



## Quick Start Guide PN/ModbusTCP Coupler

Version

**2<sup>en</sup>**  
as of FW 1.00

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## 1. Safety instructions

### Target audience

This description is only intended for **trained personnel qualified** in control and automation engineering who are familiar with the applicable national standards.

For installation, commissioning, and operation of the components, compliance with the instructions and explanations in this operating manual is essential. The specialist personnel is to ensure that the application or the use of the products described fulfills all safety requirements, including all applicable laws, regulations, provisions, and standards.

### Intended use

The device has a protection rating of IP 20 (open type) and must be installed in an electrical operating room or a control box/cabinet in order to protect it against environmental influences. To prevent unauthorized operation, the doors of control boxes/cabinets must be closed and possibly locked during operation.

The consequences of improper use may include personal injury to the user or third parties, as well as property damage to the control system, the product, or the environment. Use the device only as intended!

### Operation

Successful and safe operation of the device requires proper transport, storage, setup, assembly, installation, commissioning, operation, and maintenance.

Operate the device only in flawless condition. The permissible operating conditions and performance limits (technical data) must be adhered to.

Retrofits, changes, or modifications to the device are strictly forbidden.

## 2. Introduction

This document explains the initial commissioning of the PN/ModbusTCP Coupler.  
You can find the most current version of the documentation under [www.helmholz.de](http://www.helmholz.de) or scan the QR code directly.



*PN/ModbusTCP Coupler  
documentation*

## 3. Function of the PN/ModbusTCP Coupler

Simple and uncomplicated connection of a PROFINET network with a ModbusTCP network is possible with the PN/ModbusTCP Coupler.

The PN/ModbusTCP Coupler enables data transmission between a PROFINET controller and ModbusTCP participants.

Received input data on one of the network sides is made available as output data to the other network side. The IO data transfer takes place live and as quickly as possible without additional handling blocks.

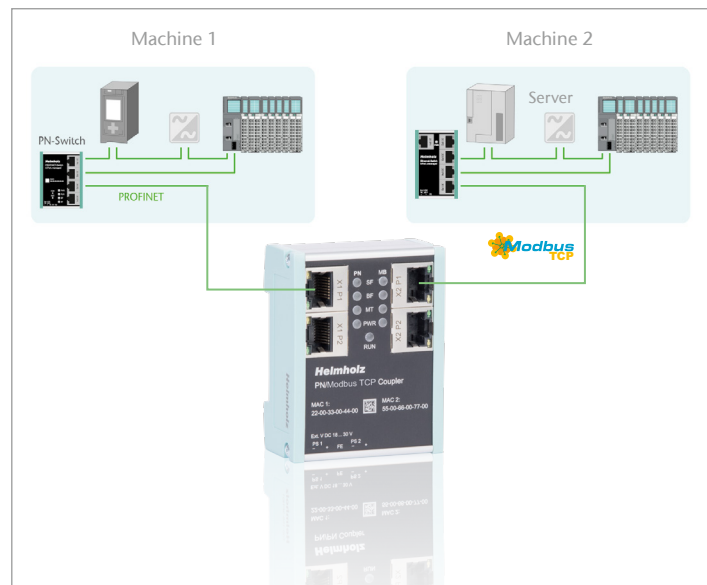
The maximum size of the transmitted data is 1024 bytes of input/output data. Up to 300 slots for IO modules are available.

The integration into the PLC engineering tool is made possible by a GSDML file; special configuration software isn't necessary.

In addition to the PROFINET / ModbusTCP communication, the PN/ModbusTCP Coupler also makes an MQTT Publisher available on both network sides.

In this way, the values exchanged via the gateway can also be distributed via MQTT to visualization or operating data recording systems.

Application example: 1



## 4. Connection

The left RJ45 sockets “X1 P1” and “X1 P2” are for the connection of the PROFINET network; the right RJ45 sockets “X2 P1” and “X2 P2” are for the connection of the ModbusTCP network.

The PN/ModbusTCP Coupler must be supplied with 24 V DC at the wide range input 18 ... 30 V via the provided connector. The power supply is designed redundantly. At least a supply path PS 1 or PS 2 must be connected.

**Note:** The housing of the PN/ModbusTCP Coupler is not grounded. Please connect the functional grounding connection (FG) of the PN/ModbusTCP coupler correctly with the reference potential.

