument List to check their communication statuses and to update their identity information. The checkbox remains activated until the start-up phase has been completed.
Extended List Changes	
Instrument List changed	This checkbox is activated whenever the Instrument List content is changing.
Active Device List changed	This checkbox is activated whenever the "Active Device list" content is changing. This is the case when a "communication loss" or a "communication recovered" event takes place for a device.
Cumulative Device Status These bits are set to 1 whenever the related status applies to one or more devices (or sub-devices) connected to the WirelessHART gateway.	
Primary Variable out of Limits	The PV is beyond its operating limits.
Non-Primary Variable out of Limits	A device variable not mapped to the PV is beyond its operating limits.
Loop Current Saturated	The loop current has reached its upper (or lower) endpoint limit and cannot increase (or decrease) any further.

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Parameter	Description
Loop Current Fixed	The loop current is being held at a fixed value and is not responding to process variations.
More status available	More status information is available via Command 48 (Read Additional Status Information).
Cold Start	A power failure or device reset has occurred.
Configuration Changed	An operation was performed that changed the device's configuration.
Device Malfunction	The device detected a serious error or failure that compromises device operation.

Cumulative Extended Device Status
These bits are set to 1 whenever the related status applies to one or more devices (or sub-devices) connected to the WirelessHART gateway.

Maintenance Required	One or more wireless devices require maintenance.
Device Variable Alert	One or more wireless devices have a device variable alert. This bit is set if any device variable is in alarm or warning state.
Critical Power Failure	One or more wireless devices have a power failure (e.g. battery low).

Device Operation in Progress
These bits are set to 1 whenever the related procedure is ongoing in one or more devices (or sub-devices) connected to the WirelessHART gateway. When an operation is ongoing, the WirelessHART gateway will return a "Busy" response code to any HART message of the host directed to the relevant device (or sub-device). These bits are not latched and simply reflect the current operation status.

"Configuration Changed bit reset" procedure	The "Configuration Changed bit" procedure is being performed at one or more devices.
"Sub-Device update" procedure	One or more sub-devices of WirelessHART adapters are being updated.
"Device update" procedure	One or more wireless devices are being updated.

Table 5.12   HART Parameters

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5.5 Engineering

The **Engineering** section consists of the following sections:

■ **Instrument List**
You can freely define an instrument list of all network devices before the devices actually join the network. Hereby you can make sure that a device is associated with the predefined I/O card number when the network is reformed or the WirelessHART Gateway is reset.

■ **Topology View**
You can upload a background image and arrange the WirelessHART devices in the image to set up the topology view.
Note that the instrument list must be available before you set up the topology view, because the set of WirelessHART devices is derived from the instrument list.
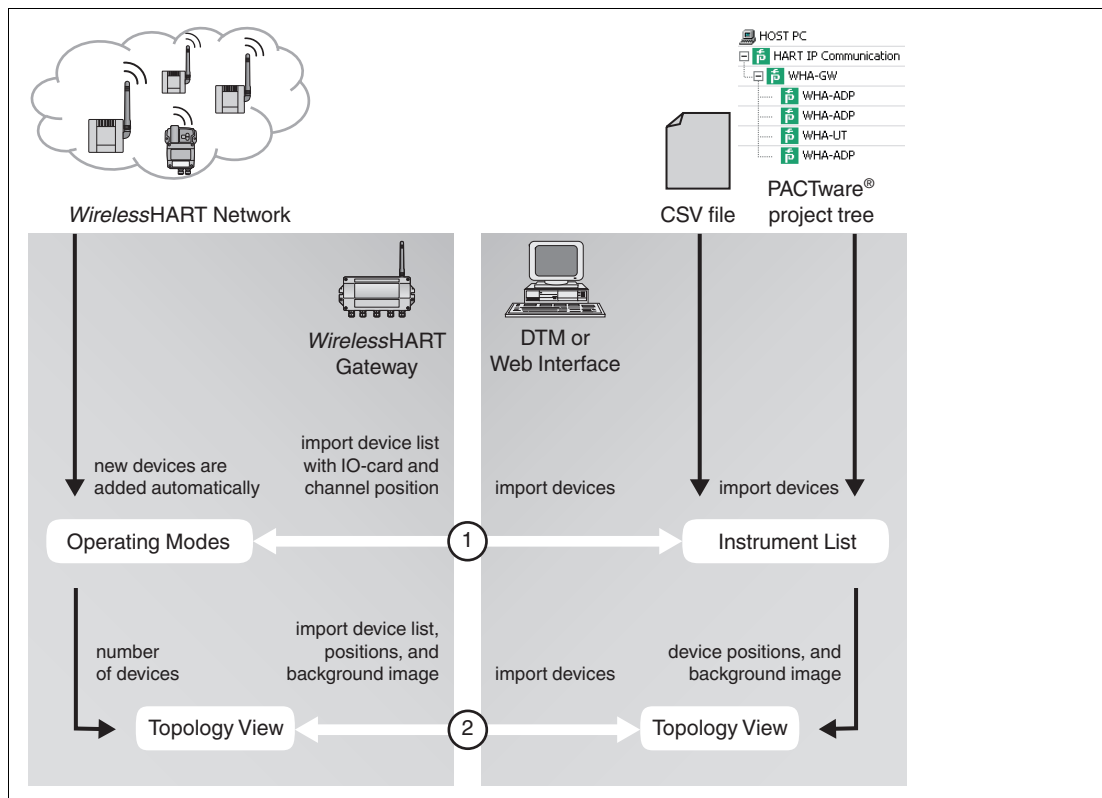

Figure 5.18   Relationship between the configuration options in the DTM or web interface and the data in the WirelessHART Gateway

1. The **Instrument List** you set up via the DTM or the web interface is not necessarily identical to the **Operating Modes** list of the WirelessHART Gateway.
    You can set up the **Instrument List** manually, import an existing list from a CSV file, import the devices from the PACTware® project tree, or import the devices from the **Operating Modes** list of the WirelessHART Gateway. You can freely edit the **Instrument List** in the DTM or web interface. Once the list of devices and their IO card and channel association is complete, you can write this information back to the **Operating Modes** list of the WirelessHART Gateway.
    The **Operating Modes** list contains all devices of the WirelessHART network and is constantly updated.
    If a new device joins the network, it is automatically inserted into the **Operating Modes** list. If the long tag or address of the new device matches an entry from the list, for example, an entry that you predefined using the **Instrument List**, the device is associated with the predefined values. If not, it is automatically associated with the next free IO card number and it will not appear in the **Instrument List** unless you import the device list from the **Operating Modes** list.

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2. In the DTM or web interface you can upload a background image and arrange the positions for all devices of the **Instrument List**. After you set up the topology view, you can write the information back to the WirelessHART Gateway.
If a new WirelessHART device joins the WirelessHART network, it is inserted at a default position by the WirelessHART Gateway. To rearrange new devices in the DTM or web interface, you can import the new device into the **Instrument List** or import the device list from the WirelessHART Gateway.

5.5.1 Instrument List

The instrument list is a copy of the **Operating Modes** list, which is currently active in the WirelessHART gateway and represents the virtual I/O system of the WirelessHART gateway. See chapter 2.1.3
Thus, unless the **Instrument List** is reloaded from the WirelessHART gateway, it may not necessarily be identical to the **Operating Modes** list that is currently active in the WirelessHART gateway.

By creating an instrument list before the devices actually join the network, you can make sure that a device is associated with a predefined I/O card number when the network is reformed or the WirelessHART gateway is reset. Note that the instrument list is used for editing the devices and that the cached values of the devices are located under **Measurement**.

For a detailed overview of the relationship between the configuration options in the DTM or web interface and the data in the WirelessHART Gateway, see chapter 5.5.

Note!

This list is stored in a non-volatile memory of the WirelessHART gateway. The card and channel number assignment will remain the same after a restart of the WirelessHART gateway or software.

Index	Long Tag	IO-Card	Channel	Device ID	Extended Device Type Code	
0	T209innen	1	0	00047B	5DE2	⊠
1	Test_Dev_574	3	0	658064	5DE1	⊠
2	Test_Dev_598	4	0	65806C	5DE1	⊠
3	T209aussen	5	0	0003D1	5DE2	⊠
4	Test_Device_604	6	0	6580A0	5DE1	⊠
5	-/-	6	1	1FCC5C	3704	⊠
6	Test_Dev_576	7	0	658048	5DE1	⊠
7	EH_SWA70_AN_FMR231	8	0	012345	11F0	⊠
8	WHA_ADP_AN_Positioner	9	0	61001D	5DE1	⊠
9	WHA-ADP-CorrTran	10	0	5C8030	5DE1	⊠
10	NEW_VEGA	7	1	F97A0B	62E2	⊠
11	CorrTran_Long_Tag_2	10	1	000000	5DE4	⊠
12	SAMSON3730	9	1	6BB623	42EF	⊠
13	MULTIDROP	11	0	610010	5DE1	⊠
14	5D0E	3	1	5E320A	5D0E	⊠
15	62E6	4	1	D1A240	62E6	⊠
16	40000003410057	2	0	00045A	5DE2	⊠
17	40000003410029	12	0	000443	5DE2	⊠
18	40000003410027	13	0	00044C	5DE2	⊠

Figure 5.19   Engineering > Instrument List

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Instrument List

Displayed Information	Description
Long Tag	Long tag of the device HART 5 devices and older devices do not support long tags. For those devices, the WirelessHART adapter uses the content of the **Message** field, which will be displayed here instead.
I/O-Card	Virtual I/O card number to which the device is mapped to. See chapter 2.1.3
Channel	Channel of the virtual I/O card the device is mapped to. The value 0 identifies a WirelessHART device or a WirelessHART adapter, while the value 1 identifies a wired device connected to a WirelessHART adapter.
Device ID	HART serial number that is assigned at manufacturing time and that differs for each HART device of a given type. The **Device ID** is used to build the HART long frame address.
Ext. Device Code	Extended device type code of the device Identifies the HART product family. Each product family is identified by a unique code.

Table 5.13   Instrument List

Caution!

System failure

If you click **Refresh** right after the device was switched on or reset, the system may stop responding.

If the device was switched on or reset, wait about 1 minute until the boot process is complete before you click **Refresh**.

Editing the Instrument List

Note!

When editing the instrument list, incomplete entries are highlighted in red. These errors must be corrected before you can apply the instrument list.
Warnings are highlighted in yellow.

1. To read the **Operating Modes** list from the WirelessHART gateway using the web interface, click **Refresh**. If using the DTM to configure the WirelessHART gateway, select the WirelessHART gateway in the project tree and choose **Device > Load from device**. If using the DTM to configure the WirelessHART gateway, you can also import the devices of the project tree by clicking **Import Project Tree** (DTM).

2. To add a device, click into the last row of the instrument list and specify the device parameters. Press **Enter** to confirm your entries.
   You can also edit existing entries by clicking into the corresponding cells of the instrument list.

3. To remove a device from the instrument list, click the ☒ X-sign at the end of the row. The respective I/O card becomes vacant again.

4. To write the current instrument list to the WirelessHART gateway using the web interface, click **Apply**. If using the DTM to configure the WirelessHART gateway, select the WirelessHART gateway in the project tree and choose **Device > Store to device**.
   Note that the consistency of the instrument list is not checked before it is applied.

To export the current instrument list to a CSV file, click **Export** (web interface) resp. **Export CSV** (DTM).

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To load the instrument list from a CSV file, click **Import** (web interface) resp. **Import CSV** (DTM).

For more information on the structure of the CSV file, see chapter 12.

Note!

If a WirelessHART Gateway is replaced with a new one, we recommend that you use the export/import functionality to transfer the settings from the old WirelessHART Gateway to the new one. Otherwise, the new WirelessHART Gateway rebuilds the WirelessHART network from scratch by default, which means that the virtual HART I/O structure in the instrument list will differ from the structure that has been defined in the old WirelessHART Gateway.

Furthermore, if using the DTM to configure the WirelessHART Gateway, you can prepare the instrument list offline and export the configuration into a CSV file. Once the WirelessHART Gateway is available on site, you can import the prepared configuration via the CSV file.

5.5.2 Security: Access Control List, Temporary Join Key

Whitelist for Access Control

The WirelessHART gateway supports the "whitelist" security mode. The whitelist is an additional security feature to ensure that only authorized personnel can add a new device. For example if an external company sets up the network by using this feature, this can help to ensure that no further changes in consequence of the setup take place.

New WirelessHART devices can only be added to the network provided that their addresses are listed in the whitelist and can be identified.

If needed, you can manipulate the join key as follows:

- Change the join key permanently for all devices connected to the network. For more information on the join key, .

- Define a temporary join key that is automatically invalidated after a defined period of time. This can be used for temporary devices needed for maintenance reasons.

You can monitor the process of this change until the join key has been successfully manipulated as required.

Defining or Changing a Whitelist

1. Go to Engineering > Security.

2. In order to copy the network to the whitelist, click on **Transfer Network to Whitelist**-

   ↳ A confirmation request dialog opens: The whitelist will be changed. The current whitelist is flushed and cannot be recovered.

3. Confirm with **Yes**.

   ↳ The new devices in the whitelist table are check marked. The whitelist is changed: The specified devices in the device list below receive a "Whitelisted" check mark (1). The whitelist is generated.

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4. Next, set the Network Access Mode pull-down menu from **Open** to **Whitelist** and confirm with **OK**.

↪ Now, only the listed devices that are check-marked as whitelisted can join and re-join the network.
Any attempts to enter the network, even with a valid network ID and join key, in order to add an unauthorized device will be rejected.
The network is logged.

Assigning a Temporary Join Key to Add Devices

A temporary join key can be useful for adding devices e. g. from subcontractors for maintenance purposes within limited periods. This way, you do not need to reveal the regular join key of your network.

1. In order to open your network: In the **Network Access Mode** pull-down menu, select **Open**.

2. Enter the temporary join key. Use the **Temporary Join Key Part 1 ... 4 (HEX) fields**.

3. Select a **Temporary Join Mode Time** from the pull-down menu.

↪ During this time, other devices are entitled to join the network. The whitelist preview grows dynamically as the devices are added to the list.

4. Start the temporary join mode. Use the double arrow buttons to **Start Temporary Join Mode**.

5. Copy devices to the whitelist and close the network again. See section "Defining or Changing a Whitelist" above.

5.5.3 Stale Value Detection (Early Warning)

The web interface offers the configuration of notification limits in case the value of a cached dynamic variable or the command 48 status information of a wireless device is going stale. This way, you are informed promptly in case the variable or information is not updated at the expected rate, i. e., at the burst rate of the field device.

The WirelessHART gateway reads the expected burst rates from each field device and "time-stamps" each burst message at the time of receipt. This way, the age of each cached value can be calculated as a percentage value of the existing burst rate.

From this information, the WirelessHART gateway can determine whether a message is overdue or not: The gateway starts to count the age of the last sent value until the gateway receives the next value from the field device and then starts to count again, and so on.

Tip

Provided that the field devices have reasonable burst rates, the specification of age threshold limits enable you to detect communication loss very early.

Example

You can define a warning and an error limit, e. g., 150 % and 300 % of the age threshold value. A burst alarm is generated if these defined values are exceeded. In the **Measurement List** of the web interface, you can check the age of the age threshold value. In this menu, the gateway indicates the age threshold value in percent in the colors green (on time), yellow (overdue), and red (error).

■ **Good value:** Value is no older than 150 % of the burst rate. The value is indicated in green.

■ **Age Threshold Warning:** Value has exceeded 150 % of the burst rate in this example. The value is indicated in yellow.
The warning limit is typically used to identify temporary communication problems.

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■ **Age Threshold Error:** Value has exceeded 300 % of the burst rate in this example. The value is indicated in red.
The age threshold error limit is typically used to indicate a - likely - complete loss of the device, e. g., due to a battery removal. In case of an error condition, it is possible to set additional individual substitution values for each variable for application-related failure handling. For more information, .

▶ **Viewing the Age Threshold Value Status**

In the WirelessHART gateway web interface, go to **Engineering > Measurement List**.

Figure 5.20   Engineering > Measurement List, viewing the age threshold value limits

5.5.4   Topology View

Here you can set up the topology view that is displayed under **Diagnostics > Wireless Communication > Topology View**. You can upload background images in any common graphic format, such as JPG or GIF. For example, you can use a satellite photo, a floor plan, or a diagram in which you want to group the devices

Note!

The **Instrument List** must be available before you set up the topology view, because the set of WirelessHART devices is derived from the **Instrument List**.

For a detailed overview of the relationship between the configuration options in the DTM or web interface and the data in the WirelessHART gateway, .

Figure 5.21   Engineering > Topology View

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> **Caution!**
>
> System failure
>
> If you click **Refresh** right after the device was switched on or reset, the system may stop responding.
>
> If the device was switched on or reset, wait about 1 minute until the boot process is complete before you click **Refresh**.

Note!

Required Display Resolution for the Topology View

In order to guarantee a fully visible, undistorted, and uncropped background image, we recommend to set the display resolution to a 4:3 proportion within the following pixel resolution range:

800 x 600 ... 1600 x 1200

Set Up the Topology View

1. To retrieve the devices from the **Operating Modes** list of the WirelessHART gateway using the web interface, click **Refresh**. If using the DTM to configure the WirelessHART gateway, select the WirelessHART gateway in the project tree and choose **Device > Load from device**. Note that reloading the device information takes some time.

2. Click **Select Map** to select a background image for the topology view.

3. Click **Browse** to select the background image.

4. Click **Upload Map** to upload the background image.

5. If required, edit the coordinates of the image origin in the **Horizontal image origin** and **Vertical image origin** boxes.

6. Enter a value in the **Resolution** box to scale the background image, for example 1 m/pixel. Note that you can set the resolution only after you have uploaded an image.

7. Arrange the WirelessHART devices in the topology view by dragging and dropping the devices to a selected position. Note that for a more accurate positioning you can use the slider to zoom in or out of the topology view. To reset the zoom to its default value, click **Reset Zoom**.

8. To write the current topology view to the WirelessHART gateway using the web interface, click **Apply**. If using the DTM to configure the WirelessHART gateway, select the WirelessHART gateway in the project tree and choose **Device > Store to device**.

To export the current devices and their positions to a CSV file, click **Export** (web interface) resp. **Export CSV** (DTM).

To load a list of devices and their positions from a CSV file, click **Import** (web interface) resp. **Import CSV** (DTM).

For more information on the structure of the CSV file, see chapter 12.

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5.6 Additional Functions

▶ Accessing the Additional Functions Window

1. If using the DTM and PACTware, right-click the device in the project tree, select **Additional functions** and choose the desired function.

