

PSSnet GW1 MOD-EtherCAT

Gateways



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SD means Secure Digital

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1 Introduction

1.1 Validity of documentation

This documentation is valid for the product PSSnet GW1 MOD-EtherCAT. It is valid until new documentation is published.

This operating manual explains the function and operation, describes the installation and provides guidelines on how to connect the product.

1.2 Using the documentation

This document is intended for instruction. Only install and commission the product if you have read and understood this document. The document should be retained for future reference.

1.3 Definition of symbols

Information that is particularly important is identified as follows:



DANGER!

This warning must be heeded! It warns of a hazardous situation that poses an immediate threat of serious injury and death and indicates preventive measures that can be taken.



WARNING!

This warning must be heeded! It warns of a hazardous situation that could lead to serious injury and death and indicates preventive measures that can be taken.



CAUTION!

This refers to a hazard that can lead to a less serious or minor injury plus material damage, and also provides information on preventive measures that can be taken.



NOTICE

This describes a situation in which the product or devices could be damaged and also provides information on preventive measures that can be taken. It also highlights areas within the text that are of particular importance.

**INFORMATION**

This gives advice on applications and provides information on special features.

2 Overview

2.1 Module features

The PSSnet GW1 MOD-EtherCAT

- ▶ operates as a protocol converter between Modbus/TCP and EtherCAT,
- ▶ can be used to exchange data between products that support Modbus/TCP or EtherCAT. For example, this may be a control system from the automation system PSS 4000 from Pilz on one side and a third-party product on the other. The third party product must support EtherCAT.

Features of the PSSnet GW1 MOD-EtherCAT:

- ▶ Can be used with Pilz products that support Modbus/TCP:
 - Control systems from the automation system PSS 4000 (e.g. PSSu H)
 - Compact/modular 3rd generation PSS-range programmable safety systems (e.g. PSS SB 3006-3 ETH-2, PSS(1) SB CPU3 ETH-2)
 - Operator terminals PMI with Modbus/TCP interface (e.g. PMI 5)
 - Motion control systems (e.g. PMCprimo Drive3, PMCprimo DriveP, PMCprimo 16+)
- ▶ 1 x RJ45 socket for connection to Modbus/TCP,
- ▶ Can manage up to 8 Modbus/TCP connections
- ▶ Can operate as a Modbus/TCP connection Server,
- ▶ Web server for managing and configuring the Gateway,
- ▶ Supports CANopen over EtherCAT,
- ▶ Operates as a Slave in the EtherCAT network,
- ▶ Transmission rate 10 MBit/s (10BaseT) and 100 MBit/s (100BaseTX),
- ▶ 2 x RJ45 socket for connection to EtherCAT,
- ▶ supports autonegotiating,
- ▶ LEDs for displaying the communication status and errors,
- ▶ input/output data
 - up to 512 Bytes acyclical data (SDO),
 - in total (RxPDO and TxPDO) max. 512 Bytes,
 - additionally it is possible to transfer data between the control systems,
- ▶ supply voltage
 - 20 ms buffer in case of supply interruptions,
 - plug-in connection terminals (either spring-loaded terminal or screw terminal).

2.2 Unit view

2.2.1 Front

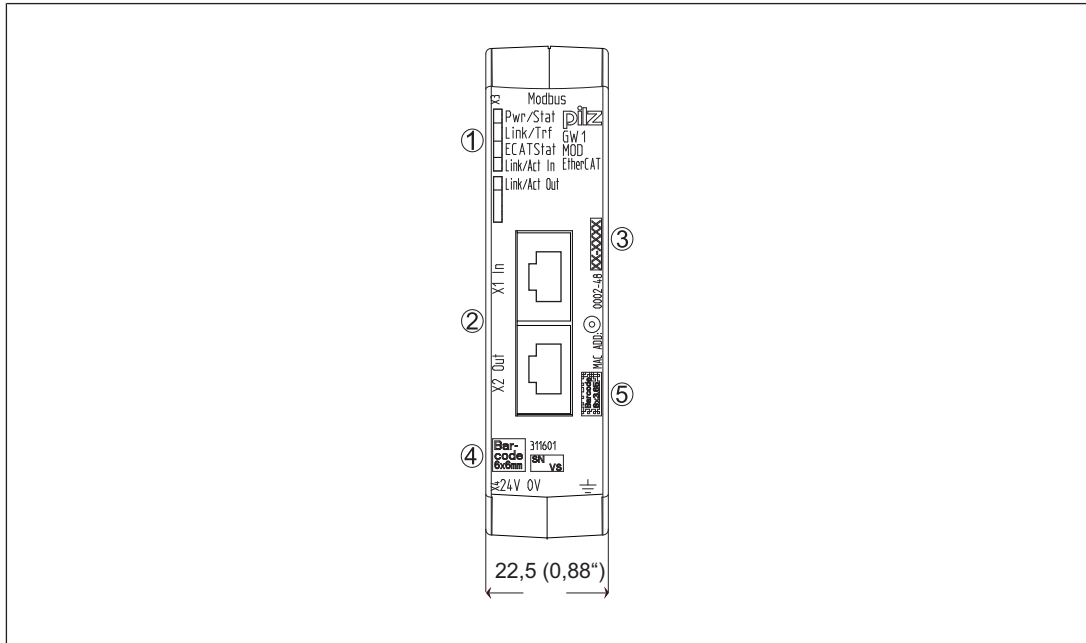


Fig.: Front view

- ①: LEDs for displaying the communication status and faults
- ②: EtherCAT interfaces X1 and X2 (RJ45)
- ③: MAC address
- ④: Barcode with the item number, serial number and version of the Gateway
- ⑤: 2D code with the MAC address

EtherCAT  is registered trademark and patented technology, licensed by Beckhoff Automation GmbH, Germany

2.2.2

Top

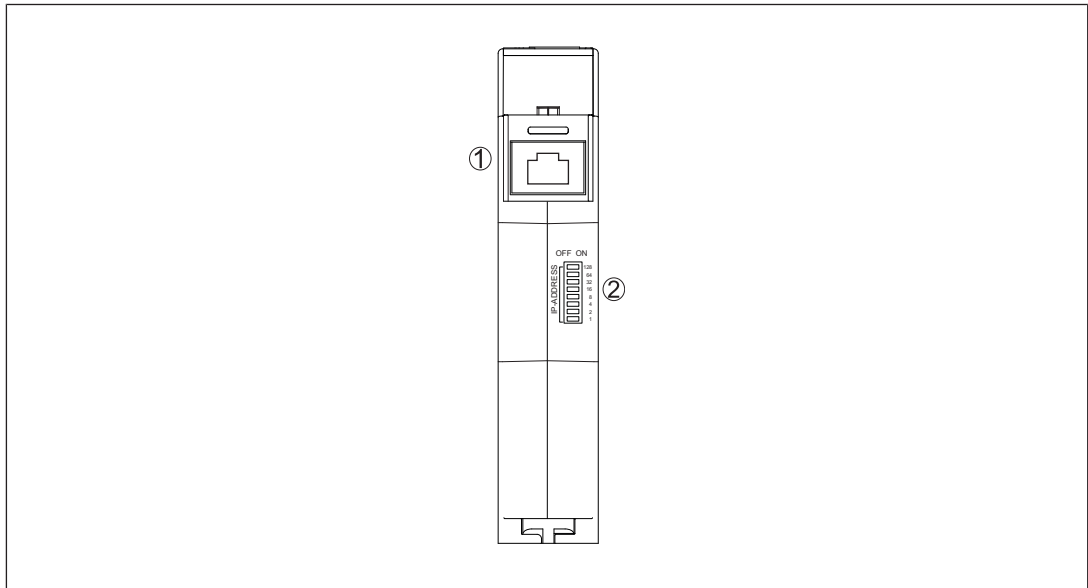


Fig.: Top

①: Modbus/TCP interface (RJ45)

