TECHDOCS
Manual

WAGO-I/O-SYSTEM 750 XTR

750-352/040-000

FC ETHERNET G3 XTR

Fieldbus Coupler ETHERNET; 3rd Generation; Extreme

Version 1.3.0

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Every conceivable measure has been taken to ensure the accuracy and completeness of this documentation. However, as errors can never be fully excluded, we always appreciate any information or suggestions for improving the documentation.

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Table of Contents

1 Notes about this Documentation

Note

Always retain this documentation!
This documentation is part of the product. Therefore, retain the documentation during the entire service life of the product. Pass on the documentation to any subsequent user. In addition, ensure that any supplement to this documentation is included, if necessary.

1.1 Validity of this Documentation

This documentation is only applicable to the “FC ETHERNET G3 XTR” (750-352/040-000).

The device FC ETHERNET G3 XTR 750-352/040-000 shall only be installed and operated according to the instructions in this manual and the system description for the WAGO-I/O-SYSTEM 750 XTR.

NOTICE

Consider power layout of the WAGO-I/O-SYSTEM 750 XTR!
In addition to these operating instructions, you will also need the system description “Design Notes /XTR – Guidelines and Recommendations for Increasing Operational Safety”, which can be downloaded at www.wago.com. There, you can obtain important information including information on electrical isolation, system power and supply specifications.

1.2 Copyright

This Manual, including all figures and illustrations, is copyright-protected. Any further use of this Manual by third parties that violate pertinent copyright provisions is prohibited. Reproduction, translation, electronic and phototechnical filing/archiving (e.g., photocopying) as well as any amendments require the written consent of WAGO Kontakttechnik GmbH & Co. KG, Minden, Germany. Non-observance will involve the right to assert damage claims.

1.3 Symbols

⚠ DANGER

Personal Injury!
Indicates a high-risk, imminently hazardous situation which, if not avoided, will result in death or serious injury.

⚠ DANGER

Personal Injury Caused by Electric Current!
Indicates a high-risk, imminently hazardous situation which, if not avoided, will result in death or serious injury.

⚠ WARNING

Personal Injury!
Indicates a moderate-risk, potentially hazardous situation which, if not avoided, could result in death or serious injury.

⚠ CAUTION

Personal Injury!
Indicates a low-risk, potentially hazardous situation which, if not avoided, may result in minor or moderate injury.

NOTICE

Damage to Property!
Indicates a potentially hazardous situation which, if not avoided, may result in damage to property.

NOTICE

Damage to Property Caused by Electrostatic Discharge (ESD)!
Indicates a potentially hazardous situation which, if not avoided, may result in damage to property.

Note

Important Note!
Indicates a potential malfunction which, if not avoided, however, will not result in damage to property.

Information

Additional Information:
Refers to additional information which is not an integral part of this documentation (e.g., the Internet).

1.4 Number Notation

Table 1: Number Notation

Number Code	Example	Note
Decimal	100	Normal notation
Hexadecimal	0x64	C notation
Binary	'100' '0110.0100'	In quotation marks, nibble separated with dots (.)

1.5 Font Conventions

Table 2: Font Conventions

Font Type	Indicates
italic	Names of paths and data files are marked in italic-type. e.g.: *C:\Program Files\WAGO Software*
Menu	Menu items are marked in bold letters. e.g.: **Save**
>	A greater-than sign between two names means the selection of a menu item from a menu. e.g.: **File** > **New**
Input	Designation of input or optional fields are marked in bold letters, e.g.: **Start of measurement range**
“Value”	Input or selective values are marked in inverted commas. e.g.: Enter the value “4 mA” under **Start of measurement range**.
[Button]	Pushbuttons in dialog boxes are marked with bold letters in square brackets. e.g.: **[Input]**
[Key]	Keys are marked with bold letters in square brackets. e.g.: **[F5]**

2 Important Notes

This section includes an overall summary of the most important safety requirements and notes that are mentioned in each individual section. To protect your health and prevent damage to devices as well, it is imperative to read and carefully follow the safety guidelines.

2.1 Legal Bases

2.1.1 Subject to Changes

WAGO Kontakttechnik GmbH & Co. KG reserves the right to provide for any alterations or modifications. WAGO Kontakttechnik GmbH & Co. KG owns all rights arising from the granting of patents or from the legal protection of utility patents. Third-party products are always mentioned without any reference to patent rights. Thus, the existence of such rights cannot be excluded.

2.1.2 Personnel Qualifications

All sequences implemented on WAGO-I/O-SYSTEM 750 devices may only be carried out by electrical specialists with sufficient knowledge in automation. The specialists must be familiar with the current norms and guidelines for the devices and automated environments.

All changes to the coupler or controller should always be carried out by qualified personnel with sufficient skills in PLC programming.

2.1.3 Use of the 750 Series in Compliance with Underlying Provisions

Fieldbus couplers, controllers and I/O modules found in the modular WAGO-I/O-SYSTEM 750 receive digital and analog signals from sensors and transmit them to actuators or higher-level control systems. Using controllers, the signals can also be (pre-) processed.

The devices have been developed for use in an environment that meets the IP20 protection class criteria. Protection against finger injury and solid impurities up to 12.5 mm diameter is assured; protection against water damage is not ensured. Unless otherwise specified, operation of the devices in wet and dusty environments is prohibited.

Operating the WAGO-I/O-SYSTEM 750 devices in home applications without further measures is only permitted if they meet the emission limits (emissions of interference) according to EN 61000-6-3. You will find the relevant information in the section “Device Description” > “Standards and Guidelines” in the manual for the used fieldbus coupler or controller.

Appropriate housing (per 2014/34/EU) is required when operating the WAGO-I/O-SYSTEM 750 in hazardous environments. Please note that a prototype test certificate must be obtained that confirms the correct installation of the system in a housing or switch cabinet.

The implementation of safety functions such as EMERGENCY STOP or safety door monitoring must only be performed by the F I/O modules within the modular WAGO-I/O-SYSTEM 750. Only these safe F I/O modules ensure functional safety in accordance with the latest international standards. WAGO's interference-free output modules can be controlled by the safety function.

2.1.4 Technical Condition of Specified Devices

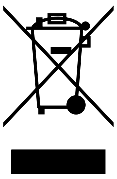
The devices to be supplied ex works are equipped with hardware and software configurations, which meet the individual application requirements. These modules contain no parts that can be serviced or repaired by the user. The following actions will result in the exclusion of liability on the part of WAGO Kontakttechnik GmbH & Co. KG:

- Repairs,
- Changes to the hardware or software that are not described in the operating instructions,
- Improper use of the components.

Further details are given in the contractual agreements. Please send your request for modified and new hardware or software configurations directly to WAGO Kontakttechnik GmbH & Co. KG.

2.1.4.1 Disposal

2.1.4.1.1 Electrical and Electronic Equipment



Electrical and electronic equipment may not be disposed of with household waste. This also applies to products without this symbol.

Electrical and electronic equipment contain materials and substances that can be harmful to the environment and health. Electrical and electronic equipment must be disposed of properly after use.
WEEE 2012/19/EU applies throughout Europe. Directives and laws may vary nationally.

Environmentally friendly disposal benefits health and protects the environment from harmful substances in electrical and electronic equipment.

- Observe national and local regulations for the disposal of electrical and electronic equipment.
- Clear any data stored on the electrical and electronic equipment.
- Remove any added battery or memory card in the electrical and electronic equipment.
- Have the electrical and electronic equipment sent to your local collection point.

Improper disposal of electrical and electronic equipment can be harmful to the environment and human health.

2.1.4.1.2 Packaging

Packaging contains materials that can be reused.
PPWD 94/62/EU and 2004/12/EU packaging guidelines apply throughout Europe. Directives and laws may vary nationally.

Environmentally friendly disposal of the packaging protects the environment and allows sustainable and efficient use of resources.

- Observe national and local regulations for the disposal of packaging.
- Dispose of packaging of all types that allows a high level of recovery, reuse and recycling.

Improper disposal of packaging can be harmful to the environment and wastes valuable resources.

2.2 Safety Advice (Precautions)

For installing and operating purposes of the relevant device to your system the following safety precautions shall be observed:

DANGER

Do not work on devices while energized!
All power sources to the device shall be switched off prior to performing any installation, repair or maintenance work.

DANGER

Install device in only one suitable enclosure!
The device is an open system. Install the device in a suitable enclosure. This enclosure must:

- Guarantee that the max. permissible degree of pollution is not exceeded.
- Offer adequate protection against contact.
- Prevent fire from spreading outside of the enclosure.
- Offer adequate protection against UV irradiation.
- Guarantee mechanical stability
- Restrict access to authorized personnel and may only be opened with tools

DANGER

Ensure disconnect and overcurrent protection!
The device is intended for installation in automation technology systems. Disconnect protection is not integrated. Connected systems must be protected by a fuse.
Provide suitable disconnect and overcurrent protection on the system side!

DANGER

Ensure a standard connection!
To minimize any hazardous situations resulting in personal injury or to avoid failures in your system, the data and power supply lines shall be installed according to standards, with careful attention given to ensuring the correct terminal assignment. Always adhere to the EMC directives applicable to your application.

⚠ WARNING

Power from SELV/PELV power supply only!
All field signals and field supplies connected to this XTR fieldbus coupler/controller (750-352/040-000) must be powered from SELV/PELV power supply(s)!

⚠ CAUTION

Do not touch hot surfaces!
The surface of the housing can become hot during operation. If the device was operated at high ambient temperatures, allow it to cool off before touching it.

NOTICE

Ensure proper contact with the DIN-rail!
Proper electrical contact between the DIN-rail and device is necessary to maintain the EMC characteristics and function of the device.

NOTICE

Replace defective or damaged devices!
Replace defective or damaged device/module (e.g., in the event of deformed contacts).

NOTICE

Protect the components against materials having seeping and insulating properties!
The components are not resistant to materials having seeping and insulating properties such as: aerosols, silicones and triglycerides (found in some hand creams). If you cannot exclude that such materials will appear in the component environment, then install the components in an enclosure being resistant to the above-mentioned materials. Clean tools and materials are imperative for handling devices/modules.

NOTICE

Clean only with permitted materials!
Clean housing and soiled contacts with propanol.

NOTICE

Do not use any contact spray!
Do not use any contact spray. The spray may impair contact area functionality in connection with contamination.

NOTICE

Do not reverse the polarity of connection lines!
Avoid reverse polarity of data and power supply lines, as this may damage the devices involved.

NOTICE

Avoid electrostatic discharge!
The devices are equipped with electronic components that may be destroyed by electrostatic discharge when touched. Please observe the safety precautions against electrostatic discharge per DIN EN 61340-5-1/-3. When handling the devices, please ensure that environmental factors (personnel, work space and packaging) are properly grounded.

NOTICE

Use only direct current (DC) for insulation testing!
Both the system voltage and field voltage side are capacitively coupled to the DIN-rail. If an I/O module is mounted on the DIN-rail, application of an AC voltage between the DIN-rail and at least one of these two potentials can lead to the destruction of the module.
Use only direct current (DC) for insulation testing. To avoid destroying the I/O module, you must discharge it completely before applying the test voltage again.

2.3 Special Use Conditions for ETHERNET Devices

If not otherwise specified, ETHERNET devices are intended for use on local networks. Please note the following when using ETHERNET devices in your system:

- Do not connect control components and control networks directly to an open network such as the Internet or an office network. WAGO recommends putting control components and control networks behind a firewall.
- Limit physical and electronic access to all automation components to authorized personnel only.
- Change the default passwords before first use! This will reduce the risk of unauthorized access to your system.
- Regularly change the passwords used! This will reduce the risk of unauthorized access to your system.
- If remote access to control components and control networks is required, use a Virtual Private Network (VPN).
- Regularly perform threat analyses. You can check whether the measures taken meet your security requirements.
- Use “defense-in-depth” mechanisms in your system's security configuration to restrict the access to and control of individual products and networks.

3 System Description

The 750 XTR Series is part of the WAGO-I/O-SYSTEM 750.

The WAGO-I/O-SYSTEM 750 is a modular, fieldbus-independent input/output system (I/O system). The configuration described here consists of a fieldbus coupler/controller (1) and the modular I/O modules (2) for any signal shapes that form the fieldbus node together. The end module (3) completes the node and is required for correct operation of the fieldbus node.

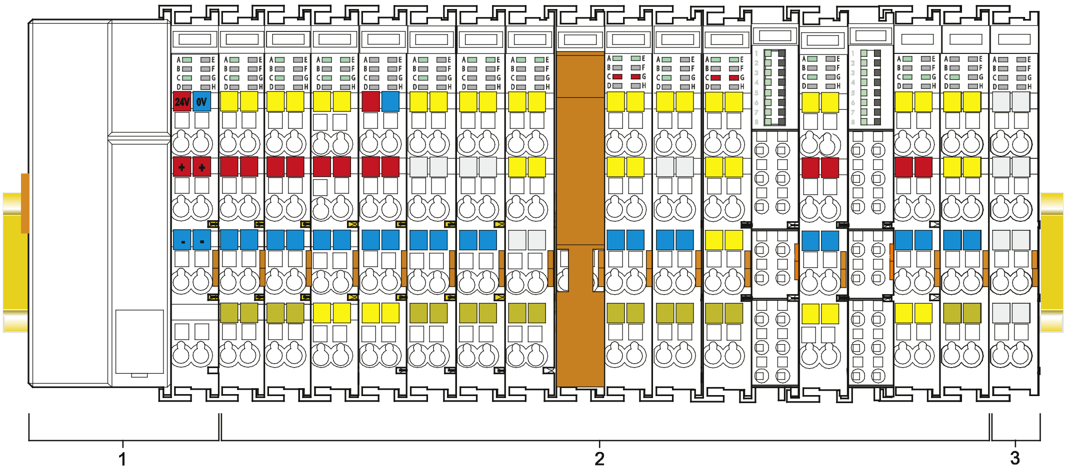


Figure 1: Fieldbus Node (Example)

Fieldbus couplers/controllers are available for different fieldbus systems.

The ECO coupler contains the fieldbus interface, electronics and a power supply for the system. The fieldbus interface forms the physical interface to the relevant fieldbus. The electronics process the data of the bus modules and make it available for the fieldbus communication.

I/O modules for diverse digital and analog I/O signals as well as special functions can be connected to the fieldbus coupler/controller. The communication between the fieldbus coupler/controller and the I/O modules is carried out via a local bus.

The components of the WAGO-I/O-SYSTEM 750 have clear termination points, light emitting diodes for status display, plug-in mini WSB tags and group marker cards for labeling.

The 1, 2 or 3 wire technology supplemented by a ground wire connection allows for direct sensor or actuator wiring.

The distinctiveness of the 750 XTR Series lies in its area of application in extreme environmental conditions. It is extremely temperature-resistant, immune to interference, as well as insensitive to vibrations and impulse voltages.
The components of the 750 XTR Series are easily recognizable by their dark-gray housing color.

3.1 Manufacturing Number

3.2 Hardware Address (MAC ID)

Each FC ETHERNET G3 XTR has an internationally unambiguous physical address, referred to as the MAC-ID (Media Access Control Identity).

As part of the labeling on the right side of this component, the MAC ID is printed in the block diagram of the fieldbus coupler/controller.
In addition, the MAC ID is located on the paper strip with two self-adhesive peel-off strips on the left side of the fieldbus coupler/controller.
The MAC ID has a fixed length of 6 bytes (48 bits) which are presented hexadecimal. The first three bytes identify the manufacturer (e.g. 00:30 DE for WAGO). The second 3 bytes comprise the unique serial number of the hardware.

The serial number indicates the delivery status directly after production. This number is part of the labeling on the side of each component.

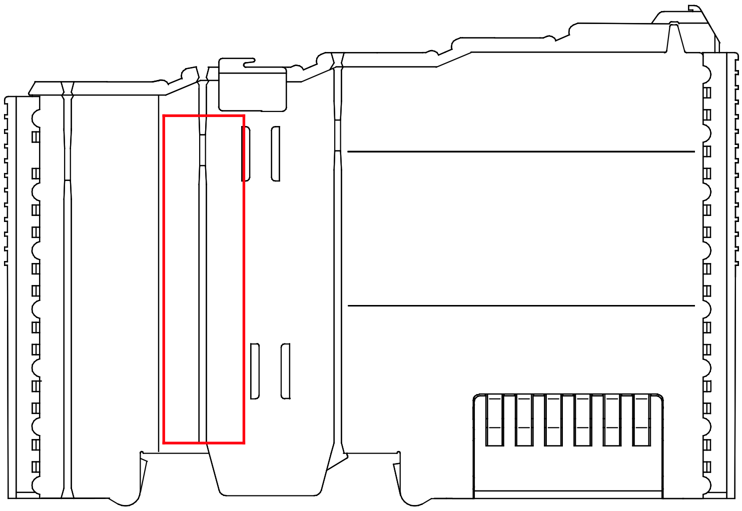


Figure 2: Marking Area for Serial Numbers

There are two serial numbers in two rows in the side marking. They are left of the release tab. The first 10 positions in the longer row of the serial numbers contain version and date identifications.

Example structure of the rows: 0114010101…

01	**14**	**01**	**01**	**01**	**(additional positions)**
WW	**YY**	**FW --**	**HW**	**FL**	**-**
Calendar week	Year	Firmware version	Hardware version	Firmware loader version	Internal information

The row order can vary depending on the production year, only the longer row is relevant. The back part of this and the shorter row contain internal administration information from the manufacturer.

In addition, the serial number is printed on the front on the cover cap of the service interface, so that it can also be read when installed.

3.3 Update

For products that can be updated, the side inscription has a prepared matrix in which the current update data can be entered in columns.

Up to 2015, the matrix has rows to enter the “NO” work order number (or “BA” to CW 13/2004), “DS” update date, “SW” software index (optional), “HW” hardware index and “FWL” firmware loader index (optional).

NO			
DS			
SW			
HW			
FWL			

Figure 3: Update Matrix up to 2015

From 2016, the matrix has rows to enter the “FA” production or work order number and to enter the “PD” production date and “AZ” item number.

FA	XXXXXXXXXX	
PD	WWJJ	
AZ	FWHWFL	

Figure 4: Update Matrix from 2016

Table 3: Legend for Figure “Update Matrix from 2016”

	Description
FA	Production order number, 10-digit
PD	KW = calendar week YY = year
AZ	FW = firmware index HW = hardware index FL = firmware loader index

For factory updates to a head station, the current production or work order number is also printed on the cover cap of the service interface.

The original manufacturing information on the product housing remains unchanged.

3.4 Storage, Assembly and Transport

Whenever possible, the components are to be stored in their original packaging. Likewise, the original packaging provides optimal protection during transport.

When assembling or repacking the components, the contacts must not be soiled or damaged. The components must be stored and transported in appropriate containers/packaging. Thereby, the ESD information is to be regarded.

3.5 Assembly Guidelines/Standards

- DIN 60204 Electrical equipment of machines
- DIN EN 50178 Electronic equipment for use in power installations (replacement for VDE 0160)
- EN 60439 Low-voltage switchgear and controlgear assemblies

3.6 Power Supply

The system power supply and field power supply must be powered via SELV/PELV power supply units.

3.6.1 Overcurrent Protection

⚠ WARNING

Possible fire hazard due to insufficient overcurrent protection!
In the event of a fault, insufficient overcurrent protection can present a possible fire hazard. In the event of a fault, excessive current flow in the components can cause significant overheating. Therefore, you should always dimension the overcurrent protection according to the anticipated power usage.

The system and field voltage of the WAGO I/O SYSTEMs 750 XTR is supplied on the head stations and bus supply modules.

For components that work with extra low voltage, only SELV/PELV voltage sources should be used.

A single voltage source supplying multiple components must be designed according to the component with the strictest electrical safety requirements.

For components which are only allowed to be supplied by SELV voltage sources, these requirements are listed in the technical data.

Most components in the WAGO-I/O-SYSTEM 750 XTR have no internal overcurrent protection. Therefore, appropriate overcurrent production must always be implemented externally for the power supply to these components, e.g. via fuses.

The maximum permissible current is listed in the technical data of the components used.

NOTICE

System supply only with appropriate fuse protection!
Without overcurrent protection, the electronics can be damaged.
If you implement the overcurrent protection for the system supply with a fuse, a fuse, max. 2 A, slow-acting, should be used.

NOTICE

Field supply only with appropriate fuse protection!
Without overcurrent protection, the electronics can be damaged.
If you alternatively implement the overcurrent protection for the field supply with an external fuse, a 10 A fuse should be used.

3.6.2 Isolation

Within the fieldbus node, there are three electrically isolated potentials:

- Electrically isolated fieldbus interface via transformer
- Electronics of the fieldbus couplers/controllers and the I/O modules (local bus)
- All I/O modules have an electrical isolation between the electronics (local bus, logic) and the field electronics. Some digital and analog input modules have each channel electrically isolated, please see catalog.

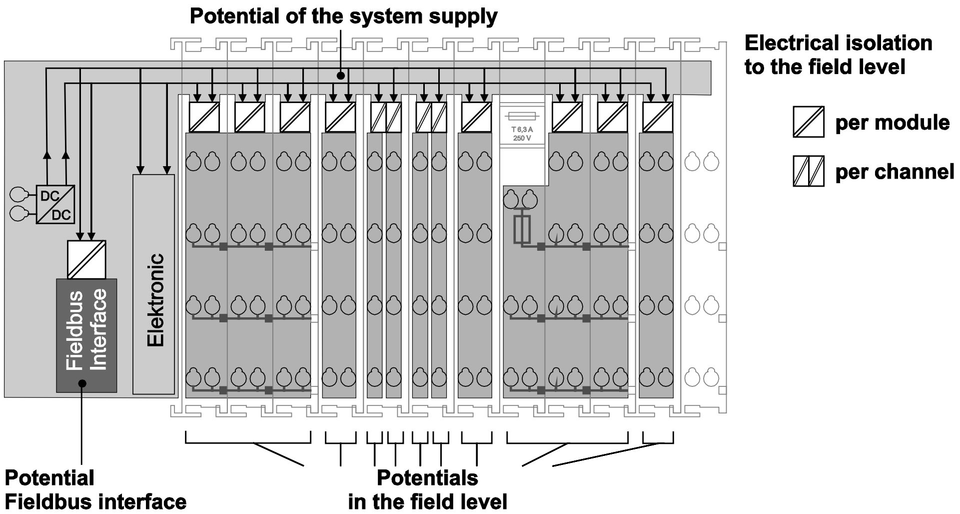


Figure 5: Isolation (Example)

3.6.3 System Supply

3.6.3.1 Connection

The WAGO-I/O-SYSTEM 750 requires a 24 V direct current system supply.
The power supply is provided via the fieldbus coupler/controller and, if necessary, in addition via internal system supply modules “System Power Supply 24 VDC XTR (750-613/040-000)”. The power supply is reverse voltage protected.

NOTICE

Do not use an incorrect voltage/frequency!
The use of an incorrect supply voltage or frequency can cause severe damage to the components.

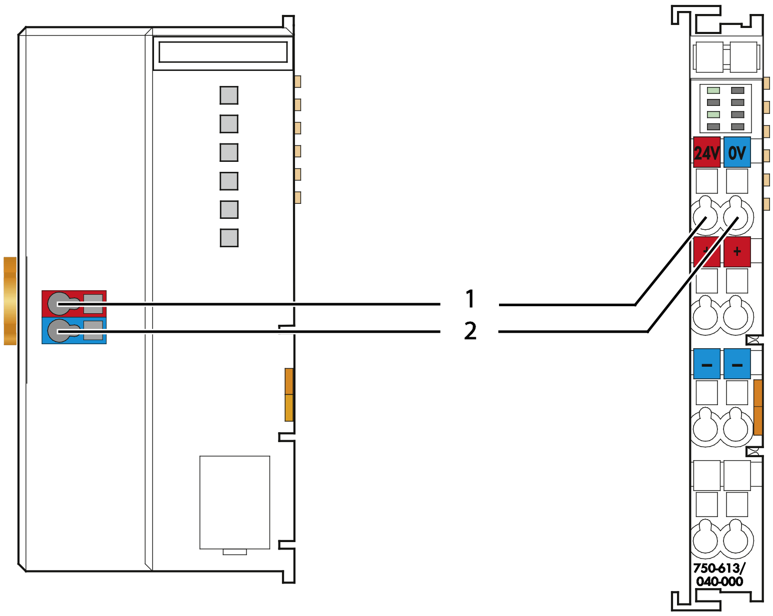


Figure 6: System supply (example)

Table 4: Legend for the “System supply” figure

Pos.	Description
1	System supply 24 VDC
2	System supply 0 V

The fed-in 24 VDC supplies all internal system components, e.g. fieldbus coupler/controller electronics, fieldbus interface and I/O modules via the local bus (5 VDC system voltage). The 5 VDC system voltage is galvanically connected to the 24 VDC supply voltage.

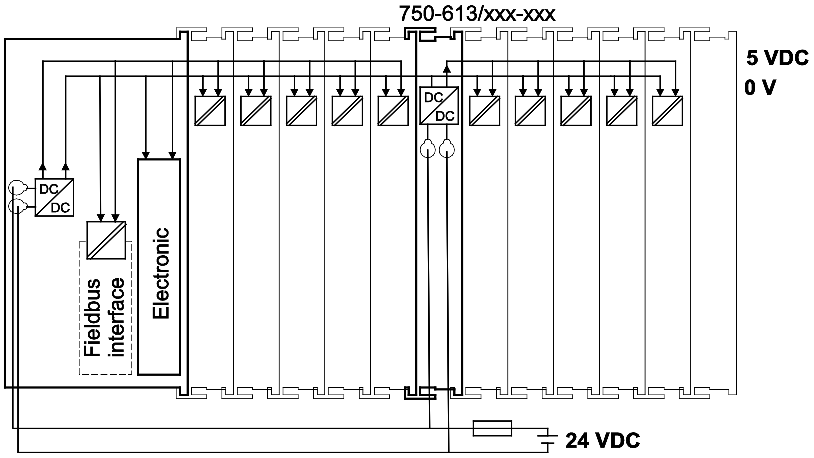


Figure 7: System Voltage (Example)

Note

Only reset the system simultaneously for all supply modules!
Reset the system by switching the system supply simultaneously at all supply modules (fieldbus coupler/controller and potential supply module with bus power supply) off and on again.

3.6.3.2 Dimensioning

Note

Recommendation
A stable power supply cannot always be assumed. Therefore, you should use regulated power supplies to ensure the quality of the supply voltage.

The supply capacity of the fieldbus coupler/controller or the internal system supply module can be taken from the technical data of the components.

Table 5: Alignment

Internal current consumption *)	Current consumption via system voltage (5 V for electronics of I/O modules and fieldbus coupler/controller).
Total current for I/O modules *)	Available current for the I/O modules. Provided by the bus power supply unit. See fieldbus coupler/controller and internal system supply module

*) See current catalog, manuals, Internet

Example:

Calculating the current consumption on an example coupler

Internal current consumption	300 mA at 5 V
Residual current for bus modules	700 mA at 5 V
Sum $I_{(5\,V)\,total}$	**1000 mA at 5 V**

The internal current consumption is indicated in the technical data for each bus terminal. In order to determine the total requirement, add together the values of all I/O modules in the node.

Note

Please note the aggregate current for I/O modules. It may be necessary to supply potential!
When the sum of the internal current consumption for the I/O modules exceeds their aggregate current, you must use a supply module with bus power supply. Install it before the position where the permissible aggregate current would be exceeded.

Example:

Calculating the total current on the example coupler

A node with an example coupler consists e. g. of the following I/O modules:
20 relay modules (750-517) and 10 digital input modules (750-405).

Internal current consumption	10 * 90 mA =	900 mA
	20 * 2 mA =	40 mA
Sum		**940 mA**

In this example, the example coupler can provide 700 mA for the I/O modules. This value is given in the associated data sheet ("Total current for I/O modules"). Consequently, an internal system supply module (750-613), e. g. in the middle of the node, should be added.

The maximum input current of the 24 V system supply is 500 mA. The exact electrical consumption ($I_{(V)}$) can be determined with the following formulas:

Fieldbus coupler or controller

$I_{(5\ V)\ total}$ = Sum of all the internal current consumption of the connected bus modules + internal current consumption fieldbus coupler/controller

Internal system supply module

$I_{(5\ V)\ total}$ = Sum of all the internal current consumption of the connected bus modules at internal system supply module

$$\text{Input current } I_{(24\ V)} = \frac{5\ V}{24\ V} * \frac{I_{(5\ V)\ total}}{\eta}$$

η = Efficiency of the power supply at nominal load 24 V

Note

Activate all outputs when testing the current consumption!

If the electrical consumption of a power supply point for the 24 V system supply exceeds 500 mA, then the cause may be an improperly dimensioned node or a defect.

During the test, you must activate all outputs.

3.6.4 Field Supply

3.6.4.1 Connection

Sensors and actuators can be directly connected to the relevant channel of the I/O module in 1, 2, 3 or 4 conductor connection technology. The I/O module supplies power to the sensors and actuators. The input and output drivers of some I/O modules require the field side supply voltage.

The power supply modules provide field side power (24 VDC). In this case it is a passive power supply without protection equipment. Power supply modules are available for different potentials, e.g. 24 VDC, 230 VAC or others.

Power supply modules with or without diagnostic capability are available for the power supply of other field potentials (e.g. 24 VDC, 0 VAC/DC … 230 VAC/DC, 120 VAC, 230 VAC). The power supply modules can also be used to set up various potential groups. The connections are connected in pairs to a power contact.

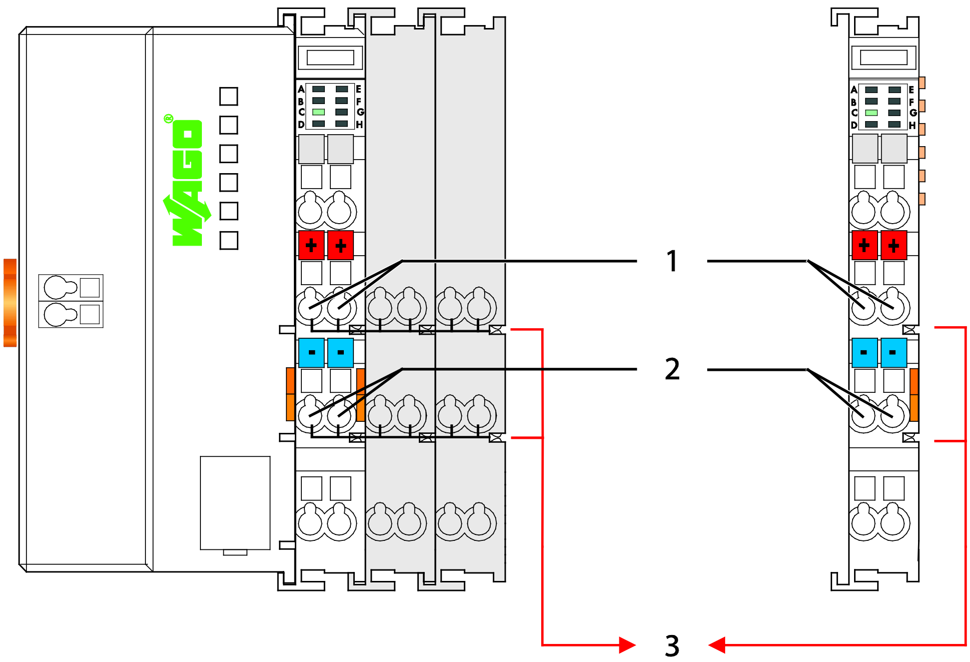


Figure 8: Field supply (sensor/actuator) (example)

Table 6: Legend for the “Field supply (sensor/actuator)” figure

Position	Beschreibung
1	Field supply 24 VDC
2	Field supply 0 V
3	Power jumper contacts (potential distribution to adjacent I/O modules)

Note

In exceptional instances, I/O modules can be directly connected to the field supply!
The 24 V field supply can be connected also directly to a bus module, if the connection points are not needed for the peripheral device supply. In this case, the connection points need the connection to the power jumper contacts.

The field-side power supply is automatically derived from the power jumper contacts when snapping an I/O module.

The current load of the power contacts must not exceed 10 A on a continual basis.

By inserting an additional power supply module, the field supply via the power contacts is disrupted. From there a new power supply occurs which may also contain a new voltage potential.

Note

Re-establish the ground connection when the connection to the power jumper contacts is disrupted!
Some I/O modules have no or very few power contacts (depending on the I/O function). Due to this, the passing through of the relevant potential is disrupted. If you require a field supply via power jumper contacts for subsequent I/O modules, then you have to use a power supply module.
Note the data sheets of the I/O modules.

Note

Use a spacer module when setting up a node with different potentials!
In the case of a node setup with different potentials, e.g. the alteration from 24 VDC to 230 VAC, you should use a spacer module. The optical separation of the potentials acts as a warning to heed caution in the case of wiring and maintenance works. Thus, you can prevent the results of wiring errors.

3.6.4.2 Fusing via Power Supply Module

Internal fusing of the field supply is possible for various field voltages via an appropriate power supply module.

Table 7: Power Supply Modules

Order No.	Field Voltage
750-601/040-000	Power Supply 24 VDC Fuse XTR
750-610/040-000	Power Supply 24 VDC Fuse Diagn XTR
750-606/040-000	Power Supply 24 VDC Diagn for Ex i XTR Modules

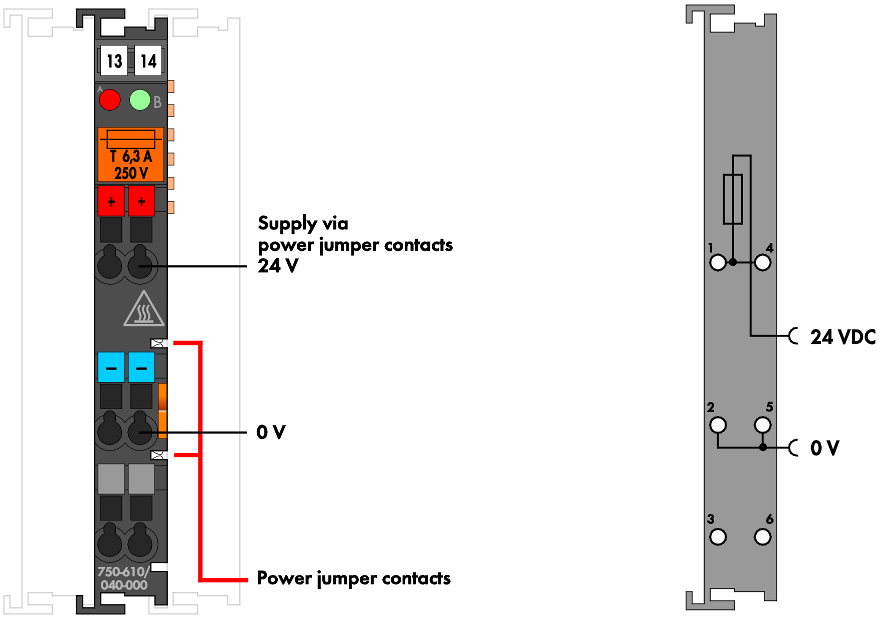


Figure 9: Supply Module with Fuse Carrier (Example 750-610/040-000)

Note

Observe the maximum power dissipation and, if required, UL requirements!
In the case of power supply modules with fuse holders, you must only use fuses with a maximum dissipation of 1.6 W (IEC 127).
For UL approved systems only use UL approved fuses.

In order to insert or change a fuse, or to switch off the voltage in succeeding I/O modules, the fuse holder may be pulled out. In order to do this, use a screwdriver for example, to reach into one of the slits (one on both sides) and pull out the holder.

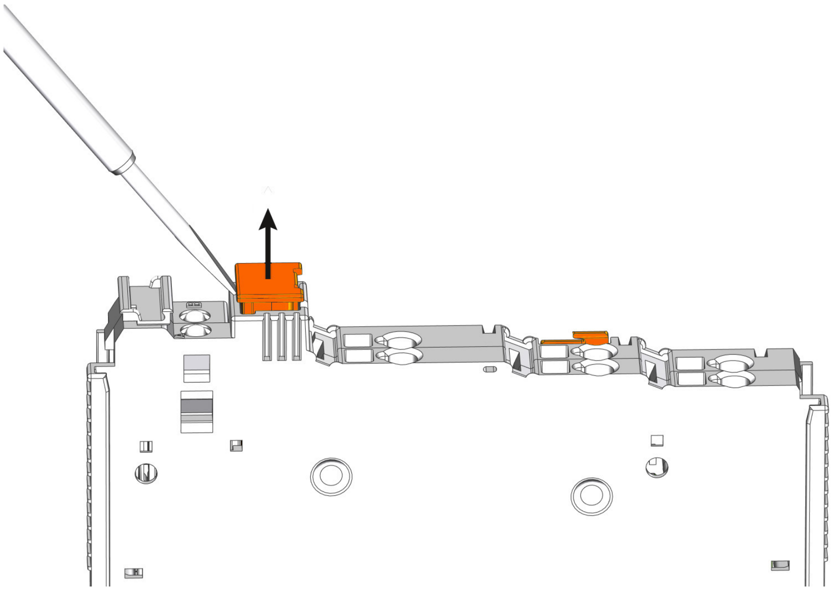


Figure 10: Removing the Fuse Carrier

Lifting the cover to the side opens the fuse carrier.

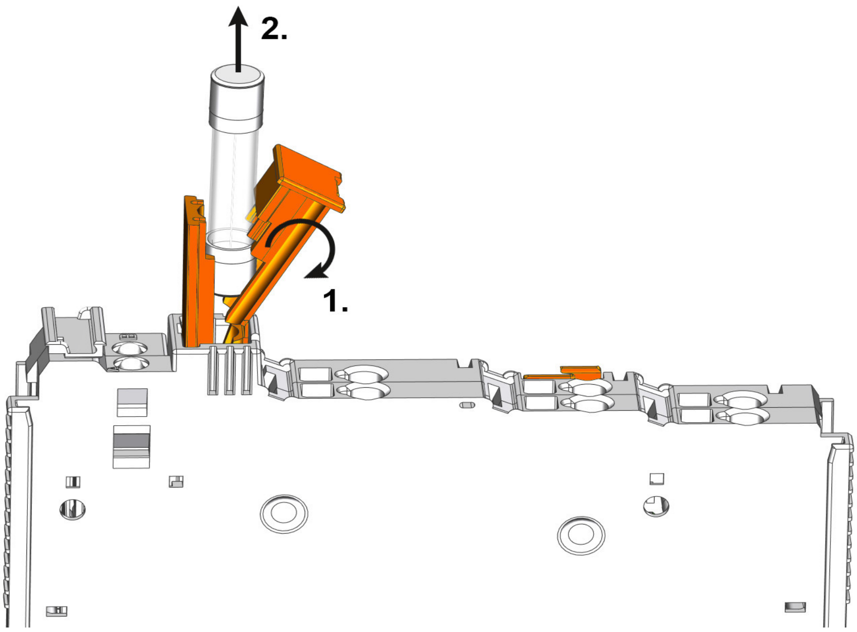


Figure 11: Opening the Fuse Carrier and Changing the Fuse

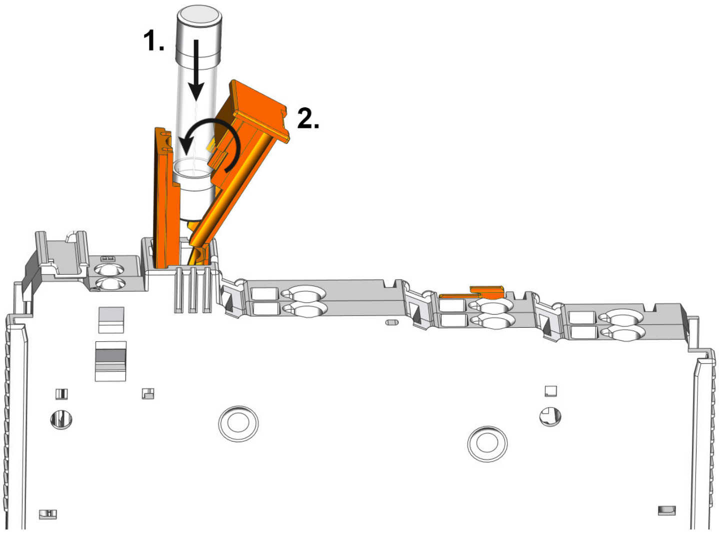


Figure 12: Changing the Fuse and Closing the Fuse Carrier

After changing the fuse, the fuse carrier is pushed back into its original position.