2. If using the web interface, select **Additional Functions** in the navigation area on the left.

5.6.1 Print Engineering Menu

In the DTM, all the settings of the WirelessHART gateway Engineering menu can be printed out. This provides a quick and easy way to get a printout of the instrument list or the network properties, etc.

▶ Printing the Engineering Menu

In the DTM select **Device > Print**

5.6.2 Set DTM Address

The table in the **Set DTM address** window shows the WirelessHART devices configured in the PACTware project and their DTM addresses. The DTM address is the device long tag as specified in the DTM of the device (offline data record). The DTM address is also displayed in the project tree structure of the PACTware project.

Note!

The **Long Tag** parameterized in the **Set DTM Address** window must be identical with the **Long Tag** of the same device parameterized in the **Set device address** window. See chapter 5.6.3
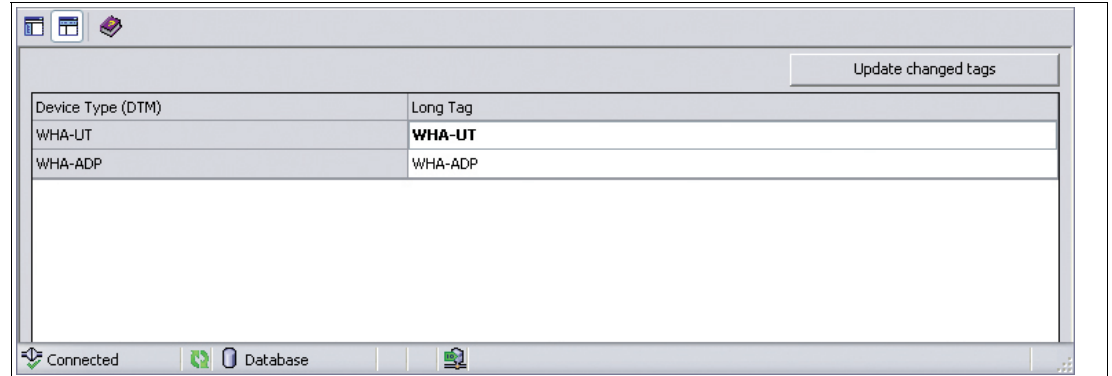Otherwise the DTM is not able to establish a connection to the device.

Figure 5.22   Additional Functions > Set DTM address

▶ Changing the DTM address

1. Place the cursor inside a cell of the **Long Tag** column.

2. Change the device long tag as required. You may change the long tags of several devices at once, if needed.

3. Close the DTM dialogs of the devices whose long tags are to be changed.

4. To apply the new DTM address(es) press **Update changed tags**.

   ↪ The new DTM addresses are displayed in the project view of PACTware.

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5.6.3 Set Device Address

The table in the **Set device address** window shows the WirelessHART devices in the network. The device address is the device long tag stored in the device.

Note!

Additional functions > Set device address is available only online, while the connection to the WirelessHART gateway and the WirelessHART device(s) is active.

Note!

The **Long Tag** parameterized in the **Set Device Address** window must be identical with the **Long Tag** of the same device parameterized in the **Set DTM address** window. See chapter 5.6.2
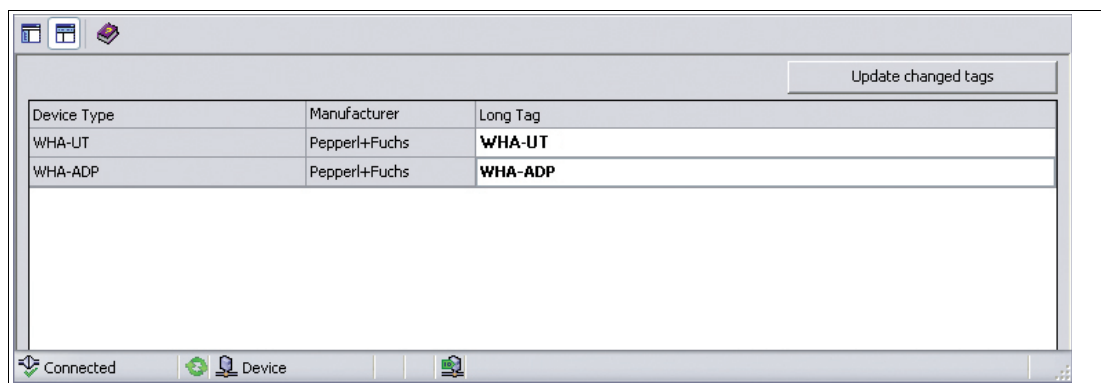Otherwise the DTM is not able to establish a connection to the device.

Figure 5.23   Additional Functions > Set device address

Changing the device address

1. Place the cursor inside a cell of the **Long Tag** column.
2. Change the device long tag as required. You may change the long tags of several devices at once, if needed.
3. To apply the new DTM address(es) press **Update changed tags**.
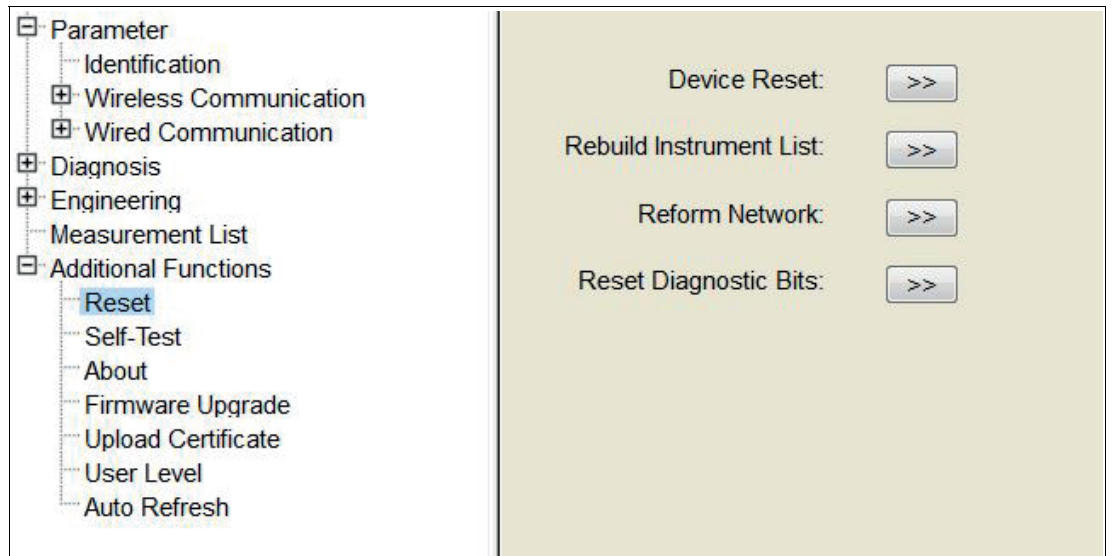
   ↳ The new DTM addresses are stored to the devices.

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5.6.4 Device Reset

Figure 5.24   Additional Functions > Device Reset

Reset Options

Parameter	Description
Device Reset	Restarts the software of the WirelessHART gateway without any impact on the established network (which is not reformed). This function does not set the parameters of the WirelessHART gateway back to their default values. It restarts the WirelessHART gateway software only.
Rebuild Instrument List	Regenerates the instrument list from scratch. The existing instrument list is overwritten. Note that the MODBUS addresses of the devices in the network will be changed by resetting the instrument list. We recommend that you create a backup of the current instrument list before rebuilding a new instrument list.
Reform Network	Restarts and re-establishes the network. For example, this function is needed to activate a new network ID. Depending on the size of the network, this process may take several minutes. This function does not set the parameters of the WirelessHART gateway back to their default values. It restarts the network only.
Reset Diagnostic Bits	Resets the HART parameters under **Diagnostics > Wired Communication > HART** to its default values.

Table 5.14   Reset Options

5.6.5 Self Test

After pressing the **Perform Self-Test** button in the **Additional Functions > Self Test** menu the device carries out a self test.

The results of the self test can be seen in the **Diagnostics** menu. See chapter 5.4

5.6.6 About

Additional Functions > About displays information about the device, its manufacturer, and its firmware version.

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5.6.7 Firmware Upgrade

Note!

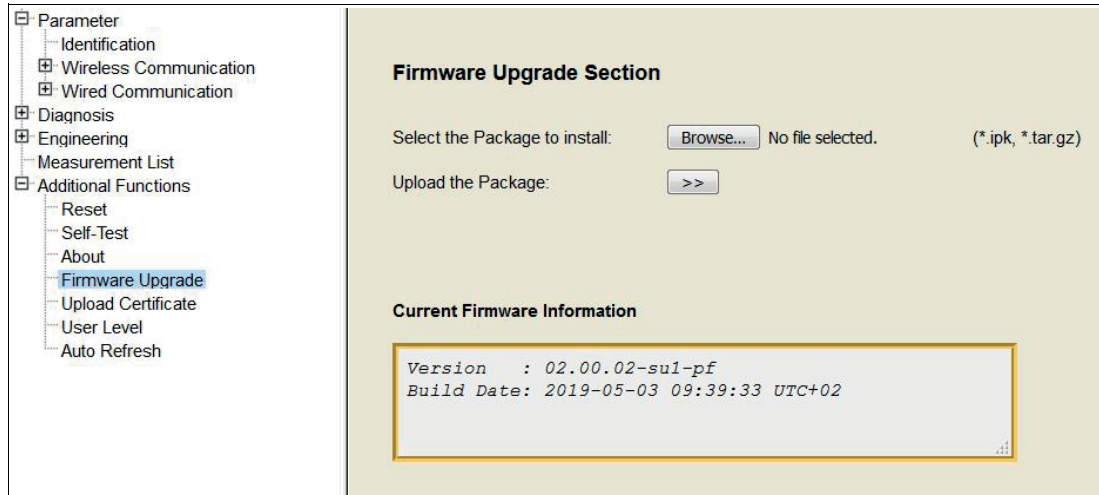This configuration option is only available in the web interface.

Figure 5.25   Additional Functions > Firmware upgrade

Upgrading the Firmware

1. Choose **Additional Functions > Firmware Upgrade**.

2. Click **Browse** to choose the firmware upgrade package (*.ipk) from your hard drive.

3. Click **Upload the Package**.

4. To install the firmware upgrade, press **Install the Package**. You can also abort the upgrade process by clicking **Discard Upgrade**.

   ↳ The installation process may take a while. When the installation is finished, **Installation Successfully Completed** is displayed.

5.6.8 Change Password

Note!

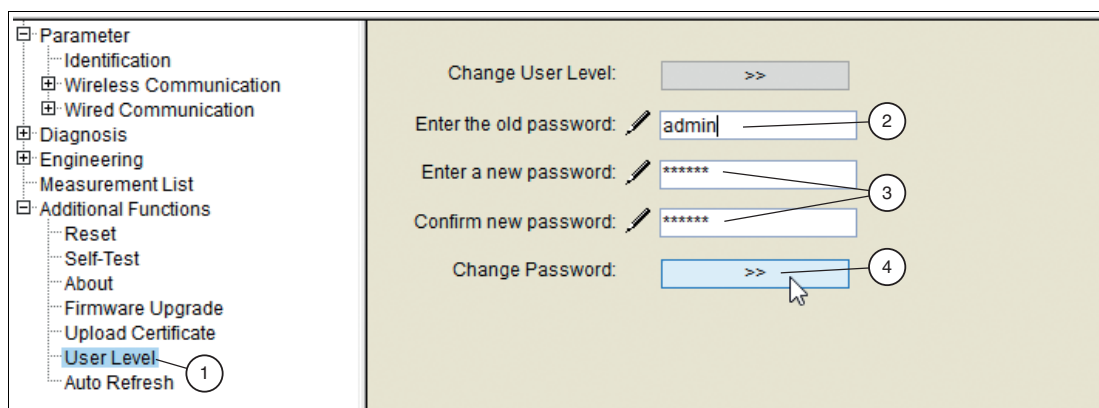This configuration option is only available in the web interface.

Figure 5.26   Changing Password

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The connection to the web interface is made using a secure connection (HTTPS) which requires a user name and a password. The factory default settings are:
User name: admin
Password: admin

You can change both user name and password in the web interface.

Changing the Password

1. Log on to the web interface of the WirelessHART gateway using the user name for which you want to change the password.

2. Choose **Additional Functions > User Level** (1).

3. Enter the old password into the corresponding fields (2).

4. Enter a new password into the corresponding fields and repeat your input (3).

5. To apply the new password, click **Change Password** (4).

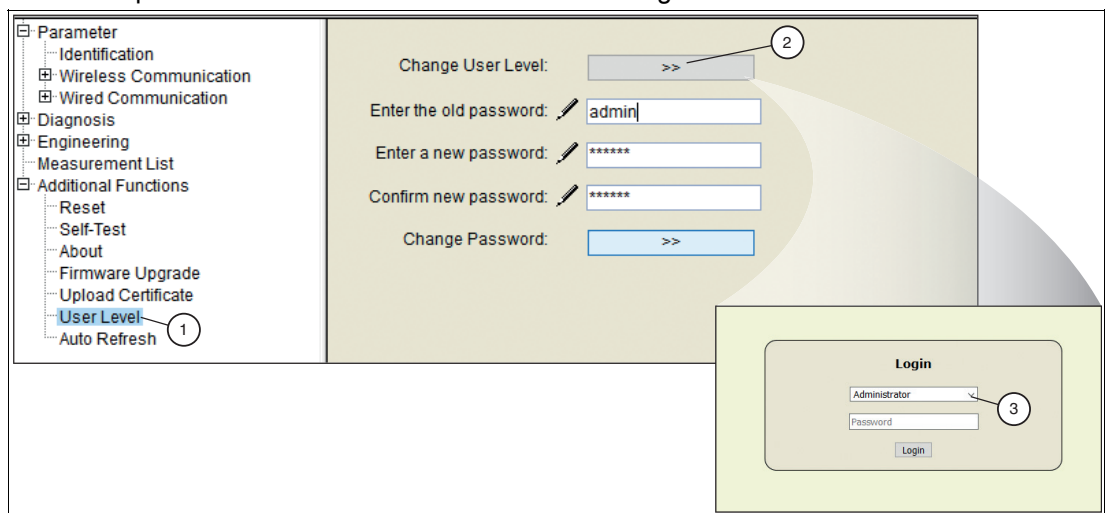   ↳ The password for the current user has been changed.

Figure 5.27   Changing User Level

Changing User Level

1. Choose **Additional Functions > User Level** (1).

2. To change the user level, click on the button**Change User Level** (2).

   ↳ The "Login Page" opens.

3. Select your user level (3). You can choos between "Administrator" and "Operator" level.

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5.6.9 Upload Certificate for HTTPS Connection

You can install a trusted certificate issued by a certification authority, such as TC TrustCenter, Thawte, or VeriSign.

A digital certificate is an electronic document that binds a public key with an identity, for example, an organization or an user. The binding between a public key and the identity is done by a signature. This signature can be self-signed or authenticated by a certification authority. The WirelessHART gateway is delivered with a self-signed certificate for the HTTPS connection. Because the web browser cannot verify the authenticity of a self-signed certificate, some web browsers display the following (or a similar) warning message in the address bar:

Certificate Error

Note!

This configuration option is only available in the web interface.
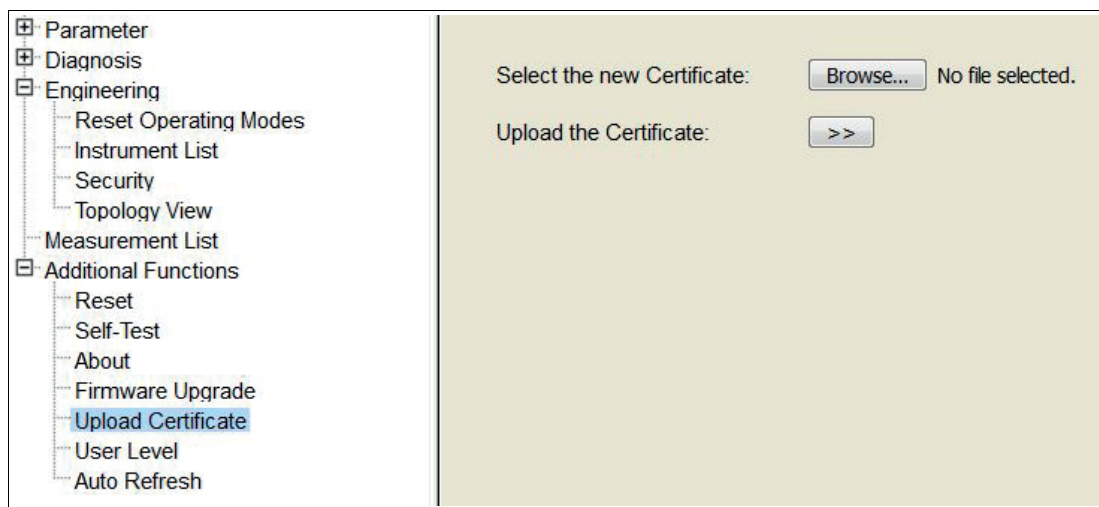

Figure 5.28   Additional Functions > Upload Certificate

Install a Trusted Certificate

Note!

Prerequisites:

- You need a certificate and a private key from a trusted authority, such as TC TrustCenter, Thawte, or VeriSign.

- Both files must comply with the following standard: X.509 Ver. 3

1. Click **Browse** and select the certificate file from the certification authority.

2. Click **>>** to upload the certificate.

   ↳ The **Upload Private Key** option appears.

3. Click **Browse** and select the private key from the certification authority.

4. Click **>>** to upload the private key.

   ↳ The **Change Certificate and Private Key** option appears.

5. Click **>>** to install the certificate and private key.

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The new certificate and private key have been successfully installed

Please, reboot the gateway for the change to take effect!

Figure 5.29   Installation confirmation

6. Go to **Additional Functions > Device Reset** and perform a device reset for the changes to take effect.

If the trusted certificate has been installed successfully, the address bar in the web browser displays a padlock icon:

This indicates that the web interface of the WirelessHART gateway is a trusted site.