②: DIP switch for IP address

2.2.3

Right-hand side

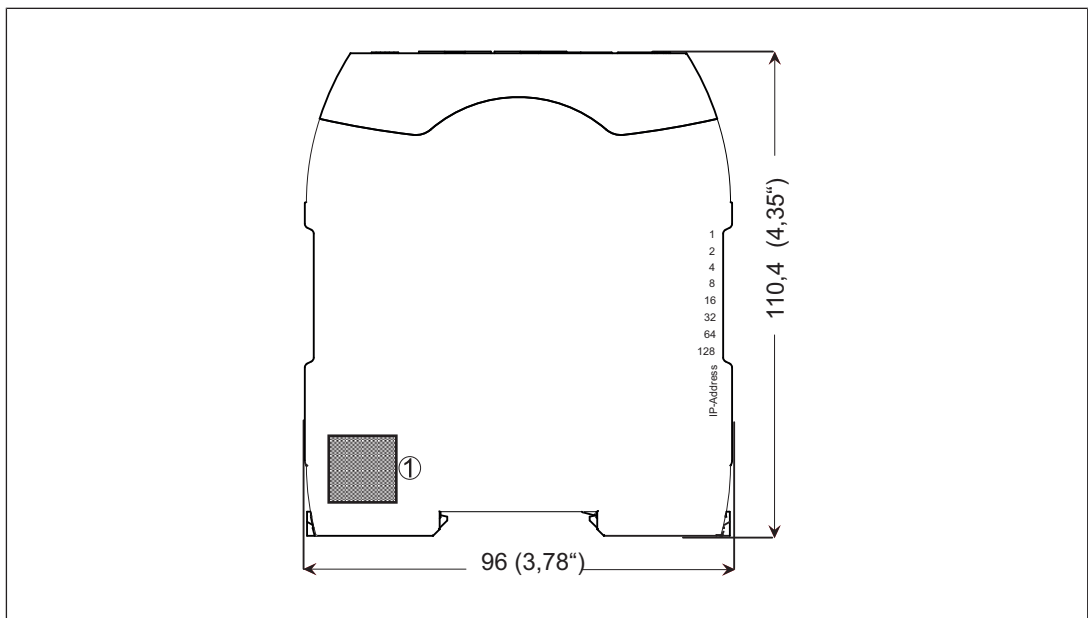


Fig.: Right-hand side

①: QR code with a link to the Pilz homepage with further information on the Gateway

2.2.4

Bottom

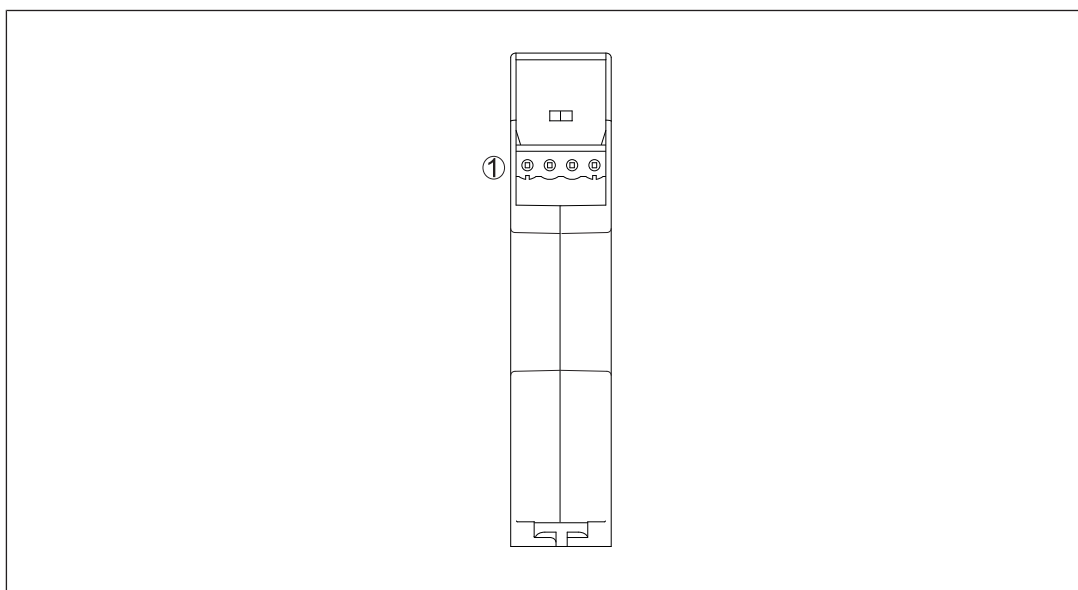


Fig.: Bottom

①: Supply voltage connection

3 Safety

3.1 Intended use

The product serves as a protocol converter between Modbus/TCP and EtherCAT. It can be used with various Pilz products as well as third-party products, provided they support the documented properties and requirements.

- ▶ **Modbus/TCP**

The Gateway can be used with products that operate as connection Client during data exchange. The product must support at least one of the documented function codes .

- ▶ **EtherCAT**

The Gateway can be used as a passive subscriber (Slave) in aEtherCAT network. The basic functions of communication via EtherCAT correspond to the System Description published by the EtherCAT User Group.

The Gateway may not be used for safety-related functions.

Intended use includes making the electrical installation EMC-compliant. The product is designed for use in an industrial environment. It is not suitable for use in a domestic environment, as this can lead to interference.

The following is deemed improper use in particular:

- ▶ Any component, technical or electrical modification to the product
- ▶ Use of the product outside the areas described in this manual
- ▶ Use of the product outside the technical details (see chapter entitled "Technical Details")

3.1.1 Electromagnetic compatibility

To ensure electromagnetic compatibility the correct procedures must be carried out during installation.

A device is electromagnetically compatible if:

- ▶ It functions without error in a given electromagnetic environment
- ▶ It does not adversely affect its own environment.

Electromagnetic interference can reach the devices through:

- ▶ Fields
- ▶ Power supplies
- ▶ Earth cabling
- ▶ Bus connections
- ▶ Interfaces
- ▶ Input and output cables

The interference can be transferred from the producer (source) to the receiver (interference sink) via the coupling routes.

Interference reaches the interference sink (e.g. the control system devices) in various ways:

- ▶ **DC coupling:**
DC coupling occurs if the source and sink of interference have common cable connections. The common cable presents complex resistances, inducing potential differences. Typical sources of interference are switches/relays, running motors or varying potentials for other systems on the same power supply.
- ▶ **Capacitive (electrical) coupling:**
A different potential between the source and interference sink (e.g. two cables) creates an electrical field. Coupling is proportional to the rate of voltage change. Typical sources of interference are contactors, static discharge, parallel signal cables.
- ▶ **Inductive (magnetic) coupling:**
A live cable produces a magnetic field which also surrounds adjacent cables. Interference voltage is induced. Coupling is proportional to the rate of current change. Typical sources of interference are mains cables running in parallel, live cables, high frequency cables, inductors, transformers, motors.
- ▶ **Electromagnetic coupling:**
A cable can emit a signal as a radio wave. This wave is then picked up by another cable. Typical sources of interference are transmitters such as radios, sparks from spark plugs, welding equipment, etc.

**NOTICE**

Powerful HF transmitters should only be operated at a distance of more than 0.6 m.

- ▶ **Static discharge:**
Static discharge occurs where there are very high differences in potential between two points. If the two points are brought closer together or if the potential difference is increased, discharges can occur in the air gaps. Typical sources of interference are people who are statically charged from a synthetic carpet, for example.

3.1.1.1**Connecting the earth cables**

Please note:

- ▶ A conductor cross section of at least 2.5 mm² should be used for the connection to the central earth bar. Connections should be kept as short as possible.
- ▶ Connections to the earth bar should always be in star form.
- ▶ Connect together the 0V connections on all the 24 V power supplies and earth the 0 V mains at a single point, or ensure that measures are in place to monitor for earth faults. Earthed supply voltages offer the best noise immunity.
- ▶ The connection of the 0 V supply to the central earth bar or earth fault monitor must be in accordance with relevant national regulations (such as EN 60204-1, NFPA 79:17-7, NEC: Article 250).
- ▶ Connections should be protected from corrosion.

- ▶ Flexible earthing straps should be used on moving earth parts (e.g. machine parts, gates). Ensure these earthing straps are as short and wide as possible.