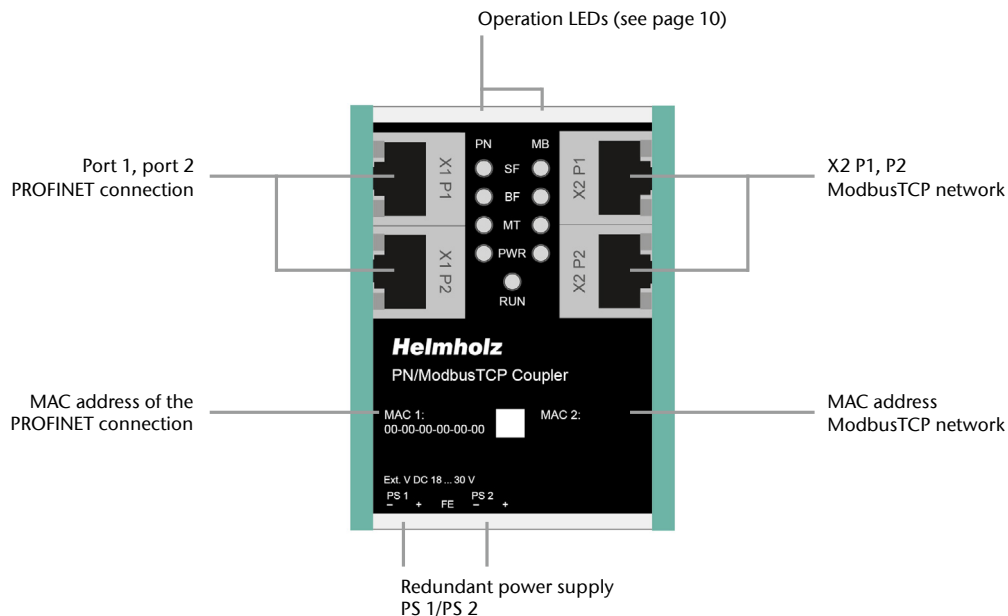
## 5. Install GSDML file

Please download the GSDML file (“GSDML-V2.34-Helmholz-PN-ModbusTCP-coupler-\_\_\_\_.xml”) under [www.helmholz.de](http://www.helmholz.de) or scan the QR code.

Install the file in the engineering tool so that the PN/ModbusTCP Coupler is available for configuration.



**PN/ModbusTCP Coupler**  
GSDML file



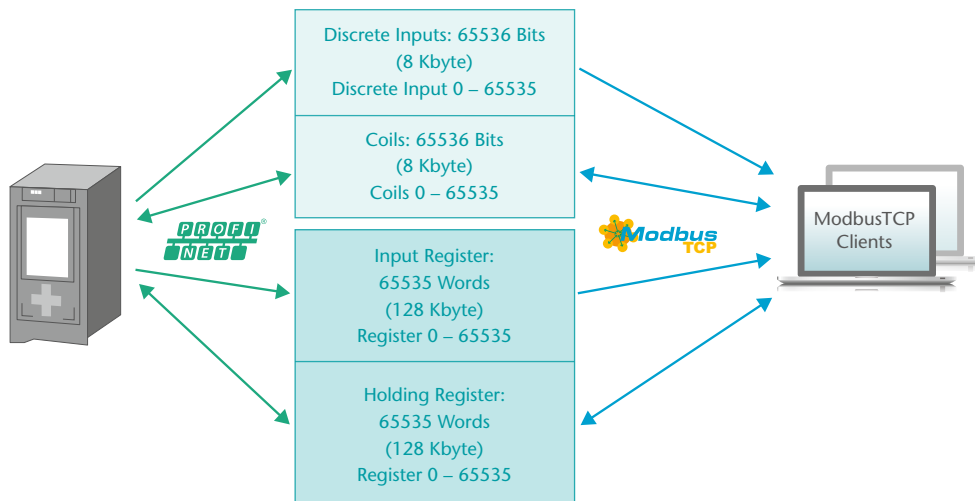
## 6. Concept of data exchange

The PN/ModbusTCP Coupler is a ModbusTCP server. It receives data via ModbusTCP, which is then transmitted to the IO image of the PROFINET PLC (inputs in the PLC) and makes data available as transmission data, which it receives from the PROFINET PLC (outputs in the PLC).