5.6.10   Auto Refresh

All the parameter values of the WirelessHART gateway web interface and DTM are automatically refreshed at a default interval of 60 s.
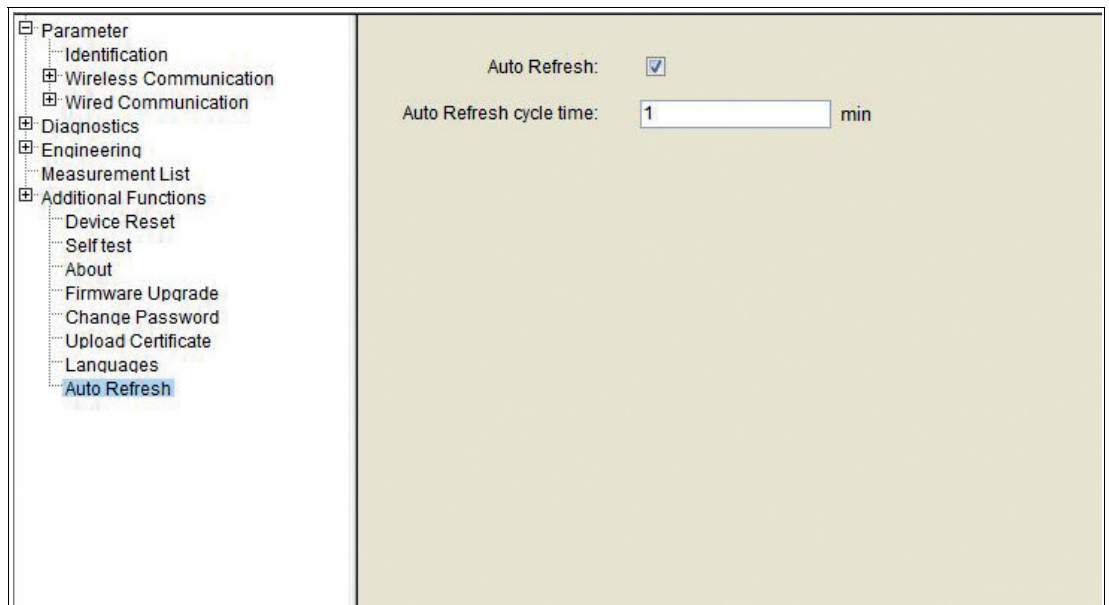
Figure 5.30   Additional Functions > Auto Refresh

Adjusting or Deactivating Auto Refresh

Select **Auto refresh** and choose a setting between 10 s ... 60 min.
Alternatively deselect **Auto refresh** altogether if required.

5.7 Measurement

The measurement list displays a comprehensive overview of all cached parameters and values of all sub devices.

Note!

This list is stored in a non-volatile memory of the WirelessHART gateway. The card and channel number assignment will remain the same after a restart of the WirelessHART gateway or software.

Note!

Please keep in mind that the dynamic values of each sub device (analogue value, PV, SV, TV, QV) are cached by the WirelessHART gateway only if the respective sub device publishes those values. See chapter 2.1.4

After a network restart, the **Operating Modes** list needs time to rebuild. During this time, some information is set to 0 or replaced by wildcard characters.

Figure 5.31   Measurement List

If required, click **Refresh** to reload the values of all sub devices.

Caution!

System failure

If you click **Refresh** right after the device was switched on or reset, the system may stop responding.

If the device was switched on or reset, wait about 1 minute until the boot process is complete before you click **Refresh**.

Note!

If using the DTM and PACTware to configure the WirelessHART gateway, the following data is available only during online parameterization.

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General Data

Displayed Information	Description
Long Tag	Displays the long tag of the device. HART 5 devices and older devices do not support long tags. For those devices, the WirelessHART adapter uses the content of the **Message** field which will be displayed here instead.
I/O Card	Indicates the virtual I/O card number to which the device is mapped to. See chapter 2.1.3
Channel	Indicates the channel of the virtual I/O card that the device is mapped to. See chapter 2.1.3 The value 0 identifies a WirelessHART device or a WirelessHART adapter, while the value 1 identifies a wired device connected to a WirelessHART adapter.
Device Type	Displays the device type as registered at the HCF.
Status	The following communication statuses exist: ❌ communication not possible 🔧 communication possible, device not identified 🔧 (flashing) communication possible, identification ongoing ✅ device connected and identified
Dev. Status	Note that the device status displayed in the list may differ from the actual device status because the HART status bits may be interpreted differently. The following device statuses exist: 🔧 maintenance required ⚠ out of specification 🔧 check function ❌ failure

Measured Values

Displayed information	Description
Loop Current	Analogue value of the primary variable
PV	Value of the primary variable
SV	Value of the secondary variable
TV	Value of the tertiary variable
QV	Value of the quaternary variable

Table 5.15   Measured Values

Age

The WirelessHART gateway reads the expected burst rates from each field device and "timestamps" each burst message at the time of receipt. This way, the age of each cached value can be calculated as a percentage value of the existing burst rate.

From this information, the WirelessHART gateway can determine whether a message is overdue or not: The gateway starts to count the age of the last sent value until the gateway receives the next value from the field device and then starts to count again, and so on.

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You can define a warning and an error limit, e. g., 150 % and 300 % of the age threshold value. A burst alarm is generated if these defined values are exceeded. In the Measurement List of the web interface, you can check the age of the age threshold value. In this menu, the gateway indicates the age threshold value in percent in the colors **green (on time), yellow (overdue), and red (error)**.

5.8 EtherNet/IP Configuration

The WirelessHART Gateway acts as an EtherNet/IP adapter and makes the data of HART devices available via EtherNet/IP. To do so, the WirelessHART Gateway can establish up to 10 cyclic data transfer connections with 4 HART devices per connection. Thus, the WirelessHART Gateway provides the data of a maximum number of 40 HART devices via cyclic connections. In addition to the cyclic connections, the WirelessHART Gateway can establish direct data transfer connections via HART tunneling for special tasks.

Steps to Setup the EtherNet/IP Connection

1. Setup the WirelessHART network. Use a cable connection to define the **Network ID** and **Join Key** for all WirelessHART devices.
   See chapter 5.2

2. Define the HART descriptors for all HART devices (field devices and WirelessHART devices) that shall be monitored via EtherNet/IP according to the dedicated naming convention.
   See chapter 5.8.1

3. Define the burst commands for all HART devices (field devices and WirelessHART devices) that shall be monitored via cyclic EtherNet/IP connections.
   See chapter 5.8.2

4. Integrate the WirelessHART Gateway in your control system by installing the Add-On Profile (AOP) or EDS file.
   See chapter 5.8.3

5. Setup the cyclic or direct data transfer with the HART devices.
   See chapter 5.8.4
   See chapter 5.8.7

5.8.1 Naming Convention for HART Descriptors

The data assignment in the EtherNet/IP protocol is performed via the HART descriptor. Therefore, all HART devices (field devices and WirelessHART devices) that shall be available via EtherNet/IP must follow a dedicated naming convention for the HART descriptor. If you want to access the data of a WirelessHART Adapter itself, for example, if you want to read its battery status, the HART descriptor of the WirelessHART Adapter must follow the same naming convention.

The naming convention for the HART descriptor applies for the cyclic and direct data transfer connections.

Use the DTM of the corresponding HART devices to define its HART descriptors.

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HART Descriptor Naming Convention

Maximum length for HART descriptors: 16 characters			
You can freely choose the first 13 characters.	The last 3 characters of the HART descriptor must contain a unique identifier that is used to assign a HART device with an EtherNet/IP connection.		
	@ Each identifier starts with an @ sign.	A ... J for **cyclic** connections	0 ... 3
		Each letter designates one cyclic connection and each number designates a HART device. Because the WirelessHART Gateway can establish up to 10 cyclic connections with 4 HART devices per connection, the namespace for cyclic connections starts with A0 and ends with J3.	
		A ... Z for **direct** connections	0 ... 3
		In addition to the cyclic connections, the WirelessHART Gateway can establish direct connections to a multitude of HART devices. The naming convention of the cyclic connection applies to direct connections as well, except that the number is not limited. Therefore the namespace for direct connections starts with A0 and ends with Z3. Note that the devices between K0 and Z3 can only be accessed via direct connections.	

The WirelessHART Gateway automatically occupies the first identifier @A0 regardless of the HART descriptor that has been defined.

Example!

If a WirelessHART network consists of a WirelessHART Gateway, 4 HART field devices, and 4 WirelessHART Adapters that shall be monitored via EtherNet/IP as well, the HART descriptors can look as follows.

- HART field devices:
  DESC01@A1
  DESC02@A2
  DESC03@A3
  DESC04@B0

- WirelessHART Adapters:
  DESC05@B1
  DESC06@B2
  DESC07@B3
  DESC08@C0

Because the WirelessHART Gateway automatically occupies the @A0 identifier, the remaining identifiers for the first cyclic connection are @A1, @A2, and @A3. The remaining devices must be assigned to new cyclic connections because each connection can incorporate a maximum number of 4 devices. The resulting identifiers are @B0, @B1, @B2, @B3, and @C0.

Tip

If you got a large number of HART field devices, you can use the identifiers from @A1 to @J3 for the HART field devices and you can use the identifiers from @K0 to @Z3 for the WirelessHART Adapters. This way, you can monitor the data of the HART field devices via **cyclic** connections and monitor the battery status of the WirelessHART Adapters only once a day via **direct** connections.

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Tip

We recommend that you assign the HART descriptors in sequence, without leaving gaps in between. For example, if the HART descriptors for 3 HART devices are set to `@A1`, `@A2`, and `@J0`, all 10 cyclic connections must be established to access the HART device `@J0`, which causes unnecessary network traffic.

5.8.2 Burst Commands for Cyclic Data Transfer

All variables can be divided into two groups: static variables that do not change often, such as configuration data, and dynamic variables that may change often, such as process data. Static variables are automatically polled by the WirelessHART Gateway whereas dynamic variables are not automatically polled. As a result, all dynamic variables required for cyclic data transfer must be bursted by the HART devices.

Note!

According to the HART specifications for WirelessHART devices, the burst configuration of wired devices has to be set up using the bridge device (WirelessHART Adapter) that connects the wired devices to the WirelessHART network. Burst commands that are set up directly on the wired device are not recognized and cause the .NoCmd48BurstConfigured bit and the .NoDataBurstCommandConfigured bit to be set. See chapter 5.8.6

Use the DTM of the corresponding WirelessHART devices to make them burst the following HART commands:

- Command 9 (Read Device Variables with Status)
- Command 48 (Read Additional Status)

As an alternative to command 9 you can also burst command 3 (Read All Dynamic Variables and Loop Current) or command 33 (Read Device Variables)

Variables Provided by these HART Commands

Cyclic Data Variable	Contained in HART Command			
	3	9	33	48
PV, SV, TV, QV	x	x	x	
PV Status, SV Status, TV Status, QV Status		x		
PV Unit, SV Unit, TV Unit, QV Unit	x	x	x	
Additional Device Status Information				x

To make the complete cyclic data valid, Commands 9 and 48 have to be bursted. As alternative to Command 9, the command 3 (Read All Dynamic Variables and Loop Current) or 33 (Read Device Variables) can be bursted.

The .NoDataBurstConfigured bit contained in DeviceStatus_Struct indicates that none of the Commands 3, 9 or 33 is bursted. The .NoCmd48BurstConfigured bit contained in DeviceStatus_Struct indicates that Command 48 is not bursted. Variables that are not retrieved through burst messages are set to the invalid. See table "Data Block of the WirelessHART Gateway" on page 93 see table "Data Block of HART Devices" on page 94

Tip

You can review the burst commands of all HART devices in the WirelessHART network under **Diagnostics > Wireless Communication > Burst Lists**. See chapter 5.4.2

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5.8.3 Integration in PLC via EtherNet/IP

Rockwell Automation ControlLogix® Control System

Integration of the WirelessHART Gateway in the Logix Controller is performed via an Add-On Profile (AOP).

You can access all software and documentation on the WirelessHART Gateway at http://www.pepperl-fuchs.com.

After installation of the Add-On Profile the WirelessHART Gateway is accessible via the device catalog of the Logix Controller.

Other Control Systems

You can also integrate the WirelessHART Gateway into a different control system by using an Electronic Data Sheet (EDS). The EDS file is used by network configuration tools to help you to identify and commission a product on a network.

You can access all software and information on the WirelessHART Gateway at http://www.pepperl-fuchs.com.

For more information on how to install an EDS file and integrate a new device, see the corresponding documentation of your control system vendor.

5.8.4 Cyclic Data Transfer in Logix Controller

► Configure IP Address of the WirelessHART Gateway

1. Double-click the WirelessHART Gateway in the **Controller Organizer** window of the Logix controller.
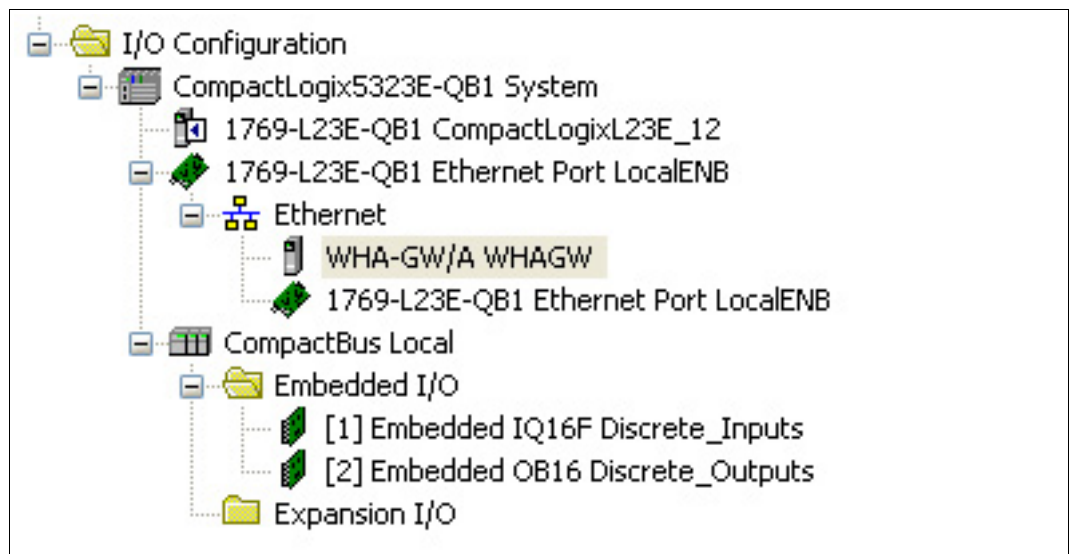

Figure 5.32 **Controller Organizer**

↳ The Add-On Profile of the WirelessHART Gateway opens.
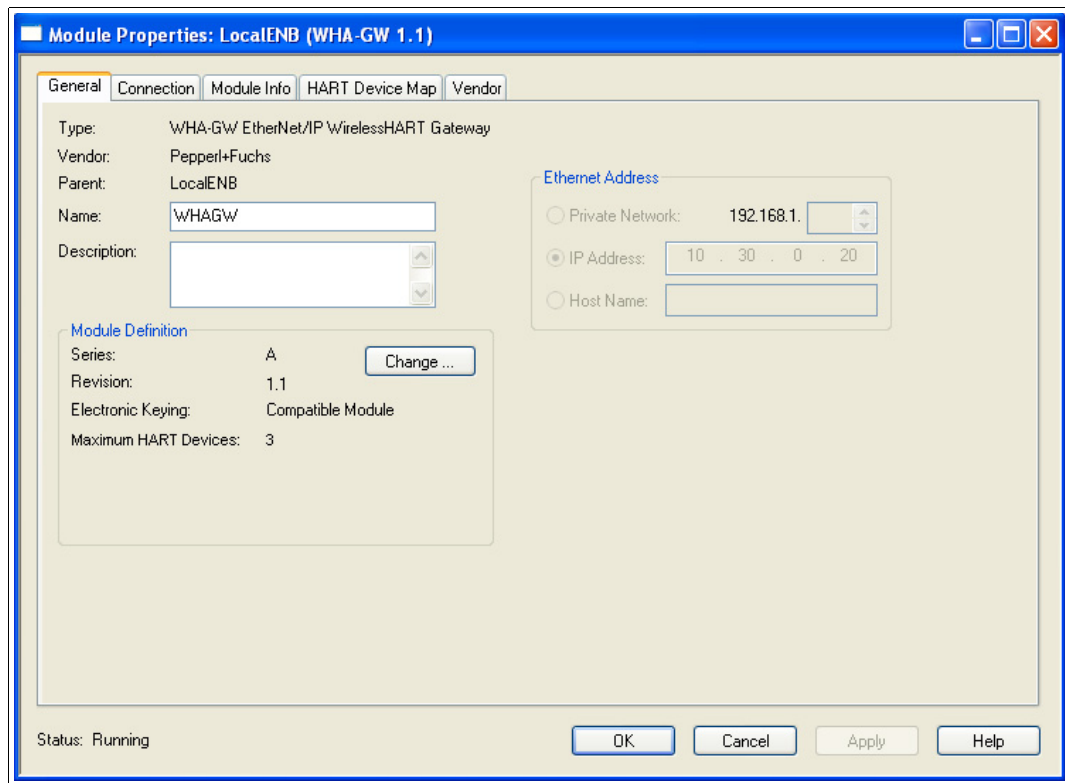
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Figure 5.33   **Module Properties** window