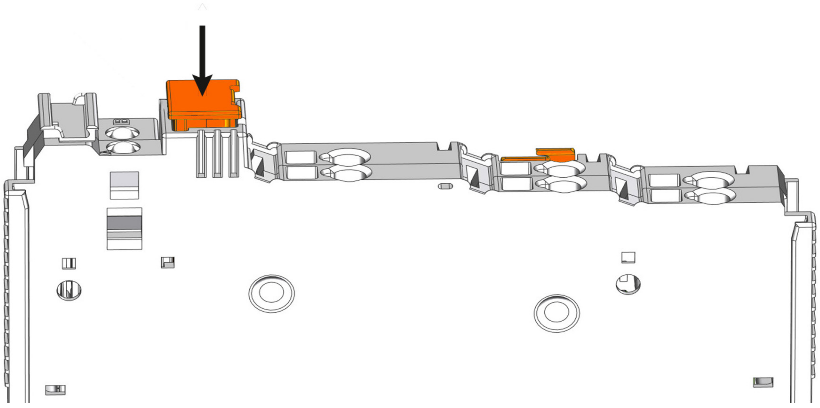


Figure 13: Push Back the Fuse Carrier

3.6.4.3 Fusing External

NOTICE

Field supply only with appropriate fuse protection!
Without overcurrent protection, the electronics can be damaged.
If you alternatively implement the overcurrent protection for the field supply with an external fuse, an F 10 A fuse should be used.

For the external fusing, the fuse modules of the WAGO series 282, 2006, 281 and 2002 are suitable for this purpose.

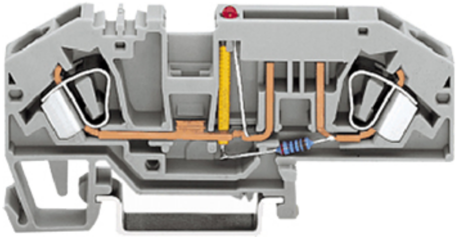


Figure 14: Fuse Modules for Automotive Fuses, Series 282

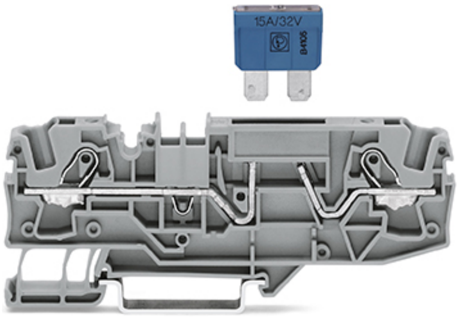


Figure 15: Fuse Modules for Automotive Fuses, Series 2006

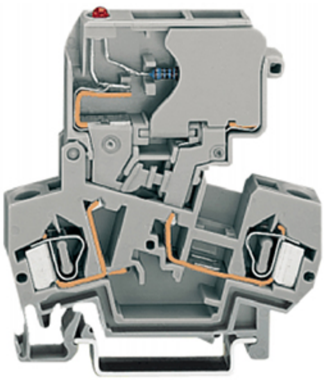


Figure 16: Fuse Modules with Pivotable Fuse Carrier, Series 281

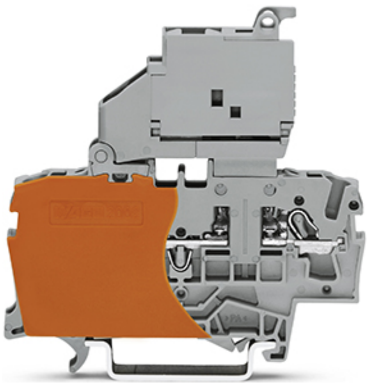


Figure 17: Fuse Modules with Pivotable Fuse Carrier, Series 2002

3.6.5 Supplementary Power Supply Regulations

The WAGO-I/O-SYSTEM 750 XTR can also be used in shipbuilding applications and onshore/offshore installations (e.g., platforms, loading facilities), as well as in telecontrol applications. This is possible via certification under the standards of leading agencies such as Germanischer Lloyd and Lloyds Register.

For standard-compliant application in substation instrumentation and control, telecontrol systems, railway technology or shipbuilding certified operation, field-side power supply filter 750-624/040-00x or power supply filter 750-626/040-000 are generally to be used for XTR module groups.

Table 8: Filter modules for 24 V power supply

Item No.	Description	Description
750-626/040-000	Supply Filter 24 VDC HI XTR	Supply Filter; 24 VDC; higher isolation; extreme: System and field supply with filtering (24 V, 0 V), i.e., fieldbus coupler/controller and System Power Supply 24 VDC XTR (750-613/040-000)
750-624/040-000	Field Supply Filter 24 VDC HI XTR	Field Side Supply Filter (Surge); 24 VDC; higher isolation; extreme: 24 V field supply with filtering
750-624/040-001	Field Supply Filter 24 VDC HI NC XTR	Field Side Supply Filter (Surge); 24 VDC; higher isolation; without power jumper contacts; extreme: 24 V field supply with filtering

Therefore, the following power supply requirements must be observed:

The 24 V system power supply for the fieldbus coupler/controller must be filtered and protected against overvoltage. Therefore, the power must be supplied via power supply filter 750-626/040-000.

The electronic power supply must only be connected via a slow blow 2 A fuse.

The 24 V field power supply systems must be protected against overvoltage. Therefore, the power must be supplied via field-side power supply filter 750-624/040-00x or power supply filter 750-626/ 040-000.

For this potential group, only the supply module 750-612/040-000 is required for a 230 V field power supply.

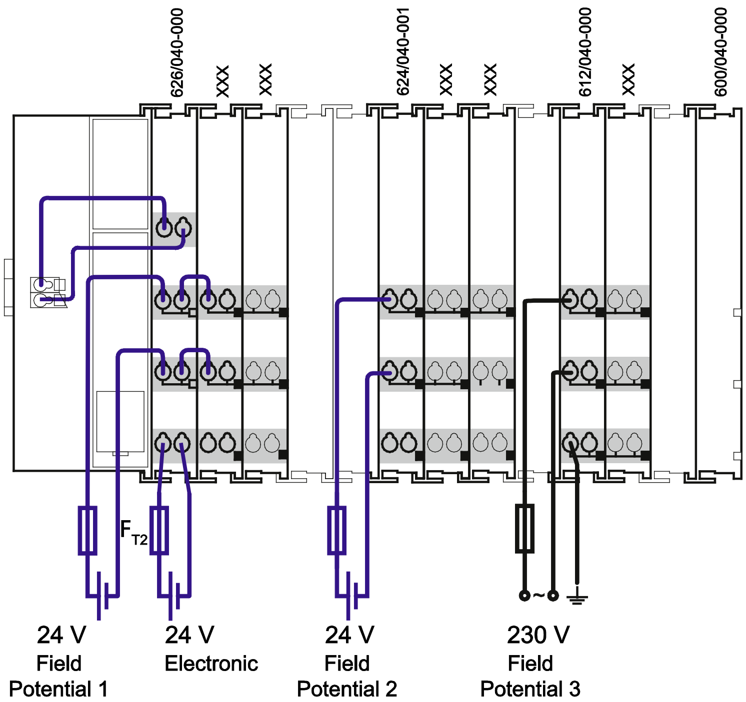


Figure 18: Power supply concept

3.6.6 Supply Example

Note

The system supply and the field supply shall be separated!
You should separate the system supply and the field supply in order to ensure bus operation in the event of a short-circuit on the actuator side.

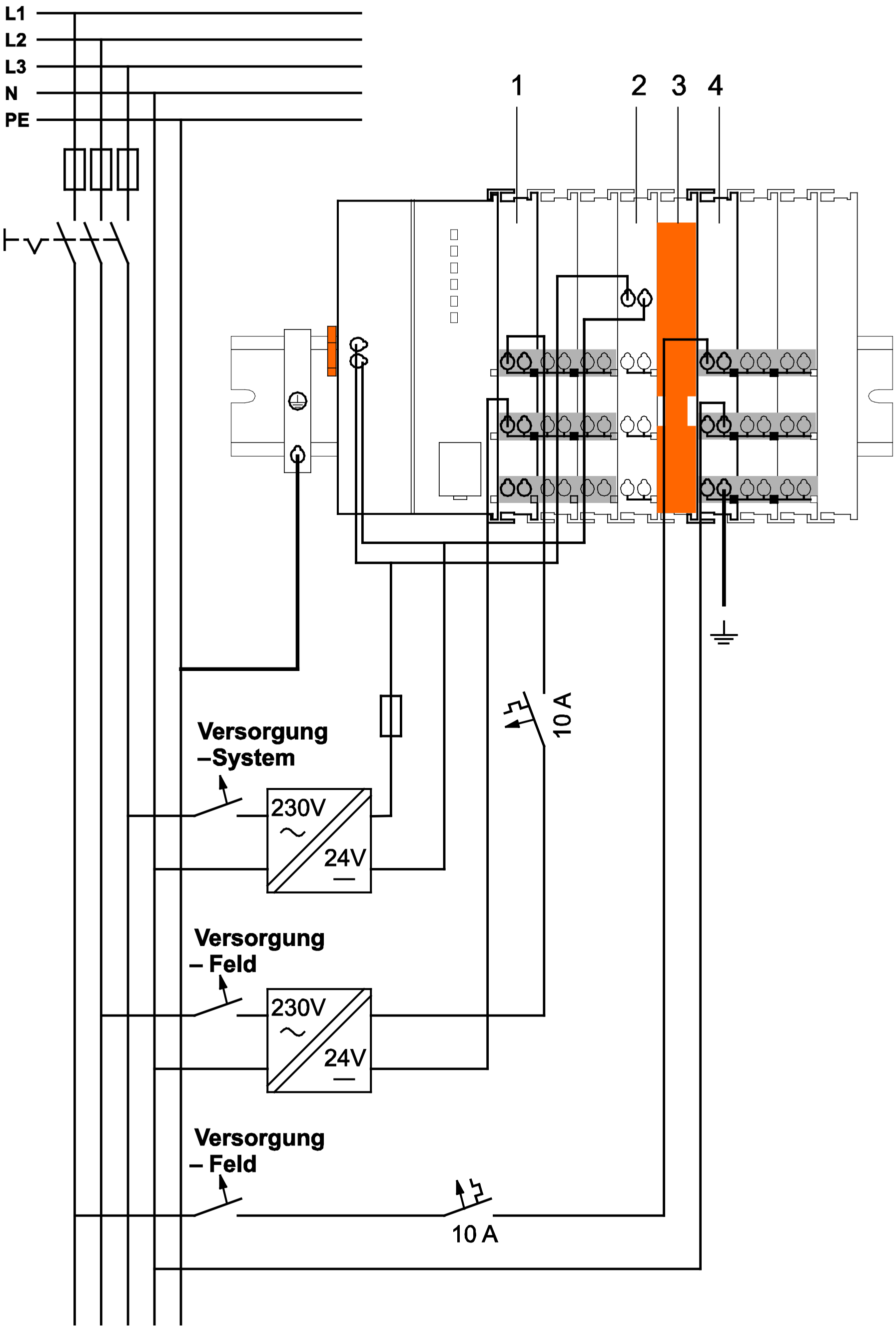


Figure 19: Supply example

Table 9: Legend for the “Supply example” figure

Pos.	Description
1	Power supply on the fieldbus coupler/controller via external system supply module
2	Supply module with bus power supply 24 V
3	Separation module recommended
4	Supply module 230 V

3.6.7 Power Supply Units

The WAGO-I/O-SYSTEM 750 XTR requires 24 VDC voltage (system supply) for operation.

Note

Recommendation
A stable power supply cannot always be assumed everywhere. Therefore, you should use regulated power supplies to ensure the quality of the supply voltage (see also table “WAGO power supply units”).

For brief voltage dips, a buffer (200 μF per 1 A load current) must be provided.

Note

Buffer for system power supply!
The system power supply must be buffered to bridge power outages. As the power demand depends on the respective node configuration, buffering is not implemented internally.
To achieve power outages of 1 ms to 10 ms according to IEC61131-2, determine the buffering appropriate for your node configuration and structure it as an external circuit.

The power demand must be determined individually depending on the entry point of the field supply. All loads through field devices and I/O modules must be taken into account. The field supply also impacts the I/O modules because the input and output drivers of some I/O modules require the voltage of the field supply.

Note

System and field supply must be isolated!
The system supply and field supply must be isolated to ensure bus operation in the event of short circuits on the actuator side.

Information

Power supply units are available in the eShop.
You can find suitable power supply units, e. g. from the EPSITRON series, in the eShop on: www.wago.com

3.7 Grounding

3.7.1 Grounding the DIN Rail

3.7.1.1 Framework Assembly

When setting up the framework, the carrier rail must be screwed together with the electrically conducting cabinet or housing frame. The framework or the housing must be grounded. The electrical connection is established via the screw. Thus, the carrier rail is grounded.

DANGER

Ensure sufficient grounding is provided!
You must take care to ensure the flawless electrical connection between the carrier rail and the frame or housing in order to guarantee sufficient grounding.

3.7.1.2 Insulated Assembly

Insulated assembly has been achieved when there is constructively no direct ohmic contact between the cabinet frame or machine parts and the carrier rail. Here, the earth ground must be set up via an electrical conductor in accordance with valid national safety regulations.

Note

Recommendation
The optimal setup is a metallic assembly plate with grounding connection which is electrically conductive linked to the carrier rail.

The separate grounding of the carrier rail can be easily set up with the aid of the WAGO ground wire terminals.

Table 10: WAGO Ground Wire Terminals

Order No.	Description
283-609	1-conductor ground (earth) terminal block make an automatic contact to the carrier rail; conductor cross section: 0.2 mm² … 16 mm^2 **Note**: Also order the end and intermediate plate (283-320).

3.7.2 Grounding Function

The grounding function increases the resistance against electro-magnetic interferences. Some components in the I/O system have a carrier rail contact that dissipates electro-magnetic interferences to the carrier rail.

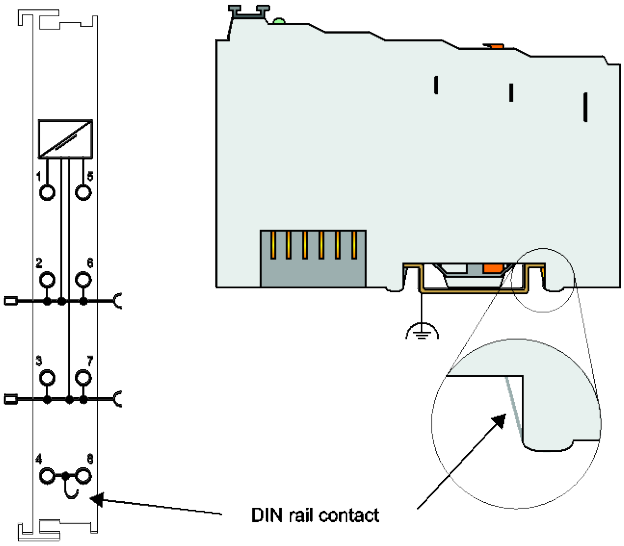


Figure 20: Carrier Rail Contact (Example)

DANGER

Ensure sufficient grounding is provided!
You must take care to ensure the direct electrical connection between the carrier rail contact and the carrier rail.
The carrier rail must be grounded.
For information on carrier rail properties, see section “Mounting” > … > “Carrier Rail Properties”.

The bottom CAGE CLAMP® connectors of the supply modules enable optional connection of a field-side functional ground. This potential is made available to the I/O module arranged on the right through the spring-loaded contact of the three power contacts. Some I/O modules are equipped with a knife-edge contact that taps this potential. This forms a potential group with regard to functional ground with the I/O module arranged on the left.

3.8 Shielding

3.8.1 General

Use of shielded cables reduces electromagnetic interference and thus increases signal quality. Measurement errors, data transmission errors and interference due to excessive voltage can be prevented.

Note

Connect the cable shield to the ground potential!
Integrated shielding is mandatory to meet the technical specifications in regards to measuring accuracy. Connect the cable shield and ground potential at the inlet to the cabinet or housing. This allows induced interference to dissipate and to be kept away from devices in the cabinet or housing.

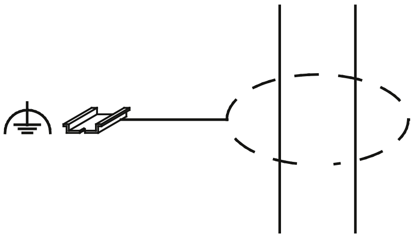


Figure 21: Cable Shield at Ground Potential

Note

Improve shielding performance by placing the shield over a large area!
Higher shielding performance is achieved via low-impedance connection between shield and ground. For this purpose, connect the shield over a large surface area, e.g., WAGO shield connecting system. This is especially recommended for large-scale systems where equalizing current or high impulse-type currents caused by atmospheric discharge may occur.

Note

Keep data and signal lines away from sources of interference!
Route data and signal lines separately from all high voltage cables and other sources of high electromagnetic emission (e.g., frequency converter or drives).

3.8.2 Fieldbus Cables

The shielding of fieldbus lines is described in the respective configuration guidelines and standards of the fieldbus system. Information on this can be provided by the corresponding fieldbus organization or specialist literature.

3.8.3 Shielded Signal Lines

Note

Use shielded signal lines!
Always use shielded signal lines for analog signals and I/O modules which are equipped with shield clamps. Only then you can ensure that the accuracy and interference immunity specified for the respective I/O module can be achieved even in the presence of interference acting on the signal cable.

On some WAGO devices you can directly clamp the shield. For all other devices use the WAGO shield connecting system.

3.8.4 WAGO Shield Connecting System

The series 790 WAGO shield connecting system consists of shield clamping saddles, busbars and various mounting carriers. These components can be used to achieve many different configurations.

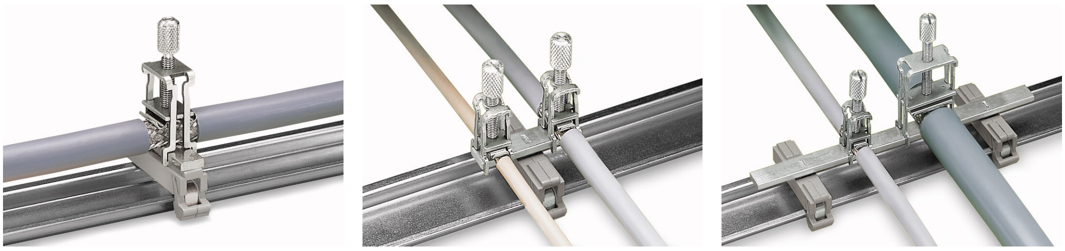


Figure 22: Examples of the WAGO Shield Connecting System

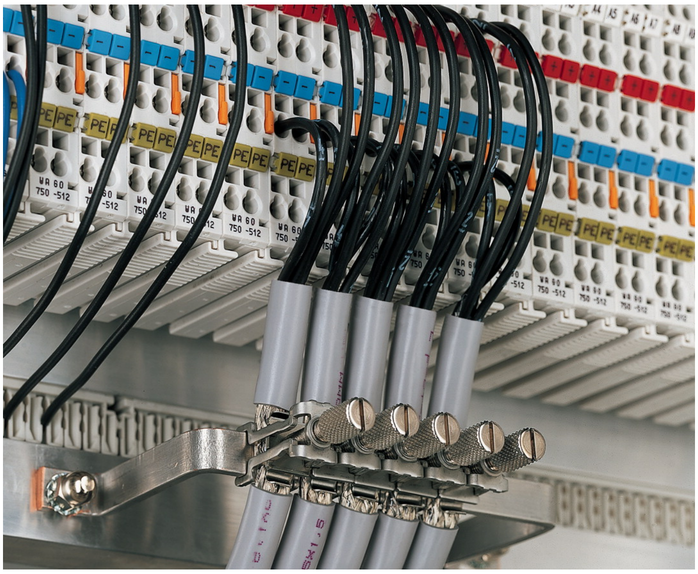


Figure 23: Application of the WAGO Shield Connecting System

4 Device Description

The 750-352/040-000 Fieldbus Coupler connects as the head station of the node assembly the WAGO-I/O-SYSTEM 750 or 753 to the ETHERNET fieldbus system.

This head station can be used for applications in machine and plant construction as well as in the process industry and building technology.

Equipped with two RJ-45 ports, which both work as 2-channel switches, the head station enables easy and cost-effective cabling such as linear bus topology for which no additional external switches or hubs are required.

With the DIP switch the last byte of the IP address, as well as the assignment of the IP address (DHCP, BootP, static setting) can be given.

In the head station, all input signals from the sensors are combined. After connecting the head station, the head station determines which I/O modules are on the node and creates a local process image from theirs data. Analog and specialty module data is sent via words and/or bytes; digital data is grouped bit-by-bit.

The local process image is divided into two data zones containing the data received and the data to be sent.

The data of the analog modules is mapped first into the process image. The modules are mapped in the order of their physical position after the head station.

The bits of the digital modules are combined into words and then mapped after the analog ones in the process image. If the number of digital I/Os is greater than 16 bits, the head station automatically begins a new word.

All sensor input signals are grouped in the coupler (slave) and transferred to the higher-order controller (master) via the fieldbus. Process data linking is performed in the higher-order controller. The higher-order controller puts out the resulting data to the actuators via the bus and the node.

The fieldbus connection consists of two ports (RJ-45). An ETHERNET switch integrated in the head station operates in the store and forward mode.
Both ports support:

- 10BASE-T / 100BASE-TX
- Full / Half duplex
- Autonegotiation
- Auto-MDI(X)

In order to send process data via ETHERNET, the head station supports a series of network protocols.

The Modbus TCP/UDP protocol and the EtherNet/IP protocol are implemented for exchanging process data.
The two communication protocols can be used optional or together.

For the management and diagnosis of the system, the HTTP and SNMP protocols are available.

For the data transfer via ETHERNET the FTP and SFTP are available.

For the automatic assignment of the IP address in the network, alternatively DHCP or BootP can be used.

An internal server is available for Web-based applications.

HTML pages stored in the head station allow access to information about the configuration, the status and the I/O data of the fieldbus node via Web browsers. It is also possible to store individual HTML pages using the implemented file system, store custom HTML pages.

4.1 View

The view below shows the different parts of the device:

- The fieldbus connection is within the lower range on the left side.
- Over the fieldbus connection is a power supply unit for the system supply.
- LEDs for bus communication, error messages and diagnostics are within the upper range on the right side.
- Down right the service interface is to be found.

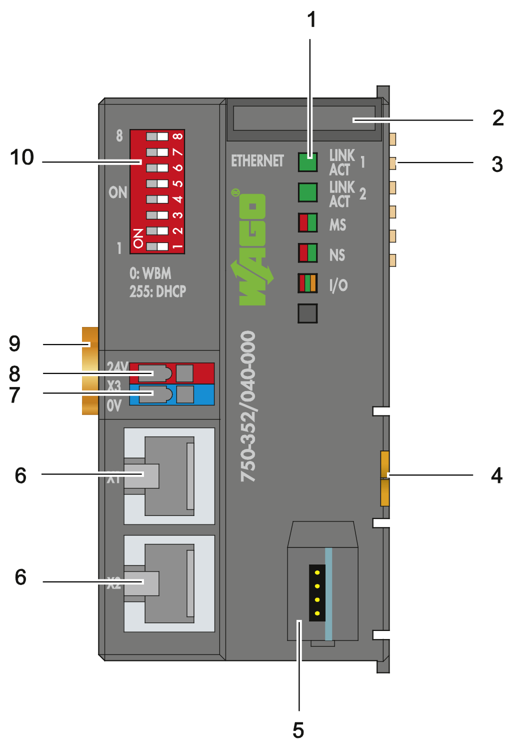


Figure 24: View

Table 11: Legend for Figure “View”

Pos.	Designa-tion	Meaning	Details see Section
1	LINK ACT 1, 2, MS, NS, I/O	Status LEDs Fieldbus	„Device Description“ > „Display Elements“
2	---	Marking possibility on four miniature WSB markers	---
3	---	Data contacts	"Connect Devices" > "Data Contacts/Local Bus"
4	---	Unlocking lug	"Mounting" > "Inserting and Removing Devices"
5	---	Service interface (open flap)	"Device Description" > "Operating Elements"
6	X1, X2	Fieldbus connection 2 x RJ-45 as 2-Port ETHERNET Switch	„Device Description“ > „Connectors“
7	-	CAGE CLAMP® Connections Field Supply 0 V	"System Description" >"Voltage Supply"
8	+	CAGE CLAMP® Connections Field Supply 24 VDC	"System Description" >"Voltage Supply"
9	---	Locking Disc	„Mounting“ > „Plugging and Removal of the Device“
10	---	Address Selection Switch	"Device Description" > "Operating Elements"

4.2 Connectors

4.2.1 Device Supply

The device is powered via terminal blocks with CAGE CLAMP® connections.

The device supply generates the necessary voltage to power the electronics of the device and the internal electronics of the connected I/O modules.

The fieldbus interface is galvanically separated to the electrical potential of the device.

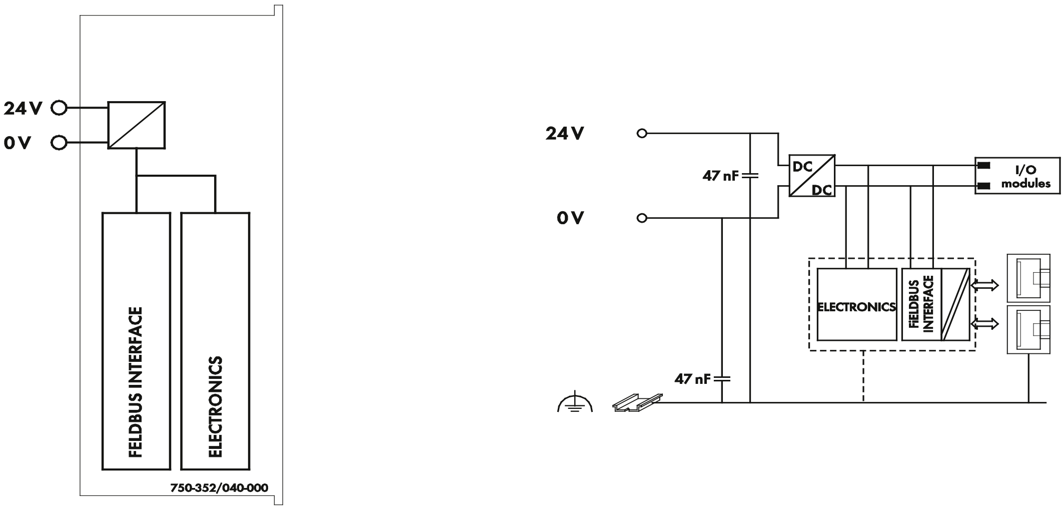


Figure 25: Device supply

4.2.2 Fieldbus Connection

The connection to the fieldbus is made via two RJ-45 plugs, which are connected to the fieldbus controller via an integrated switch.
The integrated switch works in store-and-forward operation and for each port, supports the transmission speeds 10/100 Mbit as well as the transmission modes full and half-duplex and autonegotiation.
The wiring of these plugs corresponds to the specifications for 100BaseTX, which prescribes a category 5 twisted pair cable as the connecting cable. Cable types S/UTP (Screened Unshielded Twisted Pair) and STP (Shielded Twisted Pair) with a maximum segment length of 100 m (approximately 328.08 feet) can be used.
The socket is arranged physically lower, allowing the coupler to fit in an 80 mm high enclosure after plug connection.

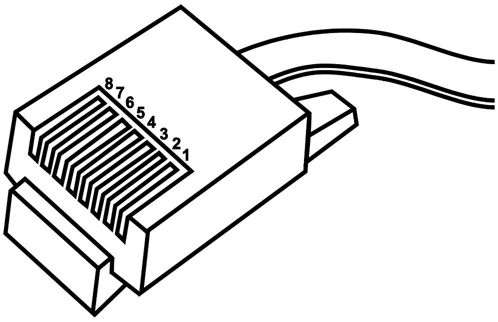


Figure 26: RJ-45 Connector

Table 12: RJ-45 Connector and RJ-45 Connector Configuration

Contact	Signal	
1	TD +	Transmit +
2	TD −	Transmit −
3	RD +	Receive +
4		free
5		free
6	RD −	Receive −
7		free
8		free

NOTICE

Do not use in telecommunication circuits!
Only use devices equipped with ETHERNET or RJ-45 connectors in LANs.
Never connect these devices with telecommunication networks.

4.3 Display Elements

The operating condition of the fieldbus coupler or the node is displayed with the help of illuminated indicators in the form of light-emitting diodes (LEDs).
The LED information is routed to the top of the case by light guides. In some cases, the LEDs are multi-colored (red, green or orange).

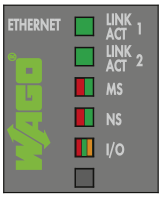


Figure 27: Display Elements

For the diagnostics of the different ranges fieldbus and node, the LED's can be divided into groups:

Table 13: Display Elements Fieldbus Status

LED	Color	Meaning
LNK ACT 1	green	indicates a connection to the physical network at port 1
LNK ACT 2	green	indicates a connection to the physical network at port 2
MS	red/green	indicates the status of the node
NS	red/green	indicates the network status

Table 14: Display Elements Node Status

LED	Color	Meaning
I/O	red/green/ orange	Indicates the operation of the node and signals via a blink code faults encountered.

Information

More information about the LED Signaling
Read the detailed description for the evaluation of the displayed LED state in the section "Diagnostics" > … > "LED Signaling".

4.4 Operating Elements

4.4.1 Service Interface

The service interface is located behind the flap.

It is used for the communication with the WAGO-I/O-*CHECK* and for downloading the firmware updates.

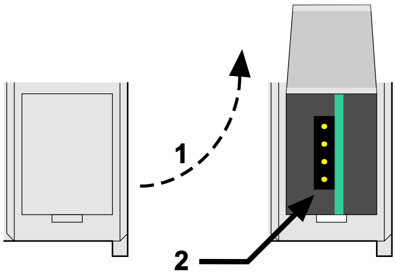


Figure 28: Service Interface (Closed and Opened Flap)

Table 15: Legend for Figure “Service Interface (Closed and Opened Flap)”

Number	Description
1	Open closed
2	View Service Interface

NOTICE

Device must be de-energized!
To prevent damage to the device, unplug and plug in the communication cable only when the device is de-energized!

The connection to the 4-pin header under the cover flap can be realized via the communication cables with the item numbers750-920 and 750-923 or via the WAGO radio adapter with the item number 750-921.

4.4.2 Address Selection Switch

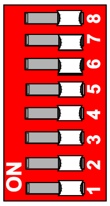


Figure 29: Address Selection Switch (for example setting “0“)

Using the address selection switch, the device can be assigned a fixed IP address.

The set value corresponds to the last digit of the IP address (host ID). The complete IP address consists of the base IP address stored in the device (factory setting: 192.168.1.0) and the host ID set on the address selection switch

The coding of the host ID is bit by bit and begins with address selection switch 1 for bit 0 (LSB) and ends with address selection switch 8 for bit 7 (MSB).

Example:

Basic IP address:	192.168.1.0
Address selection switch (1 … 8):	"11011001" = 155
IP address:	192.168.1.155

The detailed use of the address selection switch in conjunction with other options for IP address assignment is described in the chapter "Commissioning".

4.5 Technical Data

4.5.1 Device Data

Table 16: Technical Data – Device

Width	50 mm
Height (from upper edge of DIN-rail)	62 mm
Depth	97 mm
Weight	112 g
Degree of protection	IP20

4.5.2 System Data

Table 17: Technical Data – System

Number of fieldbus nodes per master	Limited by ETHERNET specification
Transmission medium	Twisted Pair CAT 5e (S/UTP or S/STP)
Fieldbus coupler connection	2 × RJ-45
Transmission performance	Class D acc. to EN 50173
Baud rate	10/100 Mbit/s
Max. length of fieldbus segment	100 m
Protocols	MODBUS/TCP (UDP), EtherNet/IP, HTTP, BootP, DHCP, DNS, FTP, SNMP
Max. number of socket links	3 HTTP, 15 MODBUS/TCP, 10 FTP, 2 SNMP, 128 for Ethernet/IP
Number of I/O modules	64
Configuration	Via PC

4.5.3 Supply

Table 4: Technical Data – Supply

Power supply via CAGE CLAMP® connectors under laboratory conditions +15 °C … +35 °C for ambient operating temperature −40 °C … +55 °C for ambient operating temperature +55 °C … +70 °C	24 VDC (power supply via SELV/PELV power supply unit) 18 V … 31.2 V (17.4 V … 31.2 V) [1)] 18 V … 28.8 V (17.4 V … 28.8 V) [1)] 18 V … 26.4 V (17.4 V … 26.4 V) [1)]
Internal current consumption (5 VDC)	450 mA
Total current for I/O modules (5 VDC)	700 mA
Input current typ. at nominal load (24 VDC)	280 mA
Power failure time acc. IEC 61131-2	Depending on external buffering
Efficiency of power supply typ. at nominal load	90 %
Isolation (peak value)	510 VAC[2)] or 775 VDC power supply/DIN rail
Rated impulse voltage	1 kV
Degree of pollution acc. to IEC 61131-2	2

[1)] Including residual ripple of 15%
[2)] When performing insulation testing, observe the instructions in the manual!

Note

Buffer for system power supply!
The system power supply must be buffered to bridge power outages. As the power demand depends on the respective node configuration, buffering is not implemented internally.
To achieve power outages of 1 ms to 10 ms according to IEC61131-2, determine the buffering appropriate for your node configuration and structure it as an external circuit.

4.5.4 Fieldbus MODBUS/TCP

Table 5: Technical Data – Fieldbus MODBUS/TCP

Input process image $_{max}$	1020 words
Output process image $_{max}$	1020 words

4.5.5 Accessories

Table 18: Technical Data – Accessories

Miniature WSB Quick marking system

4.5.6 Connection Technology

Table 19: Technical Data – Wiring Interface

Connection technology	CAGE CLAMP®
Conductor range	0.08 mm² …1.5 mm² / AWG 28 … 14
Strip length	5 mm … 6 mm / 0.22 in

Table 20: Technical Data – Data Contacts

Data contacts	Sliding contacts, self-cleaning, hard gold plated

4.5.7 Mechanical Conditions

Table 21: Technical Data – Mechanical Conditions

Vibration resistance	Max. 5g *

* Follow the installation instructions

4.5.8 Climatic Environmental Conditions

Table 22: Technical Data – Climatic Environmental Conditions

Surrounding air temperature, operation	−40 °C … +70 °C
Surrounding air temperature, storage	−40 °C … +85 °C
Relative humidity *)	95 %
Elevation above sea level	
without temperature derating	0 m … 2000 m
with temperature derating	2000 m … 5000 m: 0.5 K per 100 m
max.	5000 m
Resistance to harmful substances	Acc. to IEC 60068-2-42 and IEC 60068-2-43
Maximum pollutant concentration at relative humidity < 75 %	$SO_2 \leq$ 25 ppm $H_2S \leq$ 10 ppm

*) Short-term condensation acc. class 3K7 / IEC EN 60721-3-3 permitted, applying E-DIN 40046-721-3 (except wind-driven precipitation, water and ice formation)

4.6 Approvals

Information

More information about approvals.
Detailed references to the approvals are listed in the document "Overview Approvals **WAGO-I/O-SYSTEM 750**", which you can find via the internet under: www.wago.com → DOWNLOADS → Documentation → System Description.

The following approvals have been granted to 750-352/040-000 fieldbus coupler/controller:

Conformity Marking

UL508

Korea Certification MSIP-REM-W43-FBC750

The following Ex approvals have been granted to 750-352/040-000 fieldbus coupler/controller:

$_{C}UL_{US}$ UL 12.12.01 – for Use in Hazardous Locations
Class I, Div2 ABCD T4

TÜV 17 ATEX 193969 X
II 3 G Ex ec IIC T4 Gc

IECEx TUN 16.0046X
Ex ec IIC T4 Gc

The following ship approvals have been granted to 750-352/040-000 fieldbus coupler/controller:

ABS (American Bureau of Shipping)

Temperature:	D (cold test with −40 °C/16 h)
Humidity:	B
Vibration:	B (vibration test with acceleration amplitude 5.0g)
EMC:	B
Enclosure:	A

LR (Lloyd's Register) Env. 1, 2, 3, 4

PRS (Polski Rejestr Statków)

4.7 Standards and Guidelines

750-352/040-000 fieldbus coupler/controller meets the following standards and guidelines:

Table 23: Standards and Rated Conditions for Explosion Protection Applications

ATEX acc. Directive 2014/34/EU	
General Requirements	
EN 60079-0:2012 + A11:2013	Group II electrical equipment
Equipment requirements in the types of protection	
EN 60079-7:2015	Electrical equipment in “e” type of protection with “ec” level of protection
EN 60079-15:2010	Electrical equipment in the “n” type of protection with “nC” level of protection
IECEx Certificates of Conformity	
General Requirements	
IEC 60079-0 ed. 6	Group II electrical equipment
Equipment requirements in the types of protection	
EC 60079-7 ed. 5	Electrical equipment in “e” type of protection with “ec” level of protection
IEC 60079-15 ed.4	Electrical equipment in the “n” type of protection with “nC” level of protection

Table 24: Climatic and Mechanical Environmental Conditions and Shipbuilding

Standard	**Test Value**
Transport	
EN 60870-2-2	Ct2(2k4) (except precipitation/water/moisture)
Mechanical Environmental Conditions	
EN 61850-3	Achieved
EN 60870-2-2	Bm
EN 60721-3-1	1M3
EN 60721-3-3	3M5
EN 60068-2-6	Acceleration 5g
IEC 60068-2-27 Shock	15g, 11 ms, 1000 shocks per axis and direction, half-sine
	25g, 6 ms, 1000 shocks per axis and direction, half-sine
EN 50155 EN 61373	Random vibration: Category 1, classes A and B
	Shock 5g, 30 ms: Category 1, classes A and B
Environmental Requirements	
EN 61850-3	Achieved
EN 60721-3-1	1K5 (except precipitation and ice formation)
EN 60721-3-3	3K7 (except wind-driven precipitation, water and ice formation)
EN 60870-2-2	C3 (except wind-driven precipitation and ice formation)
EN 50155	TX (−40 … +70 °C)
Shipbuilding (Mechanical/Climatic Environmental Conditions and EMC)	
Shipbuilding*)	Temperature: D (cold test with −40 °C/16 h) Humidity: B Vibration: B (vibration test with acceleration amplitude 5.0g) EMC: B Enclosure: A

*) The list of ship certifications issued is available in the section “Approvals”.

The fieldbus coupler/controller 750-352/040-000 meets the following EMC standards as these standards relate to the fieldbus coupler/controller:

Table 25: EMC – Immunity to Interference

Standard	**Test Value**
Electrostatic Discharge	
• EN 61000-4-2 • EN 60255-26 • IEEE C37.90.3	8 kV (contact discharge) 8 kV (air discharge)
High-frequency Electromagnetic Fields	
• EN 61000-4-3 • EN 60255-26 • IEEE C37.90.2	20 V/m (80 MHz … 1 GHz) 10 V/m (1 GHz … 3 GHz)
Fast Electrical Transient Disturbances / Burst	
• EN 61000-4-4 • EN 60255-26 • IEEE C37.90.1	4 kV
Surge Voltage / Surge	
• EN 61000-4-5 • EN 60255-26	1 kV (conductor/conductor) 2 kV (conductor/ground)
Conducted Disturbances, Induced by High-frequency Fields	
• EN 61000-4-6 • EN 60255-26	10 V (150 kHz … 80 MHz)
Magnetic Fields With Electrical Frequencies	
• EN 61000-4-8 • EN 60255-26	300 A/m continuous / 1000 A/m for 1 s
Pulse-shaped Magnetic Fields	
• EN 61000-4-9	300 A/m
Damped Oscillatory Magnetic Fields	
• EN 61000-4-10	100 A/m
Voltage Dips, Short-term Interruptions and Voltage Fluctuations	
• EN 61000-4-11 • EN 60255-26	Standard not applicable
Damped Sinusoidal Oscillations	
• EN 61000-4-12	1 kV (conductor/conductor) 2 kV (conductor/ground)
Harmonics and Interharmonics	
• EN 61000-4-13	Standard not applicable
Conducted Asymmetric Disturbances	
• EN 61000-4-16	30 V continuous 300 V for 1 s

Table 25: EMC – Immunity to Interference

Standard	**Test Value**
Line Frequency Disturbances	
• EN 60255-26	Standard not applicable
Alternating Components of the Voltage to DC Line Connections	
• EN 61000-4-17 • EN 60255-26	15 %
Damped Oscillatory Waves	
• EN 61000-4-18 • EN 60255-26 • IEEE C37.90.1	1.25 kV conductor/conductor 2.5 kV conductor/ground
Voltage Dips, Short-term Interruptions and Voltage Fluctuations to DC Supply Inputs	
• EN 61000-4-29 • EN 60255-26	See section “Power Supply Units”
Harmonics	
• Shipbuilding *)	Max. 2 W DC: 3 V_{eff}, AC: 10 % to 15th harmonic 10 % … 1 % for 15th to 100th harmonic 1 % for 100th to 200th harmonic

*) The list of ship certifications issued is available in the section “Approvals”.