3.1.1.2 Cable routing

It is possible to differentiate between cables according to their function. The following groups exist:

- ▶ Group 1: Data and supply lines for DC voltages below 60 V and AC voltages below 25 V
- ▶ Group 2: Data and supply lines for DC voltages from 60 V to 400 V and AC voltages from 25 V to 400 V.
- ▶ Group 3: Supply lines above 400 V

Cabling inside buildings:

- ▶ The cable groups listed above should be laid separately.
- ▶ Cables of the same group can be laid within the same cable duct.
- ▶ Cables from group 1 and group 2 should be laid in separate groups or in cable ducts which are at least 10 cm apart.
- ▶ Cables from group 1 and group 3 should be laid in separate groups or in cable ducts which are at least 50 cm apart.
- ▶ Data and signal lines should be laid as close as possible to an earthed surface.

Cabling to open air systems:

- ▶ As far as possible use metal conduits. These should be electrically connected and earthed.
- ▶ Ensure there is sufficient protection against lightning by using metal conduits earthed at both ends, or concrete cable ducts with reinforcements connected across the joints.

3.1.1.3 Equipotential bonding

Potential differences can occur if the devices are connected to different earth or ground connections. Even cable shields that are connected at either end and have different earth connections can cause potential differences. In order to avoid interference, equipotential bonding cables must be installed.

In doing so you must ensure the following:

- ▶ Select a low impedance equipotential bonding cable.
- ▶ Select the following as standard values for the cross section of the equipotential bonding cables:
 - 16 mm² for equipotential bonding cable up to 200 m in length
 - 25 mm² for equipotential bonding cable over 200 m in length
- ▶ If the control system devices are connected with shielded signal cables which are earthed at either end, the impedance is calculated as follows:
 - Impedance equipotential bonding cable = 10 % of shield impedance.
- ▶ Use copper or galvanised steel equipotential bonding cable.

- ▶ Connect equipotential bonding cables to the earth bar over as wide a surface area as possible.
- ▶ As short a distance as possible should be kept between the equipotential bonding cable and signal cable.

3.1.1.4 Shielding

Interference currents must be diverted to cable shields via shield bars.

In doing so you must ensure the following:

- ▶ Connect the shields with low impedance to the shield bar or earth bar.
- ▶ Use cables with braided screening, with a minimum cover area of 80 %.
- ▶ When laying cables without equipotential bonding or using foil shields: Connect the shield at one end.
- ▶ If possible, use metal or metallised plugs to connect cables for serial data transfer. Always refer to the regulations relating to the fieldbus systems.
- ▶ If the shield is not to be connected at the end of the cable, it must have no connection to the connector housing.
- ▶ If the shield is to be connected, connect it to the shield bar at the point where the cable enters the cabinet, without making a break in the cable. Use metal cable clamps which cover the shield over a wide surface area. Route the shield as far as the units, but do not connect it to the units.

Digital inputs and outputs do not need shielded cables.

However, if the connection cables have a shield, it should be connected at one end.

Analogue inputs and the incremental encoder inputs on speed monitors should always be connected using shielded cables.

3.1.1.5 Lighting in the control cabinet

Use low interference panel lighting for inside the control cabinet.

3.1.1.6 Testing the EMC-compliance of an installation

You can use the list below to check that the installation of the Gateway is EMC-compliant.

Check	Measures	Done
Are there areas with a high probability of interference? (e.g. computers running, process control areas, distribution cabinets, cable casing, frequency converters, hand-held radios etc.).	EMC protection in these areas should be planned with particular care.	
Are areas where computers are running or areas such as process control rooms sufficiently shielded from electromagnetic coupling?	If necessary shield the whole area.	
Does the cable layout take into account the principles of EMC compliance?	Some important points: Lay cables close to earth, keep clear of other electrical equipment, keep cables in ducts separate from other parts of the installation, keep cables as short as possible, avoid multiple crossovers.	
Is the supply voltage free of interference?	Supplies with interference voltages should be fitted with a mains filter.	
EMC characteristics of individual units / all units tested once installed?	Test EMC characteristics under operating conditions, e.g. while hand-held radios are in use, or HF frequency generators are close by. Test static discharge with operating personnel, test mutual interference between units under different operating conditions.	
Earthed parts connected correctly?	The connections between the units, racking bars, earth conductors and shield bars are important. Inactive metal parts should be connected over a wide surface area and earthed at a central point; with insulated metal: Remove insulation or use special contact fixings; protect the connection from corrosion; connect the cabinet doors to the body of the cabinet using earthing straps.	
Cable groups laid separately?	Separate cables into groups. Supply and signal leads should be laid separately.	
Are the shields connected correctly?	Use shielded cables for analogue and data leads; use metallic plugs; connect cable shields to shield bar at point of entry to cabinet; connect cable shields over a wide surface area and with low impedance.	
Equipotential bonding carried out?	If the installation extends over a wide area: lay equipotential bonding cable.	
Are inductive loads switched?	Sufficient fuse protection should be used with inductive loads	
24 VDC power supply?	Power supplies must conform to EN 60742:9/1995, EN 60950-1:2006/A11:2009 or EN 50178: 10/97.	

3.2 Safety regulations

3.2.1 Use of qualified personnel

The products may only be assembled, installed, programmed, commissioned, operated, maintained and decommissioned by competent persons.

A competent person is someone who, because of their training, experience and current professional activity, has the specialist knowledge required to test, assess and operate the work equipment, devices, systems, plant and machinery in accordance with the general standards and guidelines for safety technology.

It is the company's responsibility only to employ personnel who:

- ▶ Are familiar with the basic regulations concerning health and safety / accident prevention
- ▶ Have read and understood the information provided in this description under "Safety"
- ▶ And have a good knowledge of the generic and specialist standards applicable to the specific application.

3.2.2 Warranty and liability

All claims to warranty and liability will be rendered invalid if

- ▶ The product was used contrary to the purpose for which it is intended
- ▶ Damage can be attributed to not having followed the guidelines in the manual
- ▶ Operating personnel are not suitably qualified
- ▶ Any type of modification has been made (e.g. exchanging components on the PCB boards, soldering work etc.).

3.2.3 Disposal

When decommissioning, please comply with local regulations regarding the disposal of electronic devices (e.g. Electrical and Electronic Equipment Act).

3.3 Safety during installation

The product requires a 24 VDC supply. Check that the external power supply provides this voltage.

The tolerance of the supply voltage must comply with the technical details. Safe operation cannot be guaranteed outside this range.

Protect the external power supply by fitting a fuse between the external power supply and the product. The size of the fuse will depend on the specification of the external power supply, the conductor cross section and on local regulations.

**WARNING!**

Risk of electrocution!

Safe electrical isolation must be ensured for the external power supply that generates the supply voltage. Failure to do so could result in electric shock.

The power supplies must comply with EN 60950-1:2006/A11:2009, EN 61558-2-6:11/1997.

**WARNING!**

Risk of electrocution!

When voltage is applied, contact with live components could result in serious or even fatal injury from an electric shock.

4 Function description

4.1 Operation

The Gateway

- ▶ operates as a protocol converter between Modbus/TCP and EtherCAT,
- ▶ operates on the Modbus/TCP side as connection Server and on the EtherCAT-side as Slave,
- ▶ Uses an LED to indicate whether there is data traffic via the connection
- ▶ Uses an LED to indicate the interface used for this data traffic
- ▶ If the connection to EtherCAT or to Modbus/TCP is no longer available, the payload is retained with the current values
- ▶ is exclusively designed for exchanging non-safety-related data

The Gateway is interposed in the data flow between the connected devices.