2. Enter the IP address of the WirelessHART Gateway in the **Ethernet Address** area on the **General** tab.

Configure Maximum Number of HART Devices

1. Select the **General** tab of the Add-On Profile of the WirelessHART Gateway.

2. Click **Change** in the **Module Definition** area on the **General** tab.

↪ The **Module Definition** window opens. This window enables you to define specific parameters for the cyclic EtherNet/IP connection as well as the number of HART devices.
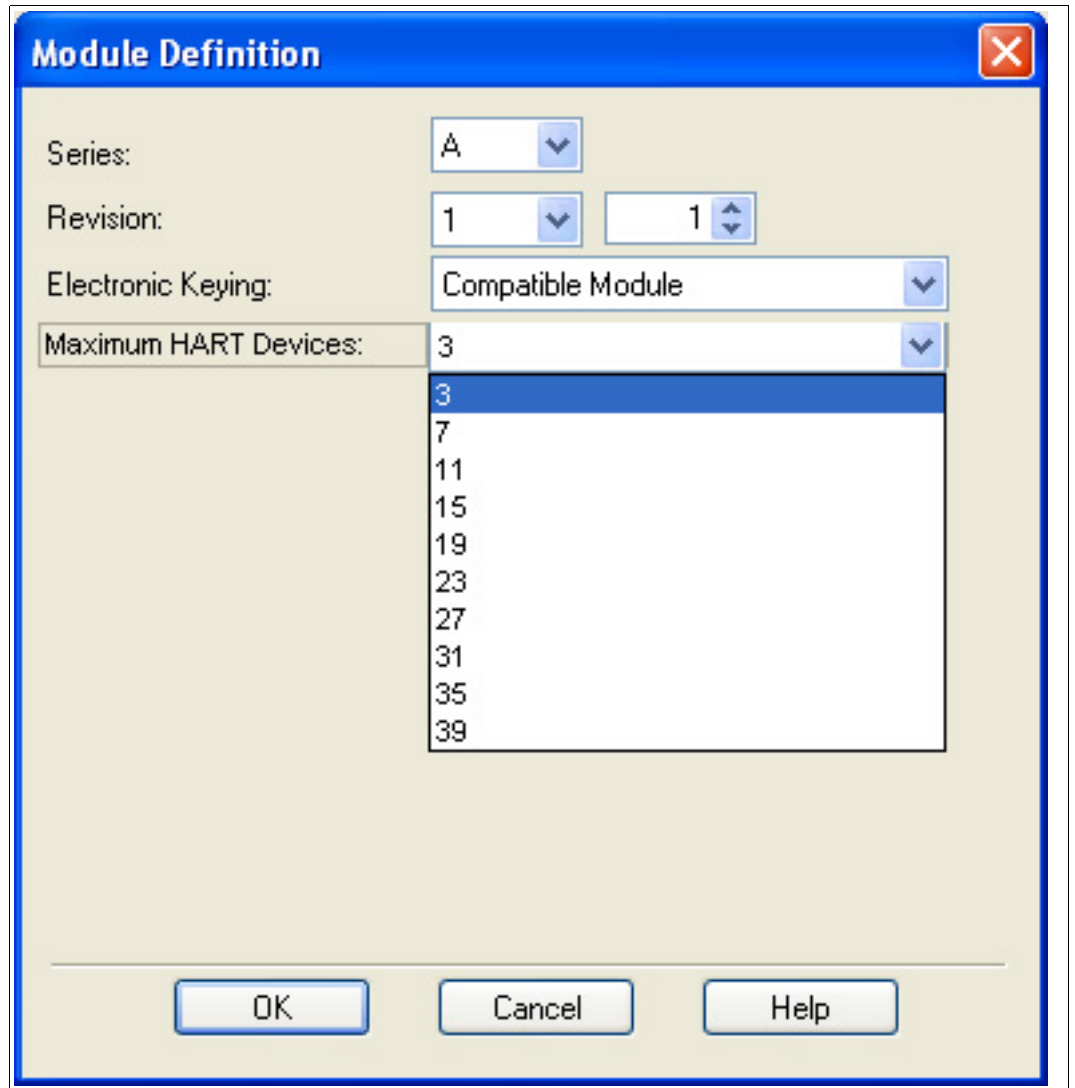
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Figure 5.34   **Module Definition** window

3. Select the maximum number of HART devices that shall be available via EtherNet/IP from the drop-down list.
    The WirelessHART Gateway establishes 10 cyclic data transfer connections with 4 HART devices per connection. Thus, the number of HART devices defines the number of connections. Because the WirelessHART Gateway is automatically included in the first connection, only 3 more HART devices can be accessed via the first connection. For example, if you want to access 4 HART devices, select **7** from the drop-down list to establish a second connection for the fourth HART device.
    Note that the HART descriptors of all HART devices that shall be available via EtherNet/IP must follow a dedicated naming convention. See chapter 5.8.1

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Review Connected HART Devices

Select the **HART Device Map** tab of the Add-On Profile of the WirelessHART Gateway.

↳ The HART device map is displayed.
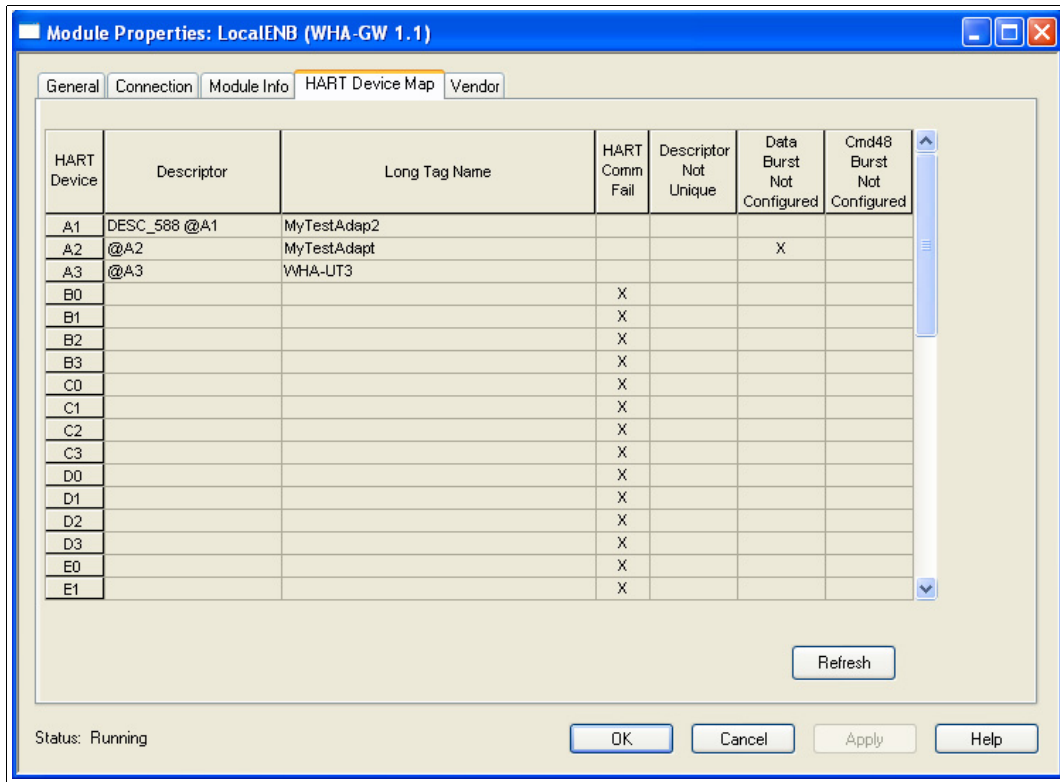

Figure 5.35   **Module Properties** window

If required, click **Refresh** to reload the HART device map.

Note!

The update of the HART device map may take up to 10 minutes. If a device is connected or disconnected, it may take up to 10 minutes until it appears or disappears from the list.

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HART Device Map

Displayed Information	Description
HART Device	Displays the identifier of the HART device. This identifier must be identical to the last 3 characters of the HART descriptor. See chapter 5.8.1
Descriptor	Displays the HART descriptor of the device. The HART descriptor must follow a dedicated naming convention. See chapter 5.8.1
Long Tag Name	Displays the long tag name of the device.
HART Comm Fail	This bit is set, if a device is not available, for example, if the connection to the device cannot be established. Note that if the maximum number of HART devices specified in the **Module Definition** window is higher than the actual number of HART devices, the **HART Comm Fail** bit is set for the missing devices.
Descriptor Not Unique	This bit is set if the HART descriptor of the device is not unique. Use the DTM of the corresponding HART devices to change the HART descriptors.
Data Burst Not Configured	This bit is set if the HART Command 9 (alternatively Command 3 and Command 33) is not bursted by the HART device. Use the DTM of the corresponding HART devices to make them burst Command 9 (alternatively Command 3 and Command 33). See chapter 5.8.2
Cmd48 Burst Not Configured	This bit is set if the HART Command 48 is not bursted by the HART device. Use the DTM of the corresponding HART devices to make them burst Command 48. See chapter 5.8.2

Display Available Variables

Double-click **Controller Tags** in the **Controller Organizer** window of the Logix controller.
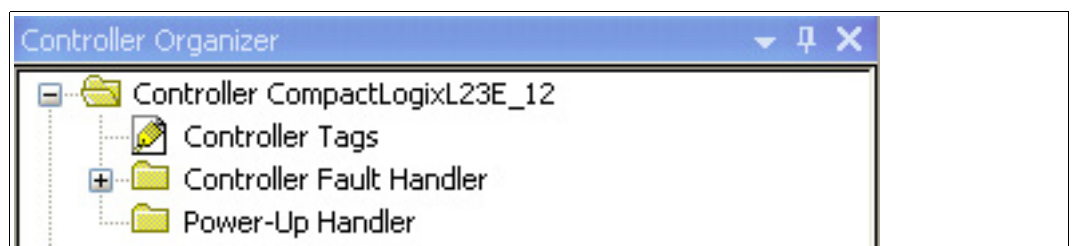

Figure 5.36   **Controller Organizer** window

↳ The **Monitor Tags** area on the right displays a detailed overview of the variables that are available for your Logix program.
See chapter 5.8.5

Figure 5.37　　　Available variables

5.8.5 Connection Parameters for Cyclic Data Transfer

Data Block of the WirelessHART Gateway used in Cyclic Data Transfer

The data block of the WirelessHART Gateway, which is transferred at the first position of the first connection has the following format.

Data Block of the WirelessHART Gateway

Structures		Data Types	Size	Invalid Value	Description
Gateway_struct			84		
	.NetworkReliability _percent	REAL	4	Quiet NaN [1]	Percentage of packets generated by wireless device correctly received by the WirelessHART Gateway
	.NetworkStability_r atio	REAL	4	Quiet NaN [1]	Ratio of successful packets to total packet transmissions on all wireless paths
	.NetworkLatency_ ms	DINT	4	-1 [1]	Average time taken for packets generated by a wireless device to reach the WirelessHART Gateway
	.LostUpstreamPac kets	DINT	4	-1 [1]	Total number of packets lost by the wireless device when transferred
Sub-structure	DeviceStatus_Stru ct		4	(always valid)	
	.GeneralStatus	BYTE	1		
	.InternalError	BOOL			Indicates an internal error. As a result, the four values above will be set to the Invalid Value and all devices will set their HARTComm fail bits.
	.DescriptorNotUni que	BOOL			Indicates that at least two HART devices have the same HART Descriptor. THis is a summary bit for all HART devices. See chapter 5.8.6
	.NoDataBurstConfi gured	BOOL			Indicates that at least one HART device contained in cyclic traffic does not burst any of the commands 3, 9, or 33. See chapter 5.8.6
	.NoCmd48BurstCo nfigured	BOOL			Indicates that at least one device contained in cyclic traffic does not burst command 48. See chapter 5.8.6
	.PassThroughQue ueOccupied	BOOL			Indicates that the maximum number of active Pass-Through requests to this device is reached. Every further request will be refused.
	.PassThroughRes ponseReady	BOOL			Indicates that at least one Pass-Through response is ready to be fetched.
	.UnusedStatus1	BYTE	1		

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Structures		Data Types	Size	Invalid Value	Description
	.FieldDeviceStatus	BYTE	1		Original status byte returned from WirelessHART Gateway. See HART specifications for details.
	.ExtendedDeviceStatus	BYTE	1		Original status byte returned from the WirelessHART Gateway. See HART specifications for details.
Sub-structure	Tag_Struct		32	(always valid)	
	.Name	BYTE[32]	32		HART Long Tag (ISO/IEC 8859-1)
Sub-structure	CMD48_Struct		28	(always valid)	
	.Cmd48Data	BYTE[25]			CMD48 data
	.Cmd48Reserved	BYTE[3]			padding bytes

The statistical values marked with [1] are invalid only if the WirelessHART Gateway has been started and the statistics have not been calculated yet. The calculated values reamin valid as long as WirelessHART Gateway is running.

Data Block of HART Devices used in Cyclic Data Transfer

This data structure is used for all devices in the Wireless HART network, except for the WirelessHART Gateway. Devices can be WirelessHART devices as well as HART field devices that are connected to a WirelessHART Adapter. While WirelessHART devices have to support HART Revision 7 or newer, HART field devices may only support HART Revision 5 or 6. For these devices, not all values become applicable and some values are replaced by other values. Notes in the following table describe the differing behavior.

Data Block of HART Devices

Structures		Data Types	Size	Invalid Value	Description
Device_struct			96		
	.PV	REAL	4	Quiet NaN	Primary Value (HART CMD 3/9/33)
	.SV	REAL	4	Quiet NaN	Secondary Value (HART CMD 3/9/33)
	.TV	REAL	4	Quiet NaN	Third Value (HART CMD 3/9/33)
	.QV	REAL	4	Quiet NaN	Fourth Value
	.PVStatus	BYTE	1	0	Status byte (HART CMD 9) [1]
	.SVStatus	BYTE	1	0	Status byte (HART CMD 9) [1]
	.TVStatus	BYTE	1	0	Status byte (HART CMD 9) [1]
	.QVStatus	BYTE	1	0	Status byte (HART CMD 9) [1]
	.PVUnit	BYTE	1	0	Units Code (HART CMD 3/9/33)
	.SVUnit	BYTE	1	0	Units Code (HART CMD 3/9/33)
	.TVUnit	BYTE	1	0	Units Code (HART CMD 3/9/33)

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Structures		Data Types	Size	Invalid Value	Description
	.QVUnit	BYTE	1	0	Units Code (HART 3/9/33)
	.PVLowerRangeValue	REAL	4	Quiet NaN	Lower Range Value of Primary Value (HART CMD 15)
	.PVUpperRangeValue	REAL	4	Quiet NaN	Upper Range Value of Primary Value (HART CMD 15)
Sub-structure	DeviceStatus_Struct		4		
	.GeneralStatus	BYTE	1	(always valid) [2]	
	.HARTCommFail	BOOL			HART communication failure: device not found/HART not enabled. [3] See chapter 5.8.6
	.DescriptorNotUnique	BOOL			Indicates that at least one other HART device has the same HART Descriptor. See chapter 5.8.6
	.NoDataBurstConfigured	BOOL			Indicates that none of the commands 3/9/33 is configured to be bursted by the HART device. See chapter 5.8.6
	.NoCmd48BurstConfigured	BOOL			Indicates that CMD48 is not configured to be bursted by the HART device. See chapter 5.8.6
	.PassThroughQueueOccupied	BOOL			Indicates that the maximum number of active Pass-Through requests to this device is reached. Every further request will be refused. [4]
	.PassThroughResponseReady	BOOL			Indicates that at least one Pass-Through response is ready to be fetched. [4]
	.UnusedStatus1	BYTE	1		fixed 0x00
	.FieldDeviceStatus	BYTE	1	(always valid) [2]	Original status byte returned by device. See HART specifications for details.
	.ExtendedFieldDeviceStatus	BYTE	1	0x00	Original status byte returned by device. See HART specifications for details. [5]
Sub-structure	Tag_Struct		32	(always valid) [2]	
	.Name	BYTE[32]	32		HART Long Tag (ISO/IEC 8859-1) [6]
Sub-structure	Cmd48_Struct		28		
	.Cmd48Data	BYTE[25]		filled with 0x00 [7]	CMD48 data
	.Cmd48Reserved	BYTE[3]			padding bytes

[1].**PVStatus.SVStatus.TVStatus.QVStatus**
Status values are only valid when the related value PV, SV, TV, or FV is valid. The default value of 0 indicates that either nothing is received yet (PV, SV, TV, or FV are invalid) or that the related value is really bad (PV, SV, TV, FV do not contain Quiet NaN as value).
For HART devices not bursting CMD 9, for example, HART 5 devices, the following simple

status shall be used:
00-hex: Not Connected (as long as no values is received from device yet (PV, SV, TV, FV contains Quiet NaN))
C0-hex: Connected (when the related value for PV, SV, TV, FV contains valid data from the device

[2] Always valid as long as .HARTCommFail bit is not set. Whenever .HARTCommFail is set, ALL values are invalid.

[3].HARTCommFail
If this bit is 1, none of the other data in Device_struct (including Sub-structures) is valid.

[4].PassThroughQueueOccupied .PassThroughResponseReady
These bits indicate only the Pass-through status of the WirelessHART Adapter itself. The status is completely independant from the Pass-through status of connected HART field devices.

[5].ExtendedFieldDeviceStatus
Only valid for devices that support HART Revision 6 or above and which burst CMD 9 or CMD 48.

[6]HART Long Tag
Devices that support HART Revision 5 return the content of Command 12 (Read Message) in this field, because the Long Tag is not defined in HART Revision 5. Message data also consists of 32 bytes.

[7].Cmd48Data
.Cmd48Data filled with 0x00 does not indicate that the Cmd48 data is invalid. Only the .NoCmd48BurstConfigured bit indicates if .Cmd48Data is valid or invalid. If .NoCmd48BurstConfigured is set , and thus the data is invalid, then .Cmd48Data will be filled with 0x00.

5.8.6   Diagnostic Bits in Cyclic Data Transfer

The cyclic data contains 4 error bits for each HART device. Each of the error bits may appear suddenly during cyclic communication when either the communication is lost or the configuration of one or more devices has changed.

.HARTCommFail

This bit indicates that the device with the HART descriptor calculated from cyclic connection number and data offset is not present, does not answer, or is still initializing. Once the device is initialized, this bit is reset. As soon as the connection to the device is lost, this bit is set again.

.DescriptorNotUnique

During the basic device identification procedure the HART descriptors of all devices in WirelessHART network are read. If the EtherNet/IP process detects that two or more devices share the same HART descriptor, the .DescriptorNotUnique bit is set in the cyclic data of the affected devices. Additionally the .DescriptorNotUnique bit inside cyclic data of WirelessHART itself is set as well, to indicate that at least one HART descriptor collision was detected.

Since the devices with identical HART descriptors share the same data offset in the same cyclic connection, the cyclic data would be filled randomly with the data of the these devices. To avoid this situation, the cyclic data is only filled with the data of the device, for which the duplicate HART descriptor was detected first. This avoids the loss of cyclic data when a new HART device with an identical HART descriptor is added to network. The same procedure is used for direct data transfer via Pass-through requests. The Pass-through request is sent to the device, for which the duplicate HART Descriptor was detected first.
If the device for which a duplicate HART Descriptor was detected first goes offline or changes its HART descriptor, the device that has been ignored is waken up from the suspended state. The device data of this device will then be used for cyclic data transfer and Pass-through requests.

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.NoDataBurstConfigured

This bit indicates that the affected device is not configured to burst Command 3, 9, or 33. This is detected during the extended initialization procedure as well as after every configuration change. Bursting of Command 3, 9, or 33 is required to publish cyclic data on EtherNet/IP without the need to poll all devices.

According to the HART specifications for WirelessHART devices, the burst configuration of wired devices has to be set up using the bridge device (WirelessHART Adapter) that connects the wired devices to the WirelessHART network. Burst commands that are set up directly on the wired device are not recognized and may cause the .NoCmd48BurstConfigured bit to be set.

.NoCmd48BurstConfigured

This bit indicates that the affected device is not configured to burst Command 48. This is detected during the extended initialization procedure as well as after every configuration change. Bursting of Command 48 is required to publish cyclic data on EtherNet/IP without the need to poll all devices.