Table 26: EMC – Emission of Interference

Standard	**Test Value** *)
Enclosure Emission of Interference	
• EN 61000-6-3 • EN 55032 Class B	30 dB(µV/m), QP, 30 MHz … 230 MHz 37 dB(µV/m), QP, 230 MHz … 1 GHz 70 dB(µV/m), Peak, 1 GHz … 3 GHz 50 dB(µV/m), AV, 1 GHz … 3 GHz 74 dB(µV/m), Peak, 3 GHz … 6 GHz 54 dB(µV/m), AV, 3 GHz … 6 GHz
• EN 61000-6-4 • EN 60255-26 • EN 55011 Class A • EN 55032 Class A	40 dB(µV/m), QP, 30 MHz … 230 MHz 47 dB(µV/m), QP, 230 MHz … 1 GHz 76 dB(µV/m), Peak, 1 GHz … 3 GHz 56 dB(µV/m), AV, 1 GHz … 3 GHz 80 dB(µV/m), Peak, 3 GHz … 6 GHz 60 dB(µV/m), AV, 3 GHz … 6 GHz
• Shipbuilding**) (Class B)	80 dB(µV/m) …50 dB(µV/m), QP, 150 kHz … 300 kHz 50 dB(µV/m) … 34 dB(µV/m), QP, 0.3 MHz … 30 MHz 54 dB(µV/m), QP, 30 MHz … 2 GHz 24 dB(µV/m), QP, 156 MHz … 165 MHz
• Shipbuilding**) (Class A)	80 dB(µV/m) … 50 dB(µV/m), QP, 150 kHz … 30 MHz 60 dB(µV/m) … 54 dB(µV/m), QP, 30 MHz … 100 MHz 54 dB(µV/m), QP, 100 MHz … 2 GHz 24 dB(µV/m), QP, 156 MHz … 165 MHz
Conducted Emission of Interference – Line Connection AC Voltage	
• EN 61000-6-3 • EN 55032 Class B	Standard not applicable
• EN 61000-6-4 • EN 55011 Class A • EN 50121-3-2	Standard not applicable
Conducted Emission of Interference – Line Connection	
• Shipbuilding**) (Class B)	96 dB(µV) … 50 dB(µV), 10 kHz … 150 kHz 60 dB(µV) … 50 dB(µV), 150 kHz … 350 kHz 50 dB(µV), 0.35 MHz … 30 MHz
• Shipbuilding**) (Class A)	120 dB(µV) … 69 dB(µV), 10 kHz … 150 kHz 79 dB(µV), 150 kHz … 500 kHz 73 dB(µV), 0.5 MHz … 30 MHz

Table 26: EMC – Emission of Interference

Standard	**Test Value** *)
Conducted Emission of Interference – Line Connection DC Voltage	
• EN 61000-6-3 • EN 60255-26 • EN 55032 Class A	79 dB(µV) QP, 0.15 MHz … 0.5 MHz 66 dB(µV) AV, 0.15 MHz … 0.5 MHz 73 dB(µV) QP, 0.5 MHz … 30 MHz 60 dB(µV) AV, 0.5 MHz … 30 MHz

*) QP = Quasi Peak Detector; AV = Average Detector

**) If necessary, please find different data in the section “Approval” (regarding approval for EMC A or EMC B).

Table 27: EMC – Emission of Interference – Telecommunication Connections

Standard	**Test Value** 1)
Telecommunication Connections	
• EN 61000-6-3 • EN 55032 Class B	84 dB(µV) … 74 dB(µV) QP 74 dB(µV) … 64 dB(µV) AV, 0.15 MHz … 0.5 MHz 74 dB(µV) … 64 dB(µV) QP, 0.5 MHz … 30 MHz 74 dB(µV) … 64 dB(µV) AV, 0.5 MHz … 30 MHz
• EN 61000-6-4 • EN 55032 Class A	97 dB(µV) … 87 dB(µV) QP, 0.15 MHz … 0.5 MHz 84 dB(µV) … 74 dB(µV) AV, 0.15 MHz … 0.5 MHz 87 dB(µV) QP, 0.5 MHz … 30 MHz 74 dB(µV) AV, 0.5 MHz … 30 MHz

1) QP = Quasi Peak Detector; AV = Average Detector

*) If necessary, please find different data in the section “Approval” (regarding approval for EMC 1 or EMC 2).

Table 28: Standards and Rated Conditions for Rail Applications (EN 50155)

	Class / Standard Compliance
4.1 Rated Operating Conditions	
4.1.1 Altitude above sea level	AX (EN 50125-1)
4.1.2 Ambient operating temperature	TX
4.1.3 Shock and vibration	1A and 1B (EN 61373)
4.1.4 Relative humidity	95 % (coated PCBs)
5.1 Power Supply	
5.1.1.1 Master voltage fluctuations	
Minimum voltage	0.725 × U_n
Maximum voltage	1.3 × U_n
5.1.1.2 Power interruptions	S1
5.4 Surge, ESD, Burst Tests	EN 50121-3-2
5.5 EMC (Emission of Interference, Immunity to Interference)	EN 50121-3-2 EN 50121-4 EN 50121-5
9.11 Materials (Fire Protection)	EN 45545-2 Hazard level HL3

WAGO is a company certified in accordance with the IRIS quality standard.

5 Mounting

5.1 Installation Position

The following mounting positions are approved for the WAGO-I/O-SYSTEM 750 XTR:

- Nominal mounting position (horizontal left)
- Floor mounting position
- Vertical top mounting position
- Vertical bottom mounting position

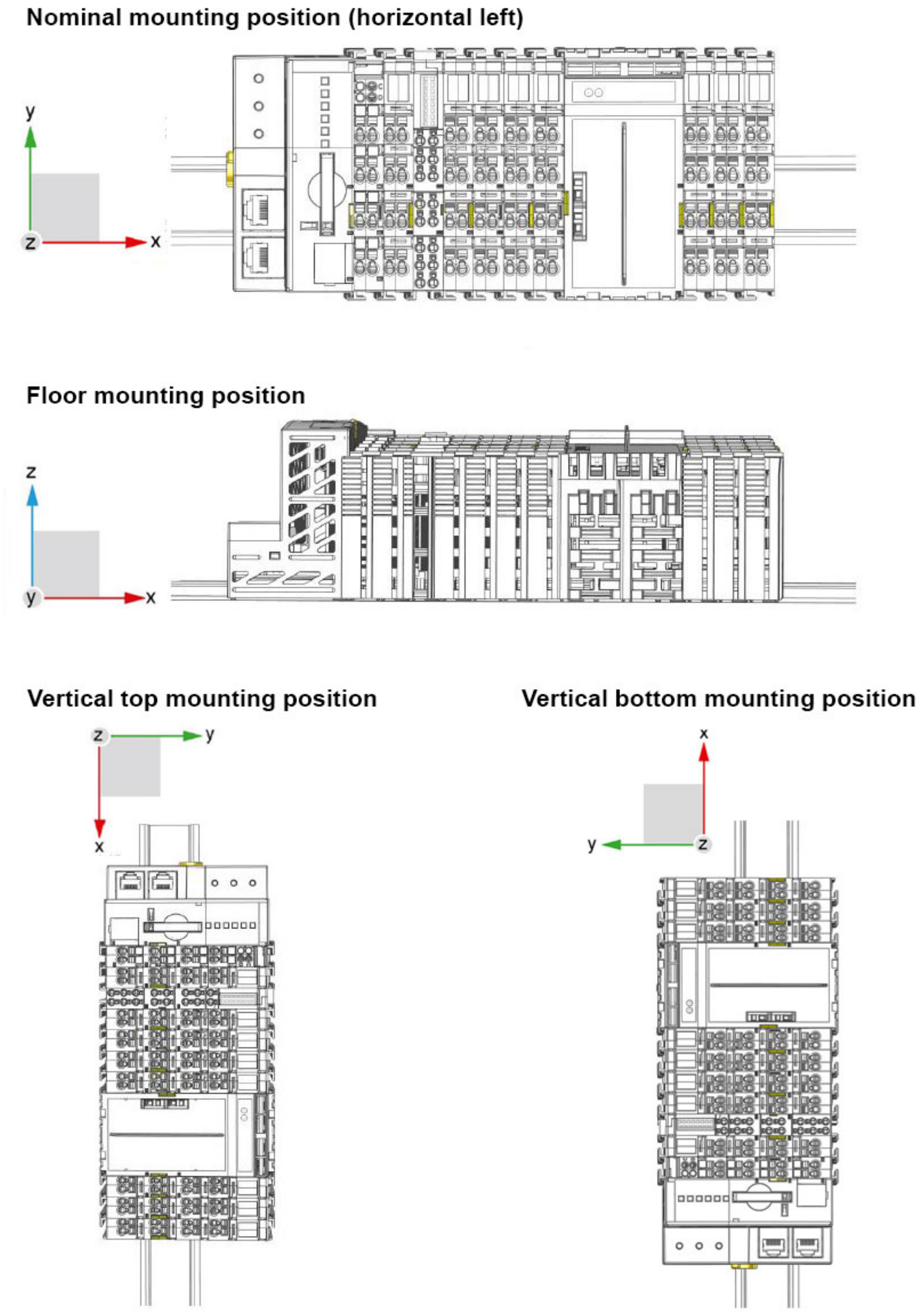


Figure 30: Mounting Positions

Note

Use an end stop in the case of vertical installation!

When mounting in the “vertical top” or “vertical bottom" mounting position, also mount an end stop below the fieldbus node to protect the fieldbus node against sliding.

WAGO item no. 249-116	End stop for DIN 35 rail, 6 mm wide
WAGO item no. 249-117	End stop for DIN 35 rail, 10 mm wide
WAGO item no. 249-197	End stop for DIN 35 rail, 14 mm wide

For vibration loads > 4g, observe the following installation instructions:

- Use pan-head screws or blind rivets at least every 60 mm (12 mm pin spacing) to secure the DIN rail.
- Make the open conductor length between strain relief and wire connection as short as possible.
- Use the reinforced end stop 249-197.

5.2 Overall Configuration

The maximum total length of a fieldbus node without fieldbus coupler/controller is 780 mm including end module. The width of the end module is 12 mm. When assembled, the I/O modules have a maximum length of 768 mm.

Examples:

- 64 I/O modules with a 12 mm width can be connected to a fieldbus coupler/controller.

- 32 I/O modules with a 24 mm width can be connected to a fieldbus coupler/controller.

Exception:

The number of connected I/O modules also depends on the type of fieldbus coupler/controller is used. For example, the maximum number of stackable I/O modules on one PROFIBUS DP/V1 fieldbus coupler/controller is 63 with no passive I/O modules and end module.

NOTICE

Observe maximum total length of a fieldbus node!
The maximum total length of a fieldbus node without fieldbus coupler/controller may not exceed 780 mm.
Also note the limitations of individual fieldbus couplers/controllers.

5.3 Mounting onto Carrier Rail

5.3.1 Carrier Rail Properties

All system components can be snapped directly onto a carrier rail in accordance with the European standard EN 60175 (DIN 35).

NOTICE

Do not use any third-party carrier rails without approval by WAGO!
WAGO Kontakttechnik GmbH & Co. KG supplies standardized carrier rails that are optimal for use with the I/O system. If other carrier rails are used, then a technical inspection and approval of the rail by WAGO Kontakttechnik GmbH & Co. KG should take place.

Carrier rails have different mechanical and electrical properties. For the optimal system setup on a carrier rail, certain guidelines must be observed:

- The material must be non-corrosive.
- Most components have a contact to the carrier rail to ground electro-magnetic disturbances. In order to avoid corrosion, this tin-plated carrier rail contact must not form a galvanic cell with the material of the carrier rail which generates a differential voltage above 0.5 V (saline solution of 0.3 % at 20°C).
- The carrier rail must optimally support the EMC measures integrated into the system and the shielding of the I/O module connections.
- A sufficiently stable carrier rail should be selected and, if necessary, several mounting points (every 20 cm) should be used in order to prevent bending and twisting (torsion).
- The geometry of the carrier rail must not be altered in order to secure the safe hold of the components. In particular, when shortening or mounting the carrier rail, it must not be crushed or bent.
- The base of the I/O components extends into the profile of the carrier rail. For carrier rails with a height of 7.5 mm, mounting points are to be riveted under the node in the carrier rail (slotted head captive screws or blind rivets).
- The metal springs on the bottom of the housing must have low-impedance contact with the DIN rail (wide contact surface is possible).

5.3.2 WAGO DIN Rails

WAGO carrier rails meet the electrical and mechanical requirements shown in the table below.

Table 29: WAGO DIN Rails

Item No.	Description
210-112	35 × 7.5; 1 mm; steel; bluish, tinned, chromed; slotted
210-113	35 × 7.5; 1 mm; steel; bluish, tinned, chromed; unslotted
210-197	35 × 15; 1.5 mm; steel; bluish, tinned, chromed; slotted
210-114	35 × 15; 1.5 mm; steel; bluish, tinned, chromed; unslotted
210-118	35 × 15; 2.3 mm; steel; bluish, tinned, chromed; unslotted
210-198	35 × 15; 2.3 mm; copper; unslotted
210-196	35 × 8.2; 1.6 mm; aluminum; unslotted

5.4 Spacing

The spacing between adjacent components, cable conduits, casing and frame sides must be maintained for the complete fieldbus node.

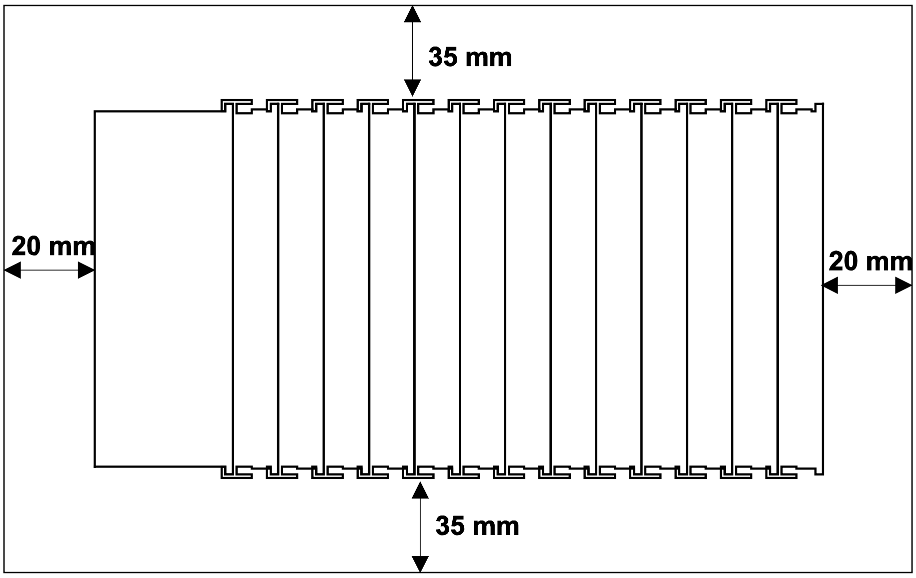


Figure 31: Spacing

The spacing creates room for heat transfer, installation or wiring. The spacing to cable conduits also prevents conducted electromagnetic interferences from influencing the operation.

5.5 Mounting Sequence

Fieldbus couplers, controllers and I/O modules of the WAGO-I/O-SYSTEM 750 are snapped directly on a carrier rail in accordance with the European standard EN 60175 (DIN 35).

The reliable positioning and connection is made using a tongue and groove system. Due to the automatic locking, the individual devices are securely seated on the rail after installation.

Starting with the fieldbus coupler or controller, the I/O modules are mounted adjacent to each other according to the project design. Errors in the design of the node in terms of the potential groups (connection via the power contacts) are recognized, as the I/O modules with power contacts (blade contacts) cannot be linked to I/O modules with fewer power contacts.

⚠ CAUTION

Risk of injury due to sharp-edged blade contacts!
The blade contacts are sharp-edged. Handle the I/O module carefully to prevent injury. Do not touch the blade contacts.

NOTICE

Insert I/O modules only from the proper direction!
All I/O modules feature grooves for power jumper contacts on the right side. For some I/O modules, the grooves are closed on the top. Therefore, I/O modules featuring a power jumper contact on the left side cannot be snapped from the top. This mechanical coding helps to avoid configuration errors, which may destroy the I/O modules. Therefore, insert I/O modules only from the right and from the top.

Note

Don't forget the bus end module!
Always plug a bus end module 750-600/040-000 onto the end of the fieldbus node! You must always use this bus end module at all fieldbus nodes with the WAGO-I/O-SYSTEM 750 XTR fieldbus couplers/controllers to guarantee proper data transfer.

Note

Increased interference!
For standard-compliant application in substation instrumentation and control, telecontrol systems, railway technology or shipbuilding certified operation, field-side power supply filter 750-624/040-001 or power supply filter 750-626/040-000 are generally to be used for XTR module groups.

Note

Mixed operation
Mixed operation (standard/XTR modules) within a node is possible when groups of modules are electrically isolated on the field side (i.e., electrically isolated power supply).

5.6 Inserting and Removing Devices

DANGER

Do not work when devices are energized!
High voltage can cause electric shock or burns.
Switch off all power to the device prior to performing any installation, repair or maintenance work.

5.6.1 Inserting the Fieldbus Coupler/Controller

1. When replacing the fieldbus coupler/controller for an already available fieldbus coupler/controller, position the new fieldbus coupler/controller so that the tongue and groove joints to the subsequent I/O module are engaged.

2. Snap the fieldbus coupler/controller onto the carrier rail.

3. Use a screwdriver blade to turn the locking disc until the nose of the locking disc engages behind the carrier rail (see the following figure). This prevents the fieldbus coupler/controller from canting on the carrier rail.

With the fieldbus coupler/controller snapped in place, the electrical connections for the data contacts and power contacts (if any) to the possible subsequent I/O module are established.

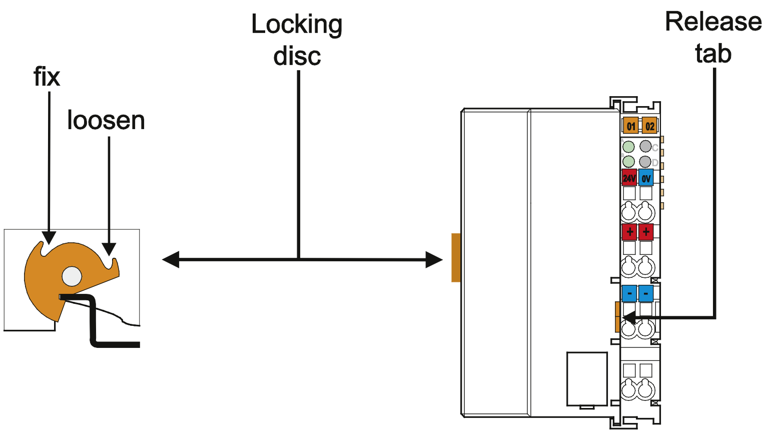


Figure 32: Release Tab of Extended ECO Fieldbus Coupler (Example)

5.6.2 Removing the Fieldbus Coupler/Controller

1. Use a screwdriver blade to turn the locking disc until the nose of the locking disc no longer engages behind the carrier rail.

2. Remove the fieldbus coupler/controller from the assembly by pulling the release tab.

Electrical connections for data or power contacts to adjacent I/O modules are disconnected when removing the fieldbus coupler/controller.

5.6.3 Inserting the I/O Module

1. Position the I/O module so that the tongue and groove joints to the fieldbus coupler/controller or to the previous or possibly subsequent I/O module are engaged.

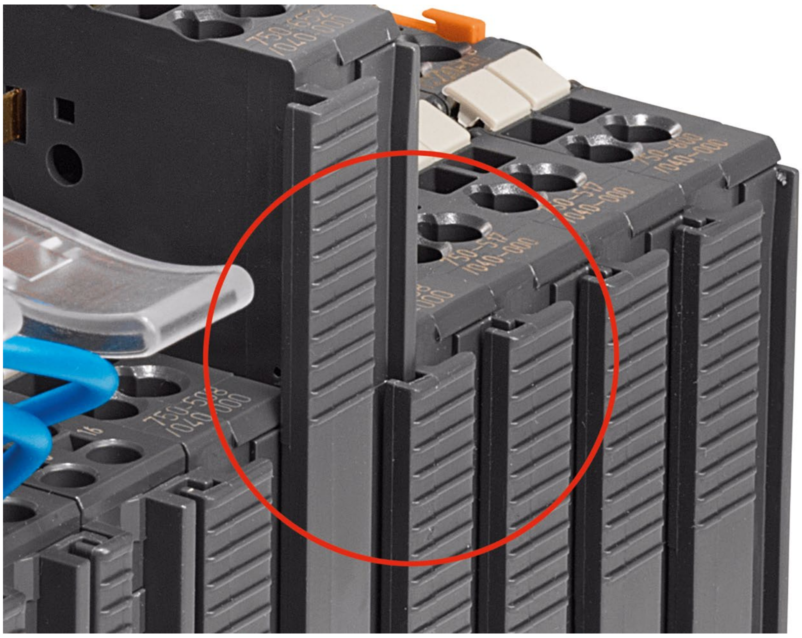


Figure 33: Insert I/O Module (Example)

2. Press the I/O module into the assembly until the I/O module snaps into the carrier rail.

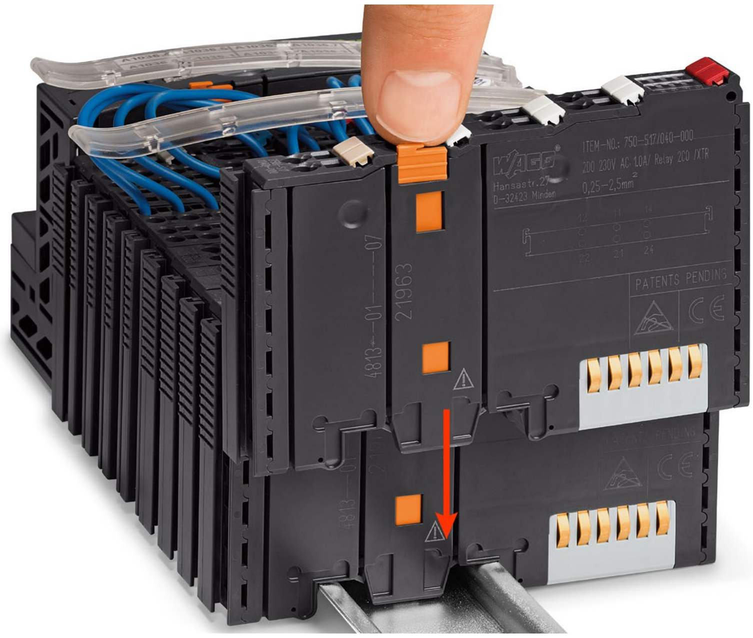


Figure 34: Snap the I/O Module into Place (Example)

With the I/O module snapped in place, the electrical connections for the data contacts and power jumper contacts (if any) to the fieldbus coupler/controller or to the previous or possibly subsequent I/O module are established.

5.6.4 Removing the I/O Module

1. Remove the I/O module from the assembly by pulling the release tab.

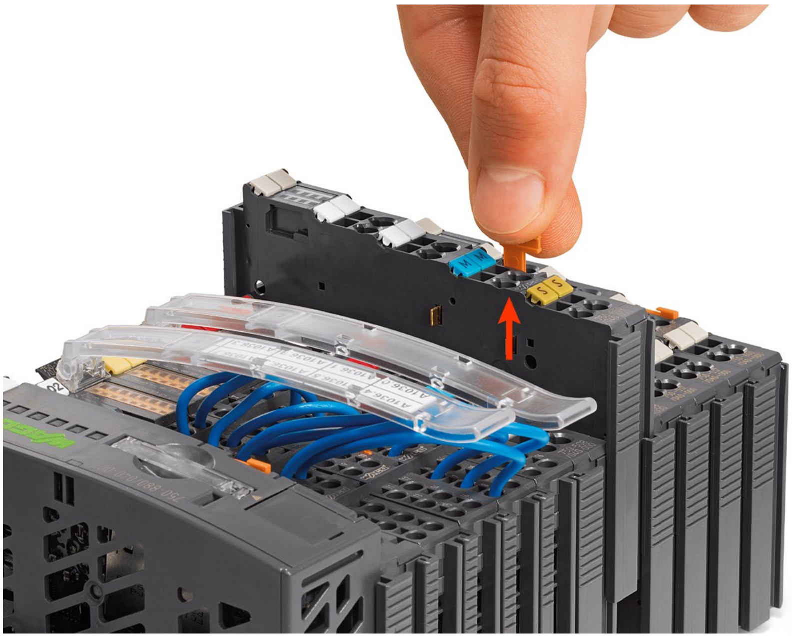


Figure 35: Removing the I/O Module (Example)

Electrical connections for data or power jumper contacts are disconnected when removing the I/O module.

6 Connect Devices

6.1 Data Contacts/Local Bus

Communication between the fieldbus coupler/controller and the I/O modules as well as the system supply of the I/O modules is carried out via the local bus. The contacting for the local bus consists of 6 data contacts, which are available as self-cleaning gold spring contacts.

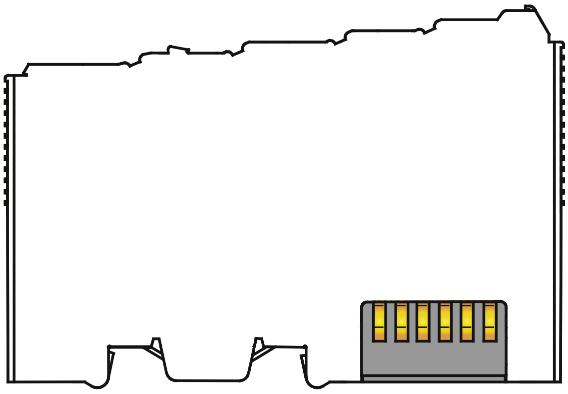


Figure 36: Data Contacts

NOTICE

Do not place the I/O modules on the gold spring contacts!
Do not place the I/O modules on the gold spring contacts in order to avoid soiling or scratching!

NOTICE

Pay attention to potential equalization from the environment!
The devices are equipped with electronic components that may be destroyed by electrostatic discharge. When handling the devices, please ensure that environmental factors (personnel, work space and packaging) are properly equalized. Do not touch any conducting parts, e.g., data contacts.

6.2 Power Contacts/Field Supply

⚠ CAUTION

Risk of injury due to sharp-edged blade contacts!
The blade contacts are sharp-edged. Handle the I/O module carefully to prevent injury. Do not touch the blade contacts.

Self-cleaning power jumper contacts used to supply the field side are located on the right side of most of the fieldbus couplers/controllers and on some of the I/O modules. These contacts come as touch-proof spring contacts. As fitting counterparts the I/O modules have male contacts on the left side.

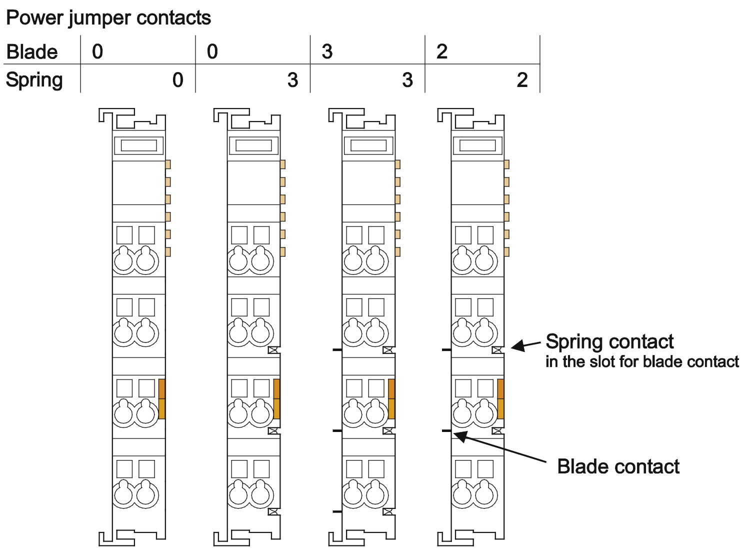


Figure 37: Example for the Arrangement of Power Contacts

6.3 Connecting a Conductor to the CAGE CLAMP®

The WAGO CAGE CLAMP® connection is appropriate for solid, stranded and finely stranded conductors.

Note

Only connect one conductor to each CAGE CLAMP®!
Only one conductor may be connected to each CAGE CLAMP®.
Do not connect more than one conductor at one single connection!

If more than one conductor must be routed to one connection, these must be connected in an up-circuit wiring assembly, for example using WAGO feed-through terminals.

1. For opening the CAGE CLAMP® insert the actuating tool into the opening above the connection.

2. Insert the conductor into the corresponding connection opening.

3. For closing the CAGE CLAMP® simply remove the tool. The conductor is now clamped firmly in place.

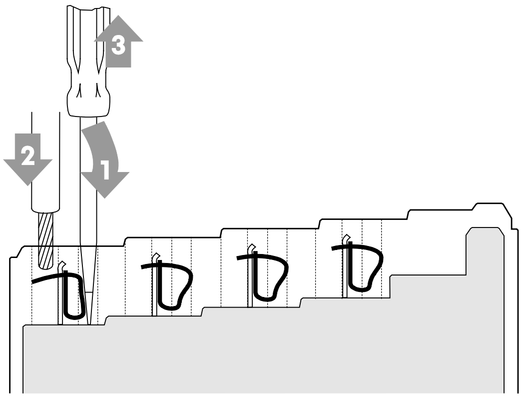


Figure 38: Connecting a Conductor to a CAGE CLAMP®

7 Function Description

7.1 Operating System

After master configuration and electrical installation of the fieldbus station, the system is operative.

The coupler begins running up after switching on the power supply or after a reset.

Upon initialization, the fieldbus coupler determines the I/O modules and configuration. The 'I/O' LED flashes red. After a trouble-free start-up, the coupler enters “Fieldbus start” mode and the 'I/O' LED lights up green.
In the event of a failure, the 'I/O' LED will blink continuously. Detailed error messages are indicated by blinking codes; an error is indicated cyclically by up to 3 blinking sequences.

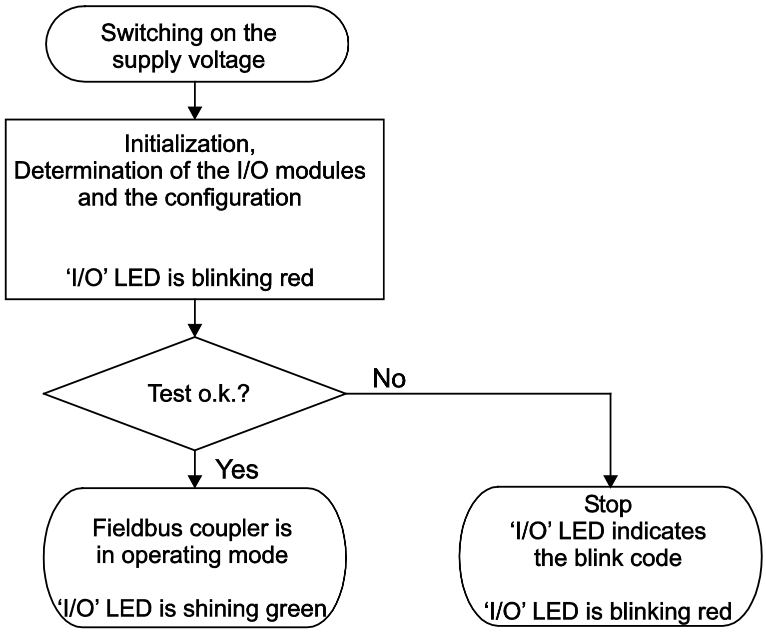


Figure 39: Operating System

Information

More information about the LED Signaling
Read the detailed description for the evaluation of the displayed LED state in the section “Diagnostics” > … > “LED Signaling”.

7.2 Process Data Architecture

7.2.1 Basic Structure

After switching on the supply voltage, the fieldbus coupler identifies all I/O modules connected with the node that send or receive data (data width/bit width > 0). In the maximum total extension the node can consist of a mixed arrangement of a maximum of 64 analog and digital I/O modules, connected on the fieldbus coupler.

The data of the digital I/O modules are bit-oriented; i.e., digital data are sent bit by bit. The data of the analog I/O modules are byte-oriented; i.e., analog data are sent byte by byte. The term "Analog I/O modules" represents the group of byte-oriented I/O modules, which send data byte by byte. This group includes, for example, counter modules and angle and distance measurement modules.

The fieldbus coupler stores the process data in the process images. The fieldbus coupler works with a process output data image (PIO) and a process input data image (PII).

The PIO is filled of the fieldbus master with the process output data. The PII is filled of the fieldbus coupler with the process input data.

Into the input and output process image the data of the I/O modules are stored in the sequence of its physical position after the fieldbus coupler in the individual process image.

First, all the byte-oriented I/O modules are stored in the process image, then the bit-oriented I/O modules. The bits of the digital I/O modules are grouped into bytes. If the amount of digital I/O information exceeds 8 bits, the fieldbus coupler automatically starts a new byte.

NOTICE

Avoid equipment damages due to addressing errors!
To avoid equipment damages within the field range, you must consider that, depending on the specific position of an I/O module in the fieldbus node, the process data of all previous byte or bit-oriented modules must be taken into account to determine its location in the process data map.

Note

Consider the Process Data size for each module!
Observe the number of input and output bits or bytes for the individual I/O modules.

For some I/O modules and their different versions, the structure of the process data depends on the fieldbus.

Information

Additional information about the fieldbus specific process image
For the fieldbus-specific process image of any WAGO-I/O-Module, please refer to the section “Structure of the Process Data”.

7.2.2 Process Data EtherNet/IP

For some I/O modules (and their variations), the structure of the process data depends on the fieldbus.

For the fieldbus controller with MODBUS and EtherNet/IP, the process image is built up word-by-word (with word alignment). The internal mapping method for data greater than one byte conforms to Intel formats.

7.3 Data Exchange

With the fieldbus coupler, data is exchanged either via the MODBUS/TCP protocol or via EtherNet/IP.

MODBUS/TCP works according to the master/slave principle. The master controller can be a PC or a PLC.

The fieldbus couplers of the WAGO-I/O-SYSTEM 750 are slave devices.

The master requests communication. This request can be directed to certain nodes by addressing. The nodes receive the request and, depending on the request type, send a reply to the master.

A defined number of simultaneous connections (socket connections) with other network devices can be established to a fieldbus coupler:

- 3 connections for HTTP (to read HTML pages from the coupler)
- 15 connections via MODBUS/TCP (to read or write input and output data of the coupler)
- 128 connections for EtherNet/IP
- 10 connections for FTP
- 2 connections for SNMP

The maximum number of simultaneous connections can not be exceeded. Existing connections must first be terminated before new ones can be set up. The FC ETHERNET G3 XTR is essentially equipped with two interfaces for data exchange:

- the interface to the fieldbus (Master)
- the interface to the I/O modules.

Data exchange takes place between the fieldbus master and the I/O modules.

If MODBUS is used as the fieldbus, the MODBUS master accesses the date using the MODBUS functions implemented in the fieldbus coupler; EtherNet/IP, in contrast, uses an object model for data access.

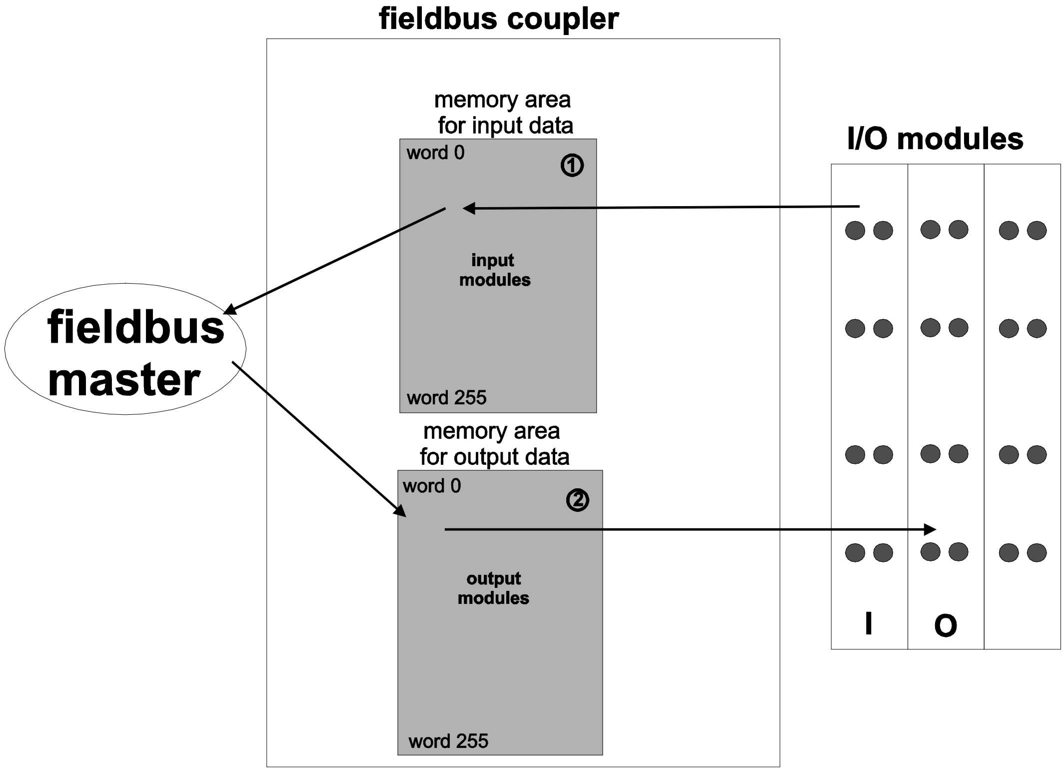


Figure 40: Memory Areas and Data Exchange

The fieldbus coupler process image contains the physical data for the bus modules.
These have a value of 0 ... 255 and word 512 ... 1275.

1 The input module data can be read by the CPU and by the fieldbus side.

2 Likewise, data can be written to the output modules from the CPU and the fieldbus side.

In addition, all output data is mirrored in the FC ETHERNET G3 XTR to a memory area with the address offset 0x0200 and 0x1000. This allows output values to be read back in by adding 0x0200 or 0x1000 to the MODBUS address.

7.3.1 Addressing

Module inputs and outputs in a fieldbus coupler are addressed internally as soon as they are started. The order in which the connected modules are addressed depends on the type of module that is connected (input module, output module).
The process image is formed from these addresses.
The physical arrangement of the I/O modules in the fieldbus node is arbitrary.

7.3.1.1 Addressing of I/O Modules

Addressing first references complex modules (modules that occupy several bytes) in accordance with their physical order downstream of the fieldbus coupler/controller; i.e., they occupy addresses starting from word 0.

Following these is the data for the remaining modules, compiled in bytes (modules that occupy less than one byte). In this process, byte by byte is filled with this data in the physical order. As soon a complete byte is occupied by the bit oriented modules, the process begins automatically with the next byte.

Note

Hardware changes can result in changes of the process image!
I f the hardware configuration is changed and/or expanded; this may result in a new process image structure. In this case, the process data addresses also change. If adding modules, the process data of all previous modules has to be taken into account.

Note

Observe process data quantity!
For the number of input and output bits or bytes of the individual IO modules please refer to the corresponding description of the IO modules.

Table 30: Data Width for I/O Modules

Data width > 1 byte (channel)	Data width = 1 bit (channel)
Analog input modules	Digital input modules
Analog output modules	Digital output modules
Input modules for thermocouples	Digital output modules with diagnostics (2 bits/channel)
Input modules for resistor sensors	Supply modules with fuse carrier/diagnostics
Pulse width output modules	Solid-state load relays
Interface modules	Relay output modules
Up/down counters	
I/O modules for angle and distance measurement	

7.3.2 Data Exchange between MODBUS/TCP Master and I/O Modules

Data exchange between the MODBUS/TCP Master and the I/O modules is conducted using the MODBUS functions implemented in the controller by means of bit-by-bit or word-by-word reading and writing routines.

There are 4 different types of process data in the controller:

- Input words
- Output words
- Input bits
- Output bits

Access by word to the digital I/O modules is carried out in accordance with the following table:

Table 31: Allocation of Digital Inputs and Outputs to Process Data Words in Accordance with the Intel Format

Digital inputs/ outputs	16.	15.	14.	13.	12.	11.	10.	9.	8.	7.	6.	5.	4.	3.	2.	1.
Process data word	Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte	High byte D1								Low byte D0							

Output can be read back in by adding an offset of 200_{hex} (0x0200) to the MODBUS address.

Note

Data > 256 words can be read back by using the cumulative offset!
All output data greater than 256 words and, therefore located in the memory range 0x6000 to 0x62FC, can be read back by adding an offset of 1000_{hex} (0x1000) to the MODBUS address.