ModbusTCP differentiates between 4 different data types:

1. Discrete Inputs: Input bits; written by the PROFINET PLC
2. Coils: Output bits or internal data bits; read by the PROFINET PLC, but can also be written
3. Input Register: Input word; written by the PROFINET PLC
4. Holding Register: Output word or internal data word; read by the PROFINET PLC, but can also be written

All data types are enumerated from 0-65535. All data types have their own storage area in the PN/ModbusTCP Coupler.



In the PN/ModbusTCP Coupler, all coils, inputs and registers are always present from the perspective of the ModbusTCP communication. It is thus always possible to access all data types from address 0-65535.

With the PROFINET configuration, that data can be assigned in the slots of the PN/ModbusTCP Coupler to the PLC-IO image that is to be accessed in the PLC program. Up to 300 slots are available for such assignments in the PN/ModbusTCP Coupler

The following modules are available for access to the ModbusTCP storage:

#### Discrete Inputs (only writing):

- Write Discrete Inputs 1 Byte (8 bits)
- Write Discrete Inputs 2 Byte (16 bits)
- Write Discrete Inputs 4 Byte (32 bits)
- Write Discrete Inputs 8 Byte (64 bits)
- Write Discrete Inputs 16 Byte (128 bits)
- Write Discrete Inputs 32 Byte (256 bits)

#### Coils (read/write):

- Write Coils 1 Byte (8 bits)
- Write Coils 2 Byte (16 bits)
- Write Coils 4 Byte (32 bits)
- Write Coils 8 Byte (64 bits)
- Write Coils 16 Byte (128 bits)
- Read Coils 1 Byte (8 bits)
- Read Coils 2 Byte (16 bits)
- Read Coils 4 Byte (32 bits)
- Read Coils 8 Byte (64 bits)
- Read Coils 16 Byte (128 bits)

#### Input Register (only writing):

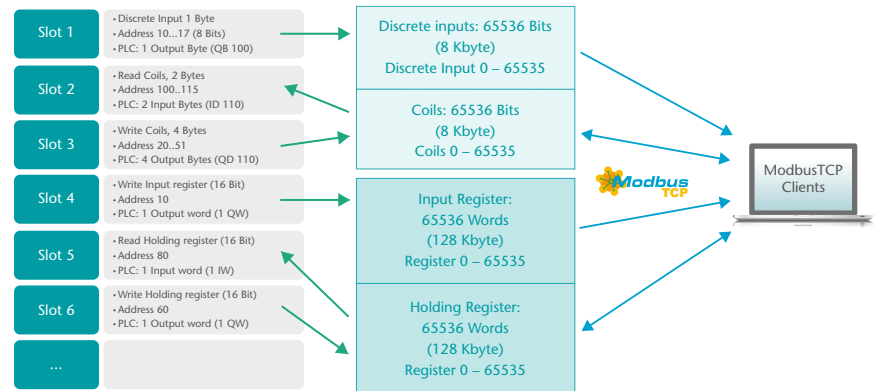
- Write Input Register (16 bits)

#### Holding Registers (read/write):

- Write Holding Register (16 bits)
- Read Input Register (16 bits)

All modules have the register numbers (Input Register, Holding Register) or the first bit address (Discrete Inputs, Coils) as parameter.

Example of a configuration:



# 7. Supported ModbusTCP function codes

The PN/ModbusTCP Coupler supports the following function codes:

Data size	Data range	Function	Function code decimal	Function code hex
Bit access	Input bits	Read discrete inputs	2	0x02
	Output bits or internal bits	Read coils	1	0x01
		Write single coil	5	0x05
		Write multiple coils	15	0x0F
16 bit access	Input data	Read input register	4	0x04
	Output data or internal information	Read holding register	3	0x03
		Write single holding register	6	0x06
		Write multiple Register	16	0x10
		Read/write multiple holding registers	23	0x17
		Mask write holding register	22	0x16