According to the HART specifications for WirelessHART devices, the burst configuration of wired devices has to be set up using the bridge device (WirelessHART Adapter) that connects the wired devices to the WirelessHART network. Burst commands that are set up directly on the wired device are not recognized and may cause the .NoCmd48BurstConfigured bit to be set.

Note that .NoCmd48BurstConfigured bit will remain active for devices that do not support Command 48, for example, HART devices of revision 5.

5.8.7 Direct Data Transfer in Logix Controller

Direct data transfer is used to send custom HART commands to WirelessHART devices or HART field devices and to receive the related response. Furthermore, you can access some status information directly.

Tip

Direct data transfer is especially useful if you got a large number of HART field devices. In this case, you can use the cyclic data transfer to monitor the data of the HART field devices and use the direct data transfer to access additional devices, for example, to monitor the battery status of the WirelessHART Adapters once a day.

Nevertheless, we recommend that you use direct data transfer only if more then 40 devices shall be accessed in the network or if the required data cannot be mapped on one of the standard HART variables (PV, SV, TV, QV). Otherwise, cyclic data transfer should be preferred to direct data transfer.

All direct data transfer is based on Class 35D-hex. Each instance of this class represents a single HART device of the WirelessHART network.

The following instance services are available for direct data transfer.

Class	Service ID	Service Name
35D-hex	01-hex	Get Attribute All
	0E-hex	Get Attribute Single
	4E-hex	Init Pass-through Message
	4F-hex	Query Pass-through Message

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Addressing

The mapping between HART devices and its assigned class instance is done via the identifier in the HART descriptor of the HART device. Thus, all devices that follow the dedicated naming convention for HART descriptors can be accessed directly, independent of whether they are contained in cyclic communication or not. See chapter 5.8.1

The PLC does not need to know the unique device address of each device. Addressing a device using its unique HART address or Long Tag is not supported.

The Instance ID for direct data transfer is calculated using the following formula:

Instance ID = $(((n^{th}$ letter in alphabet) - 1) * 4) + ((number inside notation) + 1)$

Relationship between Identifiers and Instance IDs

Identifier in HART Descriptor	Cyclic Data Transfer	Instance ID for Direct Data Transfer
WHA-GW	1st connection, position 1	1
@A1, @A2, @A3	1st connection, positions 2, 3, and 4	2, 3, 4
@B0, @B1, @B2, @B3	2nd connection, positions 1, 2, 3, and 4	5, 6 ,7 ,8
@C0, @C1, @C2, @C3	3rd connection, positions 1, 2, 3, and 4	9, 10, 11, 12
...	...	...
@Z0, @Z1, @Z2, @Z3	-	101, 102, 103, 104

As a result, you can access the first 40 devices that can also be accessed via cyclic data transfer, plus another 64 devices that can only be accessed via direct data transfer.

Example!

The HART device with the identifier `@B3` can be accessed directly by sending a HART command to Instance ID 8 of Class 35D-hex.

5.8.8 Connection Parameters for Direct Data Transfer

Accessing Device Status Information

Each instance of Class 35D-hex represents a single HART device of the WirelessHART network and provides some status attributes containing the data of the assigned device. These attributes can be accessed via the standard EtherNet/IP services **Get Attribute Single** and **Get Attribute All**.

Attribute ID	Access	Name	Data Type	Description
1	Get	Device Status	BYTE[4]	See table "Data Block of HART Devices" on page 94 > DeviceStatus_Struct.
2	Get	HART Descriptor	BYTE[16]	See HART specifications.
3	Get	HART Long Tag	BYTE[32]	See HART specifications.

Sending and Retrieving Custom HART Requests in Logix Controller

Sending and receiving of HART data is handled via the **Init Pass-through Message** and **Query Pass-through Message** services.

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The HART command data sent and received through the services is the raw HART data. Thus, the HART Data in the request packet must be encoded in Big Endian format and that the HART data in the reply packet is received in Big Endian format. While HART uses the Big Endian format, Logix uses the Little Endian format. This means the bytes in a number are in the opposite order so they must be reversed before use.

Logix also aligns data on boundaries that permit fast access and HART packs them into the smallest space. HART encodes text strings in **Packed ASCII** using 6 bits per letter. When using pass-through messaging, your Logix program must be aware of these data layout issues.

Pass-through Init Message Layout Details

Use the **Init Pass-through Message** service to send a custom HART command to a HART device in the WirelessHART network. The service can be initiated using ID 4E-hex.

The following tables show the request and reply packet structures.

Request Packet

Offset	Format	Description	Notes
0	USINT	HART Command	HART Command Number
1	USINT	HART Byte Count	Size of HART Data field
2 - 256	USINT	Hart Data	Hart Command Data (Big Endian)
Request size = 2 ... 257 bytes			

The single fields are directly related to the fields of a HART command.

Delimiter	Address	[Expansion Bytes]	Command	Byte Count	[Data]	Check Byte

Table 5.16   HART Frame Format

- The Address is provided indirectly through the Class instances. See table "Relationship between Identifiers and Instance IDs" on page 98

- The HART Command Number is the same as it would be passed in a real HART frame. In case of an Extended Command Number, this fields contains only the indicator value 31 and the real Extended Command Number is passed in the HART Data field.

- The HART Data field contains all bytes between the Byte Count field and the Check Byte field of a HART frame.

An immediate response to the request is sent by the WirelessHART Gateway, containing the status of the request and a handle for requesting the answer if the request was accepted.

If the queue for active Pass-through requests is occupied, all requests will be refused with Pass-through status set to Busy. Additionally the .PassThroughQueueOccupied bit in cyclic data is set. this bit remains active until at least one Pass-through response had arrived and was fetched via the Query service.

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Reply Packet

Byte	Format	Description	Notes
0	USINT	Pass-through Status	See table "Pass-through Status" on page 101
1	USINT	HART Command	Echo
2	USINT	Handle	Handle for use with the Query service that identifies the HART message Only valid if Pass-Through Status = Initiated
3	USINT	Queue Space Remaining	■ Pass-through Status = Initiated or Busy Number of requests that can still be queued ■ Pass-through Status = Dead Pass-through Error Code See table "Pass-through Error Codes" on page 101
Reply size = 4 bytes			

Pass-through Query Message Layout Details

Use the **Query Pass-through Message** service to request a response to a custom HART command that was sent via the **Init Pass-through Message** service. The service can be initiated using ID 4F-hex.

The following tables show the request and reply packet structures.

Request Packet

Byte	Format	Description	Notes
0	USINT	Handle	Identifies the HART message. Received by the Init service.
Request size = 1 byte			

Reply Packet

Byte	Format	Description	Notes
0	USINT	Pass-through Status	See table "Pass-through Status" on page 101
1	USINT	HART Command	Echo of HART Command
2	USINT	HARTCommStatus	HART Response Code (Response Status Byte #1)
3	USINT	HART Field Device Status	■ Pass-through Status = Success HART Field Devcie Status / Communication Status (Response Status Byte #2) ■ Pass-through Status = Dead Pass-through Error Code See table "Pass-through Error Codes" on page 101
4	USINT	HART Byte Count	Number of Data Bytes in Reply for HART Command
5 - 259	USINT	HART Data	HART Response Data (Big Endian, as many bytes as in HART Byte Count)
Reply size = 6 ... 260 bytes			

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If at least one Pass-through response is ready to be fetched, the .PassThroughResponseReady bit is set in cyclic data of the device, the response come from. Each pending response is automatically discarded 15 seconds after the response arrived at the WirelessHART Gateway. Depending on the RPI of the cyclic connection, the time between the cyclic message where the .PassThroughResponseReady bit is set and the time the response is discarded, may be shorter than 15 seconds.

Pass-through Status

Value	Name	Service	Description
0	Success	Query	Device response received. No errors.
32	Busy - Try again later	Init	Command not started because there is no more space in the queue.
33	Initiated - Command started	Init	Command successfully started. Use Query service to poll for response.
34	Running - Try again later	Query	Command response not received yet.
35	Dead	Init/Query	An error occurred. See table "Pass-through Error Codes" on page 101

Pass-through Error Codes

Value	Definition	Description
81-hex	No response from HART device	There is a device with a HART descriptor matching the one calculated by the addressed Class Instance, but the connection to the device was lost.
87-hex	Instance does not have a device connected	There is no device with a HART Descriptor matching the one calculated by the address Class Instance.
89-hex	Size of message too small to hold size of HART message	The EtherNet/IP process looks at the size of the HART Data field in the request and validates that the incoming message size is large enough to send all of the data.
8A-hex	Invalid handle	The handle contained in the Query service request could not be associated to any pending request.

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6 Configuration via Device Type Manager (DTM) and PACTware

If using the device type manager (DTM) and PACTware to configure the WirelessHART gateway, the WirelessHART gateway must be connected via Ethernet or RS-485.

Configuration via DTM is identical to the configuration via web interface with the exception of a few options that are pointed out in the relevant sections. Thus, after you have added the communication DTM and the device(s) in PACTware, you can follow the instructions for configuration via web interface.

You can download PACTware, the WirelessHART DTM, the HART IP Communication DTM, and the HART Communication DTM from www.pepperl-fuchs.com.

▶ Creating a New Project?

Select **File > New** or click ⬜ **Create New Project**.

↳ A new, unnamed project appears in the main window. The project initially consists of the entry **HOST PC**.

▶ Updating the Device Catalog

1. Start PACTware.

2. Select **View > Device Catalog**.

   ↳ The **Device Catalog** window opens.

3. Click **Update Device Catalog** to update the device catalog.

4. Click **Yes** to continue.

   ↳ The updated device catalog appears.

6.1 Ethernet Communication

In order to enable Ethernet communication, you need to add the HART IP Communication DTM to your project first.

▶ Adding HART IP Communication DTM

1. Select **HOST PC** in the project view.

2. Choose **Device > Add device** or click ⬜ **Add device**.

3. Select the entry **HART IP Communication**.

4. Click **OK**.

   ↳ The HART IP Communication DTM is added to the project.

Figure 6.1   HART IP Communication DTM in project view

5. To edit the parameters, right-click **HART IP Communication** and select **Properties**.

6. Set the parameters according to your preferences. In most cases, the default values should be fine.

7. Click **OK** to save the changes and to close the **Properties** window.

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The IP address, bus address and UDP port of the communication DTM must match the parameters of the WirelessHART gateway. In some cases, for example, if the WirelessHART gateway has already been used in another project, you may have to edit these parameters. When using a new WirelessHART gateway, there is no need to change these parameters, because the default settings of the WirelessHART gateway already match the default settings of the Ethernet Communication DTM.

▶ Edit DTM Addresses of the Ethernet Communication DTM

1. Right-click **HART IP Communication**.
2. Choose **Additional Functions > Set DTM addresses**.

   ↳ The **Set DTM addresses** window is displayed.
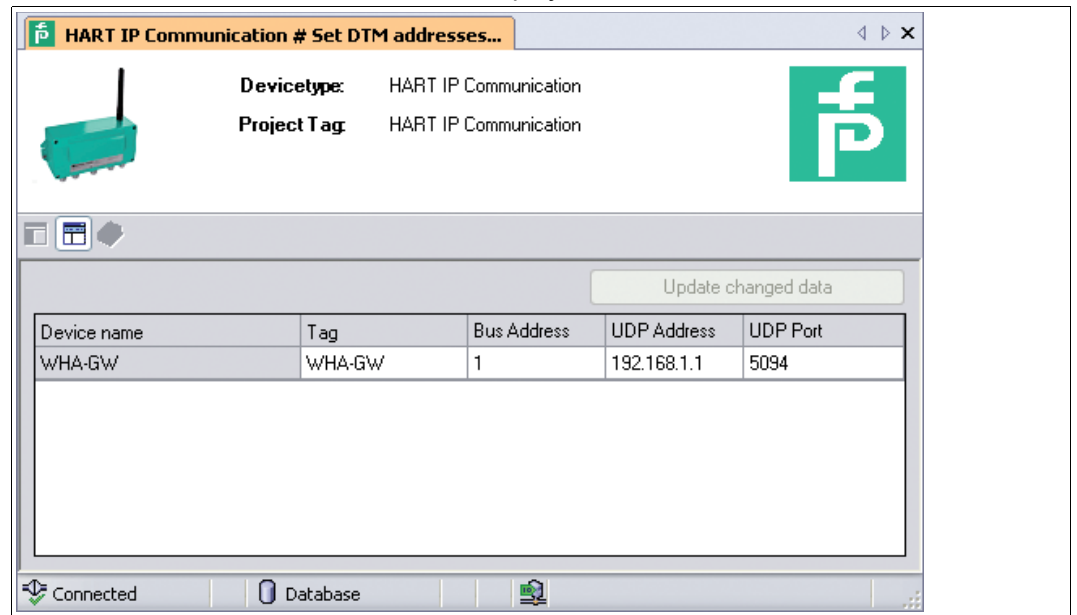
Figure 6.2   **Set DTM address** window

3. Change the parameters as required (see following table).
4. Click **Update changed data** to apply the new settings.
5. Disconnect and re-establish the connection between the DTM and the WirelessHART gateway to activate the new settings.

HART IP communication DTM			WirelessHART gateway	
Parameter	Explanation	Default	Parameter	Default
Tag	Gateway name in the **Project** view of PACTware. Any name may be entered (not relevant for connection to the WirelessHART gateway)	WHA-GW	–	–
Bus Address	Gateway polling address Must match the settings of the WirelessHART gateway.	1	**Parameterization > Wired Communication > Protocols > HART > Bus Address**	1

HART IP communication DTM			WirelessHART gateway	
Parameter	Explanation	Default	Parameter	Default
UDP Address	Gateway IP address Must match the settings of the WirelessHART gateway.	192.168.0 01.001	**Parameterization > Wired Communication > Interfaces > Ethernet > IP Address**	192.168.0 01.001
UDP Port	Gateway port number (HART over UDP) Must match the settings of the WirelessHART gateway.	5094	**Parameterization > Wired Communication > Protocols > HART > Port Number**	5094

Search for Gateways

The Ethernet communication DTM scans and identifies gateways on the Ethernet segment and lists the IP addresses of the connected gateways in a table.

6.2 RS-485 Communication

In order to enable RS–485 communication, you need to add the HART Communication DTM to your project first.

▶ Adding HART Communication DTM

Note!

The HART Communication DTM is not included in the WirelessHART DTM Collection. It can be downloaded separately from www.pepperl-fuchs.com.

1. Select **HOST PC** in the project view.

2. Choose **Device > Add device** or click **Add device** .

3. Select the entry **HART Communication** and click **OK**.

   ↳ The HART Communication DTM is added to the project.

Figure 6.3   HART Communication DTM in project view

4. To edit the parameters, right-click the HART communication DTM and select **Properties**.

5. Set the parameters according to the following table.

6. Click **OK** to save the changes and to close the parameter window.

Parameter	Description	Default
Communication interface	Select **HART multiplexer**.	HART modem
Port	Select the COM port of the RS-485 to RS-232 converter or of the RS-485 to USB converter.	COM1
Baudrate	Select the baud rate of the WirelessHART gateway.	19200
RTS Control	Depending on the RS-485 to RS-232 converter used, it may be necessary to switch the request-to-send control on or off, in order to switch correctly between reception and transmitting mode.	Toggle

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Parameter	Description	Default
Master	Specify if you want the WirelessHART gateway to be the primary or the secondary master. If there is already a primary master, define the WirelessHART gateway as secondary master.	Primary Master
Preamble	Select the number of preambles for HART communication.	5
Number of communication retries	Select the number of retries for HART communication in case of an error.	3
Start address	Select the address range in which the HART Communication DTM searches for HART multiplexers.	0
End address		15

6.3 Devices

After you have added a communication DTM, add the devices for the WirelessHART gateway.

Adding Devices

1. In the project view, right-click on the entry of the communication DTM.
2. To add a device to the project, choose **Add device**.
3. Select the entry **WHA-GW**.
4. Click **OK**.

   ↳ The device for the WirelessHART gateway is added to the project.

Figure 6.4   New device below HART IP Communication DTM in project tree

Tip

After you have added the device for the WirelessHART gateway, you can easily add other WirelessHART devices by performing a topology scan. To do so, right-click the WirelessHART gateway and select **Connect**. When you have an active connection to the WirelessHART gateway, right-click the WirelessHART gateway and select **Topology Scan**.

Topology Scan

The DTM provides a topology scan wizard to detect and store the device structure of the scanned network in an FDT project. The scan is performed independently on each level for the communication DTM, the WirelessHART gateway, and the devices.

Note!

Note on Hardware Version

Automatic topology scanning is possible with the WirelessHART gateway, revision 3 or higher.

Topology Scan: Creating the Project Tree Online

You can create the complete project tree for communication DTMs using the topology scan. The following example shows how to create a project tree for the HART IP Communication DTM. Ensure that you have added HART IP Communication DTM to the project tree. Ensure that the HART IP Communication DTM remains active, and proceed as follows:

1. Right-click on the **HART IP Communication DTM**, and go to **Topology Scan**.

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↪ The topology scan wizard opens.

2. Optionally, you can make settings for the HART IP communication DTM: In the Scan Tree, right-click onto the **HART IP Communication DTM**. From the context menu that opens, select **DTM Functions > Parameter**. In the Settings section on the right, for the HART IP Communication DTM enter a suitable project tag, determine the communication timeout, and the number of retries.