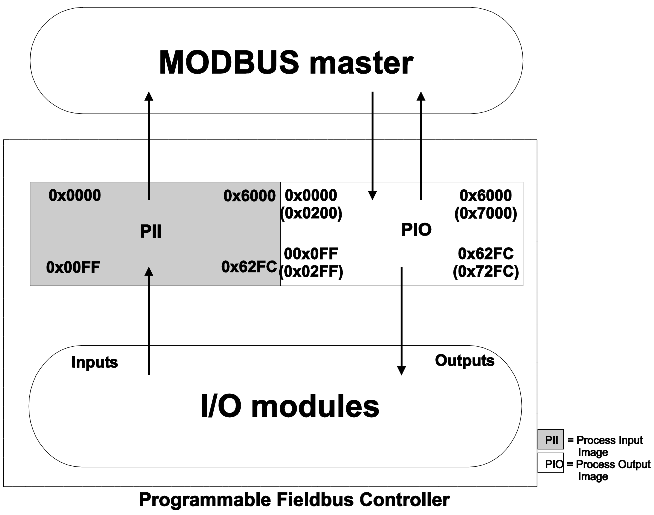


Figure 41: Data Exchange Between MODBUS Master and I/O Modules

Register functions start at address 0x1000. These functions can be addressed in a similar manner with the MODBUS function codes that are implemented (read/write).
The specific register address is then specified instead of the address for a module channel.

Information

Additional Information
A detailed description of the MODBUS addressing may be found in Chapter "MODBUS Register Mapping".

7.3.3 Data Exchange between EtherNet/IP Master and I/O Modules

The data exchange between EtherNet/IP master and the I/O modules is objectoriented. Each node on the network is depicted as a collection of objects.

The “assembly” object specifies the structure of the objects for the data transmission. With the assembly object, data (e.g. I/O data) can be combined into blocks (mapped) and sent via a single message connection. Thanks to this mapping, less access to the network is necessary.

There is a distinction between input and output assemblies.

An input assembly reads in data from the application via the network or produces data on the network.

An output assembly writes data to the application or consumes data from the network.

The fieldbus coupler / controller provides a fixed number of assembly instances (static assembly).

After switching on the supply voltage, the I/O data from the input and output process image are assigned to the respective assembly instances. The assignment takes place in blocks of digital and analog input and output data.

Usually the data exchange takes place using I/O connections. When the connection is established, the assembly instances (and thus the I/O data) to be transferred in the connection are selected. Subsequently, the associated I/O data can be read and/or written by the master.

Information

Additional Information:
The assembly instances for the static assembly are described in the section “EtherNet/IP”.

8 Commissioning

This section shows a step-by-step procedure for starting up exemplarily a WAGO fieldbus node.

Note

Good example!
This description is just an example and only serves to describe the procedure for a local start-up of a single fieldbus node with a non-networked computer under Windows.

Two work steps are required for start-up. The description of these work steps can be found in the corresponding following sections.

- **Connecting PC and fieldbus node**
- **Assigning the IP address to the fieldbus node**

Note

The IP address must occur in the network only once!
For error-free network communication, note that the assigned IP address must occur only once in the network!
In the event of an error, the error message “IP address configuration error” (error code 6 – error argument 7) is indicated by 'I/O' LED at the next power-on.

There are various ways to assign the IP address.
The various options are described in the following sections individually.

Following the commissioning descriptions after which the fieldbus node is ready for communication, the following topics are described:

- **Preparing the Flash File System**
- **Synchronizing the real-time clock**
- **Restoring factory settings**

8.1 Connecting Client PC and Fieldbus Nodes

1. Mount the fieldbus node on the TS 35 carrier rail.
   Follow the mounting instructions found in the “Mounting” section.

2. Connect the 24 V power supply to the supply terminals.

3. Connect the PC's ETHERNET interface to the fieldbus coupler's ETHERNET interface (RJ-45).

4. Turn the operating voltage on.

The fieldbus coupler is initialized. The coupler determines the I/O module configuration and creates a process image.
During start-up, the I/O LED (red) flashes.
If the I/O LED lights up green after a brief period, the fieldbus coupler is operational.

If an error has occurred during startup, a fault code is flashed by the I/O LED.
If the I/O LED flashes 6 times (indicating error code 6) and then 4 times (indicating error argument 4), an IP address has not been assigned yet.

8.2 Assigning the IP Address to the Fieldbus Node

- Use **address selection switch** (DIP switch) to assign IP address (manually).

- **Automatic assignment of addresses via DHCP**
  (IP address via the fieldbus)
- **Assigning IP Address via** “**WAGO Ethernet Settings”**
  (static IP address via the serial communication port or the ETHERNET interface)
- **Assigning IP Address via BootP**
  (IP address via the fieldbus)

8.2.1 Assigning IP Address via Address Selection Switch

Use the address selection switch to set the host ID, i.e., the last byte of the IP address, which is entered in the Web-Based Management System on WBM page “**TCP/IP**”, entry “**DIP switch IP-Address**”**,** with values between 1 and 254 binary coded.

Example:

DIP switch IP address:	192.168.1
Set DIP switch value:	**50** (binary coded: 00110010)
Resulting IP address saved in the fieldbus coupler:	192.168.1.**50**

Note

Host ID 1 - 254 via address selection switch freely adjustable!
Use the address selection switch to set the last byte of the IP address to a value between 1 and 254. The DIP switch is then enabled and the IP address is composed of the DIP switch base address stored in the fieldbus coupler and the host ID set on the DIP switch.
The IP address make via the Web-based Management System or “WAGO Ethernet Settings” is disabled.

Note

Address selection switch values 0 and 255 are predefined, address selection switch disabled!
If you use the address selection switch to set the value 0 or 255, the address selection switch is disabled and the setting configured in the fieldbus coupler is used.
With the value 0, the settings of the Web based Management System or “WAGO Ethernet Settings” apply.
If you set the value 255, the configuration via DHCP is activated.

The base address used consists of the first three bytes of the IP address. This always depends on the DIP switch IP address currently saved in the fieldbus coupler.
If there is still no static IP address in the fieldbus coupler, the default value **192.168.1** defined by the firmware as the base address is used when setting the DIP switch to 1 - 254.
The address selection switch setting then overwrites the value of the host ID.

Information

More information about changing the static base address
You can also change the base address currently saved in the fieldbus coupler as required.
Proceed as described in the section “Assigning IP Address via Web-Based Management System”.

1. To configure the IP address via the address selection switch by setting the host ID (last position of the IP address) to a value that does not equal 0/255, first convert the host ID to the binary representation.
   For example, host ID “50” results in a binary code of “00110010”.

2. Set the bits in sequence using the 8 address switches. Start with address switch 1 to set bit 0 (LSB) and end with address switch 8 for bit 7 (MSB).

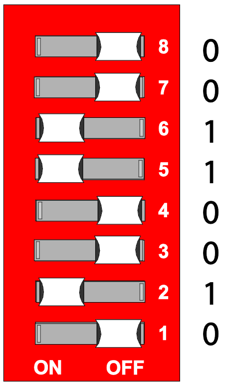


Figure 42: Address Selection Switch, for Example the Value Setting “50” ($2^1 + 2^4 + 2^5$)

3. Restart the fieldbus node after adjusting the address selection switch to apply the configuration changes.

8.2.2 Assigning IP Address via DHCP

If you want to use DHCP to assign the IP address, it happens automatically via a DHCP server on the network.

Note

Total network failure when there are two DHCP servers in the network!
To prevent network failure, never connect a PC, on which a DHCP server is installed, to a global network. In larger networks, there is usually a DHCP server already that can cause collisions and subsequent network failure.

Note

There must be a DHCP server in the network for further configuration!
Install a DHCP server on your client PC in the local network if not already available. You can download a DHCP server free of charge on the Internet.

Note

Assign the DHCP server a fixed IP address and note common subnet!
Note that the DHCP server must have a fixed IP address and that the fieldbus node and DHCP server must be in the same subnet.

Note

Via DHCP assigned IP addresses are only temporarily valid!
Note that an IP address assigned via DHCP is limited in time. If the DHCP server is not available at the end of its useful life, the fieldbus node sets the IP address free and then the fieldbus node is no longer accessible!

The following step is included:

- Enable DHCP
- Assigning the IP address permanently by option “use IP from EEPROM“

8.2.2.1 Enable DHCP

Note

Set the address selection switch to 255 for assigning the IP address via DHCP!
Set the address selection switch to 255 to disable the DIP switch and to enable DHCP.
Restart the fieldbus node after adjusting the address selection switch to apply the configuration changes.

Alternatively, DHCP will be enabled via the WBM or via “WAGO Ethernet Settings“.

Note

DHCP must be enabled on the Web pages or in “WAGO Ethernet Settings”!
Note if an access to the internal Web pages of WBM is already possible via an IP address, you enable DHCP on the "Port" HTML page of the WBM, so is assigned via DHCP a new IP address. DHCP is not enabled by default when delivered.
In other case you can also enable DHCP via “WAGO Ethernet Settings” in the **Network** tab.

An IP address is automatically assigned after restarting the fieldbus node.

Information

More information about reading the IP address
You can use “WAGO Ethernet Settings”, button **[Identify]**, via Service Interface to read the IP addresses currently assigned.

8.2.2.2 Assigning the IP address permanently by option “use IP from EEPROM“

Note

IP stored in EEPROM must be used to assign the address permanently!
To apply the new IP address permanently in the fieldbus coupler, the option ”use IP from EEPROM“ must be selected. Thus, the IP address is automatically entered as static address and used in the EEPROM.

You can enable the option in the Web-based Management System.

1. Open the **Web browser** on your client (such as the Microsoft Internet Explorer) to have the HTML pages displayed.

2. Enter the **IP address** for your fieldbus node in the address line of the browser and press **[Return]**.

3. If a dialog window then appears with a password prompt, as Administrator, enter the user name: "**admin**" and the password "**wago**".

   This is provided for secure access and entails three different user groups: admin, user and guest.

   A start page is then displayed in the browser window with information about your fieldbus controller (start page can be changed on HTML page “Security”).
   You can navigate to the respective configuration pages using the hyperlinks in the left navigation bar.

4. In the left navigation bar click on **Port** to open the HTML page for selecting a protocol.

You are shown a list of all the protocols supported by the coupler.

5. Select the option “use IP from EEPROM“.
   At the same time disables the use of DHCP server.

6. Confirm your changes with button **[SUBMIT]**.

7. Then restart in order for the settings to take effect.

8. For a restart, click in the left navigation bar on the link **[Security]** to open the HTML page on which you can set passwords and trigger a software reset.

9. Click on the button **[Software Reset]** at the bottom of the page**.**

   Then the coupler/controller starts with the configurations, which were previously loaded into the EEPROM and the connection to the browser is interrupted.

10. Now you must use the changed IP address, if you want to access again on this device via browser.

8.2.3 Assigning IP Address via “WAGO Ethernet Settings”

Note

Note Software Compatibility!
Refer to the version of the software specified in "Software Compatibility" in the Technical Data.

This program is used to configure an IP address, to reset the fieldbus coupler/controller parameters to the factory settings and to restore the Flash File System in which the WBM pages of the fieldbus coupler/controller are stored. "WAGO Ethernet Settings" can be used via the serial service interface or via the ETHERNET interface.

For initial commissioning, however, the way via the serial service interface is described here, because for access via the ETHERNET interface the currently assigned IP address must already be known.

WAGO communication cables or WAGO radio-link adapters can be used for data communication via the serial service interface.

NOTICE

Do not connect Communication Cable when energized!
To prevent damage to the service interface, do not connect or disconnect 750-920 respectively 750-923 Communication Cable when energized! The fieldbus coupler/controller must be de-energized!

Note

Set the address selection switch to 0 for an IP assignment via software!
Set the address selection switch to “0” to disable the DIP switch.
Restart the fieldbus node after adjusting the address selection switch to apply the configuration changes.

1. Using a WAGO Communication cable 750-920 respectively 750-923, connect your PC with the service interface of the head station of the fieldbus node.

2. Start “**WAGO Ethernet Settings”** program.

3. Click on **[Read]** to read in and identify the connected fieldbus node.

4. Select the **Network** tab.
5. To assign a permanent address, select the option "Static configuration" in the field **Source** (DHCP is the default).

6. Enter the required **IP Address** and, if applicable, the address of the subnet mask and gateway.

7. Click on the **[Write]** button to apply the settings in the fieldbus node.

8. You can now close "WAGO Ethernet Settings" or make other changes in the Web-based Management System as required. To open the Web-based Management System click on the button **[Start WBM]** on the right side.

8.2.4 Assigning the IP Address via BootP

A BootP server can be used to assign a fixed IP address.

Assigning the IP address using a BootP server depends on the respective BootP program. Handling is described in the respective manual for the program or in the respective integrated help texts.

Note

Set the address selection switch to 0 for active software configuration!
Set the address selection switch to 0 to disable the DIP switch.
If an access to the internal Web pages of WBM is already possible via an IP address, then the software configuration via the WBM can be done.
In the default status, configuration via DHCP is activated.
If not yet been assigned IP address, you can otherwise use “WAGO Ethernet Settings” or enable BootP in the **Network** tab of “WAGO Ethernet Settings”.
Restart the fieldbus node after adjusting the address selection switch to apply the configuration changes.

Note

IP address assignment is not possible via the router!
The IP address is assigned via patch cable, switches or hubs. Addresses cannot be assigned via routers.

Note

BootP must be enabled on the Web pages!
Note that BootP must be enabled on the internal Web pages of the WBM, HTML page “Port configuration”.
BootP is enabled by default when delivered.

Information

Additional Information
Assigning IP addresses using a BootP server can be carried out in any Windows and Linux operating system. Any BootP server may be used.

The following steps are included:

- Note MAC ID
- Note IP address
- Assigning the IP address and enable BootP
- Assigning the IP address permanently by option “use IP from EEPROM”

8.2.4.1 Note MAC ID

1. Write down the coupler’s MAC address (see label or peel-off strip).
   If the fieldbus is already installed, turn off the operating voltage of the fieldbus coupler, then take the fieldbus coupler out of the assembly of your fieldbus node and note the MAC ID of your fieldbus coupler.
   The MAC ID is applied to the back of the fieldbus coupler or on the self-adhesive peel-off strip on the side of the fieldbus coupler.

   MAC ID of the fieldbus coupler: 0 0 : 3 0 : D E : _ _ : _ _ : _ _

2. Plug the fieldbus coupler into the assembly of the fieldbus node.

3. Use the fieldbus cable to connect the fieldbus connection of your mechanically and electrically assembled fieldbus node to an open interface on your PC.
   The PC must be equipped with a network card for this connection. The transfer rate then depends on the network card of your PC.

4. Start the PC that assumes the function of the master and BootP server.

5. Switch on the power at the fieldbus coupler (DC 24 V power supply unit).

The fieldbus coupler is initialized. The coupler determines the I/O module configuration and creates a process image.
During start-up, the I/O LED (red) flashes.
If the I/O LED lights up green after a brief period, the fieldbus coupler is operational.

If an error occurs during start-up indicated by the I/O LED flashing red, evaluate the error code and argument and resolve the error.

Information

More information about LED signaling
The exact description for evaluating the LED signal displayed is available in the section “Diagnostics” > … > “LED Signaling”.

Error code 6, followed by error argument 4, is indicated by the I/O LED after coupler start-up with 6 red error code flashes, followed by four red flashes of the error argument. This indicates that an IP address has not yet been assigned.

8.2.4.2 Determining IP addresses

1. If the PC is already integrated into an IP network, you can determine the PC's IP address by clicking on **Control Panel** from the **Start Menu / Settings**.

2. Double-click on the **Network** icon.
The network dialog window appears.

For Windows 2000/XP:

- Select **Network and Dial-Up Connections**
- In the dialog window that then appears, right click on **LAN Connection** and open the **Properties** link.
- Mark the entry **Internet Protocol (TCP/IP)**

For Windows 7:

- Choose **Network and Sharing Center** by using Control Panel.
- In the dialog window that then appears, right click on **LAN Connection** and open the **Properties** link.
- Mark the entry **Internet Protocol V4**

For Windows 8 and higher:

- Choose **Network and Internet** >> **Network and Sharing Center** by using Control Panel.
- In the dialog window that then appears, click on "Connections:" **LAN Connection** and open the **Properties** link.
- Confirm the security prompt with **[Yes]**.
- Mark in the Properties window / register Network the entry **Internet Protocol V4**.

Note

Reinstall TCP/IP components if required!
If the "Internet Protocol Version 4 (TCP/IPv4)" entry is missing, install the corresponding TCP/IP components and reboot your computer.
You will need the installation CD for Windows 2000, XP or 7.

3. Then click on the **Properties...** button

4. The IP address, subnet mask and, where required, the PC's gateway address appear in the Properties window. Note these values:

PC IP address: ___ . ___ . ___ . ___
Subnet mask: ___ . ___ . ___ . ___
Gateway: ___ . ___ . ___ . ___

5. Now select the desired IP address for your fieldbus node.

Note

Assign the PC a fixed IP address and note common subnet!
Note that the PC, on which the BootP server is listed, must have a fixed IP address and that the fieldbus node and PC must be in the same subnet.

6. Note the IP address you have selected:

   Fieldbus node IP address: ___ . ___ . ___ . ___

1. Based on the handling, which depends on the BootP program set, assign the required IP address for your fieldbus node.

2. Enable the query/response mechanism of the BootP protocol based on the handling, which depends on the BootP program set or e. g. in “WAGO Ethernet Settings“ (**Network** tab, **Source** “BootP”).

3. To apply the new IP address, use e.g. a hardware reset to restart your fieldbus node by interrupt the voltage supply for approx. 2 seconds.

4. Restart the fieldbus node.

   The fieldbus node then starts with the new IP address assigned via BootP.

5. In order to use the IP address permanently, select in the WBM on "TCP/IP" WBM page the option "IP configuration source: static" (see chapter "Apply IP address permanently (option "static ")").

8.2.4.3 Assigning the IP address permanently by option “use IP from EEPROM“

When the BootP protocol is enabled the coupler expects the BootP server to be permanently available. If there is no BootP server available after a Power On reset, the network will remain inactive.

Note

IP stored in EEPROM must be used to assign the address permanently!
To apply the new IP address permanently in the fieldbus coupler, the option “use IP from EEPROM” must be selected.
Thus, the IP address is automatically entered as static address and used in the EEPROM.

You can enable the option in the Web-based Management System.

1. Open the **Web browser** on your client (such as the Microsoft Internet Explorer) to have the HTML pages displayed.

2. Enter the **IP address** for your fieldbus node in the address line of the browser and press **[Return]**.

3. If a dialog window then appears with a password prompt, as Administrator, enter the user name: "**admin**" and the password "**wago**".

   This is provided for secure access and entails three different user groups: admin, user and guest.

   A start page is then displayed in the browser window with information about your fieldbus coupler (start page can be changed on HTML page “Security”).
   You can navigate to other information using the hyperlinks in the left navigation bar.

4. In the left navigation bar click on **Port** to open the HTML page for selecting a protocol.

You are shown a list of all the protocols supported by the coupler.

5. Select the “use IP from EEPROM“ option.
   At the same time disables the request of BootP server.

6. Confirm your changes with button **[SUBMIT]**.

7. Then restart in order for the settings to take effect.

8. For a restart, click in the left navigation bar on the link **[Security]** to open the HTML page on which you can set passwords and trigger a software reset.

9. Click on the button **[Software Reset]** at the bottom of the page**.**

   Then the coupler/controller starts with the configurations, which were previously loaded into the EEPROM and the connection to the browser is interrupted.

10. Now you must use the changed IP address, if you want to access again on this device via browser.

8.2.4.4 Reasons for Failed IP Address Assignment

- The PC on whom the BootP server is running is not located in the network as the fieldbus coupler/controller; i.e., the IP addresses do not match.

  Example:

Sub net mask:	255.255.255.0 (default value for a fieldbus coupler/controller n)
PC‘s IP:	192.168.**2**.100
fieldbus coupler/controller‘s IP:	192.168.**1**.200

  Due to the sub net mask, the first 3 digits of the IP addresses must match.

- PC and/or head station is/are not linked to the ETHERNET

8.3 Testing the Function of the Fieldbus Node

1. To ensure that the IP address is correct and to test communication with the fieldbus node, first turn off the operating voltage of the fieldbus node.

2. Create a non-serial connection between your PC and the fieldbus node.

The head station is initialized. The head station determines the I/O module configuration of the fieldbus node and creates a process image.
During start-up, the I/O LED (red) flashes.
If the I/O LED lights up green after a brief period, the fieldbus node is operational.

If an error occurs during start-up indicated by the I/O LED flashing red, evaluate the error code and argument and resolve the error.

Information

More information about LED signaling
The exact description for evaluating the LED signal displayed is available in the section “Diagnostics” > … > “LED Signaling”.

8.4 Preparing the Flash File System

The flash file system must be prepared in order to use the Web interface of the fieldbus coupler to make all configurations.

The flash file system is already prepared when delivered.
However, if the flash file system has not been initialized on your fieldbus coupler or it has been destroyed due to an error, you first must initialize it manually to access it.

NOTICE

Do not connect Communication Cable when energized!
To prevent damage to the service interface, do not connect or disconnect 750-920 respectively 750-923 Communication Cable when energized! The fieldbus coupler/controller must be de-energized!

Note

Resetting erases data!
Note that resetting erases all data and configurations.
Only use this function when the flash file system has not been initialized yet or has been destroyed due to an error.

1. Switch off the supply voltage of the fieldbus coupler.
2. Connect the communication cable 750-920 or 750-923 respectively the *Bluetooth*® Adapter 750-921 to the service interface of the fieldbus coupler and to your computer.
3. Switch on the supply voltage of the fieldbus coupler.

The fieldbus coupler is initialized. The coupler determines the I/O module configuration and creates a process image.
During start-up, the I/O LED (red) flashes.
If the I/O LED lights up green after a brief period, the fieldbus coupler is operational.

If an error occurs during start-up indicated by the I/O LED flashing red, evaluate the error code and argument and resolve the error.

Information

More information about LED signaling
The exact description for evaluating the LED signal displayed is available in the section “Diagnostics” > … > “LED Signaling”.

4. Start the “**WAGO Ethernet Settings**” program.

5. In the top menu bar, select **[Reset File System]** to format the file system and to extract the WBM pages of the flash file system.

Formatting and extracting is complete when the status window displays "Resetting the file system successfully".

Note

Restart the Fieldbus node after resetting file system!
Make a restart of the fieldbus node, so that the WBM pages can be displayed after resetting file system.

8.5 Setting Date and Time

The fieldbus coupler's system time enables a date and time indication for files in the flash file system.

Note

System time will be reset when the controller is de-energized!
The fieldbus coupler 750-352/040-000 does not have a real-time clock. For this reason, the current system time will be reset when the controller is de-energized! After switching on the operating voltage, the system time starts at 01/01/2000 00:00:00 a.m.

At start-up, synchronize the system time with the computer's current time.

There are two options to synchronize the system time:

- Synchronize the system time using "**WAGO Ethernet Settings**"
- Synchronize the system time using the **Web Based Management System**

Synchronize the system time using "WAGO Ethernet Settings"

Note

Do not set time during a WAGO I/O-*CHECK* communication!
Note that setting the clock during a WAGO I/O-*CHECK* communication may cause communication errors. Therefore set the time only if WAGO I/O-*CHECK* is not yet started.

1. Switch off the supply voltage of the fieldbus controller.
2. Connect the communication cable 750-920 or 750-923 respectively the *Bluetooth*® Adapter 750-921 to the service interface of the fieldbus controller and to your computer.
3. Switch on the supply voltage of the fieldbus controller.

The fieldbus coupler is initialized. The coupler determines the I/O module configuration and creates a process image.
During start-up, the I/O LED (red) flashes.
If the I/O LED lights up green after a brief period, the fieldbus coupler is operational.

If an error occurs during start-up indicated by the I/O LED flashing red, evaluate the error code and argument and resolve the error.

Information

More information about LED signaling
The exact description for evaluating the LED signal displayed is available in the section “Diagnostics” > … > “LED Signaling”.

4. Start the “**WAGO Ethernet Settings”** program.

5. Select the **Date and Time** tab.

6. Click on the **[Apply]** button.

Synchronize the system time using the Web-based Management-System

1. Launch a Web browser (e.g., MS Internet Explorer or Mozilla) and enter in the address bar the IP address you have assigned to your fieldbus node.

2. Click **[Enter]** to confirm.
   The WBM start page is displayed.

3. Select “Clock” in the left navigation bar.

4. Enter your user name and password in the displayed query dialog box (default: user = "admin", password = "wago" or: user = "user", password = "user"). The WBM page "Clock" is displayed.

5. Set the current time and date values, as well as the time zone deviation in the input fields, and select the desired option for the display and Daylight Saving Time (DST).

6. Click on **[SUBMIT]** to apply the changes in your fieldbus node.

7. Restart the fieldbus node to apply the settings of the Web interface.

8.6 Restoring Factory Settings

To restore the factory settings, proceed as follows:

1. Switch off the supply voltage of the fieldbus coupler.

2. Connect the communication cable 750-920 or 750-923 respectively the *Bluetooth*® Adapter 750-921 to the service interface of the fieldbus coupler and to your computer.

3. Switch on the supply voltage of the fieldbus coupler.

4 Start the **WAGO-ETHERNET-Settings** program.

5. In the top menu bar, select **[Factory Settings]** and click **[Yes]** to confirm.

A restart of the fieldbus node is implemented automatically. The start takes place with the default settings.

9 Configuring via the Web-Based Management System (WBM)

An integrated Web server can be used for configuration and administration of the device. The HTML pages together, they are referred to as the Web-based Management System (WBM).

The presentation of these web pages takes place after a user registration for access via a web browser (eg Microsoft Internet Explorer, Mozilla Firefox, etc). For login, 3 different password-protected user authorization groups are provided as standard:

Table 32: WBM User Groups

User Group	Default Password	Access Rights
admin	wago	Read/write access to all WBM pages as well as passwords modification and CODESYS application download, if this is enabled for CODESYS (WBM page "Security"> "PLC Security "> " CODESYS port authentication")
user	user	Read/write access to all WBM pages, but no write authorization on WBM-page "Security"
guest	guest	Read only

When closing the web browser, the user is automatically logged out and the WBM session is closed.

The WBM pages saved internally provide current information about the configuration and status of the device. In addition, it is possible to change the configuration of the device here.
Also HTML pages created by yourself can be save via the implemented file system.

Note

Always restart after making changes to the configuration!
The system must always be restarted for the changed configuration settings to take effect.

1. To open the WBM, launch a Web browser.

2. Enter the IP address of the fieldbus coupler/controller in the address bar.

3. Click **[Enter]** to confirm.
   The start page of WBM loads.

4. Select the link to the desired WBM page in the left navigation bar.
   A login dialog appears.

5. Enter your user name and password in the query dialog (default: user = “admin”, password = “wago” or user = “user”, password = “user”).
   The corresponding WBM page is loaded.

6. Make the desired settings.

7. Press **[SUBMIT]** to confirm your changes or press **[UNDO]** to discard the changes.

8. Restart the system to apply the settings (WBM page “Security”, button **[SOFTWARE RESET]**).

You can access the following described WBM pages via the links given in the navigation bar:

- Information
- Ethernet
- TCP/IP
- Port
- SNMP
- SNMP V3
- Watchdog
- Security
- Modbus
- EtherNet/IP
- Features
- I/O config
- Disk Info

9.1 Information

The WBM page “Information” contains an overview of all important information about your fieldbus coupler/controller.

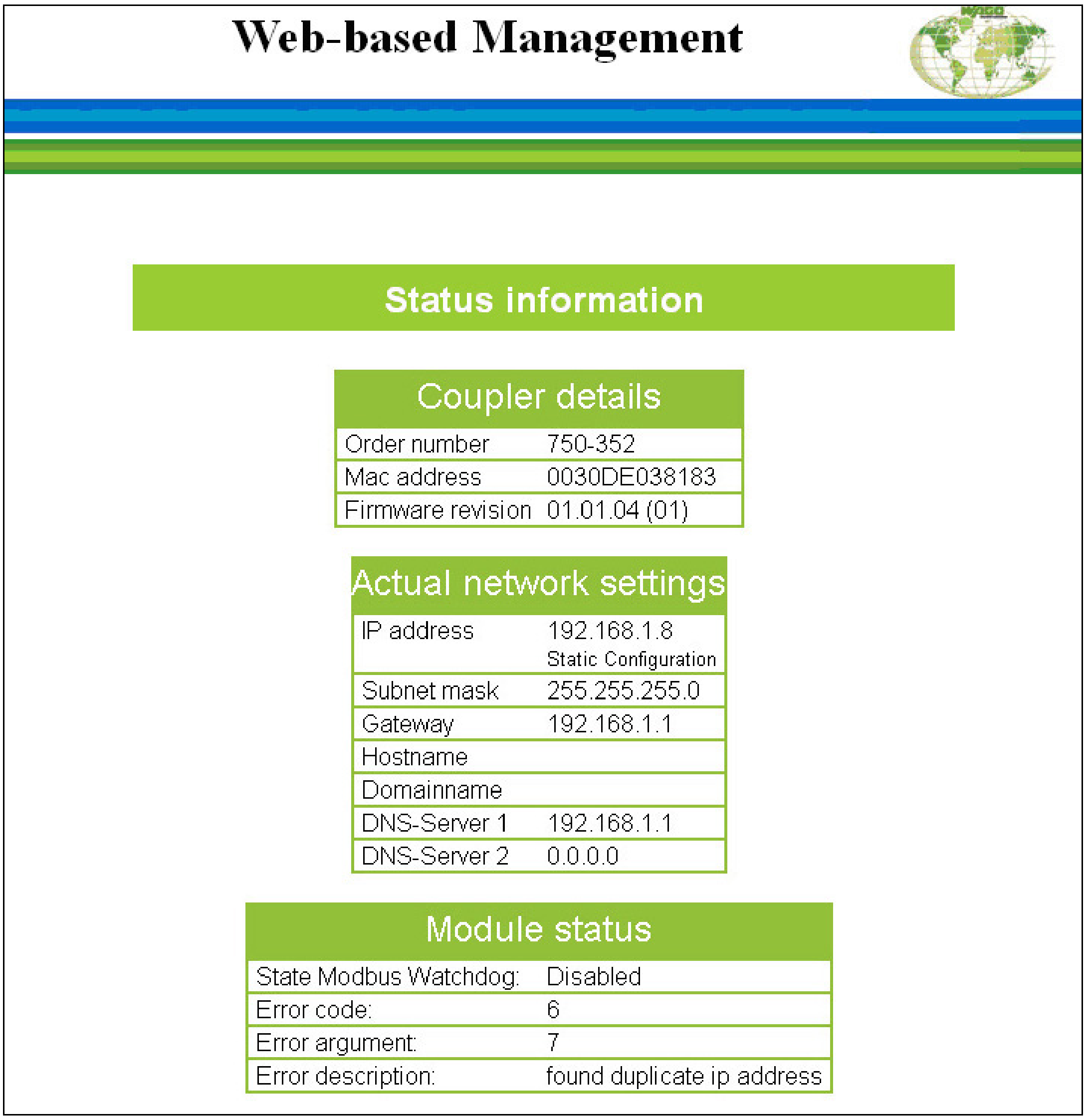


Figure 43: WBM page “Information” (example)

Table 33: WBM Page “Information”

Coupler details			
Entry	**Default**	**Value (example)**	**Description**
Order number	750-352/040-000	750-352/040-000	Order number
Mac address	0030DEXXXXXX	0030DE000006	Hardware MAC address
Firmware revision	kk.ff.bb (rr)	01.01.09 (00)	Firmware revision number (kk = compatibility, ff = functionality, bb = bugfix, rr = revision)
Actual network settings			
Entry	**Default**	**Value (example)**	**Description**
IP address	0.0.0.0	192.168.1.80	IP address, Type of IP address assignment
Subnet mask	255.255.255.0	255.255.255.240	Subnet mask
Gateway	0.0.0.0	192.168.1.251	Gateway
Host name	___	___	Host name (not assigned here)
Domain name	___	___	Domain name (not assigned here)
DNS server 1	0.0.0.0	0.0.0.0	Address of first DNS server
DNS server 2	0.0.0.0	0.0.0.0	Address of second DNS server
Module status			
Entry	**Default**	**Value (example)**	**Description**
State Modbus Watchdog	Disabled	Disabled	Status of Modbus Watchdog
Error code	0	10	Error code
Error argument	0	5	Error argument
Error description	Coupler running, OK	KBUS diag error (Error code 4 / Error argument 2)	Error description

9.2 Ethernet

Use the “Ethernet” WBM page to set the data transfer rate and bandwidth limit for each of the two switch ports for data transfer via Ethernet.

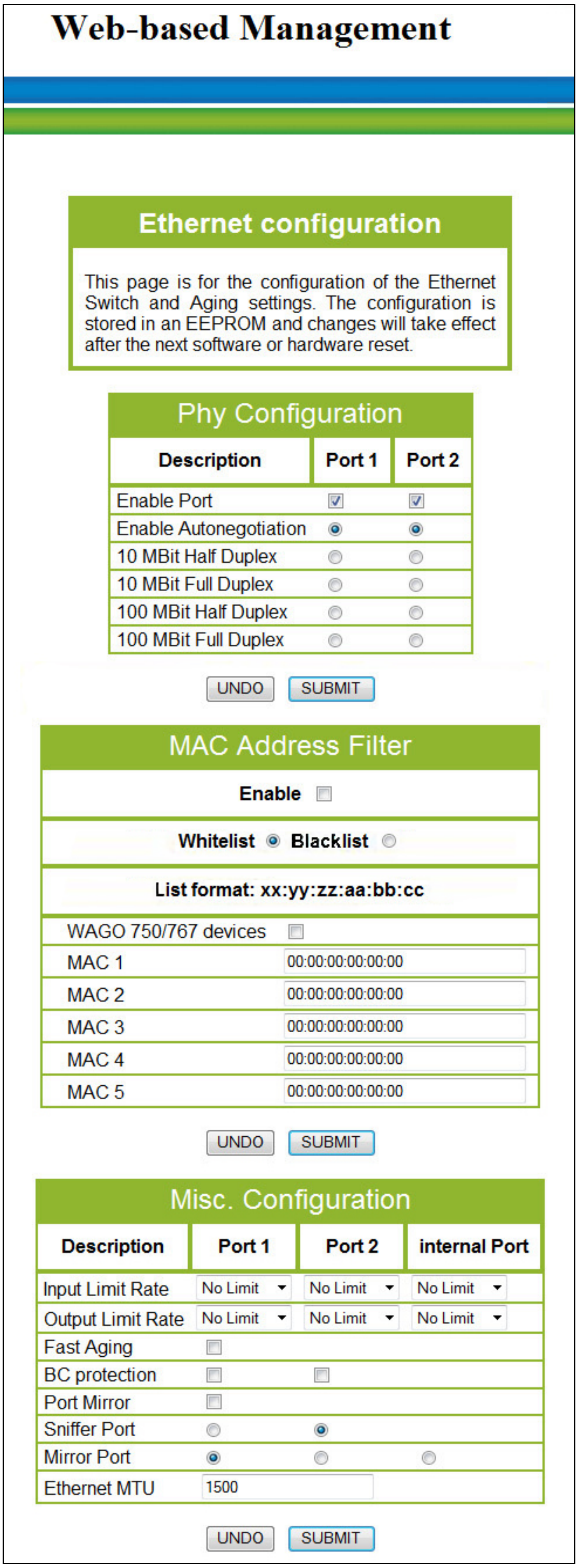


Figure 44: WBM page “Ethernet”

Table 34: WBM Page “Ethernet”

Phy Configuration			
Entry	**Default**	**Description**	
Enable Port	☑	☑	Enable Port 1/Port 2
		☐	Disable Port 1/Port 2
Enable autonegotiation	⊙	⊙	Enable Autonegotiation Automatically set the best possible transmission speed with “Enable Autonegotiation”.
		○	Enable Autonegotiation
10 MBit Half Duplex 10 MBit Full Duplex 100 MBit Half Duplex 100 MBit Full Duplex	○ ○ ○ ○	Select half or full duplex for the ETHERNET to configure a fixed transmission speed 10 or 100 MBit	
MAC Address Filter			
Entry	**Default value**	**Description**	
Enable	☐	☑	Activate MAC address filter.
		☐	Deactivate MAC address filter.
Whitelist	⊙	⊙	Only the following registered MAC addresses have network access to the fieldbus coupler, others are blocked.
		○	All MAC addresses have network access to the fieldbus coupler, regardless of the list entries.
Blacklist	○	⊙	Only the following registered MAC addresses are blocked for the network access to the fieldbus coupler, others have free access.
		○	All MAC addresses have network access to the fieldbus coupler, regardless of the list entries.
MAC 1	00:00:00:00: 00:00	Filter for the first MAC address (hexadecimal).	
MAC 2	00:00:00:00: 00:00	Filter for the second MAC address (hexadecimal).	
MAC 3	00:00:00:00: 00:00	Filter for the third MAC address (hexadecimal).	
MAC 4	00:00:00:00: 00:00	Filter for the fourth MAC address (hexadecimal).	
MAC 5	00:00:00:00: 00:00	Filter for the fifth MAC address (hexadecimal).	
Misc. Configuration			
Entry	**Port** **1 | 2 | int.**	**Description**	
Input Limit Rate	No Limit ▾	The Input Limit Rate limits network traffic when receiving. The rate is indicated in megabits or kilobits per second. If the limit is exceeded, packets are lost.	
Output Limit Rate	No Limit ▾	The Output Limit Rate limits network traffic when sending. The rate is indicated in megabits or kilobits per second. If the limit is exceeded, packets are lost.	
Fast Aging	☐	☑	Enable “Fast Aging” "Fast Aging" ensures that the cache for the MAC addresses is cleared faster in the switch. This may be required if a redundancy system (e.g., using a Jet-Ring network or comparable technology) needs to be set up.
		☐	Disable “Fast Aging”. The time to discard the cache entries is five minutes.

BC protection	☐	☐		☑ Broadcast Protection limits the number of broadcast telegrams per unit of time. If protection is on, the broadcast packets are limited at 100 Mbit to 8 packets per 10 ms and at 10 Mbit to 8 packets per 100 ms. If the limit is exceeded, packets are lost. ☐ Broadcast Protection disabled.
Port Mirror	☐			☑ Enable port mirroring Port Mirroring is used for network diagnostics. Packets are mirrored from one port (mirror port) to another (sniffer port). ☐ Disable port mirroring
Sniffer Port	○	⊙		Select the sniffer port the mirror port should be mirrored to.
Mirror Port	⊙	○	○	Select the mirror port which should be mirrored to the sniffer port.
Ethernet MTU	1500			Maximum packet size of a protocol, which can be transferred without fragmentation ("Maximum Transmission Unit" - MTU)

Note

Set the MTU value for fragmentation only!
Only set the value for MTU, i.e., the maximum packet size between client and server, if you are using a tunnel protocol (e.g., 1452 for VPN) for ETHERNET communication and the packets must be fragmented.
Setting the value is independent of the transmission mode selected.

Note

Configure ETHERNET transmission mode correctly!
A fault configuration of the ETHERNET transmission mode may result in a lost connection, poor network performance or faulty performance of the fieldbus coupler/controller.

Note

All ETHERNET ports cannot be disabled!
Both ETHERNET ports can be switched off. If both ports are disabled and you press **[SUBMIT]**, the selection is not applied and the previous values are restored.

9.3 TCP/IP

You can configure network addressing and network identification on the “TCP/IP” WBM page.

Note

Set the DIP switch to “0” and enable “use IP from EEPROM”!
Before you change parameters on this page, set the DIP switch to zero and on the “Port” WBM page, set the “use IP from EEPROM” option!
If these conditions are not met, the DIP switch settings are applied instead.