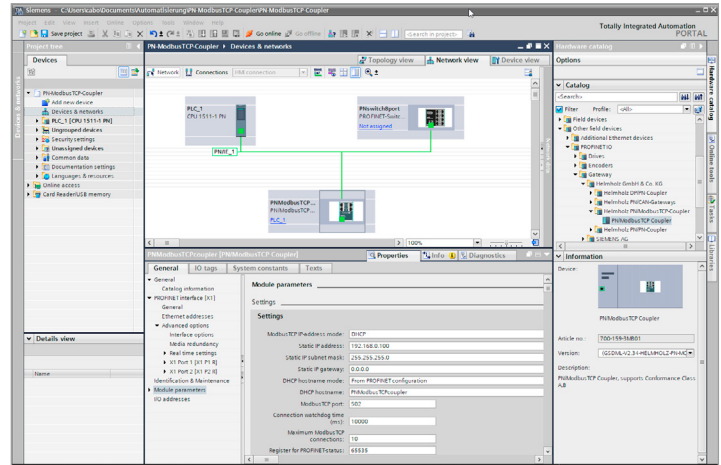


## 8. Configuration in the TIA portal

The PN/ModbusTCP Coupler can be found in the hardware catalog under “Other field devices / PROFINET IO / Gateway / Helmholz GmbH & Co. KG / Helmholz PN/ModbusTCP Coupler”.

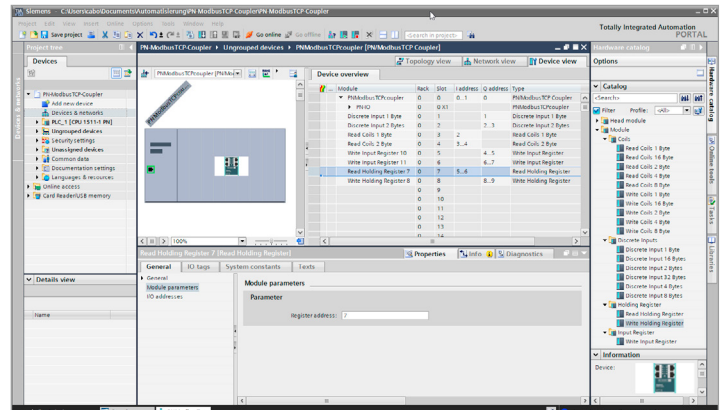
The PN/ModbusTCP Coupler can be completely configured via the GSDML file in the PROFINET configurator. An additional configuration software is not necessary. The ModbusTCP network settings can also be made through the website if needed.

Provide the PN/ModbusTCP Coupler with a PROFINET name under “General”. Connect the PROFINET network of the PROFINET controller with the PN/ModbusTCP Coupler.



Now insert the desired modules for discrete inputs, coils, input registers or holding registers into the slots.

All modules have the register number (input register, holding register) or the first bit address (discrete inputs, coils) as parameter. In the case of the input bits and coils, these can be addressed together in one slot from 8 bits (1 Byte) to 256 bits (32 Bytes). Addressing of individual bits is not possible via the PROFINET PLC; the smallest unit is one byte.



# 9. Parameters of the PN/ModbusTCP Coupler

The configuration of the PN/ModbusTCP Coupler can take place completely through the PROFINET hardware configurator. However, several parameters can also be optionally set via the website, e.g. the IP address of the ModbusTCP server, the DHCP host name.

<i>ModbusTCP</i>	Definition of the IP address for the ModbusTCP network.	<i>monitoring (ms):</i>	communication no longer takes place via this connection.
<i>IP address mode:</i>	“DHCP”, “Static IP”, “use IP from webpage setting”		Range: 1–65535 ms
<i>Static IP address:</i>	The static IP address can be indicated here when the address mode has been set to “Static IP”.	<i>Maximum number of ModbusTCP connections:</i>	Number of participants that can establish connections with the PN/ModbusTCP coupler simultaneously.
<i>Static IP subnet mask:</i>	The subnet mask can be indicated here when the address mode has been set to “Static IP”.	<i>Register for PROFINET status:</i>	Number of the register from which the status of the PN/ModbusTCP coupler can be read out via ModbusTCP. Range 0-65535
<i>DHCP host name mode:</i>	Adopt from the PROFINET configuration or from the web page	<i>Status of website:</i>	On which network interfaces should the website be displayed.
<i>DHCP host name:</i>	DHCP name of the device	<i>MQTT Publisher option:</i>	On which network interfaces should the MQTT Publisher be activated.
<i>ModbusTCP port:</i>	Port to which the ModbusTCP driver listens. Port 502 is always active, even when another port has been set here.		
<i>ModbusTCP connection</i>	Time in which a connection is closed when		