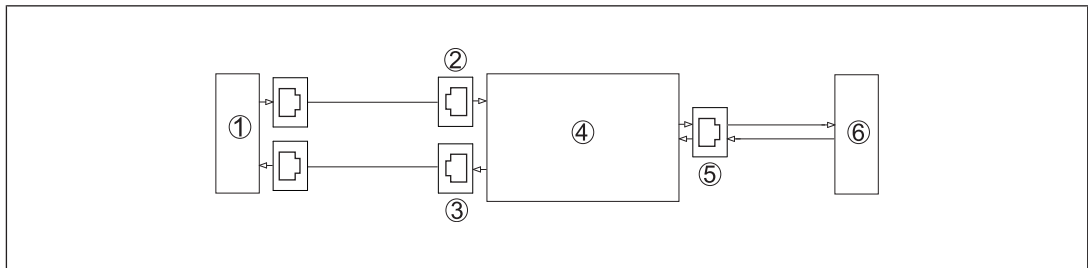


Fig.: Protocol conversion, Modbus/TCP to EtherCAT

- ▶ Signal path from EtherCAT Master to Modbus/TCP interface
EtherCAT Master ① -> EtherCAT input X1 on the Gateway ② -> Protocol conversion ④ -> Data input/output Modbus/TCP interface ⑤ -> Modbus/TCP ⑥
- ▶ Signal path from Modbus/TCP-enabled product to EtherCAT Master:
Modbus/TCP ⑥ -> Data input/output Modbus/TCP interface ⑤ -> Protocol conversion ④ -> EtherCAT output X2 on the Gateway ③ -> EtherCAT-Master ①

4.1.1 Block diagram

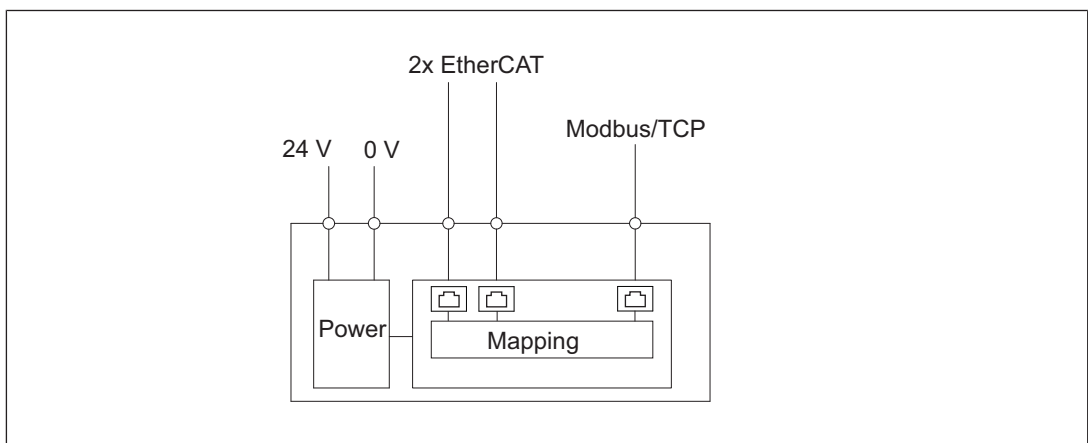


Fig.: Block diagram

4.2 Modbus/TCP

The Gateway can manage a max. of 8 Modbus/TCP connections. The Gateway is always the connection Server. The connection Clients may be various devices, e.g. PC, control system, display unit. They can access the Gateway simultaneously.

Port number "502" in the Gateway is set as the default for data exchange via a Modbus/TCP connection.

4.2.1 Modbus/TCP data ranges (Server connections)

The product supports the following Modbus/TCP data areas:

Data area	Modbus syntax	Example
Coils (Bit) 0x00000 ... 0x65535 [read/write]	0x[xxxxx]	0x00031
Discrete Inputs (Bit) 1x00000 ... 1x65535 [read only]	1x[xxxxx]	1x08193
Input Register (Wort/16 Bits) 3x00000 ... 3x65535 [read only]	3x[xxxxx]	3x00002
Holding Register (Wort/16 Bits) 4x00000 ... 4x65535 [read/write]	4x[xxxxx]	4x00805

Modbus/TCP data areas



INFORMATION

Addressing for Pilz systems starts at "0". On devices from other manufacturers, addressing may start at "1".

Please refer to the operating manual provided by the relevant manufacturer.

4.2.2 Data transfer limits

This table contains the maximum data lengths supported per telegram:

Data transfer		Max. data length per telegram
Read data (Bit)	FC 01 (Read Coils)	1 ... 2000
	FC 02 (Read Discrete Inputs)	
Read data (Word)	FC 03 (Read Holding Registers)	1 ... 125
	FC 04 (Read Input Register)	

Data transfer		Max. data length per telegram
Write data (Bit)	FC 05 (Write Single Coil)	1 Bit
	FC 15 (Write Multiple Coils)	1 ... 1968
Write data (Word)	FC 06 (Write Single Register)	1 Word
	FC 16 (Write Multiple Registers)	1 ... 123 Words
Read and write data (Word)	FC 23 (Read/Write Multiple Registers)	Read 1 ... 125 Words Write 1 ... 121 Words

Data transfer limits

**INFORMATION**

There may be some restrictions in data length, depending on the device that is used. Please refer to the information stated in the operating manual of the relevant unit.

4.2.3**Function codes (Client connections)**

The connection Client can access the Gateway's data areas using the following function codes (FC):

Data area	Modbus syntax	Example
FC 01	Read Coils	The connection Client reads bit data from the connection Server, data length = 1 Bit, content, content: input/output data (data received from 0x)
FC 02	Read Discrete Input	The connection Client reads bit data from the connection Server, data length = 1 Bit, content, content: input/output data (data received from 1x)
FC 03	Read Holding Register	The connection Client reads word data from the connection Server, data length = 1 Word, content: diagnostic word (data received from 4x)
FC 04	Read Input Register	The connection Client reads word data from the connection Server, data length = 1 Word, content: diagnostic word (data received from 3x)

Data area	Modbus syntax	Example
FC 05	Write Single Coil	The connection Client writes to one bit datum in the connection Server, data length = 1 Bit, content: input data (send data to 0x)
FC 06	Write Single Register	The connection Client writes to one word datum in the connection Server, data length = 1 Word, content: input data (send data to 4x)
FC 15	Write Multiple Coils	The connection Client writes to multiple bit data in the connection Server, data length = 1 Bit, content: input data (send data to 0x)
FC 16	Write Multiple Registers	The connection Client writes to multiple word data in the connection Server, data length = 1 Word, content: input data (send data to 4x)
FC 23	Read/Write Multiple Registers	The connection Client reads and writes multiple word data within a telegram (receive data from 3x and send data to 4x)

4.3 EtherCAT

The manufacturer's ID, the device ID and any functions supported by a field device are defined in a device description file. The device description file (Electronic Data Sheet, EDS) is fieldbus-dependent. The content and format of a device description file are specified in the fieldbus standard. The file is needed in order to include an unknown field device in the respective fieldbus configuration tool and in order to configure the plant-specific requirements.

An EDS file in XML format is used for EtherCAT devices.

4.4 Translation tables

Only Register 4x is represented in the tables. The same assignment applies for Registers 0x, 1x, and 3x.

4.4.1 Payload

EtherCAT				Modbus	
		SDO			
PDO	Index	Index	Subindex (hex)	Register	Byte
RxPDO	0x1600	2000	1	4x00001	Low Byte
			2		High Byte
			3	4x00002	Low Byte
			4		High Byte
			5 ... 20	4x00003 ... 4x00016	Low Byte High Byte
TxPDO	0x1A2	2002	1	4x00129	Low Byte
			2		High Byte
			3	4x00130	Low Byte
			4		High Byte
			5 ... 20	4x00133 ... 4x00144	Low Byte High Byte

Key to abbreviations:

TxPDO: Transmit Process Data Object

RxPDO: Receive Process Data Object

4.4.2 Diagnostic data

EtherCAT Byte	Modbus Register		Access type	Meaning in EtherCAT
200a:001	4x01001	Low Byte	RO	IP address (Modbus), HL Byte
200a:002		High Byte	RO	IP address (Modbus), HH Byte
200a:003	4x01002	Low Byte	RO	IP address (Modbus), LL Byte
200a:004		High Byte	RO	IP address (Modbus), LH Byte
200a:005	4x01003	Low Byte	RO	Subnet Mask (Modbus), HL Byte
200a:006		High Byte	RO	Subnet Mask (Modbus), HH Byte
200a:007	4x01004	Low Byte	RO	Subnet Mask (Modbus), LL Byte
200a:008		High Byte	RO	Subnet Mask (Modbus), LH Byte
200a:009	4x01005	Low Byte	RO	Gateway (Modbus), HL Byte
200a:010		High Byte	RO	Gateway (Modbus), HH Byte