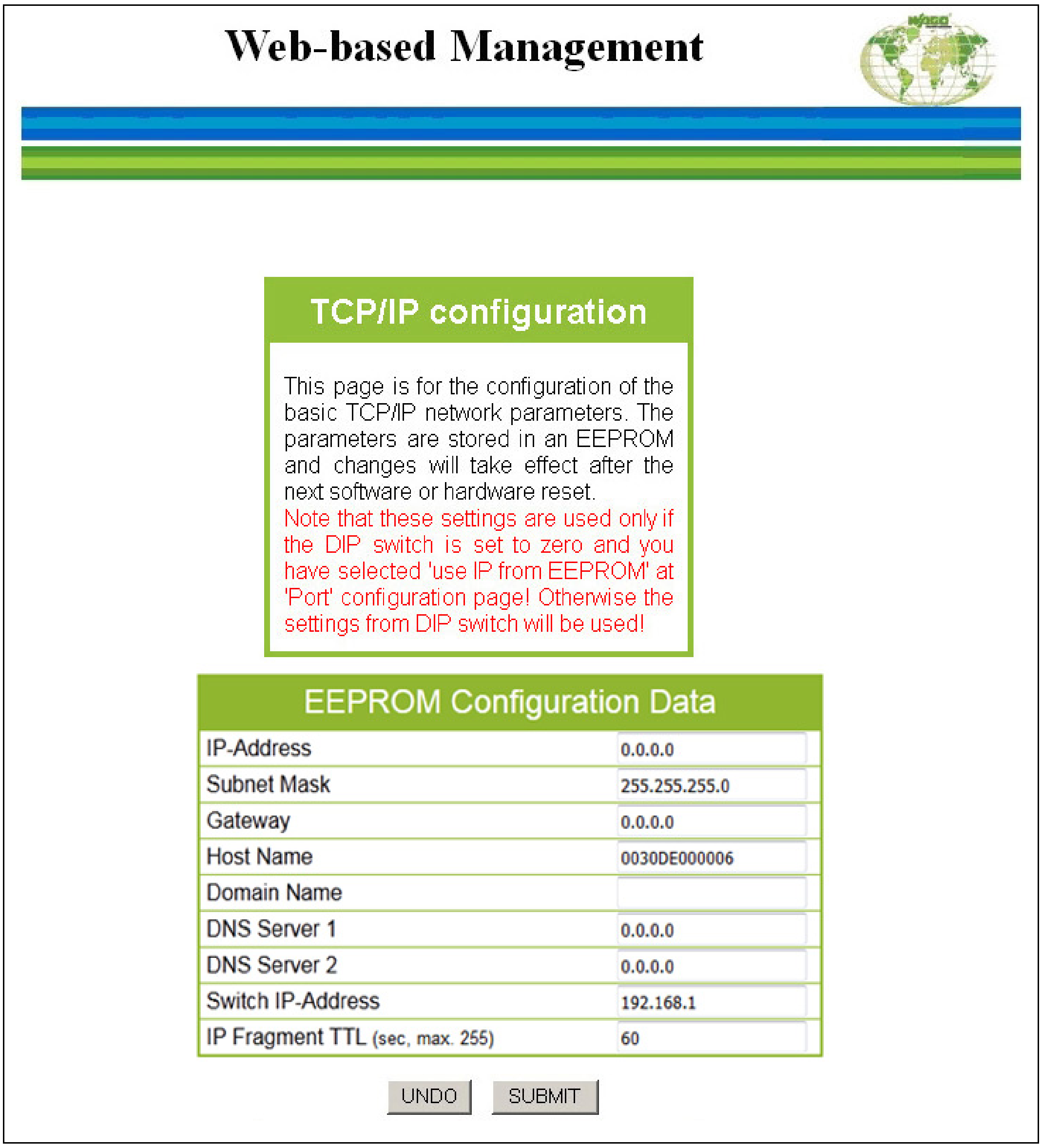


Figure 45: WBM page “TCP/IP”

Table 35: WBM Page “TCP/IP”

EEPROM Configuration Data			
Entry	**Default**	**Value (example)**	**Description**
IP address	0.0.0.0	192.168.1.200	Enter IP address
Subnet mask	255.255.255.0	255.255.255.0	Enter subnet mask
Gateway	0.0.0.0	0.0.0.0	Enter gateway
Host name	0030DEXXXXXX	0030DE026005	Enter host name
Domain name			Enter domain name
DNS Server1	0.0.0.0	0.0.0.0	Enter IP address of the first DNS server
DNS Server2	0.0.0.0	0.0.0.0	Enter optional IP address of the second DNS server
Switch IP-Address	192.168.1	192.168.5	Network address for the configuration of the IP address with DIP switch
IP Fragment TTL (sec. max. 255)	60	60	Life of a packet (Time to Live)

9.4 Port

Use the “Port” WBM page to enable or disable services available via the IP protocol.

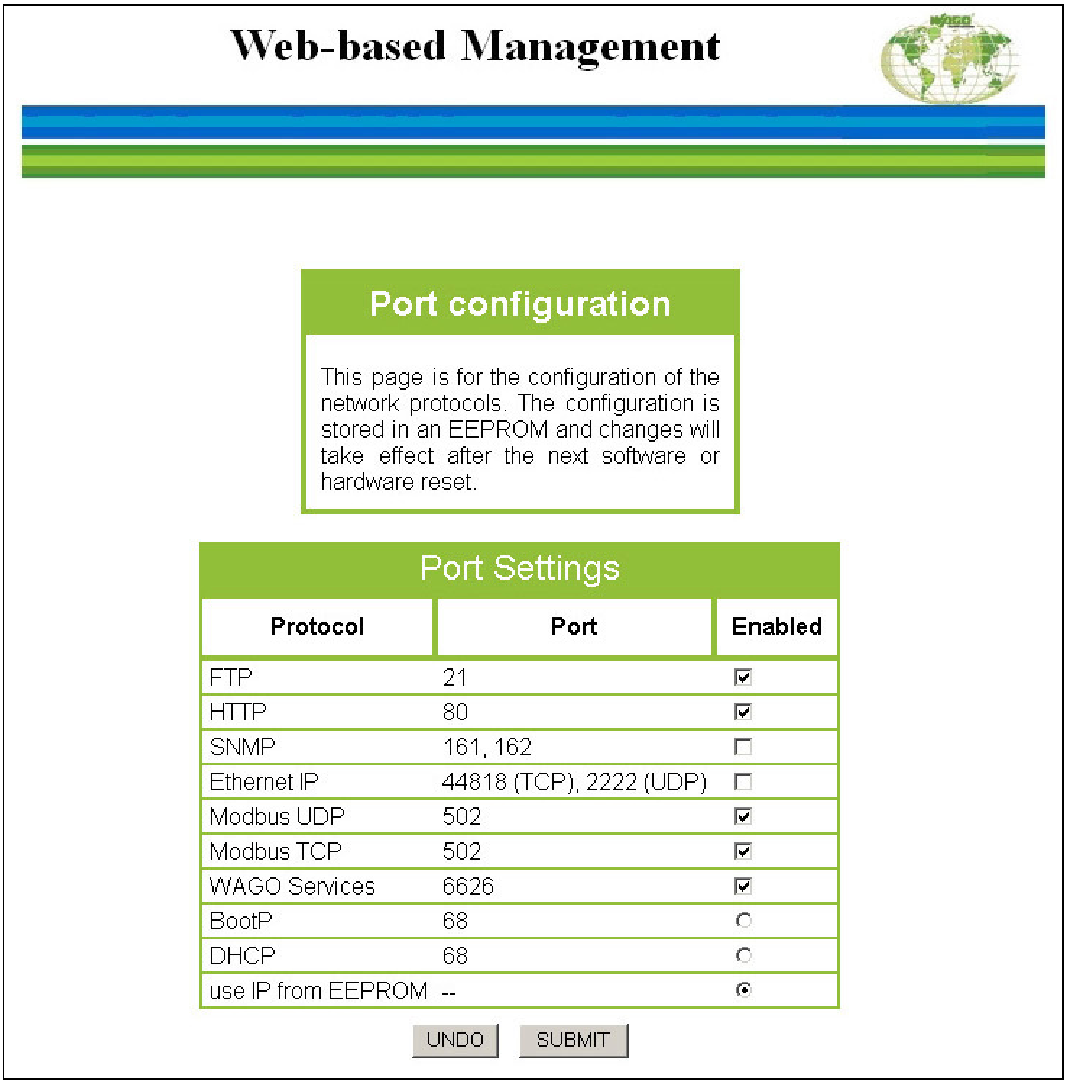


Figure 46: WBM page “Port”

Table 36: WBM page "Port"

Port Settings			
Entry	**Entry**	**Entry**	
FTP (Port 21)	Enabled ☑	☑	activating "File Transfer Protocol"
		☐	deactivating "File Transfer Protocol"
HTTP (Port 80)	Enabled ☑	☑	activating "Hypertext Transfer Protocol"
		☐	deactivating "Hypertext Transfer Protocol"
SNMP (Port 161, 162)	Enabled ☑	☑	activating "Simple Network Management Protocol"
		☐	deactivating "Simple Network Management Protocol"
Ethernet IP (TCP-Port 44818, UDP-Port 2222)	Enabled ☐ *)	☑	activating EtherNet/IP protocol
		☐	deactivating EtherNet/IP protocol
Modbus UDP (Port 502)	Enabled ☑ *)	☑	activating MODBUS/UDP protocol
		☐	deactivating MODBUS/UDP protocol
Modbus TCP (Port 502)	Enabled ☑ *)	☑	activating MODBUS/TCP protocol
		☐	deactivating MODBUS/TCP protocol
WAGO Services (Port 6626)	Enabled ☑	☑	activating WAGO services
		☐	de activating WAGO services
BootP (Port 68)	Enabled ◉	◉	activating "Bootstrap Protocol"
		○	deactivating "Bootstrap Protocol"
DHCP (Port 68)	Enabled ○	◉	activating "Dynamic Host Configuration Protocol"
		○	deactivating "Dynamic Host Configuration Protocol"
use IP from EEPROM	Enabled ○	◉	activating use of IP address from EEPROM
		○	deactivating use of IP address from EEPROM

*) Only either EtherNet/IP or Modbus UDP/TCP should be enabled so that fieldbus process data exchange is possible.
However, if both protocols are to be enanbled, the assignment must be made via the file: /etc/io-config.xml.

Note

Alternative IP address assignment!
You can only select the DHCP, BootP and "use IP from EEPROM" settings as an alternative!

9.5 SNMP

On the WBM page “SNMP”, you can perform the settings for the Simple Network Management Protocol.

SNMP is a standard for device management within a TCP/IP network. The Simple Network Management Protocol (SNMP) is responsible for transporting the control data that allows the exchange of management information, the status and statistic data between individual network components and a management system.

The fieldbus coupler supports SNMP in versions 1, 2c and 3.

The SNMP of the ETHERNET TCP/IP coupler includes the general MIB according to RFC1213 (MIB II).

SNMP is processed via port 161. The port number for SNMP traps (agent messages) is 162.

Note

Enable port 161 and 162 to use SNMP!
Enable ports 161 and 162 in the WBM in menu “port”, so that the fieldbus coupler can be reached via SNMP. The port numbers cannot be modified.

Note

Modify parameter via WBM or SNMP objects!
However, parameters that can be set on the WBM pages can also be changed directly by the appropriate SNMP objects.

Information

Additional Information:
Additional information for SNMP, the Management Information Base (MIB) and traps (event messages via SNMP) may be obtained from section “Fieldbus Communication” > … > “SNMP (Simple Network Management Protocol).”

Note that the settings for SNMPV1/V2c and SNMPV3 are separate from each other: The different SNMP versions can be activated or used in parallel or individually on a fieldbus coupler.

9.5.1 SNMP V1/V2c

The SNMP version 1/2c represents a community message exchange. The community name of the network community must thereby be specified.

Table 37: WBM Page “SNMP”

SNMP Configuration		
Entry	**Value (Default)**	**Description**
Name of device	**750-352/040-000**	Device name (sysName)
Description	**FC ETHERNET G3 XTR 750-352/040-000**	Device description (sysDescription)
Physical location	LOCAL	Location of device (sysLocation)
Contact	support@wago.com	E-mail contact address (sysContact)
SNMP v1/v2 Manager Configuration		
Entry	**Value (Default)**	**Description**
Protocol Enable	SNMP V1/V2c ☑	☑ Activating SNMP Version 1/2c ☐ Deactivating SNMP-Version 1/2c
Local Community Name	public	Used community name
SNMP v1/v2 Trap Receiver Configuration		
Entry	**Value (Default)**	**Description**
Trap Receiver 1	0.0.0.0	IP address of **1.** used SNMP manager
Community Name 1	public	**1.** Community name of the network community used
Trap Version	V1 ◉ V2 ○	V1 ◉ V2 ○ Activating Traps Version 1 V1 ○ V2 ◉ Activating Traps Version 2
Trap Receiver 2	0.0.0.0	IP address of **2.** used SNMP manager
Community Name 2	public	**2.** Community name of the network community used
Trap Version	V1 ◉ V2 ○	V1 ◉ V2 ○ Activating Traps Version 1 V1 ○ V2 ◉ Activating Traps Version 2

9.5.2 SNMP V3

In SNMP version 3, exchanging messages is user-related. Each device, that knows the passwords set via WBM, may read or write values from the fieldbus coupler.

In SNMP v3, user data from SNMP messages can also be transmitted in encoded form. This is why SNMP v3 is often used in safety-related networks.

Via this WBM page "SNMP V3" two independent SNMPV3 users can be defined and activated (User 1 and User 2).

Table 38: WBM Page “SNMP V3”

SNMP v3 (user based)			
Entry	**Value (Example)**	**Description**	
1. User / 2. User	activate ☑	☑ Activating user 1 or 2	
		☐ Deactivating user 1 or 2	
Authentification Type	None ○ MD5 ◉ SHA1 ○	None ◉ MD5 ○ SHA1 ○	No encryption of the authentication
		None ○ MD5 ◉ SHA1 ○	Encryption of the authentication with MD5
		None ○ MD5 ○ SHA1 ◉	Encryption of the authentication with SHA1
Security Authentification Name	Security Name	Enter the name, if the “authentification type” MD5 or SHA1 has been selected	
Authentification Key	Authentification Key	Enter the password with at least 8 characters, if “authentification type” MD5 or SHA1 has been selected	
Privacy Enable	DES ☑	☑ Activate the DES encryption of the data	
		☐ Deactivate the DES encryption of the data	
Privacy Key	Privacy Key	Enter the password of at least 8 characters in the encryption with DES	
Notification/ Trap enable	V3 ☑	☑ Activate the notification traps of the SNMP version 3	
		☐ Deactivate the notification traps of the SNMP version 3	
Notification Receiver IP	192.168.1.10	IP address of the notification manager	

Two independent SNMPv3 users can be defined and activated via the html page (user 1 and user 2).

9.6 Watchdog

Click the link "Watchdog" to go to a WBM page where you can specify the settings for the connection and MODBUS watchdog.

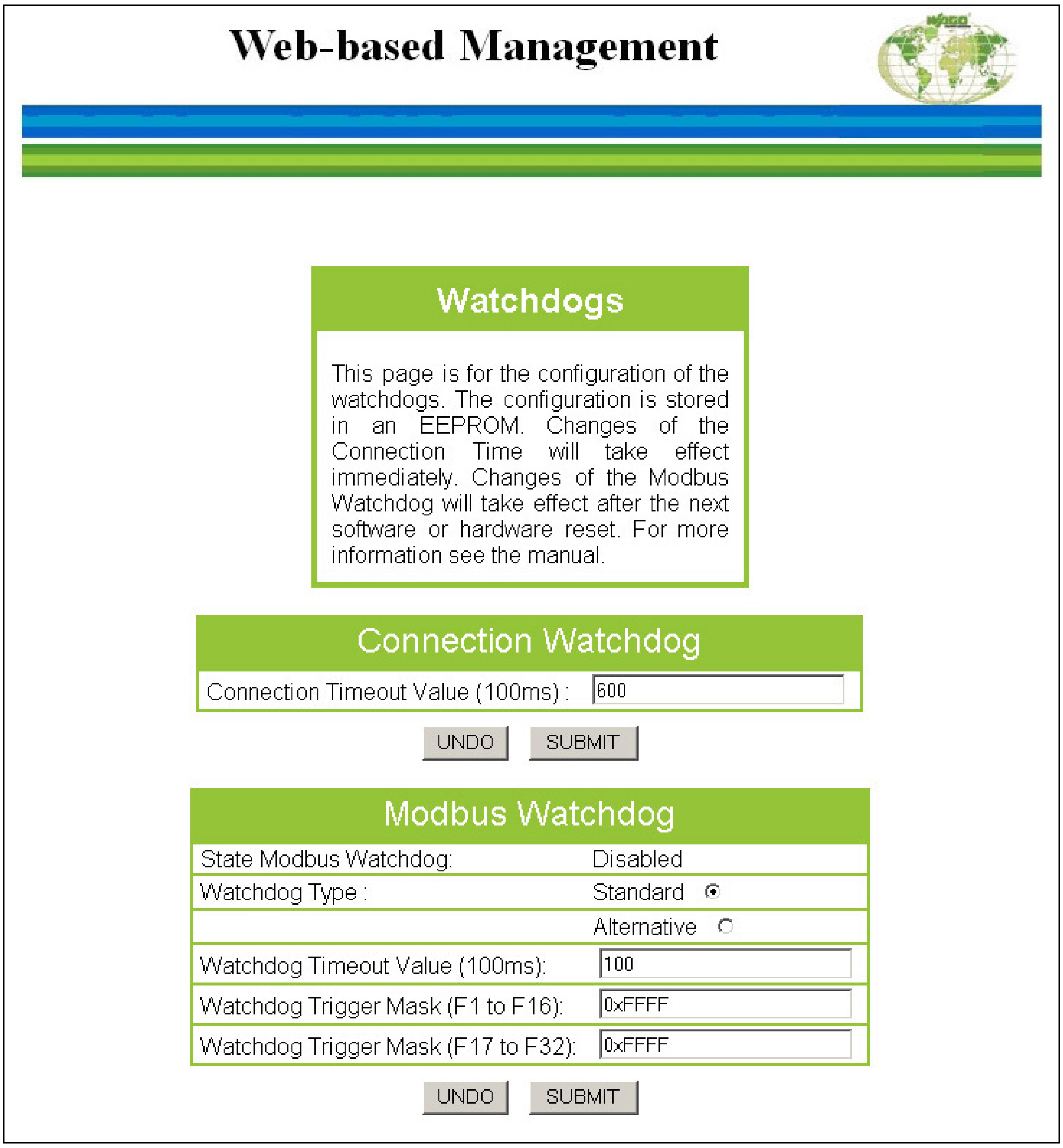


Figure 47: WBM Page “Watchdog”

Table 39: WBM Page “Watchdog”

Connection watchdog		
Entry	**Default**	**Description**
Connection Timeout Value (100 ms)	600	Monitoring period for TCP links. After the completion of this period without any subsequent data traffic, the TCP connection is closed.
Modbus Watchdog		
Entry	**Default**	**Description**
State Modbus Watchdog	Disabled	Enabled – Watchdog is activated Disabled – Watchdog is disabled
Watchdog Type	Standard ◉	The set coding mask (watchdog trigger mask) is evaluated to determine whether the watchdog time is reset.
	Alternative ○	The watchdog time is reset by any Modbus/TCP telegram.
Watchdog Timeout Value (100 ms)	100	Monitoring period for Modbus links. After the completion of this period without receiving a Modbus telegram, the physical outputs are set to "0".
Watchdog Trigger Mask (F 1 to F16)	0xFFFF	Coding mask for certain Modbus telegrams (Function Code FC1 ... FC16)
Watchdog Trigger Mask (F17 to F32)	0xFFFF	Coding mask for certain Modbus telegrams (Function Code FC17 ... FC32)

9.7 Security

Use the “Security” WBM page with passwords to set up read and/or write access for various user groups to protect against configuration changes.

Note

Changing the passwords requires administrator rights and software reset!
You can only change the passwords as an administrator with the user rights "admin" and the associated password.
Press the **[Software Reset]** button to restart the software for the setting changes to take effect.

Note

Note password restrictions!
The following restriction is applied for passwords:

- Max. 32 characters inclusive special characters.

Note

Renew access after software reset!
If you initiate a software reset on this page, then the fieldbus coupler/controller starts with the configurations previously loaded into the EEPROM and the connection to the browser is interrupted.
If you changed the IP address previously, you have to use the changed IP address to access the device from the browser.
You have not changed the IP address and performed other settings; you can restore the connection by refreshing the browser.

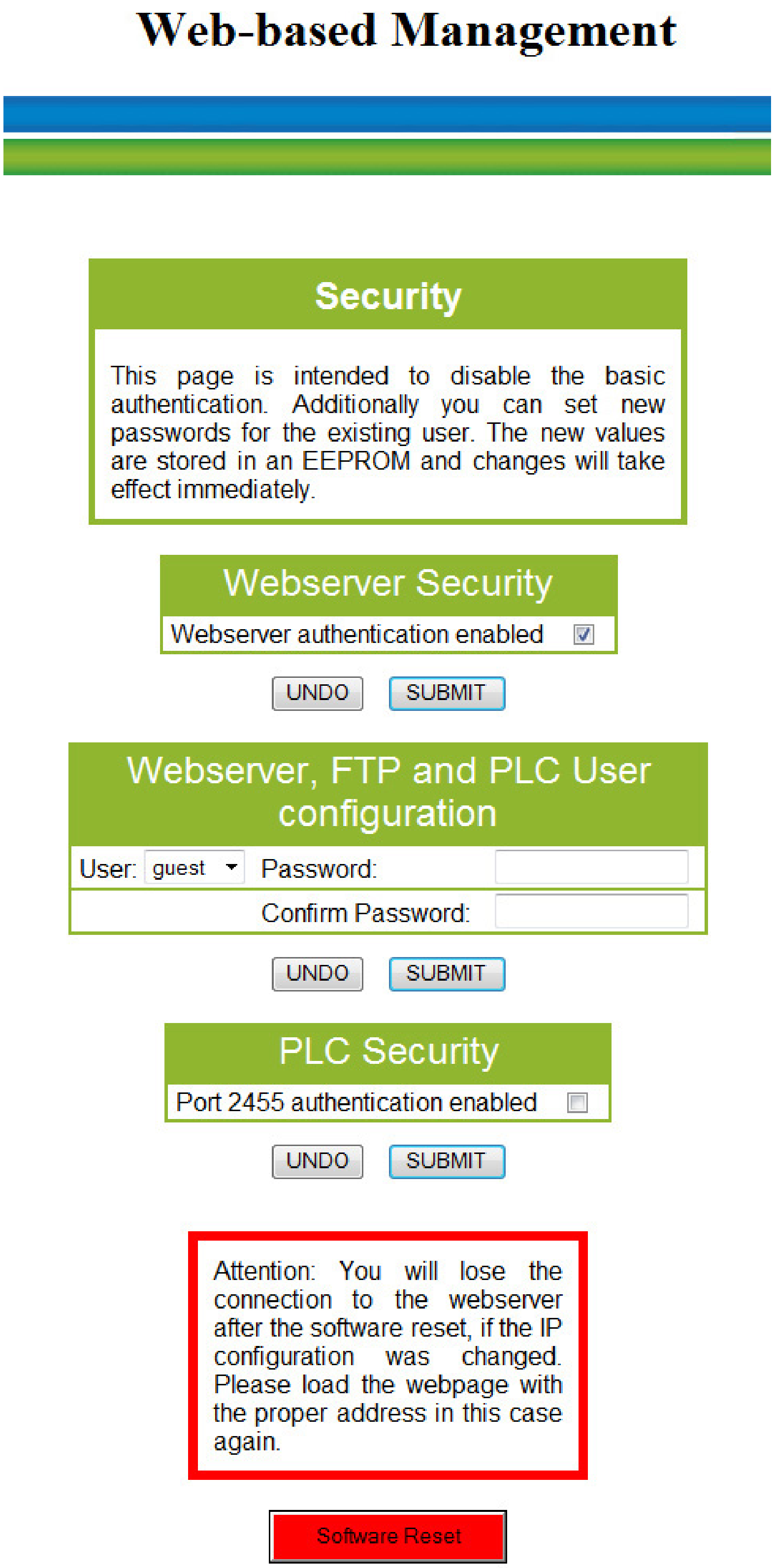


Figure 48: WBM page “Security”

Table 40: WBM Page “Security”

Webserver Security			
Entry	**Default**	**Description**	
Webserver authentication enabled	☑	☑	Enable password protection to access the Web interface
		☐	Disable password protection to access the Web interface
Webserver and FTP User configuration *)			
Entry	**Default**	**Description**	
User	*)	Select user permissions: - Admin (all permissions) - User (supported to a limited extent) or - Guest (display only)	
Password	*)	Enter password	
Confirm password		Enter password again to confirm	

*) The following default groups exist:

User: Admin	Password: wago
User: User	Password: user
User: Guest	Password: guest

9.8 MODBUS

Use the “MODBUS” WBM page to specify the settings for the Modbus protocol.

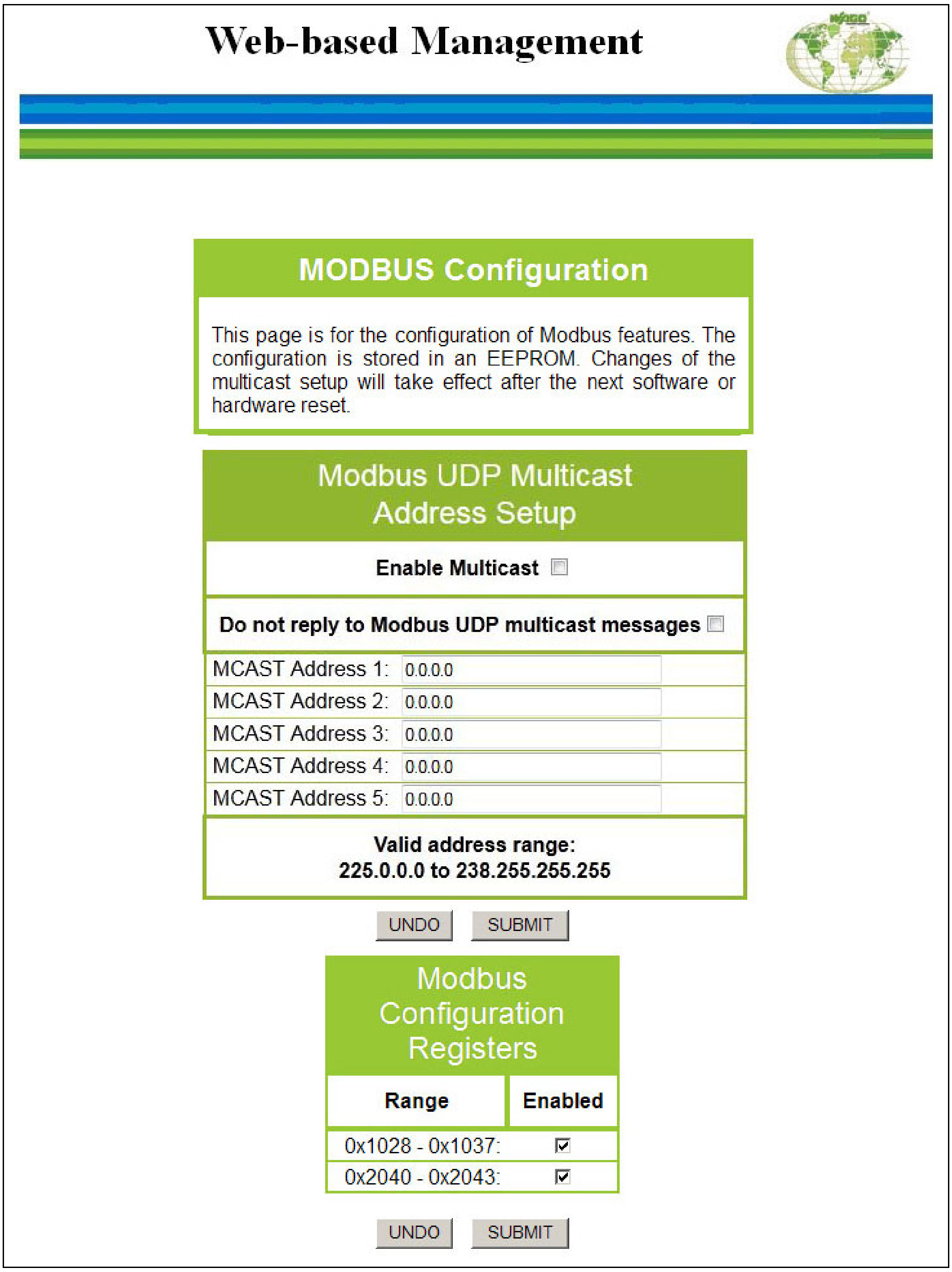


Figure 49: WBM page “Modbus”

Table 41: WBM page "Modbus"

Modbus UDP Multicast Address Setup			
Entry	**Default value**	**Description**	
Enable Multicast	☐	☑	Enable Multicast for Modbus UDP transmission. In addition to its own IP address, the fieldbus coupler receives Modbus commands for the following registered MCAST addresses.
		☐	Multicast for Modbus UDP transmission is not enabled. The fieldbus coupler receives Modbus commands only for the own IP address.
Do not reply to Modbus UDP multicast messages	☐	☑	The reply to Modbus UDP multicast messages is deactivated.
		☐	The reply to Modbus UDP multicast messages is activated.
MCAST Address 1 ... 5:	0.0.0.0	Multicast address 1... 5, for the multicast will be enabled. The valid address range is shown in the WBM. Multiple assigned addresses are not valid.	

Modbus Configuration Registers			
Entry	**Default value**	**Description**	
Range	**Enabled**		
0x1028 – 0x1037	☑	☑	Enable Modbus configuration register range.
0x2040 – 0x2043	☑	☐	Disable Modbus configuration register range.

Note

Multicast function only active with a valid MCAST address!

The multicast function is only active with a valid MCAST address.
If you activate the "**Enable Multicast**" function, it is therefore necessary to always enter an MCAST address that is not equal to 0.0.0.0. Otherwise, clicking on the **[SUBMIT]** button automatically deactivates the function again.
If the "**Enable Multicast**" function is already enabled with valid addresses, then you can no longer describe these MCAST address fields with invalid addresses, because when clicking on the **[SUBMIT]** button, they are reset to the previously valid addresses. The function "**Enable Multicast**" remains active.

9.9 Features

Use the “Features” WBM page to enable or disable additional functions.

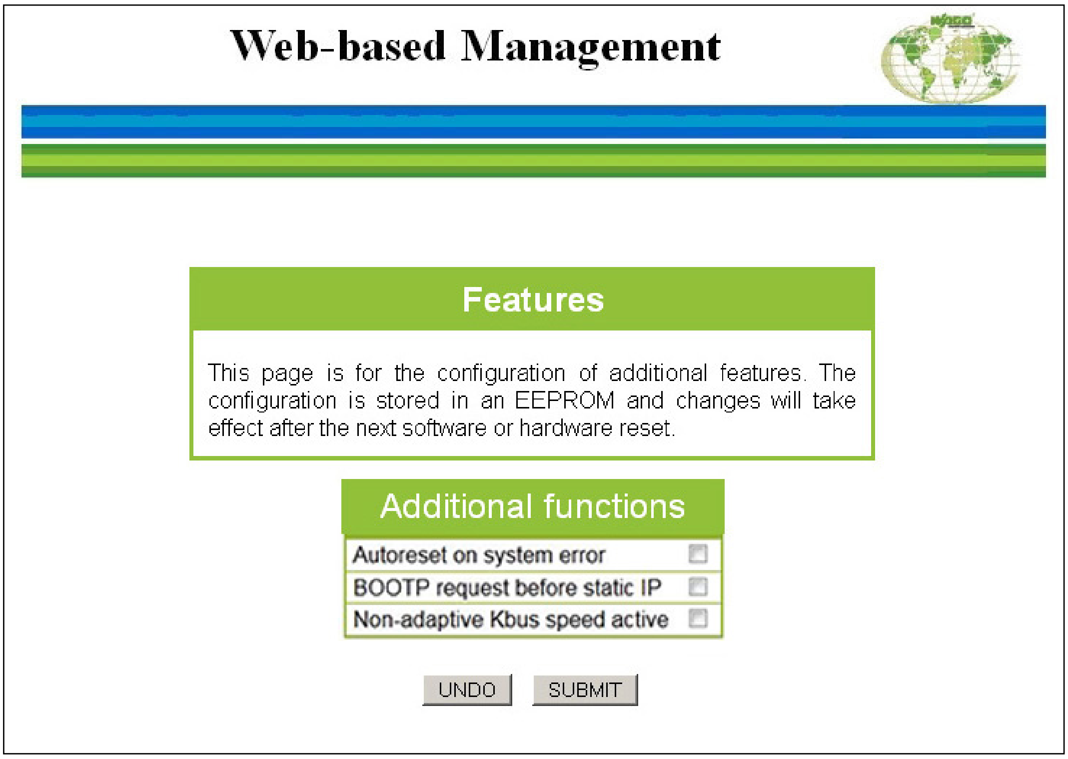


Figure 50: WBM Page “Features”

Table 42: WBM Page “Features”

Additional Functions			
Entry	**Default**	**Description**	
Autoreset on system error	☐	☑	Enables an automatic software reset to be conducted when a system error occurs
		☐	Disables an automatic software reset to be conducted when a system error occurs
BootP Request before Static-IP	☐	☑	Automatically set the static IP address enabled. For this configuration, the fieldbus coupler/ controller uses a statically configured IP address if the request via BootP fails.
		☐	Automatically set the static IP address disabled. For this configuration, the IP address request via BootP is repeated in the event of error.
Non-adaptive Kbus speed active	☐	☑	Disable the rate adjustment of the local bus for short fieldbus nodes. With short fieldbus nodes, doing so makes more computing power available for the PLC application. The local bus rate is correspondingly lower.
		☐	Enables the rate adjustment of the local bus.

9.10 I/O Config

Click the link “I/O config” to view the number of modules that are connected to your hardware.

The data in the second line are not relevant for the present fieldbus coupler, because software-technical hardware configuration is not performed in a fieldbus coupler. You always find the value “0” for the number of modules in the I/O configuration.

Note

Hardware Configuration will not be performed in a fieldbus coupler!
Note that you do not need to perform a software-technical hardware configuration of a fieldbus coupler, this is only necessary for the functionality of a programmable fieldbus controller in an application.

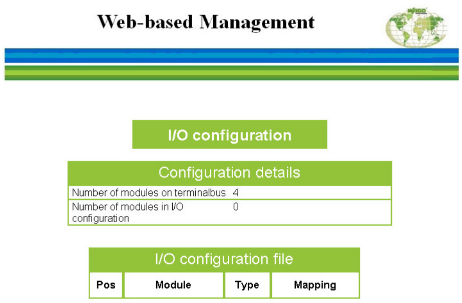


Figure 51: WBM page “IO configuration”

Table 43: WBM Page “I/O Config”

Configuration details		
Entry	**Value (Example)**	**Description**
Number of modules on terminal bus	5	Number of I/O modules (hardware)
Number of modules in I/O configuration	5	Number of I/O modules in the hardware configuration of the I/O

10 Diagnostics

10.1 LED Signaling

For on-site diagnostics, the fieldbus coupler has several LEDs that indicate the operational status of the fieldbus coupler or the entire node (see following figure).

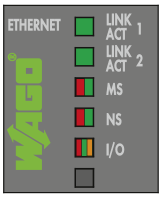


Figure 52: Display Elements

The diagnostics displays and their significance are explained in detail in the following section.

The LEDs are assigned in groups to the various diagnostics areas:

Table 44: LED Assignment for Diagnostics

Diagnostics area	LEDs
Fieldbus status	• LINK ACT Port 1 • LINK ACT Port 2 • MS • NS
Node status	• I/O

10.1.1 Evaluating Fieldbus Status

The health of the ETHERNET Fieldbus is signaled through the top LED group ('LINK ACT 1, 2', 'MS', und 'NS').

The two-colored LEDs 'MS' (module status) and 'NS' (network status) are solely used by the EtherNet/IP protocol. These two LEDs conform to the EtherNet/IP specifications.

Table 45: Fieldbus Diagnostics – Solution in Event of Error

LED Status	Meaning	Solution
LINK ACT 1, 2		
green	The fieldbus node is connected to the physical network.	-
green flashing	The fieldbus node sends and receives ETHERNET telegrams	-
off	The fieldbus node is not connected to the physical network.	1. Check the fieldbus cable.
MS		
green	Normal operation	-
green flashing	The system is not yet configures	-
red	The system indicates a not remediable error	1. Restart the device by turning the power supply off and on again. 2. If the error still exists, please contact the I/O support.
red/green flashing	Self test	-
off	No system supply voltage	1. Check the supply voltage.
NS		
green	At least one connection (Modbus TCP or EtherNet/IP) is developed (also connection to the Message rout applies)	-
green flashing	No connection (Modbus TCP or EtherNet/IP).	-
red	The system indicates a double IP-address in the network	1. Use an IP address that is not used yet.
red flashing	At least one connection (Modbus TCP or EtherNet/IP) announced a Timeout, where the controller functions as target.	1. Restart the device by turning the power supply off and on again. 2. Develop a new connection.
red/green flashing	Self test	-
off	No IP address is assigned to the system.	1. Assign to the system an IP address for example by BootP or DHCP.

10.1.2 Evaluating Node Status – I/O LED (Blink Code Table)

The communication status between fieldbus coupler/controller and the I/O modules is indicated by the I/O LED.

Table 46: Node Status Diagnostics – Solution in Event of Error

LED Status	Meaning	Solution
I/O		
green	The fieldbus node is operating correctly.	Normal operation.
orange flashing	Start of the firmware. 1 … 2 seconds of rapid flashing indicates start-up.	-
red	Fieldbus coupler/controller hardware defect	Replace the fieldbus coupler/controller.
red flashing	Flashing with approx. 10 Hz indicates the initialization of the local bus or a local bus error.	Note the following flashing sequence.
red cyclical flashing	Up to three successive flashing sequences indicate local bus errors. There are short intervals between the sequences.	Evaluate the flashing sequences based on the following blink code table. The blinking indicates an error message comprised of an error code and error argument.
off	No data cycle on the local bus.	The fieldbus coupler/controller supply is off.

Device boot-up occurs after turning on the power supply. The I/O LED flashes orange.

Then the local bus is initialized. This is indicated by flashing red at 10 Hz for 1 … 2 seconds.

After a trouble-free initialization, the I/O LED is green.

In the event of an error, the I/O LED continues to blink red. Blink codes indicate detailed error messages. An error is indicated cyclically by up to 3 flashing sequences.

After elimination of the error, restart the node by turning the power supply of the device off and on again.

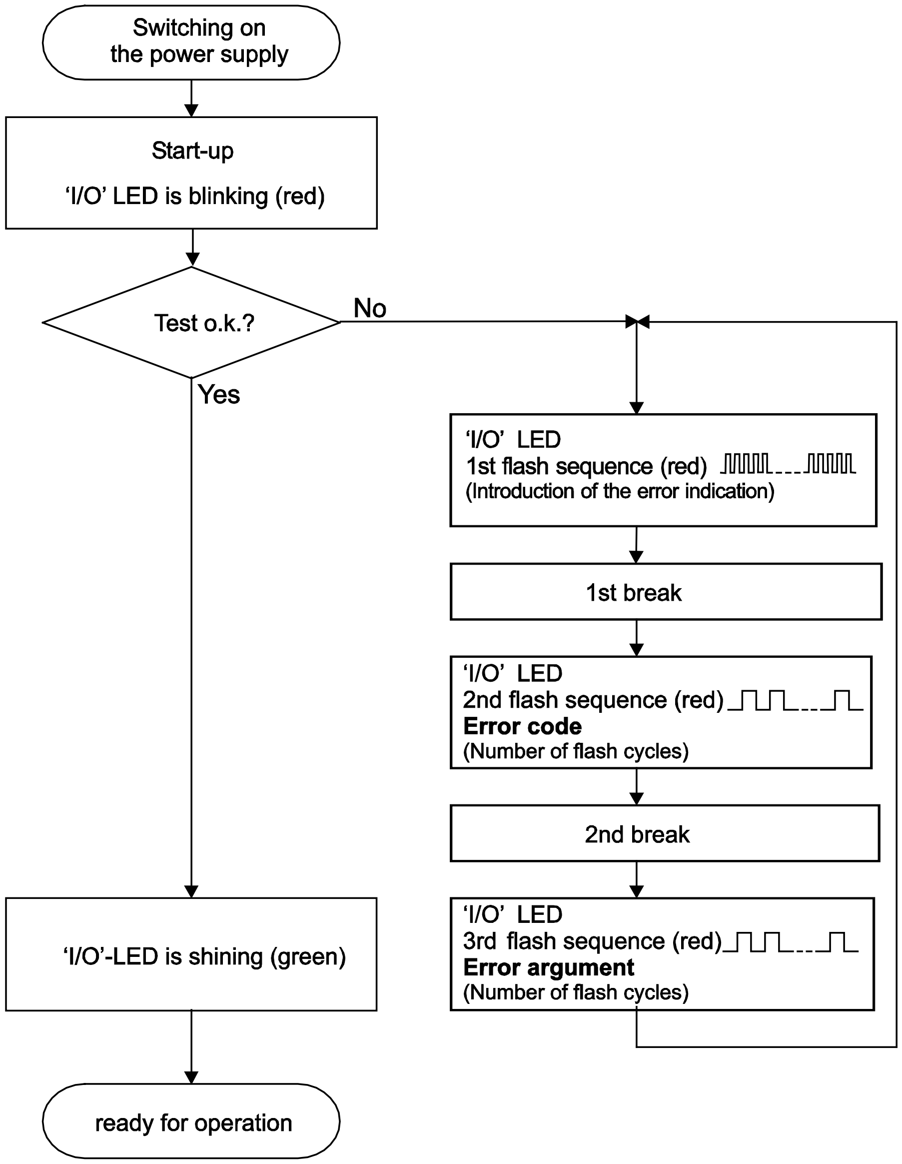


Figure 53: Node Status – I/O LED Signaling

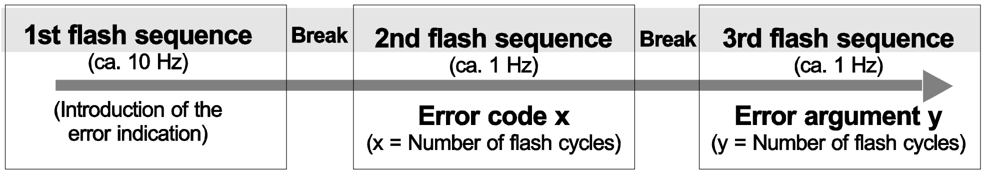


Figure 54: Error Message Coding

Example of a module error:

- The I/O LED starts the error display with the first flashing sequence (approx. 10 Hz).
- After the first break, the second flashing sequence starts (approx. 1 Hz): The I/O LED blinks four times.
  Error code 4 indicates "data error internal data bus".
- After the second break, the third flashing sequence starts (approx. 1 Hz): The I/O LED blinks twelve times.