Figure 6.5   Parameter > DTM Functions for HART IP Communication DTM

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3. In order to start the topology scan, click on the blue single arrow (1) in the lower left section of the wizard dialog.
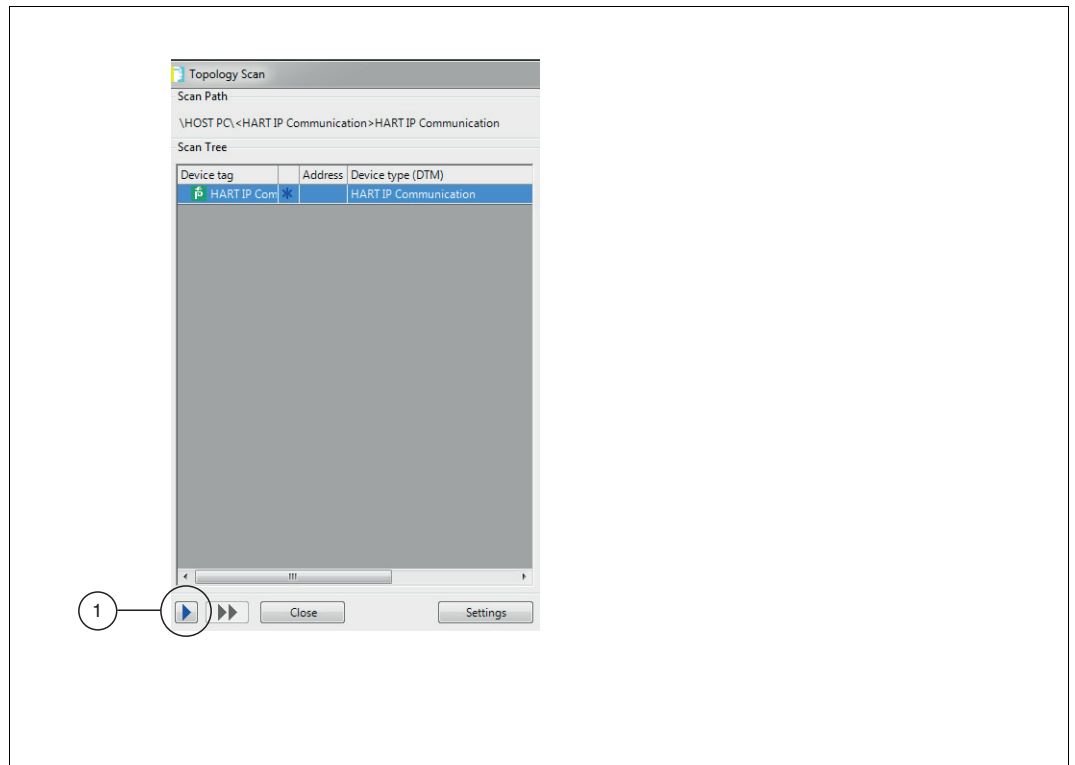
↳ Scanning is indicated by a status bar. All gateways on the network are listed. All devices that are connected to the gateways are listed. As scanning takes place, the Scan Tree section fills with all the detected participants of network, at the same time the project tree is updated.
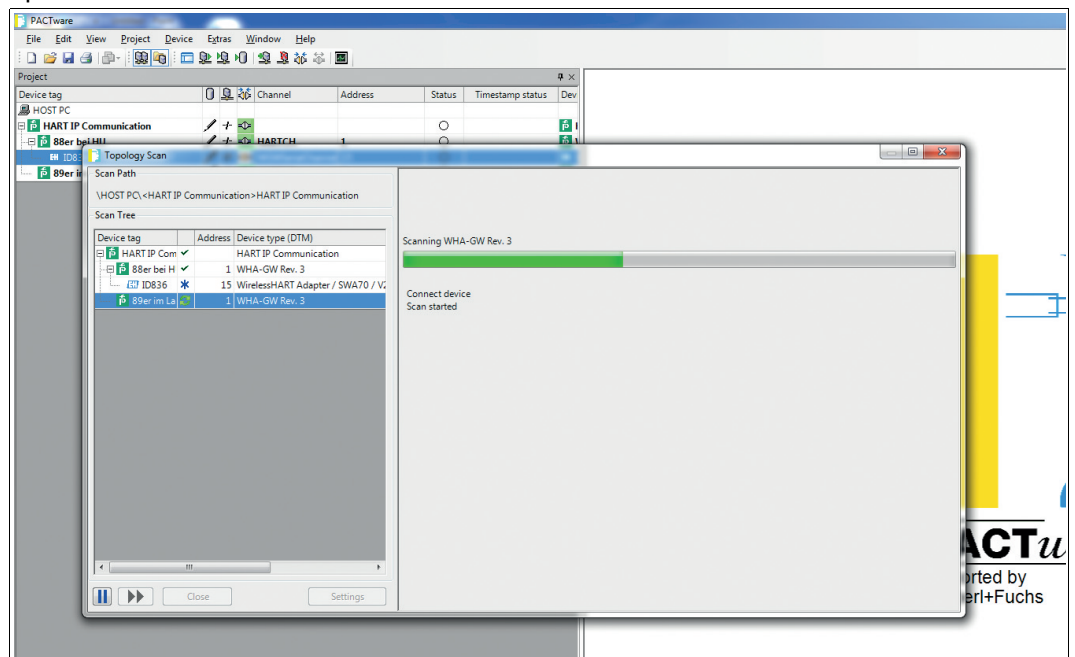
Figure 6.6   Topology scan: Filling up project tree while scanning

4. Close the topology scan wizard.

↳ Your FDT project tree is complete.

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▶ Rescanning in Case of Failed Device Detection

In case the topology scan cannot detect any connected devices, ensure that all devices are switched on. Then you can manually rescan the topology as follows:

1. Manually rescan the WirelessHART adapter. Assign a device type and a semantic ID manually. Confirm by clicking on **Apply**.
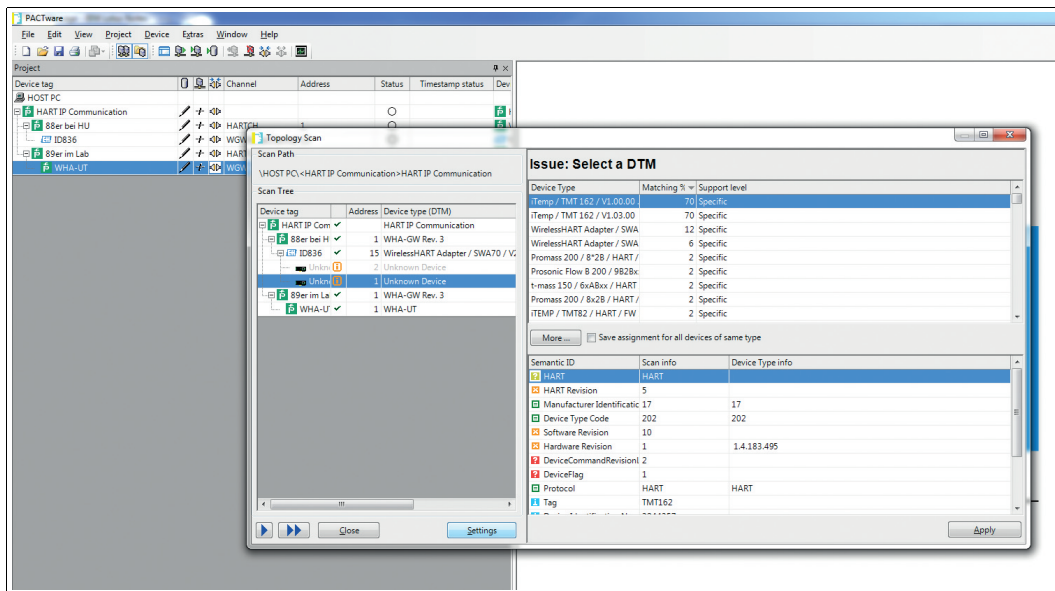
Figure 6.7   Topology scan wizard: Issues after completing the scan, in general unkown devices on the network

2. Close the topology scan wizard.

↳ Your FDT project tree is complete.

6.4 Online and Offline Parameterization (PACTware)

The concept of online and offline parameterization applies only to configuration via device type manager (DTM) with PACTware.

■ **Offline Parameterization** (not connected to device)

If there is no active connection to the device, you can edit and save the data that is stored locally in PACTware. You can transfer the local data to the device, as soon as a connection to the device has been established.

■ **Online Parameterization** (connected to device)

If there is an active connection to the device, you can directly edit the data that is stored on the device. Parameter changes are immediately stored on the device.

Note!

Data that is edited and stored on the device during online parameterization is **not** automatically synchronized with the offline data in the PACTware project. If you change device parameters in online mode, the data in PACTware differs from the data on the device. To make sure the data in PACTware matches the data on the device after online parameterization, load the data from the device into the PACTware project.

▶ Offline Parameterization

1. Right-click the device in the PACTware project view.

2. Choose **Parameter > Offline Parameterization**.

↳ The window containing the offline data record appears.

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3. Modify a parameter by typing in a new value or choosing a new value from the drop-down list.

4. To accept the new value, press **Enter**.

5. After all parameter changes have been made, save your project by choosing **File > Save**.

6. To write the new offline configuration to the device, right-click the device in the project view and choose **Connect**.

↳ A connection to the device is established.

7. Right-click the device again and choose **Store to device**.

↳ The new configuration is stored in the device.

▶ Online Parameterization

Note!
Some options are only available during online parameterization. These options are pointed out in the relevant sections.

1. Right-click the device in the PACTware project view.

2. Select **Connect**.

↳ A connection to the device is established.

3. Right-click the device in the PACTware project view.

4. Select **Parameter > Online Parameterization**.

↳ The window containing the online data opens and the data is read from the device.

5. Modify a parameter by typing in a new value or choosing a new value from the drop-down list.

6. To accept the new value, press **Enter**.

↳ The new value is stored in the device immediately.

7. After all parameter changes have been made, you can load the online configuration into the PACTware project. To do this, right-click on the device entry in the project view and choose **Load from device**.

8. Save your project by choosing **File > Save**.

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7 Configuration via DD file and Emerson AMS Suite

You can also configure the WirelessHART gateway by integrating it into a process control system. The exact procedure how to integrate a device depends on the process control system. Please refer to the documentation of your process control system manufacturer.

You can download the device description for the WirelessHART gateway from www.pepperl-fuchs.com. Install the DD file according to the instructions from the documentation of your process control system manufacturer.

This manual describes the integration into a process control system using the example of the Emerson AMS Suite. When integrating the WirelessHART gateway into the Emerson AMS Suite, the WirelessHART gateway must be connected to your PC via Ethernet.

7.1 Integration

The WirelessHART gateway is integrated into the Emerson AMS Suite by creating a new wireless network that is established by the WirelessHART gateway.

▶ Create New Wireless Network

1. Make sure the AMS Device Manager is not running.

2. Choose **Start > Programs > AMS Device Manager > Network Configuration** to start **Network Configuration**.

↳ The **Network Configuration** window appears.
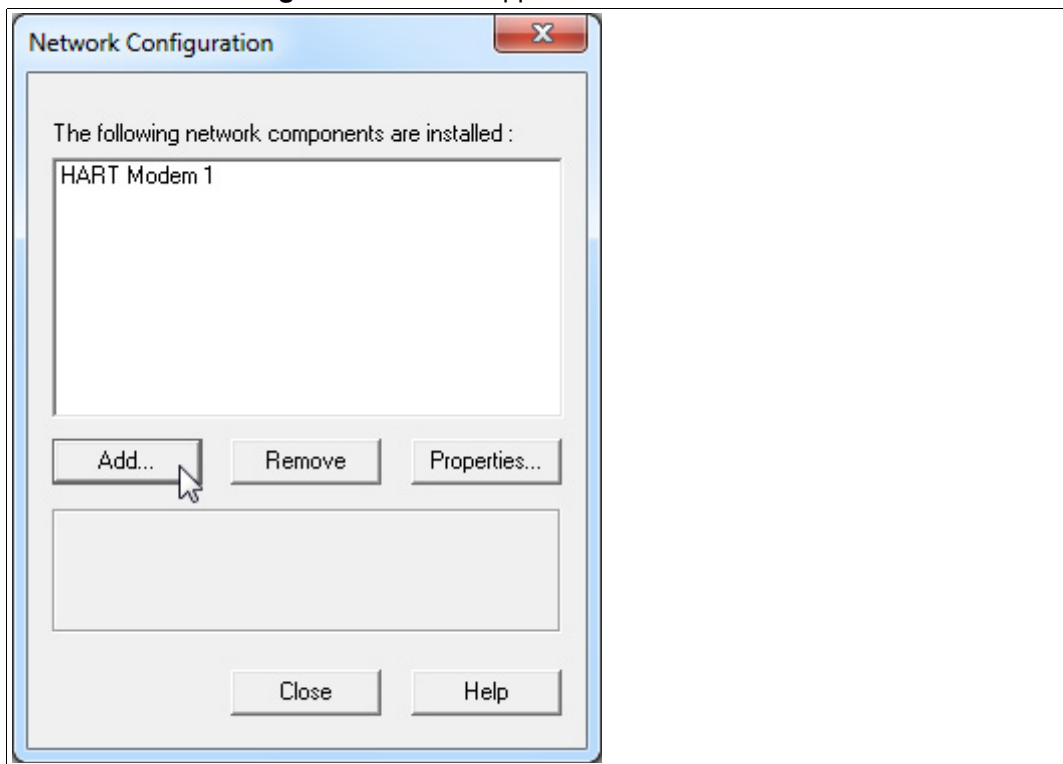
Figure 7.1   **Network Configuration** window

3. Click **Add**.

4. Select **Wireless Network** and click **Install**.

↳ The **Add Wireless Network Wizard** window appears.

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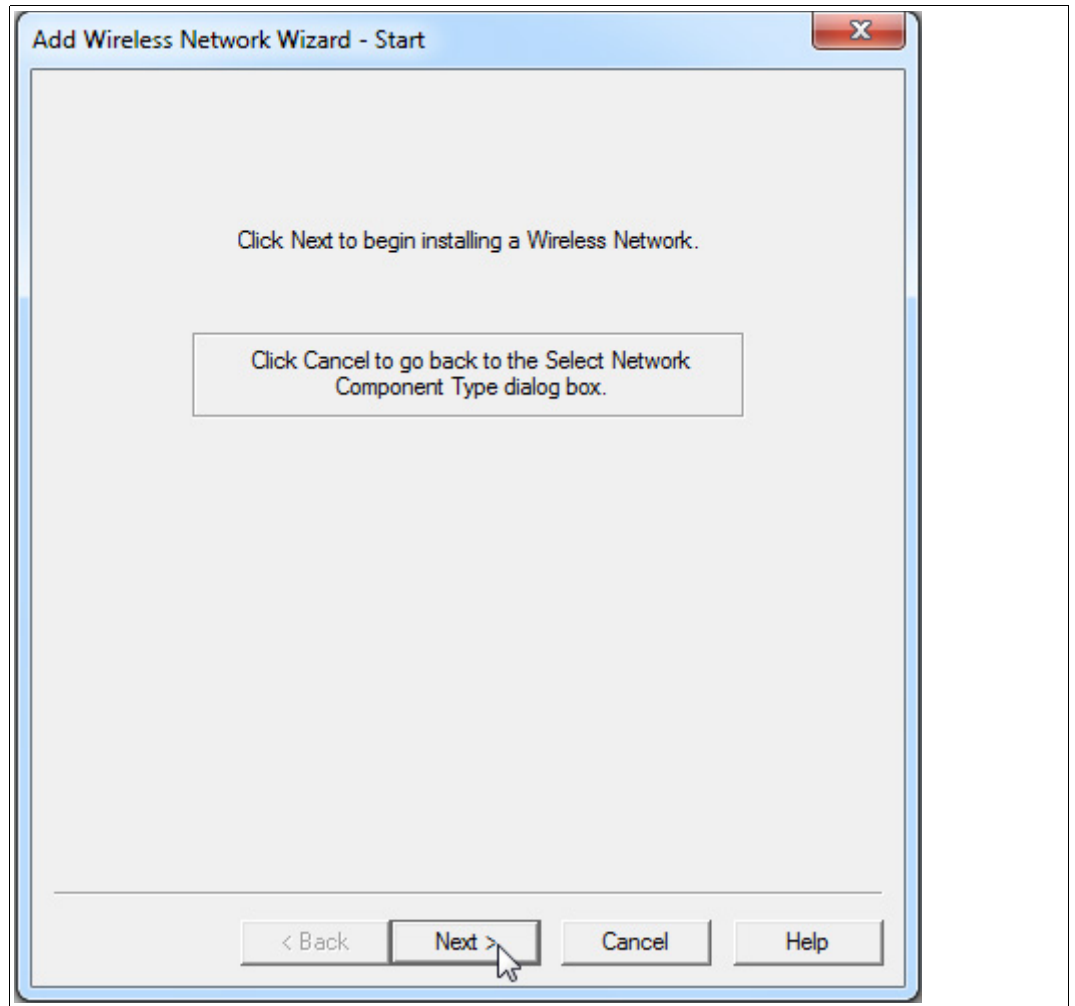
Figure 7.2   **Add Wireless Network Wizard** window

5. Click **Next**.

6. Enter a name for the network in the **Network Name** field and click **Next**.

7. Enter the IP address of the WirelessHART gateway in the **Smart Wireless Gateway Name or IP Address** field and click **Add**. The default IP address is 192.168.001.001. If you changed the IP address of the WirelessHART gateway, type in the new IP address.

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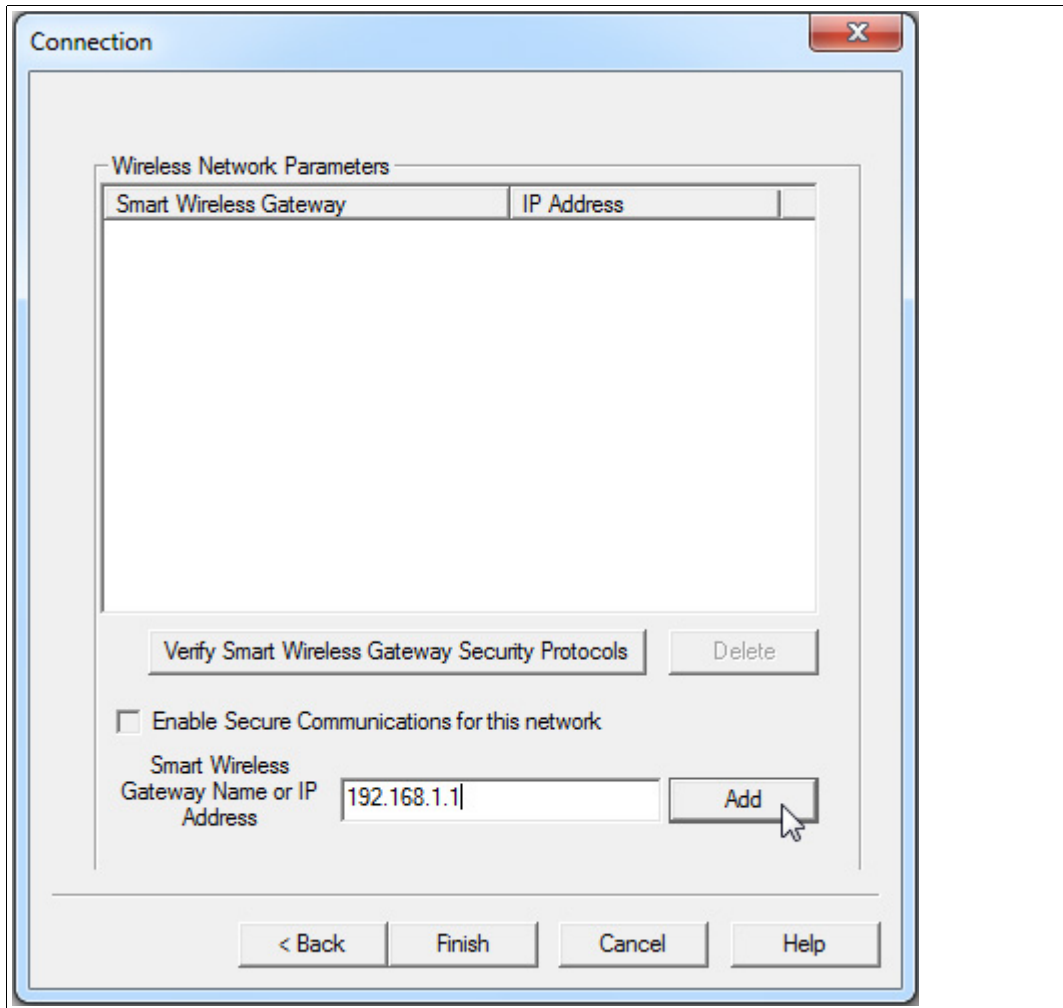
Figure 7.3   **Connection** window

↳ The IP address is displayed in the upper area under **Wireless Network Parameters**.