EtherCAT Byte	Modbus Register		Access type	Meaning in EtherCAT
200a:011	4x01006	Low Byte	RO	Gateway (Modbus), LL Byte
200a:012		High Byte	RO	Gateway (Modbus), LH Byte
200a:013	4x01007	Low Byte	RO	DHCP activated (Modbus)
200a:014		High Byte	RO	Reserved
200a:015	4x01008	Low Byte	RO	Max. number of Modbus connections
200a:016		High Byte	RO	Reserved
200a:017	4x01009	Low Byte	RO	Current number of Modbus connections
200a:018		High Byte	RO	Reserved
200a:019	4x01010	Low Byte	RO	Modbus Port Number, L Byte, (default: 502)
200a:020		High Byte	RO	Modbus Port Number, H Byte, (default: 502)
200a:021	4x01011	Low Byte	RO	Keep Alive Time of Modbus connections in ms, L Byte, (default: 32000)
200a:022		High Byte	RO	Keep Alive Time of Modbus connections in ms, H Byte, (default: 32000)
200a:023	4x01012	Low Byte	RO	Reserved
200a:024		High Byte	RO	Reserved
200a:025	4x01013	Low Byte	RO	Reserved
200a:026		High Byte	RO	Reserved
200a:027	4x01014	Low Byte	RO	Reserved
200a:028		High Byte	RO	Reserved
200a:029	4x01015	Low Byte	RO	Reserved
200a:030		High Byte	RO	Reserved
200a:031	4x01016	Low Byte	RO	Reserved
200a:032		High Byte	RO	Reserved
200a:033	4x01017	Low Byte	RO	Reserved
200a:034		High Byte	RO	Reserved
200a:035	4x01018	Low Byte	RO	Reserved
200a:036		High Byte	RO	Reserved
200a:037	4x01019	Low Byte	RO	Reserved
200a:038		High Byte	RO	Reserved
200a:039	4x01020	Low Byte	RO	EtherCAT Address
200a:040		High Byte	RO	EtherCAT Address
200a:041	4x01021	Low Byte	RO	EtherCAT Alias

EtherCAT Byte	Modbus Register		Access type	Meaning in EtherCAT
200a:042		High Byte	RO	EtherCAT Alias
200a:043	4x01022	Low Byte	RO	EtherCAT Link State Port 0 ▶ Upper nibble: Loop state – 1 = Loop closed – 2 = Loop open ▶ Lower nibble: Link state – 0 = No Link – 1 = Link e.g.: 0x10 = No link, Loop closed, 0x21 = Link, Loop open
200a:044		High Byte	RO	Reserved
200a:045	4x01023	Low Byte	RO	EtherCAT Link State Port 1 ▶ Upper nibble: Loop state – 1 = Loop closed – 2 = Loop open ▶ Lower nibble: Link state – 0 = No Link – 1 = Link e.g.: 0x10 = No link, Loop closed, 0x21 = Link, Loop open
200a:046		High Byte	RO	Reserved
200a:047	4x01024	Low Byte	RO	EtherCAT RUN State (LED ECATStat) ▶ 0 = LED off ▶ 1 = Init ▶ 2 = Pre-Operational ▶ 4 = Safe-Operational ▶ 8 = Operational) Key to LED statuses Display elements for device diagnostics  35]
200a:048		High Byte	RO	Reserved
200a:049	4x01025	Low Byte	RO	EtherCAT ERR State (LED ECATStat) ▶ 0 = LED off (No Error) ▶ 1 = LED on (Error) Key to LED statuses Display elements for device diagnostics  35]
200a:050		High Byte	RO	Reserved

RO = Read Only

4.5 Interfaces

The Gateway has two EtherCAT interfaces and a Modbus/TCP interface to

- ▶ Receive data from the EtherCAT interface,
- ▶ Receive data from the Modbus/TCP interface,
- ▶ Send the translated data to the EtherCAT interface or to the Modbus/TCP interface.
 - The Modbus/TCP data is translated for EtherCAT using the mapping table; the same applies with the EtherCAT data for Modbus/TCP.

The connection to EtherCAT-enabled devices is made via the two 8-pin RJ45 sockets.

Information on displaying the downloaded fieldbus data and on configuration and management of the Gateway can be found under [Web server](#)  35].

5 Installation

5.1 General installation guidelines

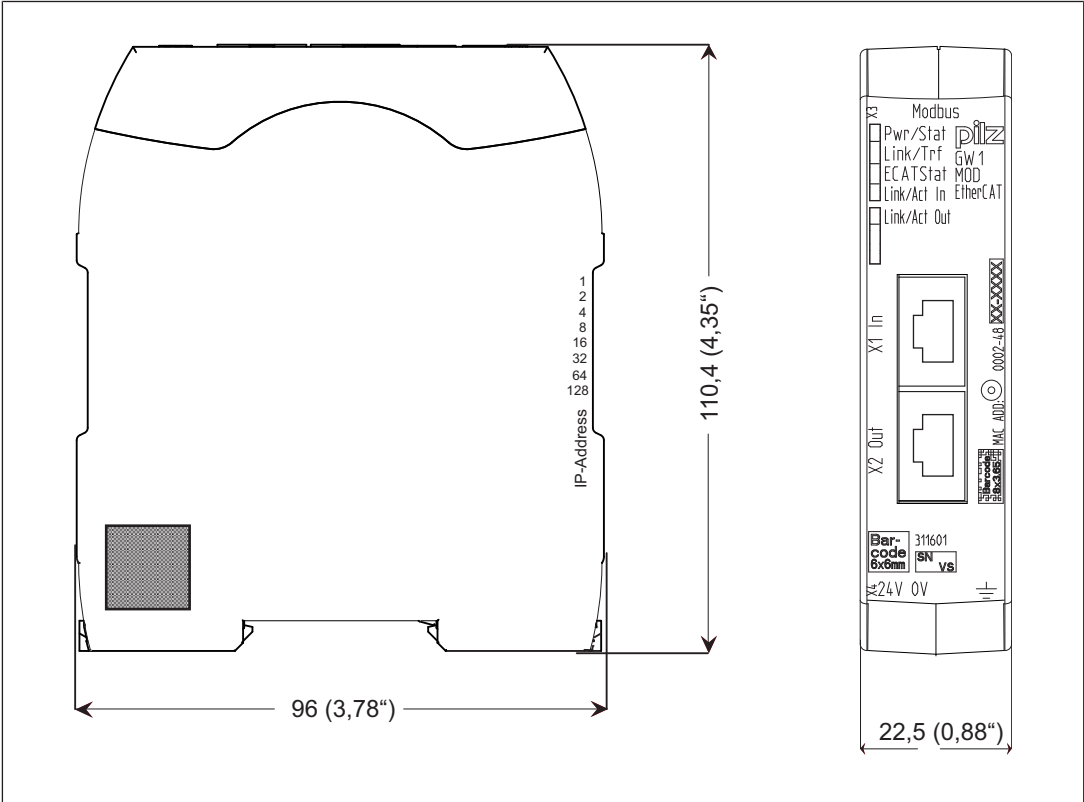
- ▶ The Gateway should be installed in a single mounting area with a protection type of at least IP54.
- ▶ Fit the Gateway to a horizontal mounting rail. The venting slots must face upwards and downwards. Other mounting positions could destroy the device.
- ▶ Use the locking elements on the rear of the unit to attach it to a mounting rail.
- ▶ In environments exposed to heavy vibration, the unit should be secured against lateral movement by using a fixing element (e.g. retaining bracket or end angle).
- ▶ The ambient temperature of the devices in the control cabinet must not exceed the figure stated in the technical details, otherwise air conditioning will be required.
- ▶ To comply with EMC requirements, the mounting rail must have a low impedance connection to the control cabinet housing.
- ▶ Push the unit upwards or downwards before lifting it from the mounting rail.
- ▶ The description below assumes that the mounting rail is already installed.

**NOTICE**

Damage due to electrostatic charging!

Electrostatic discharge can damage components. Ensure against discharge before touching the product, e.g. by touching an earthed, conductive surface or by wearing an earthed armband.

5.1.1 Dimensions



5.2 Mounting distances

When installing the device in the control cabinet / mounting space it is essential to maintain a certain distance from the top and bottom, as well as to other heat-producing devices (see diagram). The values stated for the mounting distances are minimum specifications.