Error argument 12 means that the local bus is interrupted behind the twelfth I/O module.

The thirteenth I/O module is either defective or has been pulled out of the assembly.

Table 47: Blink Code Table for the 'I/O' LED Signaling, Error Code 1

Error code 1: "Hardware and configuration error"		
Error Argument	**Error Description**	**Solution**
1	Overflow of the internal buffer memory for the attached I/O modules.	1. Turn off the power for the node. 2. Reduce the number of I/O modules and turn the power supply on again. 3. If the error persists, replace the fieldbus coupler.
2	I/O module(s) with unknown data type	1. Determine the faulty I/O module. First turn off the power supply for the node. 2. Plug the end module into the middle of the node. 3. Turn the power supply on again. 4. - LED continues to flash? - Turn off the power supply and plug the end module into the middle of the first half of the node (toward the fieldbus controller). - LED not flashing? - Turn off the power and plug the end module into the middle of the second half of the node (away from the fieldbus controller). 5. Turn the power supply on again. 6. Repeat the procedure described in step 4 while halving the step size until the faulty I/O module is detected. 7. Replace the faulty I/O module. 8. Inquire about a firmware update for the fieldbus coupler.
3	Invalid check sum in the parameter area of the fieldbus coupler.	1. Turn off the power supply for the node. 2. Replace the fieldbus coupler and turn the power supply on again.
4	Fault when writing in the serial EEPROM.	1. Turn off the power supply for the node. 2. Replace the fieldbus coupler and turn the power supply on again.
5	Fault when reading the serial EEPROM	1. Turn off the power supply for the node. 2. Replace the fieldbus coupler and turn the power supply on again.
6	The I/O module configuration after AUTORESET differs from the configuration determined the last time the fieldbus coupler was powered up.	1. Restart the fieldbus coupler by turning the power supply off and on.

Table 47: Blink Code Table for the 'I/O' LED Signaling, Error Code 1

Error code 1: “Hardware and configuration error”		
Error Argument	**Error Description**	**Solution**
7	Invalid hardware-firmware combination.	1. Turn off the power supply for the node. 2. Replace the fieldbus coupler and turn the power supply on again.
8	Timeout during serial EEPROM access.	1. Turn off the power supply for the node. 2. Replace the fieldbus coupler and turn the power supply on again.
9	Bus controller initialization error	1. Turn off the power supply for the node. 2. Replace the fieldbus coupler and turn the power supply on again.
10 ... 13	not used	
14	Maximum number of gateway or mailbox modules exceeded	1. Turn off the power for the node. 2. Reduce the number of corresponding modules to a valid number.

Table 48: Blink Code Table for the 'I/O' LED Signaling, Error Code 2

Error code 2: -not used-		
Error Argument	**Error Description**	**Solution**
-	Not used	

Table 49: Blink Code Table for the 'I/O' LED Signaling, Error Code 3

Error code 3: "Protocol error, internal bus"		
Error Argument	**Error Description**	**Solution**
-	Local bus communication is faulty, defective module cannot be identified.	--- Are passive power supply modules (750-613/040-000) located in the node? --- 1. Check that these modules are supplied correctly with power. 2. Determine this by the state of the associated status LEDs. --- Are all modules connected correctly or are there any 750-613/040-000 Modules in the node? --- 1. Determine the faulty I/O module by turning off the power supply.. 2. Plug the end module into the middle of the node. 3. Turn the power supply on again. 4. --- LED continues to flash? --- Turn off the power supply and plug the end module into the middle of the first half of the node (toward the fieldbus coupler). --- LED not flashing? --- Turn off the power and plug the end module into the middle of the second half of the node (away from the fieldbus coupler). 5. Turn the power supply on again. 6. Repeat the procedure described in step 4 while halving the step size until the faulty I/O module is detected. 7. Replace the faulty I/O module. 8. Inquire about a firmware update for the fieldbus coupler.

Table 50: Blink Code Table for the 'I/O' LED Signaling, Error Code 4

Error code 4: "Physical error, internal bus"		
Error Argument	**Error Description**	**Solution**
-	Local bus data transmission error or interruption of the local bus at the fieldbus coupler	1. Turn off the power supply to the node. 2. Plug in an end module behind the fieldbus coupler. 3. Turn the power supply on. 4. Observe the error argument signaled. --- Is no error argument indicated by the I/O LED? --- 5. Replace the fieldbus coupler. --- Is an error argument indicated by the I/O LED? --- 5. Identify the faulty I/O module by turning off the power supply. 6. Plug the end module into the middle of the node. 7. Turn the power supply on again. 8. --- LED continues to flash? --- Turn off the power and plug the end module into the middle of the first half of the node (toward the fieldbus coupler). --- LED not flashing? --- Turn off the power and plug the end module into the middle of the second half of the node (away from the fieldbus coupler). 9. Turn the power supply on again. 10. Repeat the procedure described in step 6 while halving the step size until the faulty I/O module is detected. 11. Replace the faulty I/O module. 12. If there is only one I/O module on the fieldbus coupler and the LED is flashing, either the I/O module or fieldbus coupler is defective. Replace the defective component.
n*	Interruption of the local bus behind the nth bus module with process data	1. Turn off the power supply to the node. 2. Replace the (n+1) I/O module containing process data. 3. Turn the power supply on.

* The number of light pulses (n) indicates the position of the I/O module.
I/O modules without data are not counted (e.g., supply modules without diagnostics)

Table 51: Blink Code Table for the 'I/O' LED Signaling, Error Code 5

Error code 5: "Initialization error, internal bus"		
Error Argument	**Error Description**	**Solution**
n*	Error in register communication during local bus initialization	1. Turn off the power supply to the node. 2. Replace the (n+1) I/O module containing process data. 3. Turn the power supply on.

* The number of light pulses (n) indicates the position of the I/O module.
I/O modules without data are not counted (e.g., supply modules without diagnostics)

Table 52: Blink code- table for the I/O LED signaling, error code 6

Error code 6: "Fieldbus specific errors"		
Error Argument	**Error description**	**Solution**
1	Invalid MACID	1. Turn off the power supply of the node. 2. Exchange fieldbus coupler. 3. Turn the power supply on again.
2	Ethernet Hardware initialization error	1. Restart the fieldbus coupler by turning the power supply off and on again. 2. If the error still exists, exchange the fieldbus coupler.
3	TCP/IP initialization error	1. Restart the fieldbus coupler by turning the power supply off and on again. 2. If the error still exists, exchange the bus coupler.
4	Network configuration error (no IP Address)	1. Check the settings of BootP server.
5	Application protocol initialization error	1. Restart the fieldbus coupler by turning the power supply off and on again. 2. If the error still exists, exchange the bus coupler.
6	Process image is too large	1. Turn off the power supply of the node. 2. Reduce number of I/O modules
7	Double IP address in network	1. Change configuration. Use another IP address, which is not yet present in network. 2. Restart the fieldbus coupler by turning the power supply off and on again.
8	Error when building the process image	1. Turn off the power supply of the node. 2. Reduce number of I/O modules 3. Restart the fieldbus coupler by turning the power supply off and on again. 4. If the error still exists, exchange the bus coupler.
9	Error with mapping between bus modules and fieldbus	1. Check io-config.xml file on the fieldbus coupler

10.2 Fault Behavior

10.2.1 Fieldbus Failure

A field bus failure is given i. e. when the master cuts-out or the bus cable is interrupted. A fault in the master can also lead to a fieldbus failure.

A field bus failure is indicated when the red “ERROR”-LED is illuminated.

If the watchdog is activated, the fieldbus coupler firmware evaluates the watchdog-register in the case of fault free communication, and the coupler answers all following MODBUS TCP/IP requests with the exception code 0x0004 (Slave Device Failure).

Information

Further Information
For detailed information on the Watchdog register see Chapter "MODBUS Functions"; "Watchdog (Fieldbus failure)".

10.2.2 Local Bus Failure

'I/O' LED indicates a local bus failure.

'I/O' LED flashes red:
When a local bus failure occurs, the fieldbus coupler generates an error message (error code and error argument).
A local bus failure occurs, for example, if an I/O module is removed.
If the error occurs during operation, the output modules operate as they do during a local bus stop.
If the local bus error is resolved, the coupler starts up after turning the power off and on similar to that of a normal start-up. The process data is transmitted again and the outputs of the node are set accordingly.

For the evaluation of a local bus error in the application program, the function block 'KBUS_ERROR_INFORMATION' is available.
For this the 'ERROR', 'BITLEN', 'TERMINALS' and 'FAILADDRESS' output values are relevant.

'ERROR'		= FALSE	= No error
	('BITLEN'		= Bit length of the local bus shift register
	'TERMINALS'		= Number of I/O modules)
'ERROR'		= TRUE	= Local Bus Error
	('BITLEN'		= 0
	'TERMINALS'		= 0)
	'FAILADRESS'		= Position of the I/O module after which the local bus interruption arose, similar to the flashed error argument of the I/O LED)

11 Fieldbus Communication

Fieldbus communication between master application and a WAGO fieldbus coupler/controller based on the ETHERNET standard normally occurs via a fieldbus-specific application protocol.

Depending on the application, this can be e.g., MODBUS/TCP (UDP), EtherNet/IP, BACnet/IP, KNXnet/IP, PROFINET, sercos or other.

In addition to the ETHERNET standard and the fieldbus-specific application protocol, there are also other communications protocols important for reliable communication and data transmission and other related protocols for configuring and diagnosing the system implemented in the WAGO fieldbus coupler/controller based on ETHERNET.

These protocols are explained in more detail in the other sections.

11.1 Implemented Protocols

11.1.1 Communication Protocols

11.1.1.1 IP (Internet Protocol)

The Internet protocol divides datagrams into segments and is responsible for their transmission from one network subscriber to another. The stations involved may be connected to the same network or to different physical networks which are linked together by routers.
Routers are able to select various paths (network transmission paths) through connected networks, and bypass congestion and individual network failures. However, as individual paths may be selected which are shorter than other paths, datagrams may overtake each other, causing the sequence of the data packets to be incorrect.
Therefore, it is necessary to use a higher-level protocol, for example, TCP to guarantee correct transmission.

IP Packet

In addition to the data units to be transported, the IP data packets contain a range of address information and additional information in the packet header.

Table 53: IP Packet

IP Header	IP Data

The most important information in the IP header is the IP address of the transmitter and the receiver and the transport protocol used.

IP Addresses

To allow communication over the network each fieldbus node requires a 32 bit Internet address (IP address).

Note

IP Address must be unique!
For error free operation, the IP address must be unique within the network.
The same IP address may not be assigned twice.

As shown below there are various address classes with net identification (net ID) and subscriber identification (subscriber ID) of varying lengths. The net ID defines the network in which the subscriber is located. The subscriber ID identifies a particular subscriber within this network.

Networks are divided into various network classes for addressing purposes:

- **Class A:** (Net ID: Byte 1, Host ID: Byte 2… Byte 4)

Table 54: Network Class A

e. g. 101 . 16 . 232 . 22

<table>
<tr><td colspan="2">01100101</td><td>00010000</td><td>11101000</td><td>00010110</td></tr>
<tr><td>0</td><td>Net ID</td><td colspan="3">Host ID</td></tr>
</table>

The highest bit in Class A networks is always '0'. This means the highest byte can be in a range of '0 0000000' to '0 1111111'.
Therefore, the address range of a Class A network in the first byte is always between 0 and 127.

- **Class B:** (Net ID: Byte 1 … Byte 2, Host ID: Byte 3… Byte 4)

Table 55: Network Class B

e. g. 181 . 16 . 232 . 22

<table>
<tr><td colspan="2">10110101</td><td>00010000</td><td>11101000</td><td>00010110</td></tr>
<tr><td>10</td><td colspan="2">Net ID</td><td colspan="2">Host ID</td></tr>
</table>

The highest bits in Class B networks are always '10'. This means the highest byte can be in a range of '10 000000' to '10 111111'.
Therefore, the address range of Class B networks in the first byte is always between 128 and 191.

- **Class C:** (Net ID: Byte 1 … Byte 3, Host ID: Byte 4)

Table 56: Network Class C

e. g. 201 . 16 . 232 . 22

<table>
<tr><td colspan="2">11000101</td><td>00010000</td><td>11101000</td><td>00010110</td></tr>
<tr><td>110</td><td colspan="3">Net ID</td><td>Host ID</td></tr>
</table>

The highest bits in Class C networks are always '110'. This means the highest byte can be in a range of '110 00000' to '110 11111'.

Therefore, the address range of Class C networks in the first byte is always between 192 and 223.

- **Additional network classes (D, E):** are only used for special tasks.

Key Data

Table 57: Key Data Class A, B and C

Network Class	Address range of the subnetwork	Possible number of Networks	Possible number of Hosts per Network
Class A	0.XXX.XXX.XXX ... 127.XXX.XXX.XXX	128 (2^7)	Approx. 16 Million (2^{24})
Class B	128.000.XXX.XXX ... 191.255.XXX.XXX	Approx. 16 Thousand (2^{14})	Ca. 65 Thousand (2^{16})
Class C	192.000.000.XXX ... 223.255.255.XXX	Approx. 2 Million (2^{21})	254 (2^8)

Each WAGO ETHERNET fieldbus coupler or controller can be easily assigned an IP address via the implemented BootP protocol. For small internal networks we recommend selecting a network address from Class C.

Note

Do not set IP addresses to 0.0.0.0 or 255.255.255.255!
Never set all bits to equal 0 or 1 in one byte (byte = 0 or 255). These are reserved for special functions and may not be allocated. Therefore, the address 10.0.10.10 may not be used due to the 0 in the second byte.

If a network is to be directly connected to the Internet, only registered, internationally unique IP addresses allocated by a central registration service may be used. These are available from Inter*NIC* (International Network Information Center).

Note

Internet access only by the authorized network administrator!
Direct connection to the Internet should only be performed by an authorized network administrator and is therefore not described in this manual.

Subnets

To allow routing within large networks a convention was introduced in the specification RFC 950. Part of the Internet address, the subscriber ID is divided up again into a subnetwork number and the station number of the node. With the aid of the network number it is possible to branch into internal subnetworks within the partial network, but the entire network is physically connected together. The size and position of the subnetwork ID are not defined; however, the size is dependent upon the number of subnets to be addressed and the number of subscribers per subnet.

Table 58: Example: Class B Address with Field for Subnet IDs

1			8	16	24	32
1	0	...	Network ID	Subnet ID	Host ID	

Subnet Mask

A subnet mask was introduced to encode the subnets in the Internet. This involves a bit mask, which is used to mask out or select specific bits of the IP address. The mask defines the subscriber ID bits used for subnet coding, which denote the ID of the subscriber. The entire IP address range theoretically lies between 0.0.0.0 and 255.255.255.255. Each 0 and 255 from the IP address range are reserved for the subnet mask.

The standard masks depending upon the respective network class are as follows:

- **Class A Subnet mask:**

Table 59: Subnet Mask for Class A Network

255	.0	.0	.0

- **Class B Subnet mask:**

Table 60: Subnet Mask for Class B Network

255	.255	.0	.0

- **Class C Subnet mask:**

Table 61: Subnet Mask for Class C Network

255	.255	.255	.0

Depending on the subnet division the subnet masks may, however, contain other values beyond 0 and 255, such as 255.255.255.128 or 255.255.255.248.

Your network administrator allocates the subnet mask number to you.

Together with the IP address, this number determines which network your PC and your node belongs to.

The recipient node, which is located on a subnet, initially calculates the correct network number from its own IP address and subnet mask. Only then the node checks the node number and, if it corresponds, delivers the entire packet frame.

Table 62: Example for an IP Address from a Class B Network

IP address	172.16.233.200	'10101100 00010000 11101001 11001000'
Subnet mask	255.255.255.128	'11111111 11111111 11111111 10000000'
Net ID	172.16.0.0	'10101100 00010000 00000000 00000000'
Subnet ID	0.0.233.128	'00000000 00000000 11101001 10000000'
Host ID	0.0.0.72	'00000000 00000000 00000000 01001000'

Note

Specification of the network mask necessary!
Specify the network mask defined by the administrator in the same way as the IP address when installing the network protocol.

Gateway

The subnets of the Internet are normally connected via gateways. The function of these gateways is to forward packets to other networks or subnets.

This means that in addition to the IP address and network mask for each network card, it is necessary to specify the correct IP address of the standard gateway for a PC or fieldbus node connected to the Internet. You should also be able to obtain this IP address from your network administrator.

The IP function is limited to the local subnet if this address is not specified.

To communicate directly with each other, host and gateway must be on the same subnet, that means the network ID must be the same.

RAW IP

Raw IP manages without protocols such as PPP (point-to-point protocol). With RAW IP, the TCP/IP packets are directly exchanged without handshaking, thus enabling the connection to be established more quickly.

However, the connection must beforehand have been configured with a fixed IP address. The advantages of RAW IP are high data transfer rate and good stability.

IP Multicast

Multicast refers to a method of transmission from a point to a group, which is a point-to-multipoint transfer or multipoint connection. The advantage of multicast is that messages are simultaneously transferred to several users or closed user groups via one address.

IP multicasting at the Internet level is realized with the help of the Internet Group Message Protocol IGMP; neighboring routers use this protocol to inform each other on membership to the group.

For distribution of multicast packets in the sub-network, IP assumes that the datalink layer supports multicasting. In the case of Ethernet, you can provide a packet with a multicast address in order to send the packet to several recipients with a single send operation. Here, the common medium enables packets to be sent simultaneously to several recipients. The stations do not have to inform each other on who belongs to a specific multicast address – every station physically receives every packet. The resolution of IP address to Ethernet address is solved by the use of algorithms, IP multicast addresses are embedded in Ethernet multicast addresses.

11.1.1.2 TCP (Transmission Control Protocol)

As the layer above the Internet protocol, TCP (Transmission Control Protocol) guarantees the secure transport of data through the network.

TCP enables two subscribers to establish a connection for the duration of the data transmission. Communication takes place in full-duplex mode (i.e., transmission between two subscribers in both directions simultaneously).

TCP provides the transmitted message with a 16-bit checksum and each data packet with a sequence number.

The receiver checks that the packet has been correctly received on the basis of the checksum and then sets off the sequence number. The result is known as the acknowledgement number and is returned with the next self-sent packet as an acknowledgement.

This ensures that the lost TCP packets are detected and resent, if necessary, in the correct sequence.

TCP Data Packet

The packet header of a TCP data packet is comprised of at least 20 bytes and contains, among others, the application port number of the transmitter and the receiver, the sequence number and the acknowledgement number.

The resulting TCP packet is used in the data unit area of an IP packet to create a TCP/IP packet.

TCP Port Numbers

TCP can, in addition to the IP address (network and subscriber address), respond to a specific application (service) on the addressed subscriber. For this the applications located on a subscriber, such as a web server, FTP server and others are addressed via different port numbers. Well-known applications are assigned fixed ports to which each application can refer when a connection is built up
(Examples: Telnet Port number: 23, http Port number: 80).
A complete list of “standardized services” is contained in the RFC 1700 (1994) specifications.

11.1.1.3 UDP (User Datagram Protocol)

The UDP protocol, like the TCP protocol, is responsible for the transport of data. Unlike the TCP protocol, UDP is not connection-orientated; meaning that there are no control mechanisms for the data exchange between transmitter and receiver. The advantage of this protocol is the efficiency of the transmitted data and the resulting higher processing speed.

11.1.2 Configuration and Diagnostics Protocols

11.1.2.1 BootP (Bootstrap Protocol)

The “Bootstrap Protocol” (BootP) can be used to assign an IP address and other parameters to the fieldbus coupler/controller in a TCP/IP network. Subnet masks and gateways can also be transferred using this protocol. Protocol communication is comprised of a client request from the fieldbus coupler or controller and a server response from the PC.

A broadcast request is transmitted to Port 67 (BootP server) via the protocol that contains the hardware address (MAC ID) for the fieldbus coupler or controller.

The BootP server then receives this message. The server contains a database in which the MAC ID and IP addresses are assigned to one another. When a MAC address is found a broadcast reply is transmitted via the network.

The fieldbus coupler/controller “listens” at the specified Port 68 for a response from the BootP server. Incoming packets contain information such as the IP address and the MAC address for the fieldbus coupler/controller. A fieldbus coupler/controller recognizes by the MAC address that the message is intended for that particular fieldbus coupler/controller and accepts the transmitted IP address into its network.

Note

IP addresses can be assigned via BootP under Windows and Linux!
You can use WAGO-BootP-Server to assign an IP address under the Windows and Linux operating systems. You can also use any other BootP server besides WAGO-BootP-Server. You can also use any other BootP server besides the WAGO-BootP-Server.

Information

More information about WAGO-BootP-Server
The process for assigning addresses using WAGO-BootP-Server is described in detail in the section “Commissioning”.

The fieldbus coupler/controller supports the following options in addition to the default “IP address” option:

Table 63: BootP Options

Option	Meaning
[OPT1] Subnet mask	32-bit address mask that displays which bits of the IP address identify the network and which identify the network stations.
[OPT2] Time zone	Time difference between the local time and the UTC (Universal Time Coordinated).
[OPT3] Gateway	IP address of the router that permits access to other networks.
[OPT6] DNS server	IP address of the name servers that converts a name into an IP address. Up to 2 DNS servers can be configured.
[OPT12] Host name	The name of the host is the unique name of a computer in a network. The host name can contain up to 32 characters.
[OPT15] Domain name	The name of the domain is the unique name of a network. The domain name can contain up to 32 characters.
[OPT42] NTP server	IP address of the Network Time Server. This address is only accepted if the protocol "SNTP" is enabled via the WBM.

The “Features” WBM page can also be used to select the “BootP Request before static IP” option. After the restart, 5 BootP queries are sent. If there is no response to any of these queries, the fieldbus coupler/controller tries to configure itself with the IP parameters saved in the EEPROM.

If you want the IP address and subnet mask are stored in the EEPROM when using the Bootstrap protocol, then the option “use IP from EEPROM” has to be switched (via the WBM, HTML page “Port”) following the configuration via BootP. When booting next the fieldbus coupler/controller uses the parameters saved in the EEPROM.
By default, BootP is activated in the fieldbus coupler/controller.

When BootP is activated, the fieldbus coupler/controller expects the BootP server to be permanently available.
If there is no BootP server available after a PowerOn reset, the network will remain inactive.

If there is an error in the saved parameters, the I/O LED reports a blink code and configuration via BootP is turned on automatically.

11.1.2.2 DHCP (Dynamic Host Configuration Protocol)

The fieldbus coupler/controller internal HTML page opened via the “Port” link provides the option to configure the network using the data saved in the EEPROM or via DHCP instead of via the BootP protocol.

DHCP (Dynamic Host Configuration Protocol) is a further development of BootP and is backwards compatible with BootP.
Both BOOTP and DHCP assign an IP address to the fieldbus node (Client) when starting; the sequence is the same as for BootP.

For configuration of the network parameters via DHCP, the fieldbus coupler/controller sends a client request to the DHCP server e.g., on the connected PC.

A broadcast request is transmitted to Port 67 (DHCP server) via the protocol that contains the hardware address (MAC ID) for the fieldbus coupler/controller.

The DHCP server then receives this message. The server contains a database in which the MAC ID and IP addresses are assigned to one another. When a MAC address is found a broadcast reply is transmitted via the network.

The fieldbus coupler/controller “listens” at the specified Port 68 for a response from the DHCP server. Incoming packets contain information such as the IP address and the MAC address for the fieldbus coupler/controller. A fieldbus coupler/controller recognizes by the MAC address that the message is intended for that particular fieldbus coupler/controller and accepts the transmitted IP address into its network.

If there is no reply, the inquiry is sent again after 4 seconds, 8 seconds and 16 seconds.
If all inquiries receive no reply, a blink code is reported via the I/O LED.

If you want the IP address and subnet mask are stored in the EEPROM when using DHCP, then the option “use IP from EEPROM” has to be switched (via the WBM, HTML page “Port”) following the configuration via DHCP.
When booting next the fieldbus coupler/controller uses the parameters saved in the EEPROM.

The difference between BOOTP and DHCP is that both use different assignment methods and that configuration with DHCP is time limited. The DHCP client always has to update the configuration after the time has elapsed. Normally, the same parameters are continuously confirmed by the server.

BOOTP can be used to assign a fixed IP address for each client where the addresses and their reservation are permanently saved in the BOOTP server database.

Because of this time dependency, DHCP is also used to dynamically assign available IP addresses through client leases (lease time after which the client requests a new address) where each DHCP client address is saved temporarily in the server database.

In addition, DHCP clients do not require a system restart to rebind or renew configuration with the DHCP server. Instead, clients automatically enter a rebinding state at set timed intervals to renew their leased address allocation with the DHCP server. This process occurs in the background and is transparent to the user.
There are three different operating modes for a DHCP server:

- **Manual assignment**
  In this mode, the IP addresses are permanently assigned on the DHCP server to specific MAC addresses. The addresses are assigned to the MAC address for an indefinite period.
  Manual assignments are used primarily to ensure that the DHCP client can be reached under a fixed IP address.

- **Automatic assignment**
  For automatic assignment, a range of IP addresses is assigned on the

DHCP server.
If the address was assigned from this range once to a DHCP client, then it belongs to the client for an indefinite period as the assigned IP address is also bound to the MAC address.

- **Dynamic assignment**
  This process is similar to automatic assignment, but the DHCP server has a statement in its configuration file that specifies how long a certain IP address may be “leased” to a client before the client must log into the server again and request an “extension”.
  If the client does not log in, the address is released and can be reassigned to another (or the same) client. The time defined by the administrator is called Lease Time.
  Some DHCP servers also assign IP addresses based on the MAC address, i.e., a client receives the same IP address as before after longer network absence and elapse of the Lease Time (unless the IP address has been assigned otherwise in the mean time).

DHCP is used to dynamically configure the network parameters.
The ETHERNET TCP/IP fieldbus coupler/controller has a DHCP client that supports the following options in addition to the default “IP address” option:

Table 64: Meaning of DHCP Options

Option	Meaning
[OPT1] Subnet mask	32-bit address mask that displays which bits of the IP address identify the network and which identify the network stations.
[OPT2] Time zone	Time difference between the local time and the UTC (Universal Time Coordinated).
[OPT3] Gateway	IP address of the router that permits access to other networks.
[OPT6] DNS server	IP address of the name servers that converts a name into an IP address. Up to 2 DNS servers can be configured.
[OPT15] Domain name *)	The name of the domain is the unique name of a network. The domain name can contain up to 32 characters.
[OPT42] NTP server	IP address of the Network Time Server. This address is only accepted if the protocol "SNTP" is activated via the WBM.
[OPT51] Lease time	The maximum duration in seconds (i.e., how long the fieldbus coupler/controller maintains the assigned IP address) can be defined here. The maximum lease time for the fieldbus controller is 48 days. This is due to the internal timer resolution. The minimum lease time is 16 minutes.
[OPT58] Renewing time	The renewing time indicates when the fieldbus coupler/controller must renew the lease time. The renewing time should be approximately half of the lease time.
[OPT59] Rebinding time	The rebinding time indicates after what amount of time the fieldbus coupler/controller must have received its new address. The rebinding time should be approximately 7/8 of the lease time.

*) In contrast to BootP, the DHCP client does not support assignment of the host name.

11.1.2.3 HTTP (Hypertext Transfer Protocol)

HTTP is a protocol used by WWW (World Wide Web) servers for the forwarding of hypermedia, texts, images, audiodata, etc.

Today, HTTP forms the basis of the Internet and is also based on requests and responses in the same way as the BootP protocol.

The HTTP server implemented in the (programmable) fieldbus coupler or controller is used for viewing the HTML pages saved in the coupler/controller. The HTML pages provide information about the coupler/controller (state, configuration), the network and the process image.

On some HTML pages, (programmable) fieldbus coupler or controller settings can also be defined and altered via the web-based management system (e.g. whether IP configuration of the coupler/controller is to be performed via the DHCP protocol, the BootP protocol or from the data stored in the EEPROM).

The HTTP server uses port number 80.

11.1.2.4 DNS (Domain Name Systems)

The DNS client enables conversion of logical Internet names such as www.wago.com into the appropriate decimal IP address represented with separator stops, via a DNS server. Reverse conversion is also possible.

The addresses of the DNS server are configured via DHCP, BootP or web-based management. Up to 2 DNS servers can be specified. The host identification can be achieved with two functions; an internal host table is not supported.

11.1.2.5 FTP-Server (File Transfer Protocol)

The file transfer protocol (FTP) enables files to be exchanged between different network stations regardless of operating system.

In the case of the ETHERNET coupler/controller, FTP is used to store and read the HTML pages created by the user, the IEC61131 program and the IEC61131 source code in the (programmable) fieldbus coupler or controller.

A total memory of 2 MB is available for the file system.

Note

Cycles for flash limited to 1 million!
Up to 1 million write cycles per sector are allowed when writing the flash for the file system. The file system supports “Wear-Leveling”, so that the same sectors are not always written to.

Information

More Information about the implemented Protocols
You can find a list of the exact available implemented protocols in the section "Technical Data" to the fieldbus coupler and/or controller.

11.1.2.6 SNMP (Simple Network Management Protocol)

The Simple Network Management Protocol (SNMP) is responsible for transporting the control data that allows the exchange of management information as well as status and statistic data between individual network components and a management system.

An SNMP management workstation polls the SNMP agents to obtain information on the relevant devices.

SNMP is supported in versions 1/2c and some fieldbus couplers/controllers in version 3.

This represents a community message exchange in SNMP versions 1 and 2c. The community name of the network community must thereby be specified.

In SNMP version 3, exchanging messages is user-related. Each device, that knows the passwords set via WBM, may read or write values from the controller. In SNMPv3, user data from SNMP messages can also be transmitted in encoded form. This way, both requested values and values to be written cannot be easily decoded by others via ETHERNET. This is why SNMPv3 is often used in safety-related networks.

The device data, that can be accessed or modified by an SNMP agent, is called SNMP object. The sets of SNMP objects are stored in a logical database called Management Information Base (MIB); this is why these objects are typically known as "MIB objects".

The SNMP of the ETHERNET controller includes both the general MIB acc. to RFC1213 (MIB II) and a special WAGO MIB.

SNMP is processed via port 161. The port number for SNMP traps (agent messages) is 161. Both ports must be enabled to use SNMP.

11.1.2.6.1 MIB II Description

MIB II acc. to RFC1213 is divided into the following groups:

Table 65: MIB II groups

Group	Identifier
System Group	1.3.6.1.2.1.1
Interface Group	1.3.6.1.2.1.2
IP Group	1.3.6.1.2.1.4
IpRoute Table Group	1.3.6.1.2.1.4.21
ICMP Group	1.3.6.1.2.1.5
TCP Group	1.3.6.1.2.1.6
UDP Group	1.3.6.1.2.1.7
SNMP Group	1.3.6.1.2.1.11

11.1.2.6.2 Traps

Standard Traps

For specific events, the SNMP agent will independently send one of the following messages without polling the manager.

Note

Enable event messages (traps) in the WBM!
Initially enable the event messages in the WBM in menu “SNMP” under “Trap Enable”. Traps in version 1, 2c and 3 may be activated separately.

The following messages are triggered automatically as traps (SNMPv1) by the fieldbus coupler/controller:

Table 66: Standard Traps

TrapType/TrapNumber/OID of the provided value	Name	Event
TrapType = 0	ColdStart	Restart the coupler/controller
TrapType = 1	WarmStart	Reset via mode selector switch (only for controller)
TrapType = 3	EthernetUp	Network connection detected
TrapType = 4	AuthenticationFailure	Unauthorized (abortive) MIB access
TrapType = 6/ ab Trap-Nummer 25 benutzerspezifisch	enterpriseSpecific	Enterprise-specific messages and function poll in the PFC program starting with enterprise trap number 25

11.1.3 Application Protocols

If fieldbus specific application protocols are implemented, then the appropriate fieldbus specific communication is possible with the respective coupler/controller. Thus the user is able to have a simple access from the respective fieldbus on the fieldbus node.

The fieldbus specific application protocols implemented in the fieldbus coupler/controller are listed in the following chapters and some special details are described.

11.2 Modbus Functions

11.2.1 General

Modbus is a manufacturer-independent, open fieldbus standard for diverse applications in manufacturing and process automation.

The Modbus protocol is implemented according to the current Internet Draft of the IETF (Internet Engineering Task Force) and performs the following functions:

- Transmission of the process image
- Transmission of the fieldbus variables
- Transmission of different settings and information on the coupler/controller

The data transmission in the fieldside takes place via TCP and via UDP.

The Modbus TCP protocol is a variation of the Modbus protocol, which was optimized for communication via TCP/IP connections.

This protocol was designed for data exchange in the field level (i.e. for the exchange of I/O data in the process image).

All data packets are sent via a TCP connection with the port number 502.

Modbus TCP segment

The general Modbus TCP header is as follows:

Table 67: Modbus TCP Header

Byte	0	1	2	3	4	5	6	7	8 … n
	Identifier (entered by receiver)		Protocol-identifier (is always 0)		Length field (High byte, low byte)		Unit identifier (Slave address)	Modbus function code	Data

Information

Additional Information
The structure of a datagram is specific for the individual function. Refer to the descriptions of the Modbus Function codes.

For the MODBUS protocol 15 connections are made available over TCP. Thus it allows digital and analog output data to be directly read out at a fieldbus node and special functions to be executed by way of simple MODBUS function codes from 15 stations simultaneously.

For this purpose a set of MODBUS functions from the Open MODBUS/TCP specification is realized.

Information

More information

More information on the “Open MODBUS/TCP specification” you can find in the Internet: www.modbus.org .

Therefore the MODBUS protocol based essentially on the following basic data types:

Table 68: Basic Data Types of MODBUS Protocol

Data type	Length	Description
Discrete inputs	1 bit	Digital inputs
Coils	1 bit	Digital outputs
Input register	16 bits	Analog input data
Holding register	16 bits	Analog output data

For each basic data type one or more function codes are defined.

These functions allow digital or analog input and output data, and internal variables to be set or directly read out of the fieldbus node.

Table 69: List of the MODBUS Functions in the Fieldbus Coupler

Function code		Function	Access method and description	Access to resources (R=read/W=write)	
Desig-nation	Value (hex)				
FC1	0x01	Read Coils	Reading of several single input bits	**R:**	Process image
FC2	0x02	Read Discrete Inputs	Reading of several input bits	**R:**	Process image
FC3	0x03	Read Holding Registers	Reading of several input registers	**R:**	Process image, internal variables
FC4	0x04	Read Input Registers	Reading of several input registers	**R:**	Process image, internal variables
FC5	0x05	Write Single Coil	Writing of an individual output bit	**W:**	Process image
FC6	0x06	Write Single Register	Writing of an individual output register	**W:**	Process image, internal variables
FC11	0x0B	Get Comm Event Counters	Communication event counter	**R:**	None
FC15	0x0F	Write Multiple Coils	Writing of several output bits	**W:**	Process image
FC16	0x10	Write Multiple Registers	Writing of several output registers	**W:**	Process image, internal variables
FC22	0x16	Mask Write Register	Writing of several bits of an individual output register by mask	**W:**	Process image
FC23	0x17	Read/Write Multiple Registers	Reading and writing of several output registers	**R/W:**	Process image

To execute a desired function, specify the respective function code and the address of the selected input or output channel or of the register.

Note

Note the number system when addressing!
The examples listed use the hexadecimal system (i.e.: 0x000) as their numerical format. Addressing begins with 0. The format and beginning of the addressing may vary according to the software and the control system. All addresses then need to be converted accordingly.

11.2.2 Use of the MODBUS Functions

The example below uses a graphical view of a fieldbus node to show which MODBUS functions can be used to access data of the process image.

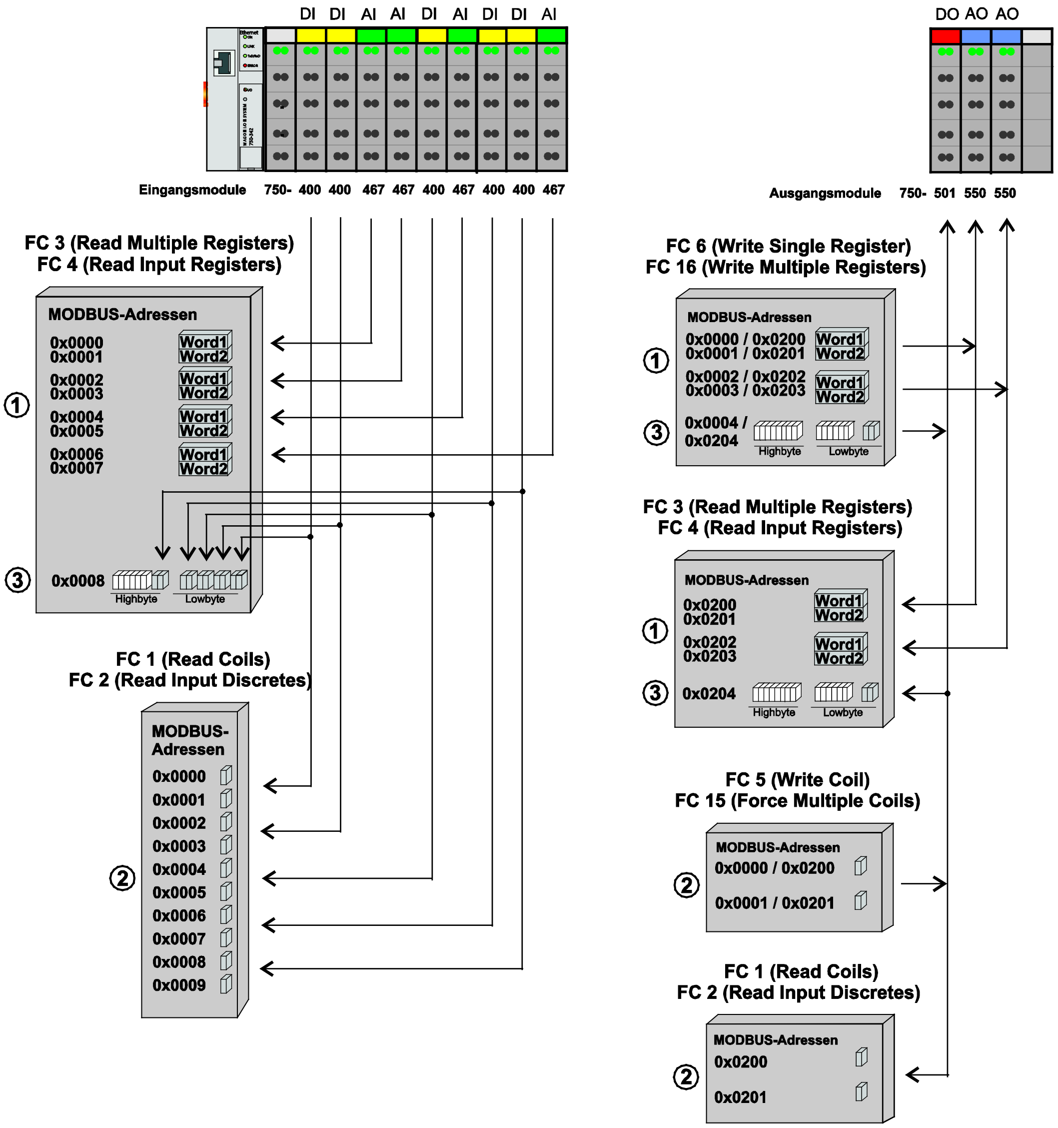


Figure 55: Use of the MODBUS Functions

Note

Use register functions to access analog signals and coil functions to access binary signals!

It is recommended that analog data be accessed with register functions ① and digital data with coil functions ②. If reading or writing access to binary signals is performed via register functions ③, an address shift may occur as soon as further analog modules are operated on the coupler/controller.

11.2.3 Description of the MODBUS Functions

All MODBUS functions are executed as follows:

1. A MODBUS TCP master (e.g., a PC) makes a request to the WAGO fieldbus node using a specific function code based on the desired operation..

2. The WAGO fieldbus node receives the datagram and then responds to the master with the proper data, which is based on the master's request.