8. Click **Finish** to close the **Add Wireless Network Wizard**.

↳ The name of the new wireless network is displayed in the **Network Configuration** window.

9. Click **Close** to exit **Network Configuration**.

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7.2 Configuration

The **Device Connection View** is a graphical representation of the WirelessHART gateway and the connected wireless and wired subdevices. From this view you can directly open the configuration window for each device.

Display Network Participants

1. Start the AMS Device Manager as administrator. To do so, right-click the program icon and select **Run as administrator**.
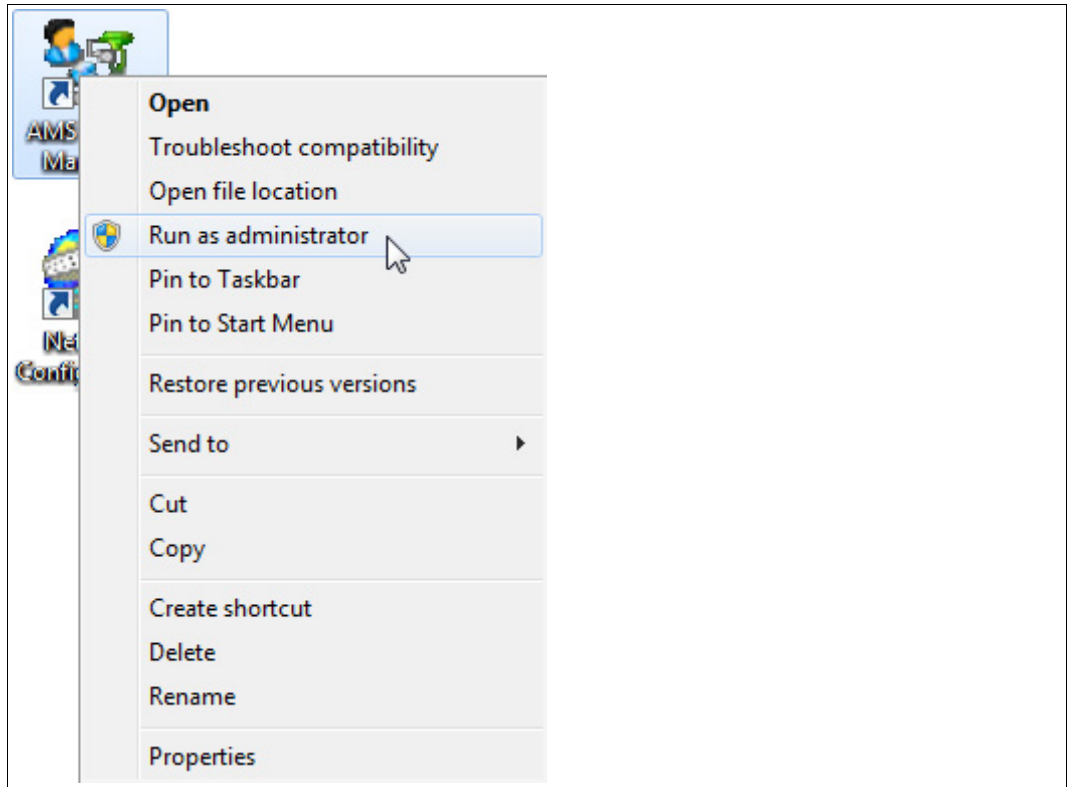
Figure 7.4   Run as administrator

2. Log in to the AMS Device Manager using your user name, password, and the **Standard** login type.

3. To establish a connection to your devices, choose **View > Device Connection View**.

↳ The **Device Connection View** window displays the networks from the **Network Configuration** window. In this example, **Wireless Network 1** represents the WirelessHART network that is established by the WirelessHART gateway.

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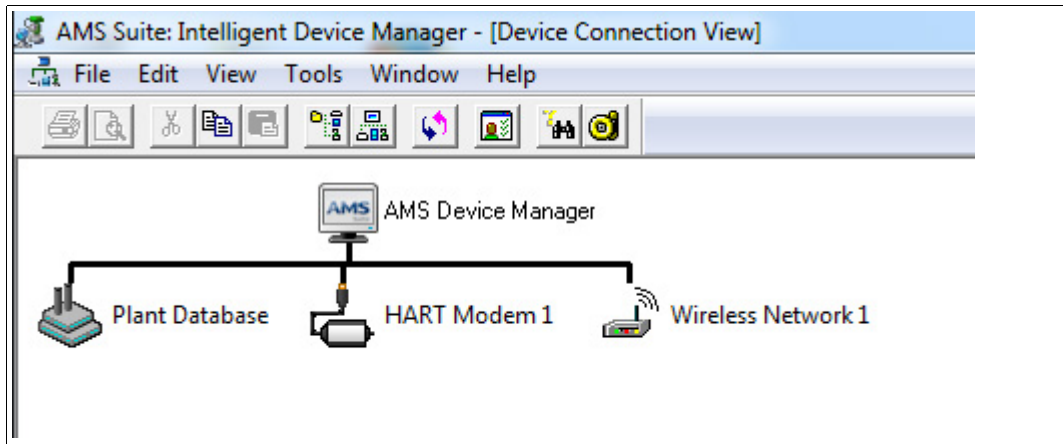
Figure 7.5   **Device Connection View** window

4. Right-click the network that is created by the WirelessHART gateway and select **Rebuild and Identify Hierarchy**.

↳ The WirelessHART gateway is displayed underneath the network. Note that if the device description has been installed, the WirelessHART gateway is displayed with a device-specific icon. Otherwise the system uses a generic icon.
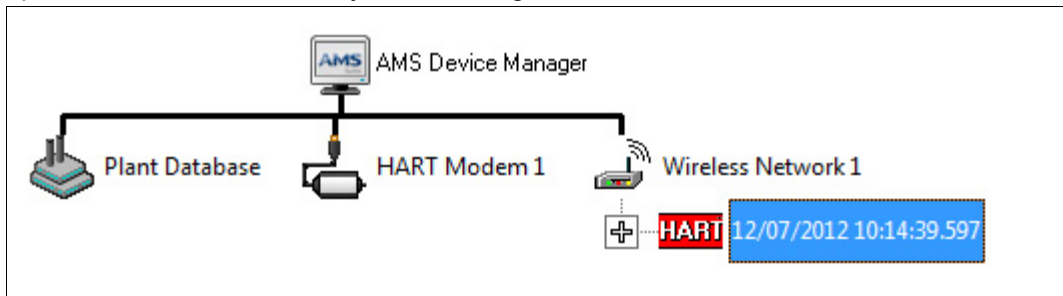
Figure 7.6   WirelessHART gateway in **Device Connection View**

5. To view the wireless and wired subdevices of the WirelessHART gateway, click the **+** symbol in front of the device icon.

↳ The AMS Device Manager checks the HART loops and adds the field devices to the network tree. Depending on the number of network participants and the network topology, this process can take up to a few minutes.

Configure WirelessHART Gateway

Note!

Unless the device description has been installed, you can only configure basic options. The device description adds device-specific options to the configuration window.

1. To open the configuration window, double-click the WirelessHART gateway in the **Device Connection View**.

↳ The configuration window of the selected device appears.

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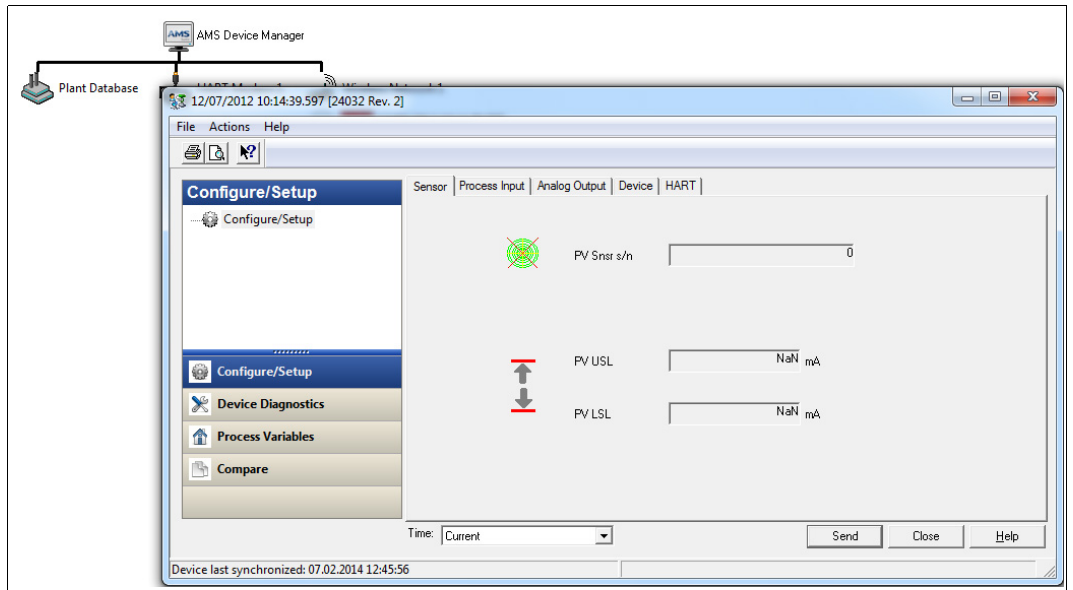
Figure 7.7   Configuration window

2. If you change the value of a field, the background color of this field turns yellow. To apply the changes, click **Send**.
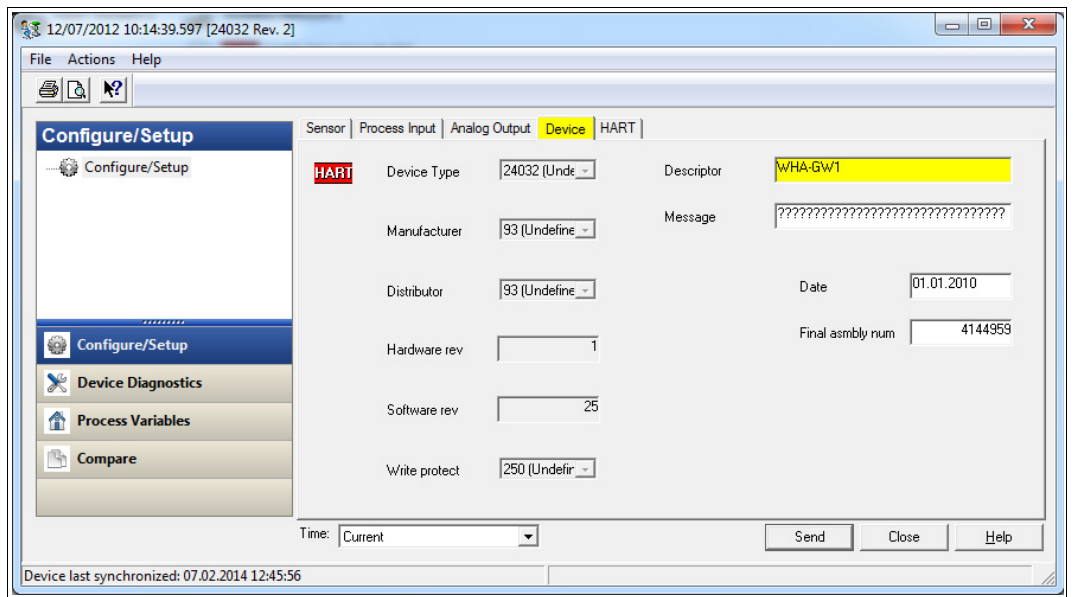
Figure 7.8   Changes are highlighted in yellow

↳ The system displays a warning message, asking you to provide an update reason and to confirm that you want to change the values.

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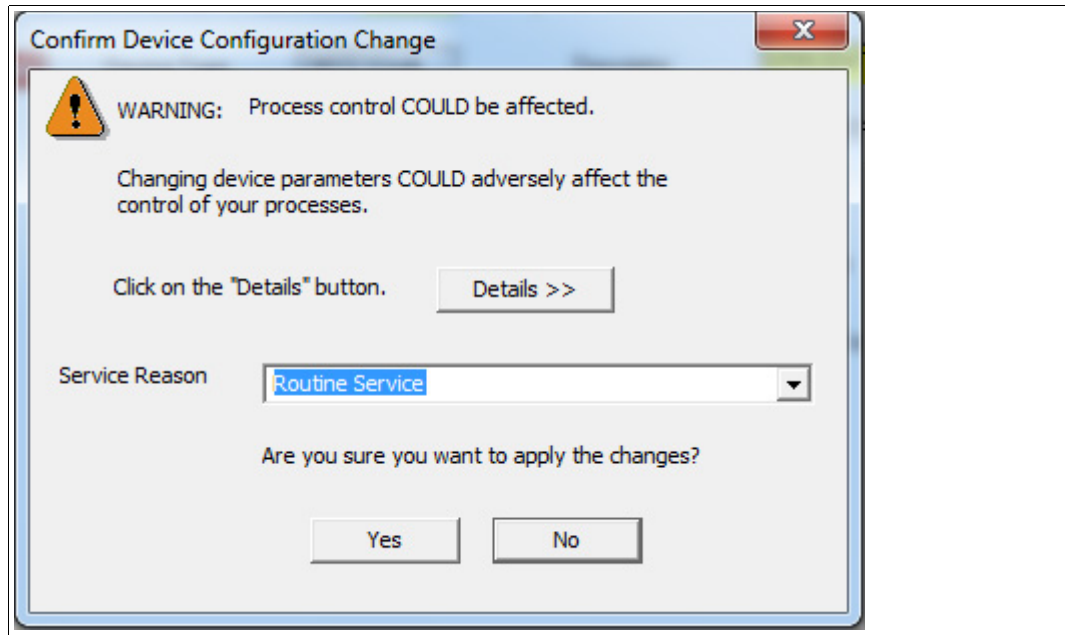
Figure 7.9   **Confirm Device Configuration Change** window

3. To confirm the configuration change, click **Yes**.

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8 Operation

8.1 Network Enhancement

After having installed and set up a wireless network, give the network a couple of hours to stabilize itself before taking the following steps.

Once the WirelessHART network is running, there are some simple measures that will help enhancing network performance and reliability. Those measures are described in the following.

Verify Connections

Check that each device has joined the network and is communicating properly. See chapter 5.4.2 Details

If you cannot establish a connection to a device, the device is probably too far away or an obstacle blocks the radio waves. In this case, add an additional device to bridge the gap.

Eliminate Bottlenecks

If the messages of several devices all have to pass through one single device to get to the WirelessHART gateway, the network has a bottleneck. If the device at the bottleneck fails, whole parts of the network get cut off from communication because there are no alternative paths to route messages.

To eliminate bottlenecks in a wireless network, add at least one device near the bottleneck to provide redundant communication paths.
There should always be at least two communication paths from one device to another.
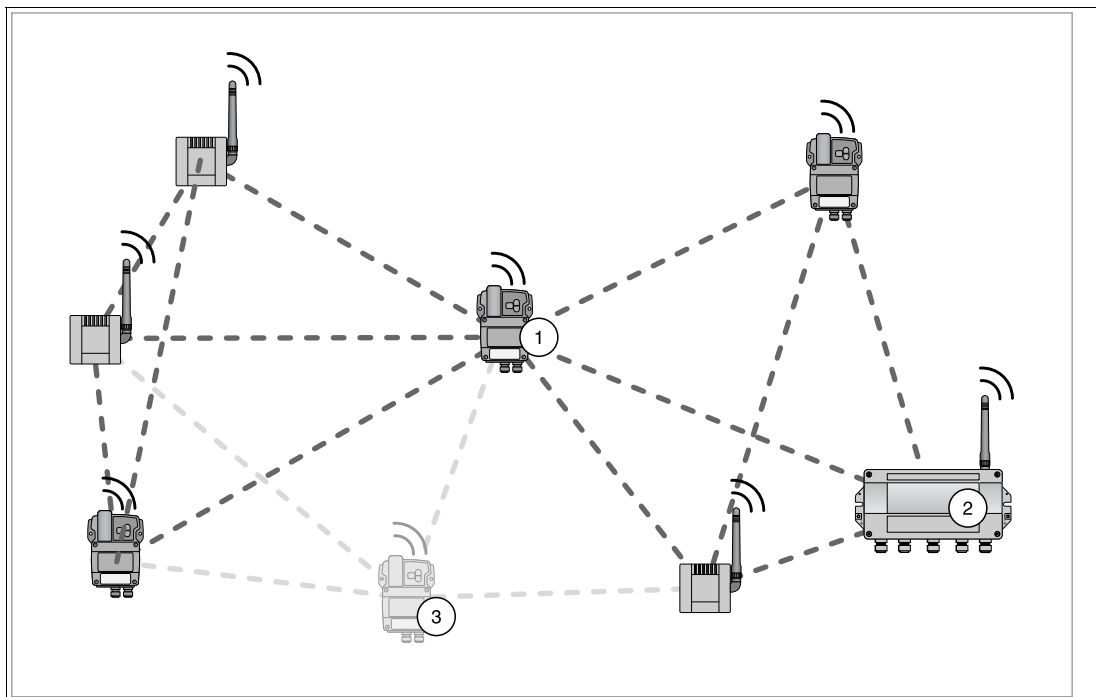
Figure 8.1   Eliminating a bottleneck

1. Bottleneck

2. WirelessHART gateway

3. Possible position of an additional WirelessHART device eliminating the bottleneck

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Expand the Network

In an industrial environment, there are several potential obstacles for radio waves, for example buildings, walls, pipes, or even moving obstacles like trucks. Those obstacles can reflect, bend, diffuse or block radio waves. The effects of reflection, bending and diffusion create new waves which interact with the original ones and with each other. They can amplify or nullify each other.