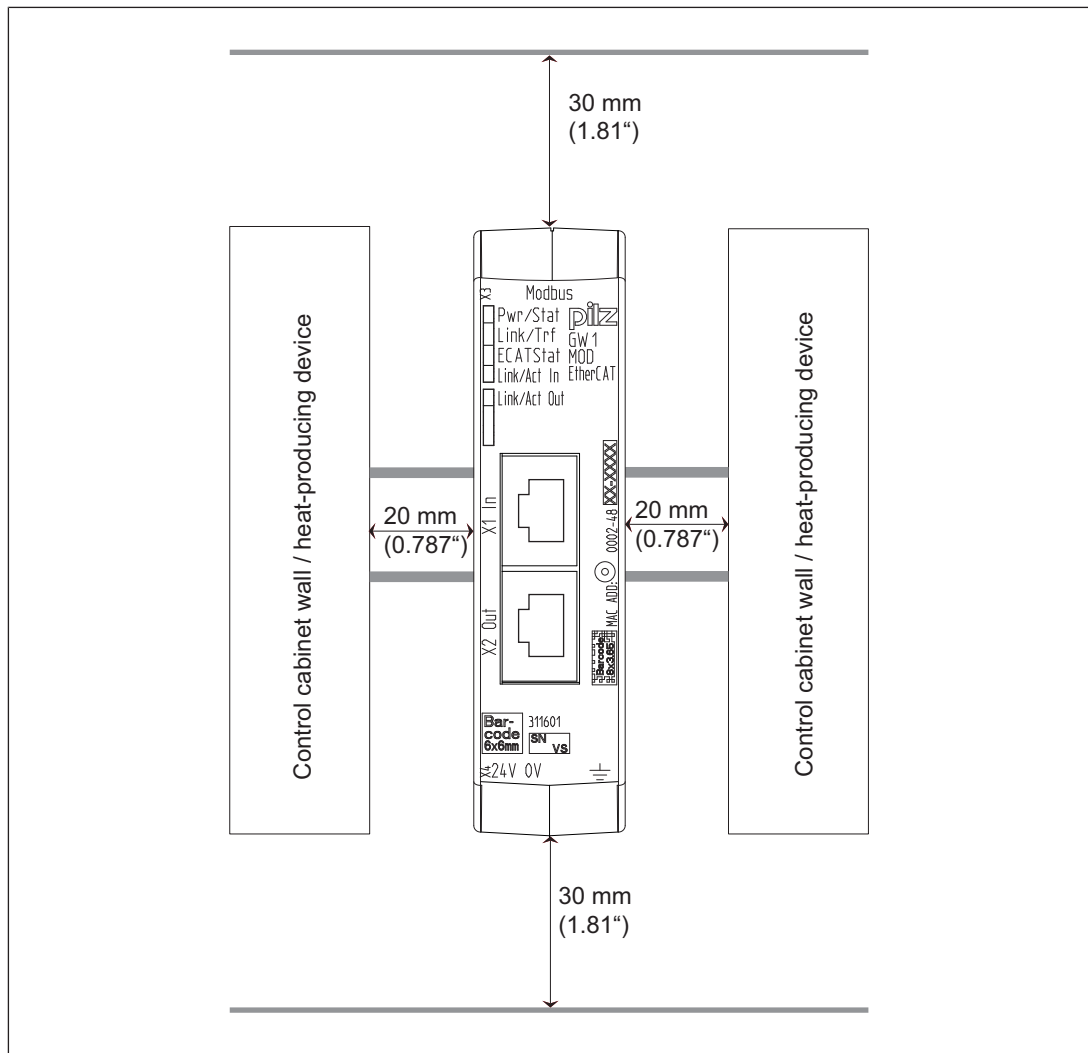


Fig.: Mounting distances

5.3 Supply voltage

The Gateway requires a 24 VDC supply.

To achieve the lowest possible residual ripple ($\leq 5\%$), we recommend that you install a three-phase bridge rectifier or regulated supply.

Protect the external power supply by fitting a fuse between the external power supply and the control system. The size of the fuse will depend on the specification of the external power supply, the conductor cross section and on local and national regulations.

5.4 Install Gateway

Use the locking elements on the rear of the product to attach it to a mounting rail.

1. Guide the product straight on to the mounting rail, so that the locking elements click into place.
2. Push the product back as far as it will go.
3. Make sure that the locking mechanisms click into position, connecting the product firmly into the mounting rail.

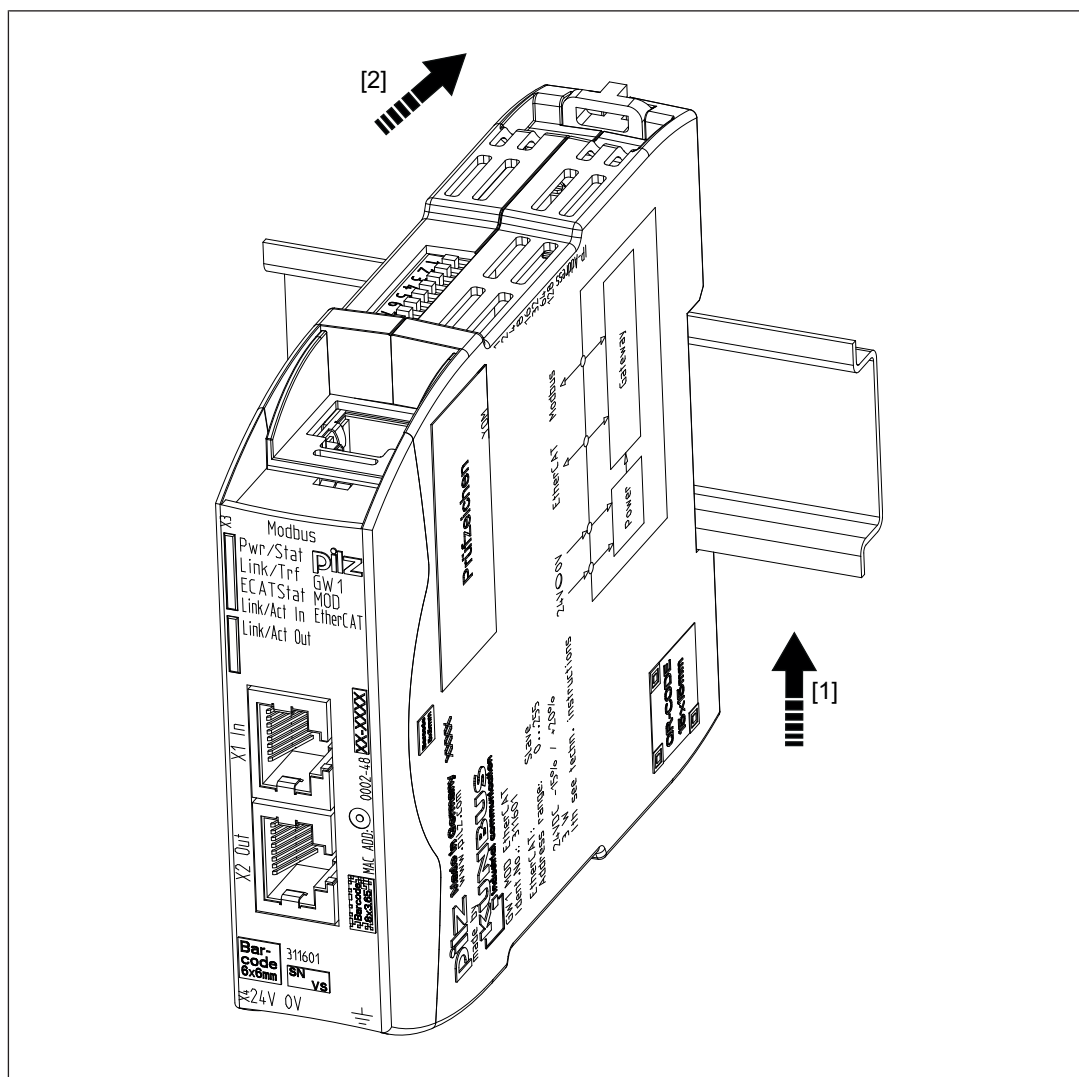


Fig.: Install Gateway on top hat rail

6 Commissioning

6.1 General wiring guidelines

Please note:

- ▶ Information given in the "Technical details" must be followed.
- ▶ Max. continuous current that the external power supply must provide: 160 mA
- ▶ Use copper wiring that can withstand temperatures of up to 75 °C.
- ▶ Always connect the mounting rail to the functional earth via an earthing terminal. This will be used to dissipate hazardous voltages in the case of a fault.
- ▶ Separate the supply voltage cable from the analogue input current lines.
- ▶ For transducers located outside the control cabinet: Where the cable enters the control cabinet, the cable shield must be connected to the earth potential over a wide surface area and with low impedance (connect in star).
- ▶ The power supply must meet the regulations for extra low voltages with protective separation.