If the WAGO fieldbus node receives an incorrect request, it sends an error datagram (Exception) to the master.
The exception code contained in the exception has the following meaning:

Table 70: Exception Codes

Exception code	Meaning
0x01	Illegal function
0x02	Illegal data address
0x03	Illegal data value
0x04	Slave device failure
0x05	Acknowledge
0x06	Server busy
0x08	Memory parity error
0x0A	Gateway path unavailable
0x0B	Gateway target device failed to respond

The following chapters describe the datagram architecture of request, response and exception with examples for each function code.

Note

Reading and writing of outputs via FC1 to FC4 is also possible by adding an offset!
In the case of the read functions (FC1 ... FC4) the outputs can be additionally written and read back by adding an offset of 200hex (0x0200) to the MODBUS addresses in the range of [0_{hex} ... FF_{hex}] and an offset of 1000_{hex} (0x01000) to the MODBUS addresses in the range of [6000_{hex} ... $62FC_{hex}$].

11.2.3.1 Function Code FC1 (Read Coils)

This function reads the status of the input and output bits (coils) in a slave device.

Request

The request specifies the reference number (starting address) and the bit count to read.
Example: Read output bits 0 to 7.

Table 71: Request of Function Code FC1

Byte	Field name	Example
Byte 0, 1	Transaction identifier	0x0000
Byte 2, 3	Protocol identifier	0x0000
Byte 4, 5	Length field	0x0006
Byte 6	Unit identifier	0x01 not used
Byte 7	MODBUS function code	0x01
Byte 8, 9	Reference number	0x0000
Byte 10, 11	Bit count	0x0008

Response

The current values of the response bits are packed in the data field. A binary 1 corresponds to the ON status and a 0 to the OFF status. The lowest value bit of the first data byte contains the first bit of the request. The others follow in ascending order. If the number of inputs is not a multiple of 8, the remaining bits of the last data byte are filled with zeroes (truncated).

Table 72: Response of Function Code FC1

Byte	Field name	Example
...		
Byte 7	MODBUS function code	0x01
Byte 8	Byte count	0x01
Byte 9	Bit values	0x12

The status of the inputs 7 to 0 is shown as byte value 0x12 or binary 0001 0010. Input 7 is the bit having the highest significance of this byte and input 0 the

lowest value.
The assignment is thus made from 7 to 0 as follows:

Table 73: Assignment of Inputs

	OFF	OFF	OFF	ON	OFF	OFF	ON	OFF
Bit	0	0	0	1	0	0	1	0
Coil	7	6	5	4	3	2	1	0

Exception

Table 74: Exception of Function Code FC1

Byte	Field name	Example
...		
Byte 7	MODBUS function code	0x81
Byte 8	Exception code	0x01 or 0x02

11.2.3.2 Function Code FC2 (Read Discrete Inputs)

This function reads the input bits from a slave device.

Request

The request specifies the reference number (starting address) and the bit count to be read.
Example: Read input bits 0 to 7

Table 75: Request of Function Code FC2

Byte	Field name	Example
Byte 0, 1	Transaction identifier	0x0000
Byte 2, 3	Protocol identifier	0x0000
Byte 4, 5	Length field	0x0006
Byte 6	Unit identifier	0x01 not used
Byte 7	MODBUS function code	0x02
Byte 8, 9	Reference number	0x0000
Byte 10, 11	Bit count	0x0008

Response

The current value of the requested bits are packed into the data field. A binary 1 corresponds to the ON status and a 0 the OFF status. The lowest value bit of the first data byte contains the first bit of the inquiry. The others follow in an ascending order. If the number of inputs is not a multiple of 8, the remaining bits of the last data byte are filled with zeroes (truncated).

Table 76: Response of Function Code FC2

Byte	Field name	Example
...		
Byte 7	MODBUS function code	0x02
Byte 8	Byte count	0x01
Byte 9	Bit values	0x12

The status of the inputs 7 to 0 is shown as a byte value 0x12 or binary 0001 0010. Input 7 is the bit having the highest significance of this byte and input 0 the lowest value. The assignment is thus made from 7 to 0 as follows:

Table 77: Assignment of Inputs

	OFF	OFF	OFF	ON	OFF	OFF	ON	OFF
Bit	0	0	0	1	0	0	1	0
Coil	7	6	5	4	3	2	1	0

Exception

Table 78: Exception of Function Code FC2

Byte	Field name	Example
...		
Byte 7	MODBUS function code	0x82
Byte 8	Exception code	0x01 or 0x02

11.2.3.3 Function Code FC3 (Read Multiple Registers)

This function reads the contents of holding registers from a slave device in word format.

Request

The request specifies the reference number (start register) and the word count (register quantity) of the registers to be read. The reference number of the request is zero based, therefore, the first register starts at address 0.
Example: Read registers 0 and 1.

Table 79: Request of Function Code FC3

Byte	Field name	Example
Byte 0, 1	Transaction identifier	0x0000
Byte 2, 3	Protocol identifier	0x0000
Byte 4, 5	Length field	0x0006
Byte 6	Unit identifier	0x01 not used
Byte 7	MODBUS function code	0x03
Byte 8, 9	Reference number	0x0000
Byte 10, 11	Word count	0x0002

Response

The reply register data is packed as 2 bytes per register. The first byte contains the higher value bits, the second the lower values.

Table 80: Response of Function Code FC3

Byte	Field name	Example
...		
Byte 7	MODBUS function code	0x03
Byte 8	Byte count	0x04
Byte 9, 10	Value register 0	0x1234
Byte 11, 12	Value register 1	0x2345

The contents of register 0 are displayed by the value 0x1234 and the contents of register 1 is 0x2345.

Exception

Table 81: Exception of Function Code FC3

Byte	Field name	Example
...		
Byte 7	MODBUS function code	0x83
Byte 8	Exception code	0x01 or 0x02

11.2.3.4 Function Code FC4 (Read Input Registers)

This function reads contents of input registers from the slave device in word format.

Request

The request specifies a reference number (start register) and the word count (register quantity) of the registers to be read. The reference number of the request is zero based, therefore, the first register starts at address 0.
Example: Read registers 0 and 1

Table 82: Request of Function Code FC4

Byte	Field name	Example
Byte 0, 1	Transaction identifier	0x0000
Byte 2, 3	Protocol identifier	0x0000
Byte 4, 5	Length field	0x0006
Byte 6	Unit identifier	0x01 not used
Byte 7	MODBUS function code	0x04
Byte 8, 9	Reference number	0x0000
Byte 10, 11	Word count	0x0002

Response

The register data of the response is packed as 2 bytes per register. The first byte has the higher value bits, the second the lower values.

Table 83: Response of Function Code FC4

Byte	Field name	Example
...		
Byte 7	MODBUS function code	0x04
Byte 8	Byte count	0x04
Byte 9, 10	Value register 0	0x1234
Byte 11, 12	Value register 1	0x2345

The contents of register 0 are shown by the value 0x1234 and the contents of register 1 is 0x2345.

Exception

Table 84: Exception of Function Code FC4

Byte	Field name	Example
...		
Byte 7	MODBUS function code	0x84
Byte 8	Exception code	0x01 or 0x02

11.2.3.5 Function Code FC5 (Write Coil)

This function writes a single output bit to the slave device.

Request

The request specifies the reference number (output address) of output bit to be written. The reference number of the request is zero based; therefore, the first coil starts at address 0.
Example: Turn ON the second output bit (address 1)

Table 85: Request of Function Code FC5

Byte	Field name	Example
Byte 0, 1	Transaction identifier	0x0000
Byte 2, 3	Protocol identifier	0x0000
Byte 4, 5	Length field	0x0006
Byte 6	Unit identifier	0x01 not used
Byte 7	MODBUS function code	0x05
Byte 8, 9	Reference number	0x0001
Byte 10	ON/OFF	0xFF
Byte 11		0x00

Response

Table 86: Response of Function Code FC5

Byte	Field name	Example
...		
Byte 7	MODBUS function code	0x05
Byte 8, 9	Reference number	0x0001
Byte 10	Value	0xFF
Byte 11		0x00

Exception

Table 87: Exception of Function Code FC5

Byte	Field name	Example
...		
Byte 7	MODBUS function code	0x85
Byte 8	Exception code	0x01, 0x02 or 0x03

11.2.3.6 Function Code FC6 (Write Single Register)

This function writes the value of one single output register to a slave device in word format.

Request

The request specifies the reference number (register address) of the first output word to be written. The value to be written is specified in the “Register Value” field. The reference number of the request is zero based; therefore, the first register starts at address 0.
Example: Write a value of 0x1234 to the second output register

Table 88: Request of Function Code FC6

Byte	Field name	Example
Byte 0, 1	Transaction identifier	0x0000
Byte 2, 3	Protocol identifier	0x0000
Byte 4, 5	Length field	0x0006
Byte 6	Unit identifier	0x01 not used
Byte 7	MODBUS function code	0x06
Byte 8, 9	Reference number	0x0001
Byte 10, 11	Register value	0x1234

Response

The reply is an echo of the inquiry.

Table 89: Response of Function Code FC6

Byte	Field name	Example
...		
Byte 7	MODBUS function code	0x06
Byte 8, 9	Reference number	0x0001
Byte 10, 11	Register value	0x1234

Exception

Table 90: Exception of Function Code FC6

Byte	Field name	Example
...		
Byte 7	MODBUS function code	0x85
Byte 8	Exception code	0x01 or 0x02

11.2.3.7 Function Code FC11 (Get Comm Event Counter)

This function returns a status word and an event counter from the slave device's communication event counter. By reading the current count before and after a series of messages, a master can determine whether the messages were handled normally by the slave.

Following each successful new processing, the counter counts up. This counting process is not performed in the case of exception replies, poll commands or counter inquiries.

Request

Table 91: Request of Function code FC11

Byte	Field name	Example
Byte 0, 1	Transaction identifier	0x0000
Byte 2, 3	Protocol identifier	0x0000
Byte 4, 5	Length field	0x0002
Byte 6	Unit identifier	0x01 not used
Byte 7	MODBUS function code	0x0B

Response

The reply contains a 2-byte status word and a 2-byte event counter. The status word only contains zeroes.

Table 92: Response of Function Code FC11

Byte	Field name	Example
...		
Byte 7	MODBUS function code	0x0B
Byte 8, 9	Status	0x0000
Byte 10, 11	Event count	0x0003

The event counter shows that 3 (0x0003) events were counted.

Exception

Table 93: Exception of Function Code FC 11

Byte	Field name	Example
...		
Byte 7	MODBUS function code	0x85
Byte 8	Exception code	0x01 or 0x02

11.2.3.8 Function Code FC15 (Write Multiple Coils)

This function sets a sequence of output bits to 1 or 0 in a slave device. The maximum number is 256 bits.

Request

The request message specifies the reference number (first coil in the sequence), the bit count (number of bits to be written), and the output data. The output coils are zero-based; therefore, the first output point is 0.

In this example 16 bits are set, starting with the address 0. The request contains 2 bytes with the value 0xA5F0, or 1010 0101 1111 0000 in binary format.

The first data byte transmits the value of 0xA5 to the addresses 7 to 0, whereby 0 is the lowest value bit. The next byte transmits 0xF0 to the addresses 15 to 8, whereby the lowest value bit is 8.

Table 94: Request of Function Code FC15

Byte	Field name	Example
Byte 0, 1	Transaction identifier	0x0000
Byte 2, 3	Protocol identifier	0x0000
Byte 4, 5	Length field	0x0009
Byte 6	Unit identifier	0x01 not used
Byte 7	MODBUS function code	0x0F
Byte 8, 9	Reference number	0x0000
Byte 10, 11	Bit count	0x0010
Byte 12	Byte count	0x02
Byte 13	Data byte1	0xA5
Byte 14	Data byte2	0xF0

Response

Table 95: Response of Function Code FC15

Byte	Field name	Example
...		
Byte 7	MODBUS function code	0x0F
Byte 8, 9	Reference number	0x0000
Byte 10, 11	Bit count	0x0010

Exception

Table 96: Exception of Function Code FC15

Byte	Field name	Example
...		
Byte 7	MODBUS function code	0x8F
Byte 8	Exception code	0x01 or 0x02

11.2.3.9 Function Code FC16 (Write Multiple Registers)

This function writes a sequence of registers in a slave device in word format.

Request

The Request specifies the reference number (starting register), the word count (number of registers to write), and the register data . The data is sent as 2 bytes per register. The registers are zero-based; therefore, the first output is at address 0.
Example: Set data in registers 0 and 1

Table 97: Request of Function Code FC16

Byte	Field name	Example
Byte 0, 1	Transaction identifier	0x0000
Byte 2, 3	Protocol identifier	0x0000
Byte 4, 5	Length field	0x000B
Byte 6	Unit identifier	0x01 not used
Byte 7	MODBUS function code	0x10
Byte 8, 9	Reference number	0x0000
Byte 10, 11	Word count	0x0002
Byte 12	Byte count	0x04
Byte 13, 14	Register value 1	0x1234
Byte 15, 16	Register value 2	0x2345

Response

Table 98: Response of Function Code FC16

Byte	Field name	Example
...		
Byte 7	MODBUS function code	0x10
Byte 8, 9	Reference number	0x0000
Byte 10, 11	Word count	0x0002

Exception

Table 99: Exception of Function Code FC16

Byte	Field name	Example
...		
Byte 7	MODBUS function code	0x85
Byte 8	Exception code	0x01 or 0x02

11.2.3.10 Function Code FC22 (Mask Write Register)

This function manipulates individual bits within a register using a combination of an AND mask, an OR mask, and the register’s current content.

Request

Table 100: Request of Function Code FC22

Byte	Field name	Example
Byte 0, 1	Transaction identifier	0x0000
Byte 2, 3	Protocol identifier	0x0000
Byte 4, 5	Length field	0x0002
Byte 6	Unit identifier	0x01 not used
Byte 7	MODBUS function code	0x16
Byte 8, 9	Reference number	0x0000
Byte 10, 11	AND mask	0x0000
Byte 12, 13	OR mask	0xAAAA

Response

Table 101: Response of Function Code FC22

Byte	Field name	Example
...		
Byte 7	MODBUS function code	0x10
Byte 8, 9	Reference number	0x0000
Byte 10, 11	AND mask	0x0000
Byte 12, 13	OR mask	0xAAAA

Exception

Table 102: Exception of Function Code FC22

Byte	Field name	Example
...		
Byte 7	MODBUS function code	0x85
Byte 8	Exception code	0x01 or 0x02

11.2.3.11 Function Code FC23 (Read/Write Multiple Registers)

This function performs a combination of a read and write operation in a single request. The function can write the new data to a group registers, and then return the data of a different group. The write operation is performed before the read.

Request

The reference numbers (addresses) are zero-based in the request message; therefore, the first register is at address 0.
The request message specifies the registers to read and write. The data is sent as 2 bytes per register.
Example: The data in register 3 is set to value 0x0123, and values 0x0004 and 0x5678 are read out of the two registers 0 and 1.

Table 103: Request of Function Code FC23

Byte	Field name	Example
Byte 0, 1	Transaction identifier	0x0000
Byte 2, 3	Protocol identifier	0x0000
Byte 4, 5	Length field	0x000D
Byte 6	Unit identifier	0x01 not used
Byte 7	MODBUS function code	0x17
Byte 8, 9	Reference number for read	0x0000
Byte 10, 11	Word count for read (1…125)	0x0002
Byte 12, 13	Reference number for write	0x0003
Byte 14, 15	Word count for write (1…100)	0x0001
Byte 16	Byte count (2 x word count for write)	0x02
Byte 17...(B+16)	Register values (B = Byte count)	0x0123

Response

Table 104: Response of Function Code FC23

Byte	Field name	Example
...		
Byte 7	MODBUS function code	0x17
Byte 8	Byte count (2 x word count for read)	0x04
Byte 9...(B+1)	Register values (B = Byte count)	0x0004 or 0x5678

Exception

Table 105: Exception of Function Code FC23

Byte	Field name	Example
...		
Byte 7	MODBUS function code	0x97
Byte 8	Exception code	0x01 or 0x02

Note

Note that if the register ranges overlap, the results are undefined!
If register areas for read and write overlap, the results are undefined.

11.2.4 MODBUS Register Mapping

The following tables display the MODBUS addressing and the internal variables.

Via the register services the states of the complex and digital I/O modules can be determined or changed.

Register Access Reading (with FC3 and FC4)

Table 106: Register Access Reading (with FC3 and FC4)

MODBUS address		IEC 61131 address	Memory range
[dec]	[hex]		
0...255	0x0000...0x00FF	%IW0...%IW255	Physical input area (1) First 256 Words of physical input data
256...511	0x0100...0x01FF	-	MODBUS exception: “Illegal data address”
512...767	0x0200...0x02FF	%QW0...%QW255	Physical output area (1) First 256 Words of physical output data
768...4095	0x0300...0x0FFF	-	MODBUS exception: “Illegal data address”
4096...12287	0x1000...0x2FFF	-	Configuration register (see Section „Configuration Register“)
12288...24575	0x3000...0x5FFF	-	MODBUS exception: “Illegal data address”
24576...25339	0x6000...0x62FB	%IW256...%IW1020	Physical input area (2) Additional 764 Words physical input data
25340...28671	0x62FC...0x6FFF	-	MODBUS exception: “Illegal data address”
28672...29435	0x7000...0x72FB	%QW256...%QW1020	Physical output area (2) Additional 764 Words physical output data
29436...65535	0x72FC...0xFFFF	-	MODBUS exception: “Illegal data address”

Register Access Writing (with FC6 and FC16)

Table 107: Register Access Writing (with FC6 and FC16)

MODBUS address		IEC 61131 address	Memory range
[dec]	[hex]		
0...255	0x0000...0x00FF	%QW0...%QW255	Physical output area (1) First 256 Words of physical output data
256...511	0x0100...0x01FF	-	MODBUS exception: “Illegal data address”
512...767	0x0200...0x02FF	%QW0...%QW255	Physical output area (1) First 256 Words of physical output data
768...4095	0x0300...0x0FFF	-	MODBUS exception: “Illegal data address”
4096...12287	0x1000...0x2FFF	-	Configuration register (see Section “Configuration Register”)
12288...24575	0x3000...0x5FFF	-	MODBUS exception: “Illegal data address”
24576...25339	0x6000...0x62FB	%QW256...%QW1020	Physical output area (2) Additional 764 Words physical output data
25340...28671	0x62FC...0x6FFF	-	MODBUS exception: “Illegal data address”
28672...29435	0x7000...0x72FB	%QW256...%QW1020	Physical output area (2) Additional 764 Words physical output data
29436...65535	0x72FC...0xFFFF	-	MODBUS exception: “Illegal data address”

The digital MODBUS services (coil services) are bit accesses, with which only the states of digital I/O modules can be determined or changed. Complex I/O modules are not attainable with these services and so they are ignored. Because of this the addressing of the digital channels begins again with 0, so that the MODBUS address is always identical to the channel number, (i.e. the digital input no. 47 has the MODBUS address "46").

Bit Access Reading (with FC1 and FC2)

Table 108: Bit Access Reading (with FC1 and FC2)

MODBUS address		Memory range	Description
[dec]	[hex]		
0...511	0x0000...0x01FF	Physical input area (1)	First 512 digital inputs
512...1023	0x0200...0x03FF	Physical output area (1)	First 512 digital outputs
1024... 12287	0x0400...0x2FFF	-	MODBUS exception: “Illegal data address”
12288...13815	0x3000...0x35F7		MODBUS exception: “Illegal data address
13816...16383	0x35F8...0x3FFF	-	MODBUS exception: “Illegal data address”
16384...17911	0x4000...0x45F7		MODBUS exception: “Illegal data address
17912...32767	0x45F8...0x7FFF	-	MODBUS exception: “Illegal data address”
	0x8000…0x85F7	Physical input area (2)	Starts with the 513th and ends with the 2039th digital input
	0x85F8…0x8FFF		MODBUS exception: “Illegal data address”
	0x9000…0x95F7	Physical output area (2)	Starts with the 513th and ends with the 2039th digital output
	0x95F8…0xFFFF		MODBUS exception: “Illegal data address”

Bit Access Writing (with FC5 and FC15)

Table 109: Bit Access Writing (with FC5 and FC15)

MODBUS address		Memory range	Description
[dec]	[hex]		
0...511	0x0000...0x01FF	Physical output area (1)	First 512 digital outputs
512...1023	0x0200...0x03FF	Physical output area (1)	First 512 digital outputs
1024...12287	0x0400...0x2FFF	-	MODBUS exception: “Illegal data address”
12288...13815	0x3000...0x35F7		MODBUS exception: “Illegal data address
13816...16383	0x35F8...0x3FFF	-	MODBUS exception: “Illegal data address”
16384...17911	0x4000...0x45F7		MODBUS exception: “Illegal data address
17912...32767	0x45F8...0x7FFF	-	MODBUS exception: “Illegal data address”
	0x8000…0x85F7	Physical output area (2)	Starts with the 513th and ends with the 2039th digital output
	0x85F8…0x8FFF		MODBUS exception: “Illegal data address”
	0x9000…0x95F7	Physical output area (2)	Starts with the 513th and ends with the 2039th digital output
	0x95F8…0xFFFF		MODBUS exception: “Illegal data address”

11.2.5 MODBUS Registers

Table 110: MODBUS Registers

Register address	Access	Length (Word)	Description
0x1000	R/W	1	Watchdog time read/write
0x1001	R/W	1 … 2	Watchdog coding mask 1…16
0x1002	R/W	1	Watchdog coding mask 17…32
0x1003	R/W	1	Watchdog trigger
0x1004	R	1	Minimum trigger time
0x1005	R/W	1	Watchdog stop (Write sequence 0xAAAA, 0x5555)
0x1006	R	1	Watchdog status
0x1007	R/W	1	Restart watchdog (Write sequence 0x1)
0x1008	R/W	1	Stop watchdog (Write sequence 0x55AA or 0xAA55)
0x1009	R/W	1	MODBUS and HTTP close at watchdog time-out
0x100A	R/W	1	Watchdog configuration
0x100B	W	1	Save watchdog parameter (Write sequence 0x55AA or 0xAA55)
0x1020	R	1 … 2	LED error code
0x1021	R	1	LED error argument
0x1022	R	1 … 4	Number of analog output data in the process image (in bits)
0x1023	R	1 … 3	Number of analog input data in the process image (in bits)
0x1024	R	1 … 2	Number of digital output data in the process image (in bits)
0x1025	R	1	Number of digital input data in the process image (in bits)
0x1028	R/W	1	Boot configuration
0x1029	R/W	1 … 9	MODBUS/TCP statistics (Write sequence 0x55AA or 0xAA55)
0x102A	R	1	Number of TCP connections
0x102B	W	1	KBUS Reset
0x1030	R/W	1	Configuration MODBUS/TCP time-out
0x1031	R	1 … 3	Read out the MAC-ID of the coupler/controller
0x1037	R/W	1	Modbus Response Delay (ms)
0x1050	R	3	Diagnosis of the connected I/O modules
0x2000	R	1 … 9	Constant 0x0000
0x2001	R	1 … 8	Constant 0xFFFF
0x2002	R	1 … 7	Constant 0x1234
0x2003	R	1 … 6	Constant 0xAAAA
0x2004	R	1 … 5	Constant 0x5555
0x2005	R	1 … 4	Constant 0x7FFF
0x2006	R	1 … 3	Constant 0x8000
0x2007	R	1 … 2	Constant 0x3FFF
0x2008	R	1	Constant 0x4000
0x2010	R	1	Firmware version
0x2011	R	1	Series code
0x2012	R	1	Coupler/controller code
0x2013	R	1	Firmware version major revision
0x2014	R	1	Firmware version minor revision

Table 111: MODBUS registers (Continuation)

Register address	Access	Length (Word)	Description
0x2020	R	1 … 16	Short description controller
0x2021	R	1 … 8	Compile time of the firmware
0x2022	R	1 … 8	Compile date of the firmware
0x2023	R	1 … 32	Indication of the firmware loader
0x2030	R	1 … 65	Description of the connected I/O modules (module 0…64)
0x2031	R	1 … 64	Description of the connected I/O modules (module 65…128)
0x2032	R	1 … 64	Description of the connected I/O modules (module 129…192)
0x2033	R	1 … 63	Description of the connected I/O modules (module 193…255)
0x2040	W	1	Software reset (Write sequence 0x55AA or 0xAA55)
0x2041	W	1	Format flash disk
0x2042	W	1	Extract HTML sides from the firmware
0x2043	W	1	Factory settings

11.2.5.1 Accessing Register Values

You can use any MODBUS application to access (read from or write to) register values. Both commercial (e.g., “Modscan”) and free programs (from http://www.modbus.org/tech.php) are available.

The following sections describe how to access both the registers and their values.

11.2.5.2 Watchdog Registers

The watchdog monitors the data transfer between the fieldbus master and the coupler/controller. Every time the coupler/controller receives a specific request (as define in the watchdog setup registers) from the master, the watchdog timer in the coupler/controller resets.

In the case of fault free communication, the watchdog timer does not reach its end value. After each successful data transfer, the timer is reset.

If the watchdog times out, a fieldbus failure has occurred. In this case, the fieldbus coupler/controller answers all following MODBUS TCP/IP requests with the exception code 0x0004 (Slave Device Failure).

In the coupler/controller special registers are used to setup the watchdog by the master (Register addresses 0x1000 to 0x1008).

By default, the watchdog is not enabled when you turn the coupler/controller on. To activate it, the first step is to set/verify the desired time-out value of the Watchdog Time register (0x1000). Second, the function code mask must be specified in the mask register (0x1001), which defines the function code(s) that will reset the timer for the first time. Finally, the Watchdog-Trigger register (0x1003) or the register 0x1007 must be changed to a non-zero value to start the timer subsequently.

Reading the Minimum Trigger time (Register 0x1004) reveals whether a watchdog fault occurred. If this time value is 0, a fieldbus failure is assumed. The timer of watchdog can manually be reset, if it is not timed out, by writing a value of 0x1 to the register 0x1003 or to the Restart Watchdog register 0x1007.

After the watchdog is started, it can be stopped by the user via the Watchdog Stop register (0x1005) or the Simply Stop Watchdog register (0x1008).

11.2.5.3 Modbus Watchdog Register

The watchdog registers can be addressed analogously with the described Modbus function codes (read and write). Instead of the address of an I/O module channel, the respective register address is therefor specified.

Table 112: Register Address 0x1000

Register address 0x1000 (4096$_{dec}$)	
Value	Watchdog time, WS_TIME
Access	Read/write
Default	0x0064
Description	This register stores the watchdog timeout value as an unsigned 16 bit value. The default value is 0. Setting this value will not trigger the watchdog. However, a non zero value must be stored in this register before the watchdog can be triggered. The time value is stored in multiples of 100ms (e.g., 0x0009 is .9 seconds). It is not possible to modify this value while the watchdog is running.

Table 113: Register Address 0x1001

Register address 0x1001 (4097$_{dec}$)	
Value	Watchdog function coding mask, function code 1...16, WDFCM_1_16
Access	Read/write
Default	0xFFFF
Description	Using this mask, the function codes can be set to trigger the watchdog function. The function code can be selected via a "1" FC 1 Bit 0 FC 2 Bit 1 FC 3 Bit 2 FC 4 Bit 3 FC 5 Bit 4 ... FC 16 Bit 15 Changes to the register value can only be made if the watchdog is deactivated. The bit pattern stored in the register defines the function codes that trigger the watchdog. Some function codes are not supported. For those the watchdog will not be triggered even if another Modbus device transmits one of them. When switching the watchdog type from "Standard" to "Alternative", the coding mask is reset to default value 0xFFFF.

Table 114: Register Address 0x1002

Register address 0x1002 (4098$_{dec}$)	
Value	Watchdog function coding mask, function code 17...32, WD_FCM_17_32
Access	Read/write
Default	0xFFFF
Description	Same function as above, however, with the function codes 17 to 32. FC 17 Bit 0 FC 18 Bit 1 ... FC 32 Bit 15 These codes are currently not supported, for this reason the default value should not be changed. Changes to the register value can only be made if the watchdog is deactivated. It is not possible to modify this value while the watchdog is running.

Table 115: Register Address 0x1003

Register address 0x1003 (4099$_{dec}$)	
Value	Watchdog trigger, WD_TRIGGER
Access	Read/write
Standard	0x0000
Description	This register is used for an alternative trigger method. The watchdog is triggered by writing different values in this register. Values following each other must differ in size. Writing of a value not equal to zero starts the watchdog after a Power-on. For a restart the written value must necessarily be unequal the before written value! A watchdog fault is reset and writing process data is possible again.

Table 116: Register Address 0x1004

Register address 0x1004 (4100$_{dez}$)	
Value	Minimum current trigger time, WD_AC_TRG_TIME
Access	Read
Standard	0xFFFF
Description	This register saves the minimum current watchdog trigger time. For user this register is irrelevant.

Table 117: Register Address 0x1005

Register address 0x1005 (4101$_{dez}$)	
Value	Stop watchdog, WD_AC_STOP_MASK
Access	Read/write
Standard	0x0000
Description	The watchdog is stopped if here the value 0xAAAA is written first, followed by 0x5555. The watchdog fault reaction is blocked. A watchdog fault is reset and writing on the process data is possible again.

Table 118: Register Address 0x1006

Register address 0x1006 (4102$_{dez}$)	
Value	While watchdog is running, WD_RUNNING
Access	Read
Standard	0x0000
Description	Current watchdog status. at 0x0000: Watchdog not active at 0x0001: Watchdog active at 0x0002: Watchdog exhausted.

Table 119: Register Address 0x1007

Register address 0x1007 (4103$_{dez}$)	
Value	Restart watchdog, WD_RESTART
Access	Read/write
Standard	0x0000
Description	This register restarts the watchdog timer after time out by writing a value of 0x1 into it. If the watchdog was stopped before the time out, it is not restarted.

Table 120: Register Address 0x1008

Register address 0x1008 (4104$_{dez}$)	
Value	Simply stop watchdog, WD_AC_STOP_SIMPLE
Access	Read/write
Standard	0x0000
Description	This register stops the watchdog by writing the value 0xAA55 or 0x55AA into it. The watchdog timeout fault is deactivated and it is possible to write in the watchdog register again. If there is an existing watchdog fault, it is reset

Table 121: Register Address 0x1009

Register address 0x1009 (4105$_{dez}$)	
Value	Close Modbus socket after watchdog timeout
Access	Read/write
Standard	0x0000
Description	0: Modbus socket is not closed 1: Modbus socket is closed

Table 122: Register Address 0x100A

Register address 0x100A (4106$_{dez}$)	
Value	Watchdog type Standard/Alternative
Access	Read/write
Standard	0x0000
Description	0: Modbus watchdog type “Standard” 1: Modbus watchdog type “Alternative”

The length of each register is 1 word; i.e., with each access only one word can be written or read. Following are two examples of how to set the value for a time overrun:

Setting the watchdog for a timeout of more than 1 second:

1. Write 0x000A in the register for time overrun (0x1000).
   Register 0x1000 works with a multiple of 100 ms;
   1 s = 1000 ms; 1000 ms / 100 ms = 10_{dec} = A_{hex})

2. Use the function code 5 to write 0x0010 (=$2^{(5-1)}$) in the coding mask (register 0x1001).

Table 123: Starting Watchdog

FC	FC16	FC15	FC14	FC13	FC12	FC11	FC10	FC9	FC8	FC7	FC6	**FC5**	FC4	FC3	FC2	FC1
Bit	15	14	13	12	11	10	9	8	7	6	5	**4**	3	2	1	0
bin	0	0	0	0	0	0	0	0	0	0	0	**1**	0	0	0	0
hex	0				0				**1**				0			

Function code 5 (writing a digital output bit) continuously triggers the watchdog to restart the watchdog timer again and again within the specified time. If time between requests exceeds 1 second, a watchdog timeout error occurs.

3. To stop the watchdog, write the value 0xAA55 or 0x55AA into 0x1008 (Simply Stop Watchdog register, WD_AC_STOP_SIMPLE).

Setting the watchdog for a timeout of 10 minutes or more:

1. Write 0x1770 (= 10*60*1000 ms / 100 ms) in the register for time overrun (0x1000).
   (Register 0x1000 works with a multiple of 100 ms;
   10 min = 600,000 ms; 600,000 ms / 100 ms = 6000dec = 1770hex)

2. Write 0x0001 in the watchdog trigger register (0x1003) to start the watchdog.

3. Write different values (e.g., counter values 0x0000, 0x0001) in the watchdog to trigger register (0x1003).

Values following each other must differ in size. Writing of a value not equal to zero starts the watchdog. Watchdog faults are reset and writing process data is possible again.

4. To stop the watchdog, write the value 0xAA55 or 0x55AA into 0x1008 (Simply Stop Watchdog register, WD_AC_STOP_SIMPLE).

Table 124: Register Address 0x100B

Register address 0x100B (4107$_{dez}$)	
Value	Save watchdog parameter
Access	Write
Standard	0x0000
Description	With writing of '0x55AA' or '0xAA55' in register 0x100B the registers 0x1000, 0x1001, 0x1002 are set on remanent.

11.2.5.4 Diagnostic Registers

The following registers can be read to determine errors in the node:

Table 125: Register Address 0x1020

Register address 0x1020 (4128$_{dec}$)	
Value	LedErrCode
Access	Read
Description	Declaration of the error code

Table 126: Register Address 0x1021

Register address 0x1021 (4129$_{dec}$)	
Value	LedErrArg
Access	Read
Description	Declaration of the error argument

11.2.5.5 Configuration Registers

The following registers contain configuration information of the connected modules:

Table 127: Register Address 0x1022

Register address 0x1022 (4130$_{dec}$)	
Value	CnfLen.AnalogOut
Access	Read
Description	Number of word-based outputs registers in the process image in bits (divide by 16 to get the total number of analog words)

Table 128: Register Address 0x1023

Register address 0x1023 (4131$_{dec}$)	
Value	CnfLen.AnalogInp
Access	Read
Description	Number of word-based inputs registers in the process image in bits (divide by 16 to get the total number of analog words)

Table 129: Register Address 0x1024

Register address 0x1024 (4132$_{dec}$)	
Value	CnfLen.DigitalOut
Access	Read
Description	Number of digital output bits in the process image

Table 130: Register Address 0x1025

Register address 0x1025 (4133$_{dec}$)	
Value	CnfLen.DigitalInp
Access	Read
Description	Number of digital input bits in the process image

Table 131: Register Address 0x1028

Register address 0x1028 (4136$_{dec}$)	
Value	Boot options
Access	Read/write
Description	Boot configuration: 1: BootP 2: DHCP 3: BootP-Request before static IP 4: EEPROM

Table 132: Register Address 0x1029

Register Address 0x1029 (4137$_{dec}$) with 9 Words		
Value	MODBUS TCP statistics	
Access	Read/write	
Description	1 word SlaveDeviceFailure	→ local bus error, fieldbus error by activated watchdog
	1 word BadProtocol	→ error in the MODBUS TCP header
	1 word BadLength	→ Wrong telegram length
	1 word BadFunction	→ Invalid function code
	1 word BadAddress	→ Invalid register address
	1 word BadData	→ Invalid value
	1 word TooManyRegisters	→ Number of the registers which can be worked on is too large, Read/Write 125/100
	1 word TooManyBits	→ Number of the coils which can be worked on is too large, Read/Write 2000/800
	1 word ModTcpMessageCounter	→ Number of received MODBUS/TCP requests
	By writing 0xAA55 or 0x55AA the register is reset.	

Table 133: Register Address 0x102A

Register address 0x102A (4138$_{dec}$) with a word count of 1	
Value	MODBUS/TCP connections
Access	Read
Description	Number of TCP connections

Table 134: Register Address 0x102B

Register Address 0x102B (4139$_{dez}$) with a Word Count of up to 1	
Value	Local bus reset
Access	Write
Description	Writing of this register restarts the local bus

Table 135: Register Address 0x1030

Register address 0x1030 (4144$_{dec}$) with a word count of 1	
Value	Configuration MODBUS/TCP time-out
Access	Read/write
Default	0x0258 (600 decimal)
Description	This is the maximum number of milliseconds the fieldbus coupler will allow a MODBUS/TCP connection to stay open without receiving a MODBUS request. Upon time-out, idle connection will be closed. Outputs remain in last state. Default value is 600 ms (60 seconds), the time base is 100 ms, the minimal value is 100 ms. If the value is set to ‘0’, the timeout is disabled. On this connection, the watchdog is triggered with a request.

Table 136: Register Address 0x1031

Register address 0x1031 (4145$_{dec}$) with a word count of 3	
Value	Read the MAC-ID of the controller
Access	Read
Description	This register gives the MAC-ID, with a length of 3 words

Table 137: Register Address 0x1037

Register address 0x1037 (4151_{dez}) with a word count of 3	
Value	Configuration of Modbus Response Delay Time
Access	Read/write
Default	0x0000
Description	This register saves the value for the Modbus Response Delay Time for a Modbus connection. The time base is 1 ms. On the Modbus TCP connection, the response will be delayed by the inscribed time.

Table 138: Register Address 0x1050

Register address 0x1050 (4176_{dec}) with a word count of 3	
Value	Diagnosis of the connected I/O modules
Access	Read
Description	Diagnosis of the connected I/O modules, length 3 words Word 1: Number of the module Word 2: Number of the channel Word 3: Diagnosis

Table 139: Register Address 0x2030

Register address 0x2030 (8240_{dec}) with a word count of up to 65	
Value	Description of the connected I/O modules
Access	Read module 0...64
Description	Length 1...65 words The node configuration can be specified in the 0x2030 register. The item number of the I/O modules or fieldbus coupler/controller (without leading 750) is listed in order. Each module is represented in a word. Because order numbers cannot be read out of digital modules, a code is displayed for them, as defined below: Bit position 0 → Input module Bit position 1 → Output module Bit position 2…7 → Not used Bit position 8…14→ Module size in bits Bit position 15 → Designation digital module

Examples:

4 Channel Digital Input Module = 0x8401

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Code	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
Hex	8				4				0				1			

2 Channel Digital Output Module = 0x8202

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Code	1	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0
Hex	8				2				0				2			

Table 140: Register Address 0x2031

Register address 0x2031 (8241$_{dec}$) with a word count of up to 65	
Value	Description of the connected I/O modules
Access	Read modules 65...128
Description	Length 1…64 words The node configuration can be specified in the 0x2031 register. The item number of the I/O modules or fieldbus coupler/controller (without leading 750) is listed in order. Because order numbers cannot be read out of digital modules, a code is displayed for them, as defined below: Bit position 0 → Input module Bit position 1 → Output module Bit position 2…7 → Not used Bit position 8…14→ Module size in bits Bit position 15 → Designation digital module

Table 141: Register Address 0x2032

Register address 0x2032 (8242$_{dec}$) with a word count of up to 65	
Value	Description of the connected I/O modules
Access	Read modules 129...192
Description	Length 1…64 words The node configuration can be specified in the 0x2032 register. The item number of the I/O modules or fieldbus coupler/controller (without leading 750) is listed in order. Because order numbers cannot be read out of digital modules, a code is displayed for them, as defined below: Bit position 0 → Input module Bit position 1 → Output module Bit position 2…7 → Not used Bit position 8…14→ Module size in bits Bit position 15 → Designation digital module

Table 142: Register Address 0x2033

Register address 0x2033 (8243$_{dec}$) with a word count of up to 65	
Value	Description of the connected I/O modules
Access	Read modules 193 ... 255
Description	Length 1…63 words The node configuration can be specified in the 0x2033 register. The item number of the I/O modules or fieldbus coupler/controller (without leading 750) is listed in order. Because order numbers cannot be read out of digital modules, a code is displayed for them, as defined below: Bit position 0 → Input module Bit position 1 → Output module Bit position 2…7 → Not used Bit position 8…14→ Module size in bits Bit position 15 → Designation digital module

Table 143: Register Address 0x2040

Register address 0x2040 (8256$_{dec}$)	
Value	Implement a software reset
Access	Write (Write sequence 0xAA55 or 0x55AA)
Description	The fieldbus coupler/controller performs a restart by writing the values 0xAA55 or 0x55AA.

Table 144: Register Address 0x2041

Register address 0x2041 (8257$_{dez}$)	
Value	Flash format
Access	Write (Write sequence 0xAA55 or 0x55AA)
Description	The file system Flash is again formatted.

Table 145: Register Address 0x2042

Register address 0x2042 (8258$_{dez}$)	
Value	Extract data files
Access	Write (Write sequence 0xAA55 or 0x55AA)
Description	The standard files (HTML pages) of the Coupler/Controller are extracted and written into the Flash.

Table 146: Register Address 0x2043

Register address 0x2043 (8259$_{dez}$)	
Value	0x55AA
Access	Write
Description	Factory settings The default settings are applied after the next reset, e.g., software reset via MODBUS register address 0x2040.