Due to the interference of reflections, moving the antenna a few centimeters can help. If there are obstacles blocking data transfers between wireless devices, add additional devices to provide alternative communication paths. The more devices exist in a WirelessHART network, the more reliable it gets.

Optimize Coexistence with other Wireless Networks

WirelessHART networks use the frequency spectrum between 2400 ... 2483.5 MHz according to IEEE 802.15.4. Various other wireless technologies also use this frequency spectrum, for example WLAN (IEEE 802.11) and Bluetooth (IEEE 802.15.1). Measures must be taken to ensure that the various wireless technologies do not affect each other.

If there are problems with other wireless technologies disrupting the WirelessHART network, create a channel blacklist that makes the WirelessHART gateway skip certain channels known to provide persistent interference.
If possible, you can also manage the frequencies used by other networks and block the usage of channels already used by the WirelessHART network (frequency management).

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9 Maintenance and Repair

9.1 WHA-GW*

> **STOP**
>
> ***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.

> **STOP**
>
> ***Danger!***
>
> Explosion hazard or loss of radio approval through unsuitable accessories
>
> The use of unsuitable or unapproved accessories may void the Ex certification or radio approval of the device and present an explosion hazard or violate the national radio regulations.
>
> Only use suitable, certified remote antennas and accessories that are listed in the installation examples or that respect the limits mentioned below. If in doubt, consult your national regulations expert.

> **STOP**
>
> ***Danger!***
>
> Danger to life from electric shock through degree of protection violation
>
> Failing to ensure the degree of protection for the enclosure according to EN 60529 can result in severe or lethal electric shock.
>
> Ensure that the enclosure meets the required degree of protection during mounting and installation activities:
> - All seals must be undamaged and correctly fitted
> - All screws of the housing/housing cover must be tightened with the appropriate torque
> - Only cables of the appropriate size must be used in the cable glands
> - All cable glands must be tightened with the appropriate torque
> - All unused cable glands must be sealed or plugged with corresponding stopping plugs

> **STOP**
>
> ***Danger!***
>
> Explosion hazard from premature powering
>
> Powering parts of the system during installation or maintenance leads to added currents. This very likely results in a current flashover generating sparks. The sparks can ignite the surrounding potentially explosive atmosphere.
>
> Prior to installation and maintenance activities, ensure that the device is disconnected from the power supply. Activate the power supply only after all the circuits required for operation have been fully assembled and connected

The national requirements apply to maintenance, servicing, and inspection of associated apparatus.

No maintenance is necessary if the devices are operated properly, observing the mounting instructions and ambient conditions.

The device must not be repaired, changed, or manipulated. In case of failure, always replace the device with an original device.

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10 Troubleshooting

10.1 Faults Indicated by LEDs of the WirelessHART Gateway

Indication	Possible cause	Corrective action
Red LED is on	Hardware fault that makes normal operation of the WirelessHART gateway impossible.	Try powering the WirelessHART gateway down and up again. If the problem persists, please return the WirelessHART gateway to Pepperl+Fuchs for repair.
Red LED flashes	Under certain conditions the LED flashes while the WirelessHART gateway tries to eliminate the fault.	If the problem persists, please contact Pepperl+Fuchs customer service.

10.2 Wired Communication Faults

Fault	Possible cause	Corrective action
The host is not able to establish an Ethernet connection to the WirelessHART gateway.	The WirelessHART gateway is connected to the Ethernet with a straight through connection although a crossover connection is necessary (or vice versa).	Access the Ethernet interface of the WirelessHART gateway. Interchange the green wire with the orange one, and the white/orange wire with the white/green one. This action changes a crossover connection into a straight-through connection and vice versa.
	The Ethernet parameters of the WirelessHART gateway are incorrect.	Check the Ethernet parameters of the WirelessHART gateway. See chapter 5.3.2
	The Local Area Connection Properties of your PC are not configured correctly.	Configure the Local Area Connection according to the instructions given.
	If you are parameterizing via the web interface: Maybe your web browser uses proxies.	Deactivate proxies in your browser.
The host is not able to establish a serial connection to the WirelessHART gateway.	Wrong parameters (e.g. COM port, address range) are set in the communication DTM.	Check the parameters in the communication DTM. See chapter 6.2 Also check the baud rate/polling address configured via the DIP switches inside the enclosure.
The host is not able to establish a serial connection to the WirelessHART gateway, or the signal quality is poor.	The terminator is not activated.	If the RS-485 bus ends at the WirelessHART gateway, activate the terminator by setting DIP switch number 7 to **ON** () or by using the serial interface ().

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10.3 Wireless Communication Faults

Fault	Possible cause	Corrective action
The WirelessHART gateway cannot find a WirelessHART device in the network.	The device has not yet joined the network.	The joining process may take a while. Check the join status in the instrument list of the WirelessHART gateway. Alternatively, check the wireless communication parameters (join status) of the device via a HART modem connected to the device.
	The device carries the wrong network ID and/or the wrong join key.	Check the wireless communication parameters of the device via a HART modem connected to the device. The device and the WirelessHART gateway must have the same network ID and join key.
	There are not enough neighboring WirelessHART devices within the device's antenna range.	Check the number of neighbors (Diagnosis > Wireless Communication). There should be at least 2 neighbors.
The wireless connection to a WirelessHART device is poor and disappears from time to time	There are not enough neighboring WirelessHART devices within the device's antenna range.	Check the number of neighbors (Diagnosis > Wireless Communication). There should be at least 2 neighbors.
	Walls or other static/moving objects block the radio signals, or the antenna is not aligned vertically.	Check the position of the WirelessHART gateway or use an external antenna. See chapter 3.1

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11 Telecommunication Compliance

- ETSI (R&TTE)

- FCC Part 15.247 for wireless applications in the area of 2.4 GHz

- EN 300 328

The usage of 2400 MHz equipment is bound to local restrictions. Ensure that local restrictions allow usage of this device before commissioning.

Country	Guideline
Bulgaria	General authorization required for outdoor use and public service.
Italy	If used outside of own premises, general authorization is required.
Japan	The device is granted pursuant to the Japanese Radio Law and the Japanese Telecommunications Business Law. The device must not be modified (otherwise the granted designation number will become invalid).
Latvia	The outdoor usage of the 2.4 GHz band requires an authorization from the Electronic Communications Office.
Norway	May be restricted in the geographical area within a radius of 20 km from the center of Ny-Alesund.
Rumania	Use on a secondary basis. Individual license required.

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12 Appendix

12.1 HART Status Information

HART Device Status

The HART device status or field device status indicates the current operating status of the field device.

Code	Parameter	Description
0x01	Primary Variable Out Of Limits	The PV is beyond its operating limits.
0x02	Non-Primary Variable Out Of Limits	A device variable not mapped on the PV is beyond its operating limits.
0x04	Loop Current Saturated	The loop current has reached its upper (or lower) endpoint limit and cannot increase (or decrease) any further.
0x08	Loop Current Fixed	The loop current is being held at a fixed value and is not responding to process variations.
0x10	More Status Available	More status information is available via command 48.
0x20	Cold Start	A power failure or device reset has occurred.
0x40	Configuration Changed	An operation was performed that changed the configuration of the device.
0x80	Device Malfunction	The device detected a serious error or failure that compromises device operation.

HART Extended Device Status

Code	Parameter	Description
0x01	Maintenance Required	This bit is set to indicate that, while the device has not malfunctioned, the field device requires maintenance.
0x02	Device Variable Alert	This bit is set if any device variable is in an alarm or warning state. The host should identify the device variable(s) causing this to be set using the device variable status indicators.
0x04	Critical Power Failure	For battery powered devices. This bit is set when the power is becoming critically low. Devices must be able to sustain their network connection for at least 15 minutes from when this bit is set.
0x08	Failure	When this bit is set, one or more device variables (for example, measurement or control values) are invalid due to a malfunction of the field device or its peripherals.
0x10	Out Of Specification	When set, this bit indicates deviations from the permissible ambient or process conditions have been detected that may compromise measurement or control accuracy (for example, device performance may be degraded given current operating conditions).
0x20	Function Check	This bit is set if one or more device variables are temporarily invalid (for example, frozen) due to ongoing work on the device.

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Command 48

Command 48 returns additional status information that is not included in the HART device status response code.

All field devices must support at least bytes 0 ... 8. Thus, the minimum response length of command 48 is 9 bytes. If a field device supports more than one analog channel, bytes 9 ... 13 must be supported as well. In this case, the minimum response length of command 48 is 14 bytes.

Response Data Bytes

Byte	Parameter	Description
0	Device-Specific Status 0 Extended Device Malfunction	▪ 0x01 **Manager Fault** ▪ 0x02 **Non-Volatile Memory Defect** ▪ 0x04 **Volatile Memory Defect** ▪ 0x08 **Ethernet Communication Fault** ▪ 0x10 **Wired Device Duplicated** ▪ 0x20 **Long Tag Duplicated** ▪ 0x40 **Electronic Defect** ▪ 0x80 **RS-485 Communication Fault**
1	Device-Specific Status 1 Gateway Operation in Progress	▪ 0x02 **Block Transfer** (not supported) ▪ 0x04 **Delayed Answer** ▪ 0x08 **Self-Test** (not supported) ▪ 0x20 **Device List Update** ▪ 0x40 **Network Manager Reset In Progress** ▪ 0x80 **Start-Up Phase**
2	Device-Specific Status 2 Extended Lists Changes	▪ 0x01 **Instrument List Changed** ▪ 0x04 **Active Device List Changed**
3	Device-Specific Status 3 Cumulative Device Status	▪ 0x01 **Primary Variable Out Of Limits** ▪ 0x02 **Non-Primary Variable Out Of Limits** ▪ 0x04 **Loop Current Saturated** ▪ 0x08 **Loop Current Fixed** ▪ 0x10 **More Status Available** ▪ 0x20 **Cold Start** ▪ 0x40 **Configuration Changed** ▪ 0x80 **Device Malfunction**
4	Device-Specific Status 4 Device Operation in Progress	▪ 0x01 **Maintenance Required** ▪ 0x02 **Device Variable Alert** ▪ 0x04 **Critical Power Failure**
5	Device-Specific Status 5 Device Operation in Progress	▪ 0x02 **"Configuration Changed Bit Reset" Procedure** ▪ 0x04 **"Sub-Device Update" Procedure** ▪ 0x08 **"Device Update" Procedure**
6	Extended Device Status	Not available

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Byte	Parameter	Description
7	Device Operating Mode	Not available
8	Standardized Status 0 Standardized Device Malfunction	■ 0x01 **Simulation Active** The device is in simulation mode and one or more of its device variables are not representative of the process. ■ 0x02 **Non-Volatile Memory Defect** The non-volatile memory check is invalid or corrupt, or the battery of a battery-powered memory is defective. ■ 0x04 **Volatile Memory Defect** The RAM memory check is invalid or corrupt. ■ 0x08 **Watchdog Reset Executed** A watchdog reset has been executed. ■ 0x10 **Environmental Conditions Out Of Range** An internal or environmental condition is beyond acceptable limits. ■ 0x20 **Power Supply Conditions Out Of Range** The power supply is outside its allowable range. ■ 0x40 **Electronic Defect** A hardware problem has been detected.
9	Standardized Status 1	Not available
10	Analog Channel Saturated	Not available
11	Standardized Status 2 Standardized Lists Changes	■ 0x01 **Instrument List Changed** When set, the gateway has lost communication with one of its sub-devices or discovered a new sub-device. This bit is reset if command 74 is issued. The current sub-device list is read using command 84. ■ 0x02 **Duplicate Master Detected** The adapter has discovered another master with the same address connected to its token-passing interface.
12	Standardized Status 3	Not available
13	Analog Channel Fixed	Not available
14 ... 24	Device-Specific Status Information	Not available

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12.2   Structure of CSV Files

Use a semicolon `;` as separator for the values in the CSV file. If a value already contains a semicolon you must put the value into quote signs `"`. If the value already contains quote signs, put the entire value into quote signs `"` and replace the original quote signs with two quote signs `""`.

Example!

The value **this is a "long tag" that contains quote signs** must be entered like this:
```
"this is a ""long tag"" that contains quote signs"
```

Avoid special characters. They can easily be corrupted or they can cause the whole data row to be skipped during the import of the CSV file.

Avoid leading blanks, trailing blanks, and tabs, especially for integer or hexadecimal values.

Respect the data type of each column.

If a mandatory column is missing, the whole file is rejected and nothing is imported.

If a mandatory value is missing, the corresponding data row is skipped.

Instrument List

The files for the instrument list contain the following columns.

File Structure

Expanded Device Type Code	Device Id	IO-Card	Channel	Long Tag
4 digits hex	6 digits hex	int decimal	int decimal	string[32]
				mandatory

Topology View

The files for the topology view contain the following columns.

Note that the X- and Y-origins of the background image are not part of the CSV file, as these coordinates are related to the background image.

File Structure

Expanded Device Type Code	Device Id	IO-Card	Channel	Long Tag	Units Code	Range	X-Coordinate	Y-Coordinate	Z-Coordinate
4 digits hex	6 digits hex	int decimal	int decimal	string[32]	int decimal	float decimal	float decimal	float decimal	float decimal
				mandatory			mandatory	mandatory	

Diagnostic Details

The files you can export under **Diagnostics > Wireless Communication > Details** contain the following columns. There are no mandatory columns as there is no import function. Nevertheless, you can export the data in CSV format for documentation.

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File Structure

Expanded Device Type Code	Device Id	IO-Card	Channel	Long Tag	Status	Device Status	Number Of Joins	Recent Join Date	Reliability	Latency	Neighbors	RSSI	Stability
4 digits hex	6 digits hex	int decimal	int decimal	string [32]	2 digits hex	2 digits hex	int decimal	yyyy:mm:dd hh:mm:ss	float	float	string [32]	int decimal	float

12.3 Supported Commands

The following tables show the HART commands supported by the device.

Note!

Unlike a HART multiplexer the WirelessHART gateway only accepts commands directly addressed to its HART slave address.

12.3.1 Universal Commands

Command		Action	Description
Identity Commands			
0	📖	Read unique identifier	12 Bytes device identifier are given in the response
11	📖	Read unique identifier using tag	12 Bytes device identifier are given in the response, if the given tag complies to the tag of the gateway
21	📖	Read unique identifier using long tag	12 Bytes device identifier are given in the response, if the given long tag complies to the long tag of the gateway
Static Parameter Commands			
13	📖	Read tag, descriptor, date	Read the 8 digit tag, the 16 digit description and the date.
18	✎	Write tag, descriptor, date	Write the 8 digit tag, the 16 digit description and the date
12	📖	Read message	Read the 32 digit message
17	✎	Write message	Write the 32 digit message
20	📖	Read long tag	Read the 32 digit long tag
22	✎	Write long tag	Write the 32 digit long tag
16	📖	Read final assembly number	
19	✎	Write final assembly number	
Status Commands			
38	✎	Reset configuration changed flag	Reset the "Configuration changed" response code
48	📖	Read additional status	

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12.3.2 Common Practice Commands

Command		Action	Description
Device Management Commands			
41	✍	Perform device self test	Initiates the self test function in the device
42	✍	Perform device reset	Immediately after the response the microprocessor of the device will be reset.
89	✍	Set real-time clock	12 Bytes device identifier are given in the response, if the given long tag complies to the long tag of the gateway.
90	📖	Read real-time clock	
512	📖	Read country code	
513	✍	Write country code	
Data Link Layer Commands			
59	✍	Write number of response preambles	The number of preambles insert in response telegrams can vary from 2 to 20. Default setting is 4.
106	✍	Flush delayed response buffers	Flush all gateway DR buffers.
I/O System Commands			
74	📖	Read I/O system capabilities	Also returns number of detected devices.
77	✍	Send command to sub-device using card/channel	Request embeds full Hart command.
85	📖	Read I/O channel statistics using card/channel	Read channel communication statistics.
86	📖	Read sub-device statistics using list index	Read device communication statistics.
84	📖	Read sub-device identity summary using list index	Allows to read the Instrument list (a single item at a time).
I/O System (HOST I/F) Commands			
88	✍	Write I/O system retry count	
94	📖	Read I/O system host statistics	Read host I/F communication statistics.

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12.3.3 Wireless Commands

Command		Action	Description
Network information commands			
768	✎	Write join key	Write the network's unique join key. Only possible in ().
773	✎	Write network ID	Write the unique network ID.
774	📖	Read network ID	Read the unique network ID.
775	✎	Write network tag	Write the network tag. The network tag identifies the device in the WirelessHART network.
776	📖	Read network tag	Read the network tag.
794	📖	Read UTC time mapping	Read the time setting for the network.
797	✎	Write Radio Power	
798	📖	Read Radio Power	
840	📖	Read Network Device's Statistics	
Active / White / Black lists commands			
814	📖	Read Device List entries using list index	
816	✎	Delete device List table entry using unique ID	
821	✎	Write network access mode	
822	📖	Read network access mode	

12.3.4 Device Commands

Command		Action	Description
835	📖	Read network device burst mode list using unique ID	Read the device burst message list.
836	✎	Flush device cached responses using unique ID	Instructs the gateway to flush all cached responses for the relevant device.

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12.4 Software License

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13	📖	Read tag, descriptor, date	Read the 8 digit tag, the 16 digit description and the date.
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22	✎	Write long tag	Write the 32 digit long tag
16	📖	Read final assembly number	
19	✎	Write final assembly number	
Status Commands			

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Command		Action	Description
38	✎	Reset configuration changed flag	Reset the "Configuration changed" response code
48	📖	Read additional status	

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512	📖	Read country code	
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84	📖	Read sub-device identity summary using list index	Allows to read the Instrument list (a single item at a time).
I/O System (HOST I/F) Commands			
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12.5.3   Wireless Commands

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773	✍	Write network ID	Write the unique network ID.
774	📖	Read network ID	Read the unique network ID.
775	✍	Write network tag	Write the network tag. The network tag identifies the device in the WirelessHART network.
776	📖	Read network tag	Read the network tag.
794	📖	Read UTC time mapping	Read the time setting for the network.
797	✍	Write Radio Power	
798	📖	Read Radio Power	
840	📖	Read Network Device's Statistics	
Active / White / Black lists commands			
814	📖	Read Device List entries using list index	
816	✍	Delete device List table entry using unique ID	
821	✍	Write network access mode	
822	📖	Read network access mode	

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