INFORMATION

Only connect and disconnect the Gateway when the supply voltage is switched off.

Please note the following when connecting the interfaces:

- ▶ The following minimum requirements of the connection cable and connector must be met:
 - Only use standard industrial Ethernet cable and connectors.
 - Only use double-shielded twisted pair cable and shielded RJ45 connectors (industrial connectors).
 - Only use 100BaseTX cable in accordance with the Ethernet standard (min. Category 5)
- ▶ Measures to protect against interference:
 - Ensure the requirements for the industrial use of EtherCAT are met, as stated in the Installation Manual published by the User Group.

6.2 Wiring the units

6.2.1 Cable requirements

Screw terminals:

- ▶ Minimum conductor cross section on field connection terminals = 0.25 mm² (AWG24),
- ▶ Maximum conductor cross section on field connection terminals for the functional earth = 2.5 mm² (AWG12),
- ▶ Torque setting with screw terminals: 0.50 Nm.

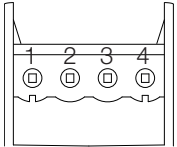
Spring-loaded terminals:

- ▶ Minimum conductor cross section on field connection terminals = 0.2 mm² (AWG24),
- ▶ Maximum conductor cross section on field connection terminals = 2.5 mm² (AWG12),
- ▶ Terminal points per connection: 2,
- ▶ Stripping length: 9 mm.

6.2.2 Terminals

The plug-in terminals for the inputs and outputs are not supplied with the system. You can select between spring-loaded terminals and a screw connection.

6.3 Terminal configuration

Module supply	Terminal configuration		X4
4-pin female connector	1	+24 V infeed for module supply	
	2	0 V infeed for module supply	
	3	Not connected	
	4	Functional earth 	

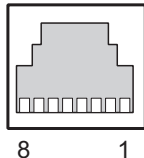
Terminal configuration

6.4 Interfaces

The following minimum requirements must be met:

- ▶ Ethernet standards (min. Category 5) 100BaseTX
- ▶ Double-shielded twisted pair cable for industrial Ethernet use
- ▶ Shielded RJ45 connectors (industrial connectors)

6.4.1 RJ45 interface

RJ45 socket, 8-pin	PIN	Standard	Crossover
	1	TD+ (Transmit+)	RD+ (Receive+)
	2	TD- (Transmit-)	RD- (Receive-)
	3	RD+ (Receive+)	TD+ (Transmit+)
	4	n.c.	n.c.
	5	n.c.	n.c.
	6	RD- (Receive-)	TD- (Transmit-)
	7	n.c.	n.c.
	8	n.c.	n.c.

Interface assignment of RJ45 socket

n.c. = not connected

6.4.1.1

RJ45 connection cable

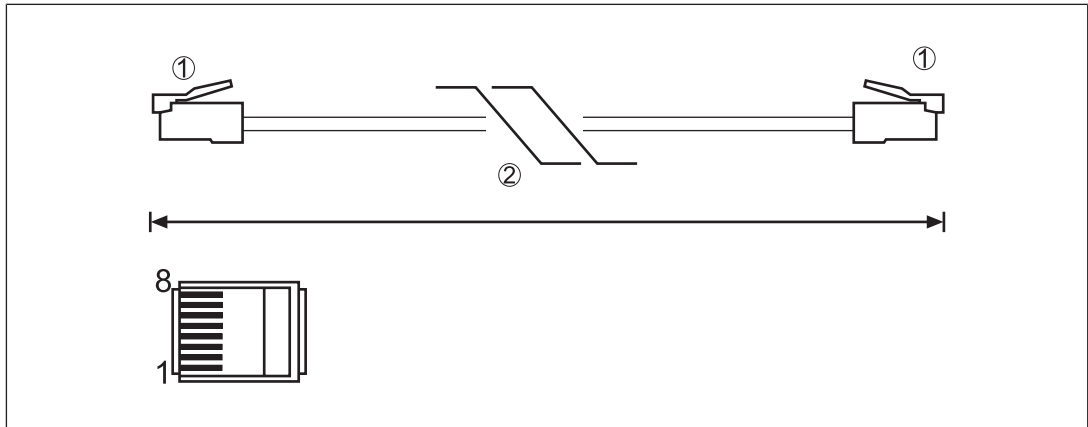


Fig.: RJ45 connection cable

①: RJ45 connector, 8-pin

②: 100BaseTX cable, max 100 m length

**NOTICE**

With the plug in connection please note that the data cable and connector have a limited mechanical load capacity. Appropriate design measures should be used to ensure that the plug-in connection is insensitive to increased mechanical stress (e.g. through shock, vibration). Such measures include fixed routing with strain relief, for example.

6.5

Address setting

6.5.1

IP address setting

The first three bytes of the IP address are: 192.168.0. The last byte of the IP address can be configured.

The subnet mask is: 255.255.255.0.

The last byte of the IP address is configured using the DIP switches. Value range: 1 ...255.

**INFORMATION**

The IP address should **only** be set when the module is switched off (no voltage applied).

The settings are **only** transferred when booting. Any changes made to the settings during operation will **not** be transferred.

There are various options for setting the last byte of the Gateway's IP address.

1. Use of the DHCP Server is enabled

DHCP is automatically enabled on a new module. In this case the IP address is taken from the DHCP Server, if the DIP switch is set to 0. The module waits for approx. 15 seconds to receive an address from a DHCP Server, in which time it uses the default IP address 192.168.0.1.

⇒ Set the DIP switch to 0.

2. Setting via the DIP switch

The IP address that is set at the DIP switch is used. DHCP is therefore disabled.

⇒ Set the DIP switch to a value between 1 – 254.

3. Enable DHCP via DIP switch

If the DIP switch is set to 255, DHCP is always used, irrespective of the configuration in the web server.

⇒ Set the DIP switch to 255.

DIP switch "IP address"	Meaning		Example: IP address 020 _D	Meaning of the switch setting in the example
	OFF	ON		
1	0	128 _D		0
2	0	64 _D		0
3	0	32 _D		0
4	0	16 _D		16
5	0	8 _D		0
6	0	4 _D		4
7	0	2 _D		0
8	0	1 _D		0

DIP switch IP address

7 Operation

7.1 Display elements

Status LEDs on the front provide information on the module's activity.

	LED on
	LED flashes
	LED flashes briefly
	LED flashes once periodically
	LED flashes twice periodically
	LED flashes three times periodically
	LED off

LED display symbols

7.1.1 Display elements for device diagnostics

LED	LED status		Meaning
Pwr/Stat		Green	Fault-free operation
		Red	Internal error (module error) or IP address conflict
			No supply voltage or device is defective

LED	LED status		Meaning
Link/Trf		Green	Link present, 100 Mbit/s
		Green	Traffic present, 100 Mbit/s
		Red	Max. 15 sec. after power-up: Still waiting for answer from DHCP Server. After more than 15 sec.: The default IP address 192.168.0.1 is already used in the network. In this case the module cannot be reached via Ethernet.
		Red	No Modbus/TCP connection
		Red	Incorrect Register range (during Client request)
		Orange	Link present, 10 Mbit/s
		Orange	Traffic present, 10 Mbit/s
			No link

LED	LED status ¹⁾		Meaning
	Green	Red	
ECATStat			Gateway in "OPERATIONAL" status
			Gateway in "SAFE-OPERATIONAL" status
			Gateway in "PRE-OPERATIONAL" status
			No supply voltage or Gateway is in the "INIT" state
			A critical error or an error in the application has occurred
			Status of the Gateway has been changed by an error in an application
			A watchdog timeout has occurred in the application
			Configuration error or error in the register data or object data
			Fault-free operation

¹⁾ In certain situations the LED ECATStat alternates red and green.