**Settings**

ModbusTCP IP-address mode: DHCP

Static IP address: 192.168.0.100

Static IP subnet mask: 255.255.255.0

Static IP gateway: 0.0.0.0

DHCP hostname mode: From PROFINET configuration

DHCP hostname: PNModbusTCPcoupler

ModbusTCP port: 502

Connection watchdog time (ms): 10000

Maximum ModbusTCP connections: 10

Register for PROFINET-status: 65535

Status Webpage: on both network sides active

MQTT Publisher option: off

☐ Diagnostic at PS1 failure

☐ Diagnostic at PS2 failure

## 10. Assign a PROFINET device name to the PN/ModbusTCP Coupler

When the configuration of the PN/ModbusTCP Coupler has been completed in the hardware configurator of the engineering tool, it can be loaded into the PLC.

In order that the PN/ModbusTCP Coupler can be found by the PROFINET controller, the PROFINET device name must be assigned to the PN/ModbusTCP Coupler. To this purpose, use the function “Assign device name”, which you can access in the Online menu with the right mouse button when the PN/ModbusTCP Coupler is activated.

With the “Update list...” button, the network can be browsed for PROFINET participants. The PROFINET device name can be assigned to the device with “Assign name”.

The clear identification of the PN/ModbusTCP Coupler is ensured here by the MAC address of the device. The MAC addresses of the device can be found on the device front of the PN/ModbusTCP Coupler.

The Helmholz IPSet tool, which can be downloaded at no charge from the Helmholz website, can also be used to set the PROFINET name.

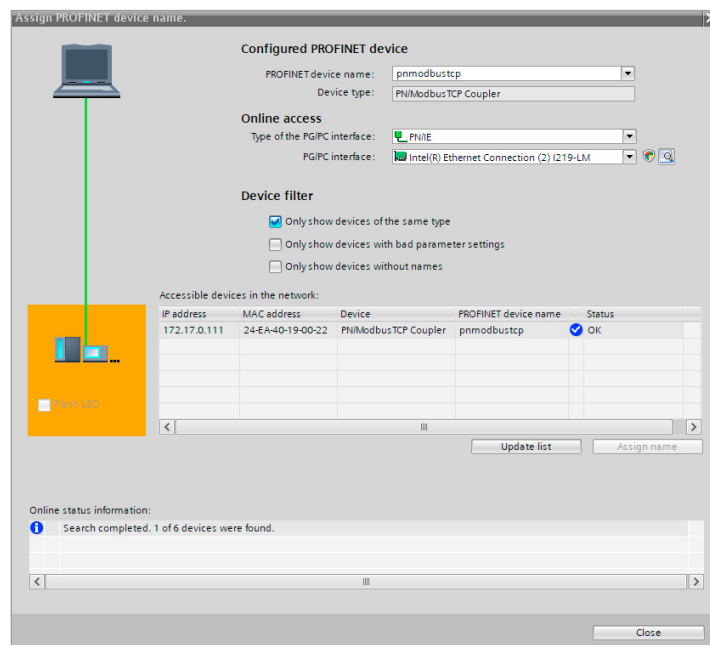
If the PN/ModbusTCP Coupler has been assigned the correct PROFINET name, it is recognized by the PLC and configured. If configuration has taken place correctly, the PROFINET “BF” LED should be off.

Alternatively, the PROFINET name or the IP address of the device can be set with the free Helmholz tool “IPset”.

The tool can be downloaded in the download area of the product under “Software”.



*PN/ModbusTCP Coupler  
IPSet*

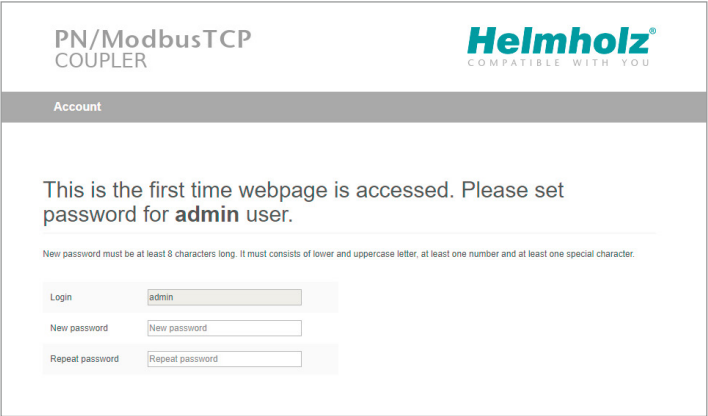


# 11. Web interface of the PN/ModbusTCP Coupler

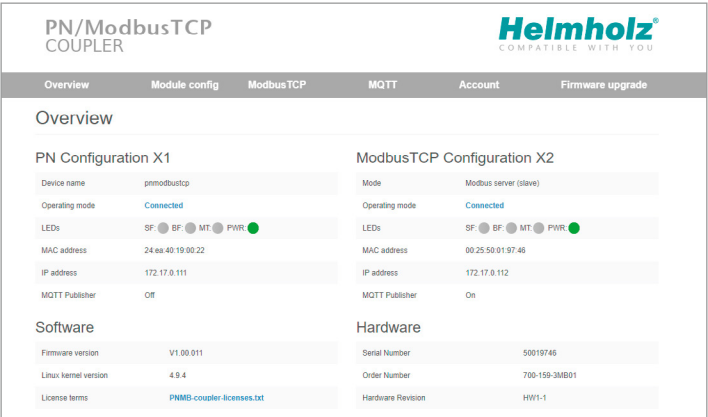
The web interface of the PN/ModbusTCP coupler provides an overview of the status and the configuration of the device, as well as the possibility for carrying out a firm-ware update.

The ModbusTCP configuration can also be set in the web interface if this hasn't been prescribed through the PROFINET configuration.

A password must be defined for the standard user "admin" with the first access to the web interface. The password can be retroactively changed in the "Account" menu.



The current settings and the status are represented in the "Overview".  
The other websites can be called up in the top line.



*Note: Calling up the website can influence the transmission capacity of the PN/ModbusTCP Coupler.*

The “Module config” page shows the IO modules defined by the PROFINET configuration. The data type and the address are also provided on the ModbusTCP page. The current value is displayed in brackets.

Overview	Module config	ModbusTCP settings	Firmware upgrade
Module Configuration			
Profinet Configuration ModbusTCP Configuration			
Slot#: 1	IN 1 Byte (00)	Coils - Address 9 (00)	
Slot#: 2	IN 2 Bytes (0000)	Coils - Address 17 (0000)	
Slot#: 3	OUT 1 Byte (41)	Coils - Address 33 (41)	
Slot#: 4	OUT 2 Bytes (0000)	Coils - Address 41 (0000)	
Slot#: 5	OUT 1 Byte (01)	Discrete Input - Address 1 (01)	
Slot#: 6	OUT 2 Bytes (0001)	Discrete Input - Address 9 (0001)	
Slot#: 7	IN 2 Bytes (0000)	Holding Register - Address 1 (0000)	
Slot#: 8	IN 2 Bytes (0000)	Holding Register - Address 2 (0000)	
Slot#: 9	IN 2 Bytes (0000)	Holding Register - Address 3 (0000)	
Slot#: 10	OUT 2 Bytes (0001)	Holding Register - Address 10 (0001)	
Slot#: 11	OUT 2 Bytes (0001)	Holding Register - Address 11 (0001)	

The IP address and the DNS name of the ModbusTCP network interface are set on the “ModbusTCP server settings” website when these have not been fixed through the GSDML configuration.

Overview	Module config	ModbusTCP settings	Firmware upgrade
ModbusTCP server settings			
Note: Some settings may be disabled due to PROFINET configuration			
Address		Parameters	
Mode	<input type="radio"/> DHCP <input checked="" type="radio"/> Static	Listening port	502
DHCP - Hostname	PNModbusTCPCoupler	Maximum number of connected clients	10
Static - IP address	172.17.0.112	Client connection watchdog [ms]	65535
Static - Netmask	255.255.255.0	PROFINET-status register address (input register)	65536
Static - Gateway	0.0.0.0		

## 12. MQTT Publisher

In addition to the PROFINET / ModbusTCP communication, the PN/ModbusTCP Coupler also makes an MQTT Publisher available.

MQTT is broadly distributed and simple protocol for the distribution of information in large networks.

The MQTT Publisher can be activated via the PROFINET configuration on the PROFINET or Modbus interface.