LED	LED status		Meaning
Link/Act In		Green	Bus connection present at X1
		Green	Data traffic present at X1
			No bus connection present at X1
Link/Act Out		Green	Bus connection present at X2
		Green	Data traffic present at X2
			No bus connection present at X2

7.2 Web server

A web server is implemented within the Gateway; it is started once the Gateway is connected to the supply voltage.

The web server is intended for use with Internet Explorer or Firefox.

Make sure that Javascript and Cookies are enabled in your browser's security settings.

7.2.1 Call web server

1. Connect the Gateway to the PC.
2. Call up the following HTML page:
 - **`http://192.168.0.xxx`**
 - For xxx, enter the value that you have set as the last byte of the IP address.
3. Enter the user name and password correctly and log on to the web server.

4. Select the option you require from the options in the overview and then follow the instructions.

7.2.2

Password management

- ▶ For access to the web server, two users have been preset in its delivery condition.

Users	Access type	Password
User	Read access only	1111
User	Read and write access	0000

- ▶ Access without a password is not possible.
 - ▶ User names and passwords can be changed.
 - ▶ If the password is changed and the new password is forgotten, you have no longer the option to access the web server via the gateway. In this case, the gateway has to be sent to Pilz and reset to the original delivery status. Thereby all settings will be lost. Ensure that the (new) password is saved reliably once the password has been changed.
 - ▶ Ensure that the configuration with the passwords of the delivery status is saved **before** changing the passwords.
1. Call up the web server.
 2. Copy these files to a PC using FTP:
 - eth_cfg.xml (Ethernet configuration),
 - password.xml (user definition).

7.3

Perform firmware update

Prerequisites

- ▶ The Gateway is connected to the PC.
- ▶ The Gateway has a firmware version from 01.01.00.
The firmware version can be read via the web server and is displayed under **Software Version**
⇒ Read the firmware version via the web server
- ▶ The firmware package file (kfu file) for the Gateway is ready.

Procedure

1. Enable the FTP Server.
 - Write the enable value 0x5049 (decimal 20553) to the Register 4x01012. The command is stated for the freely available program modpoll as an example:
 - Command line entry: **modpoll -m tcp -r 1012 -t 4 192.168.0.xxx 20553**
 - For **xxx**, enter the value that you have set as the last byte of the IP address.
2. Establish an FTP connection to the Gateway, using the current user name and password.
 - Download the kfu file to the Gateway.

- Restart the Gateway (reset the supply voltage or via the web server). The firmware is updated on restart. The Gateway is ready for operation again after approx. 20 seconds.
- 3. Disable the FTP Server again.
 - Write a value other than the enable value in the Register 4x01012. The command is stated for the freely available program modpoll as an example:
 - Command line entry: ***modpoll -m tcp -r 1012 -t 4 192.168.0.xxx 1234***
 - For ***xxx***, enter the value that you have set as the last byte of the IP address.
 - In the example, the enable value is overwritten with the value ***1234***.
- 4. Read firmware version
 - ⇒ The firmware version can be read via the web server and is displayed under **Software Version**.

7.4 Exchange Gateway

When exchanging the Gateway, the current configuration should be saved first, so that the configuration can be imported into the new Gateway.

Recommended procedure:

1. Call up the web server and save the configuration.
 - ⇒ Copy these files to a PC using FTP:
 - eth_cfg.xml (Ethernet configuration),
 - password.xml (user definition).
2. Switch off the supply voltage.
3. Disconnect all cables from the Gateway.
4. Remove the Gateway from the mounting rail.
5. Install the new Gateway in accordance with the Installation Manual, [Installation !\[\]\(4ce5ce4881ca883a7dba2b062139b60b_img.jpg\) 26](#).
6. Incorporate the Gateway into the network, [Address setting !\[\]\(0f8385cddd3320eae0e3e17ac3c9846f_img.jpg\) 32](#).
 - ⇒ Make sure that the settings for the IP address are exactly the same as they were on the old module.
7. Copy the configuration data to the new Gateway via FTP.
8. Restart the Gateway via the web server.

8 Technical Details

General	
Approvals	CE, cULus Listed
Electrical data	
Supply voltage	
for	Module supply
Voltage	24 V
Kind	DC
Output of external power supply (DC)	3 W
Status indicator	LED
Fieldbus interface	
Fieldbus interface	EtherCAT
Unit type	Slave
Log	CANopen over EtherCAT
Maximum data length of fieldbus interface	
Input	512 Byte
Output	512 Byte
Input/output combined	512 Byte
Transmission rates	100 MBit/s
Connection	RJ45
Operating modes	Auto-MDIX
Galvanic isolation	Yes
Type of galvan. isolation	Funktionsisolierung
MODBUS	
Number of MODBUS connections	8
Connection type	RJ45
Unit type	Server
Permitted address range MODBUS/TCP port	1 - 65535
Operating mode	Auto-MDIX, Autonegotiation
Default port MODBUS/TCP	502
Transmission rates	10 MBit/s, 100 MBit/s
Galvanic isolation	Yes
Times	
Supply interruption before de-energisation	20 ms
Default value, keep-alive time	32000 ms
Environmental data	
Ambient temperature	
In accordance with the standard	EN 60068-2-14
Temperature range	0 - 60 °C
Storage temperature	
In accordance with the standard	EN 60068-2-1/-2
Temperature range	-25 - 70 °C

Environmental data	
Climatic suitability	
In accordance with the standard	EN 60068-2-30, EN 60068-2-78
Humidity	93 % r. h. at 40 °C
Condensation during operation	Not permitted
EMC	EN 61131-2
Vibration	
In accordance with the standard	EN 60068-2-6
Frequency	5 - 150 Hz
Acceleration	1g
Shock stress	
In accordance with the standard	EN 60068-2-27
Acceleration	15g
Duration	11 ms
Max. operating height above sea level	2000 m
Airgap creepage	
In accordance with the standard	EN 61131-2
Overvoltage category	II
Protection type	
In accordance with the standard	EN 60529
Mounting area (e.g. control cabinet)	IP54
Housing	IP20
Terminals	IP20
Potential isolation	
Potential isolation between	EtherCAT and system voltage
Type of potential isolation	Functional insulation
Rated surge voltage	500 V
Potential isolation between	Modbus and system voltage
Type of potential isolation	Functional insulation
Rated surge voltage	500 V
Mechanical data	
DIN rail	
Top hat rail	35 x 7,5 EN 50022
Material	
Bottom	PC
Front	PC
Connection type	Spring-loaded terminal, plug-in, screw terminal, plug-in
Conductor cross section with screw terminals	
1 core flexible	0,25 - 2,5 mm², 24 - 12 AWG
2 core with the same cross section, flexible without crimp connectors or with TWIN crimp connectors	0,2 - 1,5 mm², 24 - 16 AWG
Torque setting with screw terminals	0,5 Nm
Conductor cross section with spring-loaded terminals:	
Flexible with/without crimp connector	0,2 - 2,5 mm², 24 - 12 AWG
Spring-loaded terminals: Terminal points per connection	2

Mechanical data	
Stripping length with spring-loaded terminals	9 mm
Dimensions	
Height	96 mm
Width	22,5 mm
Depth	110,4 mm
Weight	90 g

The standards current on 2012-10 apply.

9 Order reference

Order reference		
Product type	Features	Order no.
PSSnet GW1 MOD-EtherCAT	Communication module for connection to EtherCAT	311 601
Order reference: Accessories		
Product type	Features	Order no.
Set spring terminals	1 set of spring-loaded terminals	783 542
Set screw terminals	1 set of screw terminals	793 542

► Support

Technical support is available from Pilz round the clock.

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Pilz develops environmentally-friendly products using ecological materials and energy-saving technologies. Offices and production facilities are ecologically designed, environmentally-aware and energy-saving. So Pilz offers sustainability, plus the security of using energy-efficient products and environmentally-friendly solutions.



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