For all IO modules defined in the PROFINET configuration, the current values of the value change are sent via MQTT.

Since MQTT works slower than the priority PROFINET/Modbus TCP communication, it is possible that not all value changes are transmitted via MQTT, but only the last value state.

### 11.1 MQTT Publisher settings

At least one MQTT broker is always required to be able to distribute data via MQTT in a network. The broker can run everywhere in the network.

The settings of the MQTT Publisher can be defined on the website under “MQTT”, separate for the two network sides.

<b>ClientID:</b>	The name of the MQTT Publisher
<b>User name / Password:</b>	Optional user name and password for login with the MQTT broker
<b>Broker IP address:</b>	Address of the MQTT broker
<b>Broker TCP port:</b>	MQTT port at the MQTT broker
<b>Keep alive (seconds):</b>	MQTT connection monitoring in the event of inactivity

*Note: The MQTT Publisher of the PN/ModbusTCP Coupler currently does not provide encoding!*

Overview

Module config

ModbusTCP

MQTT

Account

Firmware upgrade

MQTT configuration

Note: Some settings may be disabled due to PROFINET configuration

Profinet Configuration X1

ClientID

PN\_MQTT

Username (Optional)

test

Password (Optional)

\*\*\*\*

Broker IP address

172.17.0.99

Broker TCP port

1883

Quality of Service

0

Keep alive (Seconds)

60

ModbusTCP Configuration X2

ClientID

MODBUS\_MQTT

Username (Optional)

test

Password (Optional)

\*\*\*\*

Broker IP address

172.17.0.9

Broker TCP port

1883

Quality of Service

0

Keep alive (Seconds)

60

11.2 MQTT format of the data

The data is transmitted in plain text format via MQTT. The syntax differs depending upon the network interface used.

	PROFINET network:	ModbusTCP network:
Module	MQTT Topic Name	MQTT Topic Name
Write discrete inputs	PN-ClientID/Slot X/Output, Y bytes (1 to 32 bytes)	ModbusTCP-ClientID/Discrete Inputs/Address X, Y Bytes (1 to 32 bytes)
Read Coils	PN-ClientID/Slot X/Input, Y bytes (1 to 16 bytes)	ModbusTCP-ClientID/Coils /Address X, Y Bytes (1 to 16 bytes)
Write Coils	PN-ClientID/Slot X/Input, Y bytes (1 to 16 bytes)	ModbusTCP-ClientID/Coils /Address X, Y bytes (1 to 16 single bytes)
Read holding register	PN-ClientID/Slot X/Output (2 byte decimal value)	ModbusTCP-ClientID/Holding Register/Register X (2 byte decimal value)
Write holding register	PN-ClientID/Slot X/Output (2 byte decimal value)	ModbusTCP-ClientID/Holding Register/Register X (2 byte decimal value)
Write input register	PN-ClientID/Slot X/Output (2 byte decimal value)	ModbusTCP-ClientID/Input Register/Register X (2 byte decimal value)
Example	PN_MQTT/Slot 1/Input, 3 bytes   0x12 0x23	MODBUS_MQTT/Coils/Address 49, 2 bytes   0x12 0x34
	PN_MQTT/Slot 5/Output   12345	MODBUS_MQTT/Holding Register/Register 10   12345

The following MQTT topics can also be read on both network interfaces:

**ClientID/Modules List:**

Contains the list of all topics made available by the PN/ModbusTCP Coupler via the addressed interface.

**ClientID/Status Register:**

Contains the value of both status bytes, see chapter 11.1.

### 13. Firmware update & reset to factory settings

A firmware update can be carried out via the web interface on the “Firmware upgrade” page.

The firmware can be selected with the Browse button. The firmware file has the ending “HUF” (Helmholz Update File).

The firmware is transferred to the PN/ModbusTCP Coupler and burned with the “Submit” button.

The PN/ModbusTCP Coupler then performs a restart and the new firmware is active.

Please download the current firmware under **www.helmholz.de** or scan the QR code.



*PN/ModbusTCP Coupler  
firmware*

*Note: It is also possible to carry out the reset to factory settings at the website.*

Overview	Module config	ModbusTCP	MQTT	Account	Firmware upgrade
<h2>Firmware Upgrade</h2> <p>Currently installed firmware: V1.00.013 Starting firmware upgrade will terminate any established ARs</p> <div><input type="button" value="Browse"/></div> <div><input type="button" value="Submit"/></div> <div><input type="button" value="Set factory defaults and reboot"/></div>					



## 14. PN/ModbusTCP status and control via the PLC

### 13.1 Status

The PN/ModbusTCP Coupler provides a **status** via the PROFINET input image:

**Byte 1:** Status bits

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
PROFINET configuration completed. Device is ready to operate.	-	Power supply detected on PS 1 (left)	Power supply detected on PS 2 (right)	MQTT connection active on network X1	MQTT connection active on network X2	ModbusTCP network has an active IP address (static or acquired via DHCP)	Network cable detected

**Byte 2:** Number of active connections

### 11.2 Control bits

The PN/ModbusTCP Coupler can be controlled via the following **control bits** in the PROFINET output image:

**Byte 1** “Control bits”

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
-	-	-	-	-	-	Reset the ModbusTCP memory (coils, inputs and registers)	Interrupt all ModbusTCP connections and prevent the establishing of connections

## 15. LED status information

	X1 PROFINET (left side)	X2 ModbusTCP (right side)
<b>SF (rot)</b>		
Off	Configuration correct	Configuration correct
On	There is no configuration, the configuration does not agree with the configuration on the right side (X2), or a diagnosis exists.	PROFINET side not configured or has failed
Flashing	PROFINET function "LED flashing" for finding the device is being carried out	
<b>BF (red)</b>		
Off	The device is configured	The device is configured
On	The device has no configuration, the PROFINET device name is incorrect, or there is no connection with the PROFINET controller.	No Ethernet cable plugged in or no Ethernet connection
Flashing	PROFINET function "LED flashing" for finding the device is being carried out	
<b>MT (yellow)</b>		
Flashing	A firmware update is being carried out	A firmware update is being carried out.
Blinking together with SF and BF.	PROFINET function "LED flashing" for finding the device is being carried out.	
<b>PWR (green)</b>		
On	PS1 Power supply present	PS2 Power supply present
<b>RUN (green)</b>		
Off	Firmware or device defective. Please contact Support	
On	The device is ready to operate	
<b>RJ45 LEDs</b>	X1 P1/P2 and X2 P1/P2	
Green (Link)	Connected	
Orange (Act)	Data transfer at the port running	

## 16. Technical data

<b>Order no.</b>	<b>700-159-3MB01</b>
Article designation	PN/ModbusTCP Coupler
Scope of delivery	PN/ModbusTCP Coupler incl. Quick Start Guide
<b>PROFINET interface</b>	
- Number	1 with 2 ports
- Protocol	PROFINET IO as defined in IEC 61158-6-10
- Transmission rate	100 Mbps full duplex
- I/O image size	max. 1024 bytes of input and output data
- Number of configurable slots	300
- Connection	2x RJ45, integrated switch
- Features	Media redundancy (MRP), automatic addressing, topology detection (LLDP, DCP), diagnosis alarms
<b>ModbusTCP interface</b>	
- Number	1 with 2 ports
- Protocol	ModbusTCP server
- Transmission rate	10/100 Mbps full duplex
- Storage size	65536 coil bits, 65536 discrete input bits, 65536 input register, 65536 holding register
- Supported function codes	1, 2, 3, 4, 5, 6, 15, 16, 22, 23
- Connection	2x RJ45, integrated switch
Status indicator	9 LEDs function status, 8 LEDs Ethernet status
Voltage supply	24 V DC (18 - 28 V DC)
Current draw	Max. 210 mA
Power dissipation	Max. 5 W
Dimensions (D x W x H)	35 mm x 58 mm x 72 mm
Weight	Approx. 135 g
Ambient temperature	0 °C to 60 °C
Transport and storage temperature	-20 °C to 80 °C
Protection rating	IP 20
Certifications	CE

**Note:**

*The contents of this Quick Start Guide have been checked by us so as to ensure that they match the hardware and software described. However, we assume no liability for any existing differences, as these cannot be fully ruled out.*

*The information in this Quick Start Guide is, however, updated on a regular basis. When using your purchased products, please make sure to use the latest version of this Quick Start Guide, which can be viewed and downloaded in the Internet at [www.helmholz.de](http://www.helmholz.de).*

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