11.2.5.6 Firmware Information Registers

The following registers contain information on the firmware of the controller:

Table 147: Register Address 0x2010

Register address 0x2010 (8208$_{dec}$) with a word count of 1	
Value	Revision, INFO_REVISION
Access	Read
Description	Firmware index, e.g. 0x0005 for version 5

Table 148: Register Address 0x2011

Register address 0x2011 (8209$_{dec}$) with a word count of 1	
Value	Series code, INFO_SERIES
Access	Read
Description	WAGO serial number, e.g. 0x02EE (750 dec.) for WAGO-I/O-SYSTEM 750

Table 149: Register Address 0x2012

Register address 0x2012 (8210$_{dec}$) with a word count of 1	
Value	Order number, INFO_ITEM
Access	Read
Description	First part of WAGO order number, e.g. 0x0349 (841 dec.) for the controller 750-841 or 0x0155 (341 dec.) for the coupler 750-341 etc.

Table 150: Register Address 0x2013

Register address 0x2013 (8211$_{dec}$) with a word count of 1	
Value	Major sub item code, INFO_MAJOR
Access	Read
Description	Firmware version major revision

Table 151: Register Address 0x2014

Register address 0x2014 (8212$_{dec}$) with a word count of 1	
Value	Minor sub item code, INFO_MINOR
Access	Read
Description	Firmware version minor revision

Table 152: Register Address 0x2020

Register address 0x2020 (8224$_{dec}$) with a word count of up to 16	
Value	Description, INFO_DESCRIPTION
Access	Read
Description	Information on the controller, 16 words

Table 153: Register Address 0x2021

Register address 0x2021 (8225$_{dec}$) with a word count of up to 8	
Value	Description, INFO_DESCRIPTION
Access	Read
Description	Time of the firmware version, 8 words

Table 154: Register Address 0x2022

Register address 0x2022 (8226$_{dec}$) with a word count of up to 8	
Value	Description, INFO_DATE
Access	Read
Description	Date of the firmware version, 8 words

Table 155: Register Address 0x2023

Register address 0x2023 (8227$_{dec}$) with a word count of up to 32	
Value	Description, INFO_LOADER_INFO
Access	Read
Description	Information to the programming of the firmware, 32 words

11.2.5.7 Constant Registers

The following registers contain constants, which can be used to test communication with the master:

Table 156: Register Address 0x2000

Register address 0x2000 (8192$_{dec}$)	
Value	Zero, GP_ZERO
Access	Read
Description	Constant with zeros

Table 157: Register Address 0x2001

Register address 0x2001 (8193$_{dec}$)	
Value	Ones, GP_ONES
Access	Read
Description	Constant with ones • –1 if this is declared as "signed int" • MAXVALUE if it is declared as "unsigned int"

Table 158: Register Address 0x2002

Register address 0x2002 (8194$_{dec}$)	
Value	1,2,3,4, GP_1234
Access	Read
Description	This constant value is used to test the Intel/Motorola format specifier. If the master reads a value of 0x1234, then with Intel format is selected – this is the correct format. If 0x3412 appears, Motorola format is selected.

Table 159: Register Address 0x2003

Register address 0x2003 (8195$_{dec}$)	
Value	Mask 1, GP_AAAA
Access	Read
Description	This constant is used to verify that all bits are accessible to the fieldbus master. This will be used together with register 0x2004.

Table 160: Register Address 0x2004

Register address 0x2004 (8196$_{dec}$)	
Value	Mask 1, GP_5555
Access	Read
Description	This constant is used to verify that all bits are accessible to the fieldbus master. This will be used together with register 0x2003.

Table 161: Register Address 0x2005

Register address 0x2005 (8197$_{dec}$)	
Value	Maximum positive number, GP_MAX_POS
Access	Read
Description	Constant in order to control arithmetic.

Table 162: Register Address 0x2006

Register address 0x2006 (8198$_{dec}$)	
Value	Maximum negative number, GP_MAX_NEG
Access	Read
Description	Constant in order to control arithmetic

Table 163: Register Address 0x2007

Register address 0x2007 (8199$_{dec}$)	
Value	Maximum half positive number, GP_HALF_POS
Access	Read
Description	Constant in order to control arithmetic

Table 164: Register Address 0x2008

Register address 0x2008 (8200$_{dec}$)	
Value	Maximum half negative number, GP_HALF_NEG
Access	Read
Description	Constant in order to control arithmetic

11.3 EtherNet/IP (Ethernet/Industrial Protocol)

11.3.1 General

EtherNet/IP stands for Ethernet Industrial Protocol and defines an open industry standard that extends the classic Ethernet with an industrial protocol. This standard was jointly developed by ControlNet International (CI) and the Open DeviceNet Vendor Association (ODVA) with the help of the Industrial Ethernet Association (IEA).

This communication system enables devices to exchange time-critical application data in an industrial environment. The spectrum of devices ranges from simple I/O devices (e.g., sensors) through to complex controllers (e.g., robots).

EtherNet/IP is based on the TCP/IP protocol family and consequently uses the bottom 4 layers of the OSI layer model in unaltered form so that all standard Ethernet communication modules such as PC interface cards, cables, connectors, hubs and switches can also be used with EtherNet/IP.
Positioned above the transport layer is the encapsulation protocol, which enables use of the Control & Information Protocol (CIP) on TCP/IP and UDP/IP.

CIP, as a major network independent standard, is already used with ControlNet and DeviceNet. Therefore, converting from one of these protocols to EtherNet/IP is easy to do. Data exchange takes place with the help of an object model.

In this way, ControlNet, DeviceNet and EtherNet/IP have the same application protocol and can therefore jointly use device profiles and object libraries. These objects enable plug-and-play interoperability between complex devices of different manufacturers.

11.3.2 Protocol overview in the OSI model

In order to clarify the interrelationships between DeviceNet, ControlNet and EtherNet/IP, the following diagram presents the associated ISO/OSI reference model.

Table 165: ISO/OSI reference model

<table>
<tr><td>7
Application Layer</td><td colspan="3">Object Library
(Communications, Applications, Time Synchronization)</td><td>Safety Object Library</td><td rowspan="3">Comon Industrial Protocol (CIP)</td></tr>
<tr><td>6
Presentation Layer</td><td colspan="3">Data Management Services
Explicit and I/O Messages</td><td>Safety Services and Messages</td></tr>
<tr><td>5
Session Layer</td><td colspan="4">Connection Management, Routing</td></tr>
<tr><td>4
Transport Layer</td><td>TCP/UDP</td><td rowspan="2">CompoNet
Network and Transport</td><td rowspan="2">ControlNet
Network and Transport</td><td rowspan="2">DeviceNet
Network and Transport</td><td rowspan="4">Network Adaptations of CIP</td></tr>
<tr><td>3
Network Layer</td><td>Internet Protocol</td></tr>
<tr><td>2
Data Link Layer</td><td>Ethernet
CSMA/CD</td><td>CompoNet
Time Slot</td><td>ControlNet
CTDMA</td><td>CAN
CSMA/NBA</td></tr>
<tr><td>1
Physical Layer</td><td>Ethernet</td><td>CompoNet</td><td>ControlNet</td><td>DeviceNet</td></tr>
</table>

11.3.3 Characteristics of the EtherNet/IP Protocol Software

The EtherNet/IP product classes are divided into 4 levels with each level containing a particular functionality. Each higher level in turn possesses at least the functionality of a lower level. The fieldbus coupler supports levels 1 and 2 of the EtherNet/IP product classes, which immediately build on each other.

Level 2 (containing Level 1)	Level 2: Level 1 + I/O Messages Server
Level 1	Level 1: Explicit Messages Server

- Unconnected Message Manager (UCMM) client and server
- 38 "Encapsulation Protocol Sessions"
- 6 Class 3 Connections ("Explicit Message")
- 3 Class 1 Connections ("Implicit Message")

11.3.4 EDS File

The “Electronic Data Sheets” file (EDS file for short) contains the characteristics of the fieldbus coupler/controller and information regarding its communication capabilities. The EDS file required for EtherNet/IP operation is imported and installed by the corresponding configuration software.

Note

Downloading the EDS file!
You can download the EDS file in the download area of the WAGO web site: http://www.wago.com.

Information

Information about installing the EDS file
When installing the EDS file, refer to the information provided in the documentation of the configuration software, which you are using.

11.3.5 Object Model

11.3.5.1 General

For network communication, EtherNet/IP utilizes an object model in which all functions and data of a device are described.
Each node in the network is depicted as a collection of objects.
The object model contains terms that are defined as follows:

Object:
An object is an abstract representation of individual, related components within a device. It is determined by its data or attributes, its outwardly applied functions or services, and by its defined behavior.

Class:
A class describes a series of objects which all represent the same type of system components. A class is the generalization of an object. All objects in a class are identical as regards form and behavior, but can comprise differing attribute values.

Instance:
An instance describes a specific and physical occurrence of an object. The terms “object,” “instance” and “object instance” all refer to a specific instance. Different instances of a class have the same services, the same behavior and the same variables (attributes). However, you can have different variable values.
For example, Finland is an instance of the “Land” object class.

Variable:
The variables (attributes) describe an externally visible characteristic or the function of an object. Typical attributes include configuration or status information.
For example, the ASCII name of an object or the repetition frequency of a periodic object is output.

Service:
A service is a function supported by an object and/or an object class. CIP defines a group of common services that are applied to the attributes. These services execute specified actions.
Example: Reading variables.

Behavior:
The behavior specifies how an object functions. The functions result from various occurrences, which are determined by the object, e.g. receiving service requests, recording internal errors or the sequence of timers.

11.3.5.2 Class Overview

CIP classes are included in the CIP specification of ODVA. They describe the properties (Volume 1, "Common Industrial Protocol") of Ethernet and CAN independent of their physical interface. The physical interface is described in a separate specification. For EtherNet/IP, this is Volume 2 ("EtherNet/IP Adaptation of CIP"), which describes the adaption of EtherNet /IP to CIP.

For this purpose, WAGO uses classes 01_{hex}, 02_{hex}, 04_{hex}, 05_{hex}, 06_{hex} and $F4_{hex}$, which are described in Volume 1 ("Common Industrial Protocol").
Classes $F5_{hex}$ and $F6_{hex}$ are supported from Volume 2 ("EtherNet/IP Adaptation of CIP").

WAGO-specific classes listed in the overview table below are also available.

All CIP Common classes listed and the WAGO-specific classes listed below that are described in detail in the following individual sections after a brief explanation of the table headings in the object descriptions.

Table 166: CIP common class

Class	Name
01_{hex}	Identity
02_{hex}	Message Router
04_{hex}	Assembly
05_{hex}	Connection
06_{hex}	Connection Manager
$F4_{hex}$	Port Class Object
$F5_{hex}$	TCP/IP Interface Object
$F6_{hex}$	Ethernet Link Object

Table 167: WAGO specific classes

Class	Name
64_{hex}	Coupler/Controller Configuration Object
65_{hex}	Discrete Input Point
66_{hex}	Discrete Output Point
67_{hex}	Analog Input Point
68_{hex}	Analog Output Point
69_{hex}	Discrete Input Point Extended 1
$6A_{hex}$	Discrete Output Point Extended 1
$6B_{hex}$	Analog Input Point Extended 1
$6C_{hex}$	Analog Output Point Extended 1
$6D_{hex}$	Discrete Input Point Extended 2
$6E_{hex}$	Discrete Output Point Extended 2
$6F_{hex}$	Analog Input Point Extended 2
70_{hex}	Analog Output Point Extended 2
71_{hex}	Discrete Input Point Extended 3

72_{hex}	Discrete Output Point Extended 3
73_{hex}	Analog Input Point Extended 3
74_{hex}	Analog Output Point Extended 3
80_{hex}	Module Configuration
81_{hex}	Module Configuration Extended 1

11.3.5.3 Explanation of the Table Headings in the Object Descriptions

Table 168: Explanation of the table headings in the object descriptions

Table heading	Description
Attribute ID	Integer value which is assigned to the corresponded attribute
Access	**Set:** The attribute can be accessed by means of Set_Attribute services. **Note** **Response also possible with Get_Attribute service!** All the set attributes can also be accessed by means of Get_Attribute services. **Get:** The attribute can be accessed by means of Get_Attribute services. **Get_Attribute_All:** Delivers content of all attributes. **Set_Attribute_Single:** Modifies an attribute value. **Reset:** Performs a restart. 0: Restart 1: Restart and restoration of factory settings
NV	**NV (non volatile):** The attribute is permanently stored in the controller.
	V (volatile): The attribute is not permanently stored in the controller. **Note** **Without specifying, the attribute is not saved!** If this column is missing, all attributes have the type V (volatile).
Name	Designation of the attribute
Data type	Designation of the CIP data type of the attribute
Description	Short description for the Attribute
Default value	Factory settings

11.3.5.4 Identity (01_{hex})

The “Identity” class provides general information about the fieldbus coupler/controller that clearly identifies it.

Instance 0 (Class Attributes)

Table 169: Identity (01 hex) – Class

Attribute ID	Access	Name	Data type	Description	Default value
1	Get	Revision	UINT	Revision of this object	1 (0x0001)
2	Get	Max Instance	UINT	Maximum number of instances	1 (0x0001)
3	Get	Number of Instances	UINT	Number of Instances	1 (0x0001)
4	Get	Max ID number of instance attribute	UINT	Maximum number of instance attributes	0 (0x0000)

Instance 1

Table 170: Identity (01 hex) – Instance 1

Attribute ID	Access	Name	Data type	Description	Default value
1	Get	Vendor ID	UINT	Manufacturer identification	40 (0x0028)
2	Get	Device Type	UINT	General type designation of the product	12 (0x000C)
3	Get	Product Code	UINT	Designation of the coupler/ controller	750-352/040-000 (in hex)
4	Get	Revision	STRUCT of:	Revision of the identity objects	Depending on the firmware
		Major Revision	UINT		
		Minor Revision	UINT		
5	Get	Status	WORD	Current status of the device	Bit 0 Assignment to a master Bit 1 = 0 reserved Bit 2 (configured) = 0 Configuration is unchanged = 1 Configuration is different to the manufacturers parameters Bit 3 = 0 reserved Bit 4-7 Extended Device Status =0010 at least one faulted I/O connection =0011 no I/O connection established Bit 8-11 not used Bit 12-15 =0 reserved
6	Get	Serial Number	UINT	Serial number	Manufacturer specific Serial number incl. the last 4 digits of MAC ID: "NNNNNNNNNN - DEXXXXXX"
7	Get	Product Name	SHORT_ STRING	Product name	WAGO 750-352/040-000 FC ETHERNET G3 XTR

Common Services

Table 171: Identity (01 hex) – Common service

Service code	Service available		Service name	Description
	Class	Instance		
01 hex	Yes	Yes	Get_Attribute_All	Supplies contents of all attributes
05 hex	No	Yes	Reset	Implements the reset service Service parameter 0: Emulates a Power On reset 1: Emulates a Power On reset and re-establishes factory settings
0E hex	No	Yes	Get_Attribute_Single	Supplies contents of the appropriate attribute

11.3.5.5 Message Router (02 hex)

The “Message Router Object” provides connection points (in the form of classes or instances), which can use a client for addressing services (reading, writing). These messages can be transmitted both when connected and when unconnected from the client to the fieldbus coupler.

Instance 0 (Class Attributes)

Table 172: Message router (02 hex) – Class

Attribute ID	Access	Name	Data type	Description	Default value
1	Get	Revision	UINT	Revision of this object	1 (0x0001)
2	Get	Max Instance	UINT	Maximum number of Instances	1 (0x0001)
3	Get	Number of Instances	UINT	Number of Instances	1 (0x0001)
4	Get	Max ID Number of Class Attributes	UINT	Maximum number of class attributes	0 (0x0000)
5	Get	Max ID Number of Instance Attributes	UINT	Maximum number of instance attributes	0 (0x0000)

Note

Get_Attribute_All service can only be used!
The class attributes are only accessible with the Get_Attribute_All service.

Instance 1

Table 173: Message router (02 hex) – Instance 1

Attribute ID	Access	Name	Data type	Description	Default value
1	Get	Object_list	STRUCT of:	-	
		Number	UINT	Number of implemented classes	40 (0x0028)
		Classes	UINT	Implemented classes	01 00 02 00 04 00 06 00 F4 00 F5 00 F6 00 64 00 65 0066 0067 00 68 00 69 00 6A 00 6B 00 6C 00 6D 00 6E 00 6F 00 70 00 71 00 72 00 73 00 74 00 80 00 81 00 A0 00 A1 00 A2 00 A6 00 A7 00 AA 00 AB 00 A3 00 A4 00 A5 00 A8 00 A9 00 AC 00 AD 00
2	Get	Number Available	UINT	Maximum number of different connections	128 (0x0080)

Common Services

Table 174: Message router (02 hex) – Common service

Service code	Service available		Service-Name	Description
	Class	Instance		
01 hex	Yes	No	Get_Attribute_All	Supplies contents of all attributes
0E hex	No	Yes	Get_Attribute_Single	Supplies contents of the appropriate attribute

11.3.5.6 Assembly Object (04 hex)

By means of the assembly classes, even several diverse objects can be combined. These could be, for example, input and output data, status and control information or diagnostic information. WAGO uses the manufacturer-specific instances in order to provide these objects for you in various arrangements. This gives you an efficient way to exchange process data. The following is a description of the individual static assembly instances with their contents and arrangements.

Static Assembly Instances – Overview

Table 175: Static assembly instances – Overview

Instance	Description
Instance 101 (65 hex)	for analog and digital output data
Instance 102 (66 hex)	for digital output data
Instance 103 (67 hex)	for analog output data
Instance 104 (68 hex)	for analog and digital input data and status
Instance 105 (69 hex)	for digital input data and status
Instance 106 (6A hex)	for analog input data and status
Instance 107 (6B hex)	for analog and digital input data
Instance 108 (6C hex)	for digital input data
Instance 109 (6D hex)	for analog input data

Instance 0 (Class Attributes)

Table 176: Assembly (04 hex) – Class

Attribute ID	Access	Name	Data type	Description	Default value
1	Get	Revision	UINT	Revision of this object	2 (0x0002)

Instance 101 (65_{hex})

This assembly instance contains analog and digital output data.

Table 177: Static assembly instances – Instance 101 (65 hex)

Attribute ID	Access	Name	Data type	Description	Default value
3	Get/Set	Data	ARRAY of BYTE	Reference on the process image: analog and digital output data	-

Instance 102 (66_{hex})

This assembly instance contains digital output data only.

Table 178: Static assembly instances – Instance 102 (66 hex)

Attribute ID	Access	Name	Data type	Description	Default value
3	Get/Set	Data	ARRAY of BYTE	Reference on the process image: only digital output data	-

Instance 103 (67_{hex})

This assembly instance contains analog output data only.

Table 179: Static assembly instances – Instance 103 (67 hex)

Attribute ID	Access	Name	Data type	Description	Default value
3	Get/Set	Data	ARRAY of BYTE	Reference of the process image: only analog output data	-

Instance 104 (68_{hex})

This assembly instance contains analog and digital input data and the status only.

Table 180: Static assembly instances – Instance 104 (68 $_{hex}$)

Attribute ID	Access	Name	Data type	Description	Default value
3	Get	Data	ARRAY of BYTE	Reference of the process image: analog and digital input data + Status	-

Instance 105 (69_{hex})

This assembly instance contains digital input data and the status only.

Table 181: Static assembly instances – Instance 105 (69 $_{hex}$)

Attribute ID	Access	Name	Data type	Description	Default value
3	Get	Data	ARRAY of BYTE	Reference of the process image: only digital input data + Status	-

Instance 106 ($6A_{hex}$)

This assembly instance contains analog input data and the status only.

Table 182: Static assembly instances – Instance 106 (6A $_{hex}$)

Attribute ID	Access	Name	Data type	Description	Default value
3	Get	Data	ARRAY of BYTE	Reference of the process image: only analog input data + Status	-

Instance 107 ($6B_{hex}$)

This assembly instance contains analog and digital input data.

Table 183: Static assembly instances – Instance 107 (6B $_{hex}$)

Attribute ID	Access	Name	Data type	Description	Default value
3	Get	Data	ARRAY of BYTE	Reference of the process image: analog and digital input data	-

Instance 108 ($6C_{hex}$)

This assembly instance contains digital input data.

Table 184: Static assembly instances – Instance 108 (6C $_{hex}$)

Attribute ID	Acces s	Name	Data type	Description	Default value
3	Get	Data	ARRAY of BYTE	Reference of the process image: only digital input data	-

Instance 109 (6D$_{hex}$)

This assembly instance contains analog input data.

Table 185: Static assembly instances – Instance 109 (6C $_{hex}$)

Attribute ID	Acces s	Name	Data type	Description	Default value
3	Get	Data	ARRAY of BYTE	Reference of the process image: only analog input data	-

Instance 1 (01 hex) "Configuration"

This Instance can optionally be used in the "Configuration Path" of a connection if the associated connection originator (for example the master) requires the specification of a "Configuration Path". The data length of this Instance is always zero.

Instance 198 (C6 $_{hex}$) “Input Only”

This instance is used to establish a connection when no outputs are to be addressed or when inputs, which are already being used in an exclusive owner connection, are to be interrogated. The data length of this instance is always zero.
This instance can only be used in the “consumed path” (seen from the slave device).

Instance 199 (C7 $_{hex}$) “Listen only”

This instance is used to establish a connection based on an existing exclusive owner connection. The new connection also has the same transmission parameters as the exclusive owner connection. When the exclusive owner connection is cleared, this connection, too, is automatically cleared. The data length of this instance is always zero.

This instance can only be used in the “consumed path” (from the point of view of the slave device).

Common Service

Table 186: Static assembly instances – Common service

Service code	Service available		Service name	Description
	Class	Instance		
0E hex	Yes	Yes	Get_Attribute_Single	Supplies contents of the appropriate attribute
10 hex	No	Yes	Set_Attribute_Single	Modifies an attribute value

The software inspects the writing of attribute 3 of assembly instances 101, 102 and 103. If the limit value has been exceeded, it is identified and, if necessary, corrected. However, a write request is not rejected. This means that if less data is received than expected, only this data is written. If more data is received than expected, the received data at the upper limit is deleted. In the case of explicit messages, however, a defined CIP is generated even though the data has been written.

11.3.5.7 Connection (05 hex)

Because the connections are established and terminated via the connection manager, the class and instance attributes of this class are not visible.

11.3.5.8 Connection Manager (06 hex)

The “Connection Manager Object” provides the internal resources that are required for the input and output data and explicit messages. In addition, the administration of this resource is an assignment of the “Connection Manager Object”.
For each connection (input and output data or explicit), another instance of the connection class is created. The connection parameters are extracted from the “Forward Open” service, which is responsible for establishing a connection.

The following services are supported for the first instance:

- Forward_Open
- Unconnected_Send
- Forward_Close

No class and instance attributes are visible.

11.3.5.9 Port Class (F4 hex)

The “Port Class Object” specifies the existing CIP ports on the fieldbus coupler/coupler. There is one instance for each CIP port.

Instance 0 (Class Attributes)

Table 187: Port class (F4 hex) – Class

Attribute ID	Access	Name	Data type	Description	Default value
1	Get	Revision	UINT	Revision of this object	1 (0x0001)
2	Get	Max Instance	UINT	Max. number of instances	1 (0x0001)
3	Get	Num Instances	UINT	Number of current ports	1 (0x0001)
8	Get	Entry Port	UINT	Instance of the port object where the request arrived.	1 (0x0001)
9	Get	All Ports	Array of Struct UINT	Array with instance attributes 1 and 2 of all instances	0 (0x0000) 0 (0x0000) 4 (0x0004) 2 (0x0002)

Instance 1

Table 188: Port class (F4 hex) – Instance 1

Attribute ID	Access	NV	Name	Data type	Description	Default value
1	Get	V	Port Type	UINT	-	4 (0x0004)
2	Get	V	Port Number	UINT	CIP port number	2 (0x0002) (EtherNet/IP)
3	Get	V	Port Object	UINT	Number of 16 bit words in the following path	2 (0x0002)
				Padded EPATH	Object, which manages this port	0x20 0xF5 0x24 0x01 (equals TCP/IP Interface Object)
4	Get	V	Port Name	SHORT_ STRING	Port name	“”
7	Get	V	Node Address	Padded EPATH	Port segment (IP address)	Depends on IP address

Common Services

Table 189: Port class (F4 hex) – Common service

Service code	Service available		Service-Name	Description
	Class	Instance		
01 hex	Yes	Yes	Get_Attribute_All	Supplies contents of all attributes
0E hex	Yes	Yes	Get_Attribute_Single	Supplies contents of the appropriate attribute

11.3.5.10 TCP/IP Interface (F5 $_{hex}$)

The “TCP/IP Interface Object” provides for the configuration of the TCP/IP network interface of a fieldbus coupler/controller. Examples of configurable objects include the IP address, the network mask and the gateway address of the fieldbus coupler/controller.

The underlying physical communications interface that is connected with the TCP/IP interface object can be any interface supported by the TCP/IP protocol. Examples of components that can be connected to a TCP/IP interface object include the following: an Ethernet interface 802.3, an ATM (Asynchronous Transfer Mode) interface or a serial interface for protocols such as PPP (Point-to-Point Protocol).
The TCP/IP interface object provides an attribute, which is identified by the link-specific object for the connected physical communications interface. The link-specific object should typically provide link-specific counters as well as any link-specific configuration attributes.

Each device must support exactly one instance of the TCP/IP interface object for each TCP/IP-compatible communications interface. A request for access to the first instance of the TCP/IP interface object must always refer to the instance connected with the interface, which is used to submit the request.

Instance 0 (Class Attributes)

Table 190: TCP/IP interface (F5$_{hex}$) – Class

Attribute ID	Access	Name	Data type	Description	Default value
1	Get	Revision	UINT	Revision of this object	1 (0x0001)
2	Get	Max Instance	UINT	Max. number of instances	1 (0x0001)
3	Get	Num Instances	UINT	Number of the current instanced connections	1 (0x0001)

Instance 1

Table 191: TCP/IP interface ($F5_{hex}$) – Instance 1

Attribute ID	Access	NV	Name	Data type	Description	Default value
1	Get	V	Status	DWORD	Interface state	-
2	Get	V	Configuration Capability	DWORD	Interface flags for possible kinds of configuration	0x00000017
3	Set	NV	Configuration Control	DWORD	Specifies, how the device gets is TCP/IP configuration after the first Power On	0x00000011
4	Get	V	Physical Link Object	STRUCT of		
			Path size	UINT	Number of 16 Bit words in the following path	0x0002
			Path	Padded EPATH	Logical path, which points to the physical Link object	0x20 0xF6 0x24 0x03 (equates to the Ethernet Link Object)
5	Set	NV	Interface Configuration	STRUCT of	-	
			IP Address	UDINT	IP address	0
			Network Mask	UDINT	Net work mask	0
			Gateway Address	UDINT	IP address of default gateway	0
			Name Server	UDINT	IP address of the primary name of the server	0
			Name Server 2	UDINT	IP address of the secondary name of the server	0
			Domain Name	STRING	Default domain name	“”
6	Set	NV	Host Name	STRING	Device name	“”

Common Services

Table 192: TCP/IP interface ($F5_{hex}$) – Common service

Service code	Service available		Service name	Description
	Class	Instance		
01_{hex}	Yes	Yes	Get_Attribute_All	Supplies contents of all attributes
$0E_{hex}$	Yes	Yes	Get_Attribute_Single	Supplies contents of the appropriate attribute
10_{hex}	No	Yes	Set_Attribute_Single	Modifies an attribute value

11.3.5.11 Ethernet Link ($F6_{hex}$)

The “Ethernet Link Object” contains link-specific counter and status information for an Ethernet 802.3 communications interface. Each device must support exactly one instance of the Ethernet Link Object for each Ethernet IEEE 802.3 communications interface on the module. An Ethernet link object instance for an internal interface can also be used for the devices, e.g. an internal port with an integrated switch.

Instance 0 (Class Attributes)

Table 193: Ethernet link ($F5_{hex}$) – Class

Attribute ID	Access	Name	Data type	Description	Default value
1	Get	Revision	UINT	Revision of this object	3 (0x0003)
2	Get	Max Instance	UDINT	Max. number of instances	3 (0x0003)
3	Get	Num Instances	UDINT	Number of the current instanced connections	3 (0x0003)

Instance 1

Table 194: Ethernet link (F6 hex) – Instance 1

Attribute ID	Acces s	Name	Data type	Description	Default value
1	Get	Interface Speed	UDINT	Transfer rate	10 (0x0A) or 100 (0x64)
2	Get	Interface Flags	DWORD	Interface configuration and status information Bit 0: Link status Bit 1: Half/full duplex Bit 2…4: Detection status Bit 5: Manual settings require reset Bit 6: Local hardware error Bit 7…31: Reserved	Value is dependent upon Ethernet connection.
3	Get	Physical Address	ARRAY of 6 UINTs	MAC layer address	MAC ID of the device
6	Set	Interface Control	STRUCT of:	Configuration of the physical interface	-
		Control Bits	WORD	Interface configuration bits Bit 0: Automatic detection Bit 1: Default duplex mode Bit 2…15: Reserved	0x0001
		Forced Interface Speed	UINT	Preset interface speed	10 (0x000A) or 100 (0x0064)
7	Get	Interface Type	USINT	Interface type Value 0: Unknown Value 1: Internal interface; e.g., in the case of an integrated switch Value 2: Twisted pair (e.g. 100Base-TX). Value 3: fiber glass (e.g. 100Base-FX). Value 4…256: Reserved	2 (0x02) – Twisted Pair
8	Get	Interface Status	USINT	Interface status Value 0: Unknown Value 1: Interface active and ready to send/receive. Value 2: Interface deactivated. Value 3: Interface is testing Wert 4…256: Reserved	-

Table 194: Ethernet link (F6 $_{hex}$) – Instance 1

Attribute ID	**Acces s**	**Name**	**Data type**	**Description**	**Default value**
9	Get/ Set	Admin Status	USINT	Admin status: Value 0: Reserved Value 1: Interface active Value 2: Interface deactivated. Is this the only CIP interface, a request for deactivation will be receipted with error code 0x09 Value 3…256: Reserved	1 (0x01)
10	Get	Interface Label	SHORT_ STRING	Name of the interface	“Port 1”

Instance 2 – Port 2

Table 195: Ethernet link (F6 hex) – Instance 2

Attribute ID	Access	Name	Data type	Description	Default value
1	Get	Interface Speed	UDINT	Transfer rate	10 (0x0000000A) or 100 (0x00000064)
2	Get	Interface Flags	DWORD	Interface configuration and status information Bit 0: Link status Bit 1: Half/full duplex Bit 2…4: Detection status Bit 5: Manual settings require reset Bit 6: Local hardware error Bit 7…31: Reserved	Value is dependent upon Ethernet connection.
3	Get	Physical Address	ARRAY of 6 UINTs	MAC layer address	MAC-ID des Fieldbus couplers/ controllers
6	Set	Interface Control	STRUCT of:	Configuration of the physical interface	-
		Control Bits	WORD	Interface configuration bits Bit 0: Automatic detection Bit 1: Default duplex mode Bit 2…15: Reserved	0x0001
		Forced Interface Speed	UINT	Preset interface speed	10 (0x000A) or 100 (0x0064)
7	Get	Interface Type	USINT	Interface type Value 0: Unknown Value 1: Internal interface; e.g., in the case of an integrated switch Value 2: Twisted pair (e.g. 100Base-TX). Value 3: fiber glass (e.g. 100Base-FX). Value 4…256: Reserved	2 (0x02) – Twisted Pair
8	Get	Interface Status	USINT	Interface status Value 0: Unknown Value 1: Interface active and ready to send/receive. Value 2: Interface deactivated. Value 3: Interface is testing Wert 4…256: Reserved	-

Table 195: Ethernet link (F6 hex) – Instance 2

Attribute ID	Access	Name	Data type	Description	Default value
9	Get/ Set	Admin Status	USINT	Admin status: Value 0: Reserved Value 1: Interface active Value 2: Interface deactivated. Is this the only CIP interface, a request for deactivation will be receipted with error code 0x09 Value 3…256: Reserved	1 (0x01)
10	Get	Interface Label	SHORT_ STRING	Name of the interface	“Port 2”

Instance 3 – Internal Port 3

Table 196: Ethernet link (F6 hex) – Instance 3

Attribute ID	Access	Name	Data type	Description	Default value
1	Get	Interface Speed	UDINT	Transfer rate	100 (0x64)
2	Get	Interface Flags	DWORD	Interface configuration and status information	3 (0x03) – Link active (Bit 0), Full duplex (Bit 1)
3	Get	Physical Address	ARRAY of 6 UINTs	MAC layer address	MAC ID of the device
6	Set	Interface Control	STRUCT of:	Configuration of the physical interface	-
		Control Bits	WORD	Interface configuration bits	3 (0x03) – Link active (Bit 0), Full duplex (Bit 1)
		Forced Interface Speed	UINT	Baud rate	100 (0x64)
7	Get	Interface Type	UINT	Interface type	1 (0x01) – internal Port
8	Get	Interface Status	UINT	Interface status	1 (0x01) – active
9	Get	Admin Status	UINT	Admin status	1 (0x01) – active
10	Get	Interface Label	SHORT_STRING	Name of the interface	"Internal Port 3"

Common Services

Table 197: Ethernet link (F6 hex) – Common service

Service code	Service available		Service-Name	Description
	Class	Instance		
01 hex	Yes	Yes	Get_Attribute_All	Supplies contents of all attributes
0E hex	Yes	Yes	Get_Attribute_Single	Supplies contents of the appropriate attribute
10 hex	No	Yes	Set_Attribute_Single	Modifies an attribute value

Note

Changes with service "Set_Attribute_Single" not directly effective!
Attributes (particularly the attributes 6 and 9) which were changed over the service "Set_Attribute_Single", become only effective after the next Power-On-Reset of the controller.

11.3.5.12 Coupler/Controller Configuration (64 hex)

The fieldbus coupler configuration class allows reading and configuration of some important fieldbus/controller process parameters. The following listings explain in details all supported instances and attributes.

Instance 0 (Class Attributes)

Table 198: Coupler/Controller configuration (64 hex) – Class

Attribute ID	Access	Name	Data type	Description	Default value
1	Get	Revision	UINT	Revision of this object	1 (0x0001)
2	Get	Max Instance	UINT	Maximum number of instances	1 (0x0001)

Instance 1

Table 199: Coupler/Controller configuration (64 hex) – Instance 1

Attribute ID	Access	NV	Name	Data type	Description	Default value
5	Get	V	ProcessState	USINT	State of coupler/controller, error mask: Bit 0: Local bus error Bit 3: Module diagnostics (0x08) Bit 7: Fieldbus error (0x80)	0
6	Get	V	DNS_i_ Trmnldia	UINT	Module diagnostics: Bit 0..7: Module number Bit 8..14: Module channel Bit 15: 0/1 Error, repair/arisen	0
7	Get	V	CnfLen. AnalogOut	UINT	Number of I/O bits for the analog output	-
8	Get	V	CnfLen. AnalogInp	UINT	Number of I/O bits for the analog input	-
9	Get	V	CnfLen. DigitalOut	UINT	Number of I/O bits for the digital output	-
10	Get	V	CnfLen. DigitalInp	UINT	Number of I/O bits for the digital input	-
11	Set	NV	Bk_Fault_ Reaction	USINT	Fieldbus error reaction 0: stop local I/O cycles 1: set all output to 0 2: no error reaction 3: no error reaction 4: PFC task takes over control of the outputs (apply to controllers)	1
12..26	Reserved for compatibility to DeviceNet					
40..43	Reserved for compatibility to DeviceNet					
45	Get	V	Bk_Led_Err _Code	UINT	I/O LED error code	0
46	Get	V	Bk_Led_Err _Arg	UINT	I/O LED error argument	0

120 (0x78)	Set	NV	Bk_Header CfgOT	UINT	Indicates whether the RUN/IDLE header is used originator → target direction 0: is used 1: is not used	0x0000
121(0x79)	Set	NV	Bk_Header CfgTO	UINT	Indicates whether the RUN/IDLE header is used originator → target direction 0: is used 1: is not used	0x0001

Common Service

Table 200: Coupler/Controller configuration (64 hex) – Common service

Service code	Service available		Service name	Description
	Class	Instance		
0E hex	Yes	Yes	Get_Attribute_Single	Supplies contents of the appropriate attribute
10 hex	No	Yes	Set_Attribute_Single	Modifies an attribute value

11.3.5.13 Discrete Input Point (65 hex)

This class allows the reading of data of a particular digital input point.

Instance 0 (Class-Attributes)

Table 201: Discrete input point (65 hex) – Class

Attribute ID	Acces s	Name	Data type	Description	Default value
1	Get	Revision	UINT	Revision of this object	1 (0x0001)
2	Get	Max Instance	UINT	Max. number of instances	-

Instance 1 ... 255 (Digital output value 1 up to 255)

Table 202: Discrete input point (65 hex) – Instance 1...255

Attribute ID	Acces s	Name	Data type	Description	Default value
1	Get	DipObj_Value	BYTE	Digital output (only Bit 0 is valid)	-

Common Services

Table 203: Discrete input point (65 hex) – Common service

Service code	Service available		Service name	Description
	Class	Instance		
0E hex	Yes	Yes	Get_Attribute_Single	Supplies contents of the appropriate attribute

11.3.5.14 Discrete Input Point Extended 1 (69 $_{hex}$)

The extension of the “Discrete Input Point” class enables the reading of data from a fieldbus node that contains over 255 digital input points (DIPs). The instance scope of the “Discrete Input Point Extended 1” class covers DIPs from 256 to 510 in the fieldbus node.

Instance 0 (Class Attributes)

Table 204: Discrete Input Point Extended 1(69 hex,) – Class

Attribute ID	Access	Name	Data type	Description	Default value
1	Get	Revision	UINT	Revision of this object	1 (0x0001)
2	Get	Max Instance	UINT	Max. number of instances	-

Instance 256 ... 510 (Digital input value 256 up to 510)

Table 205: Discrete output point (66 $_{hex}$) – Instance 256...510

Attribute ID	Access	Name	Data type	Description	Default value
1	Get	DipObj_Value	BYTE	Digital input (only Bit 0 is valid)	-

Common Services

Table 206: Discrete Input Point Extended 1 (69 $_{hex}$) – Common service

Service code	Service available		Service-name	Description
	Class	Instance		
0E $_{hex}$	Yes	Yes	Get_Attribute_Single	Supplies contents of the appropriate attribute

11.3.5.15 Discrete Input Point Extended 2 (6D $_{hex}$)

The extension of the “Discrete Input Point” class enables the reading of data from a fieldbus node that contains over 510 digital input points (DIPs). The instance scope of the “Discrete Input Point Extended 2” class covers DIPs from 511 to 765 in the fieldbus node.

Instance 0 (Class Attributes)

Table 207: Discrete Input Point Extended 2 (6D hex) – Class

Attribute ID	Access	Name	Data type	Description	Default value
1	Get	Revision	UINT	Revision of this object	1 (0x0001)
2	Get	Max Instance	UINT	Max. number of instances	-

Instance 511 ... 765 (Digital input value 511 up to 765)

Table 208: Analog input point (67 hex) – Instance 1

Attribute ID	Acces s	Name	Data type	Description	Default value
1	Get	AipObj_Value	ARRAY of BYTE	Analog input	-
2	Get	AipObj_Value_Length	USINT	Length of the input data AipObj_Value (in byte)	-

Common Services

Table 209: Analog input point (67 hex) – Common service

Service code	Service available		Service name	Description
	Class	Instance		
0E hex	Yes	Yes	Get_Attribute_Single	Supplies contents of the appropriate attribute

11.3.5.16 Discrete Input Point Extended 3 (71 hex)

The extension of the “Discrete Input Point” class enables the reading of data from a fieldbus node that contains over 765 digital input points (DIPs). The instance scope of the “Discrete Input Point Extended 3” class covers DIPs from 766 to 1020 in the fieldbus node.

Instance 0 (Class-Attributes)

Table 210: Discrete Input Point Extended 3 (71 hex) – Class

Attribute ID	Acces s	Name	Data type	Description	Default value
1	Get	Revision	UINT	Revision of this object	1 (0x0001)
2	Get	Max Instance	UINT	Max. number of instances	-

Instance 766 ... 1020 (Digital input value 766 up to 1020)

Table 211: Discrete Input Point Extended 3 (71 hex) – Instance 766...1020

Attribute ID	Access	Name	Data type	Description	Default value
1	Get	DipObj_Value	BYTE	Digital input (only Bit 0 is valid)	-

Common Services

Table 212: Discrete Input Point Extended 3 (71 hex) – Common service

Service code	Service available		Service-Name	Description
	Class	Instance		
0E hex	Yes	Yes	Get_Attribute_Single	Supplies contents of the appropriate attribute

11.3.5.17 Discrete Output Point (66 hex)

This class enables data exchange for a particular digital output point.

Instance 0 (Class Attributes)

Table 213: Discrete Output Point (66 hex) – Class

Attribute ID	Access	Name	Data type	Description	Default value
1	Get	Revision	UINT	Revision of this object	1 (0x0001)
2	Get	Max Instance	UINT	Max. number of instances	-

Instance 1 ... 255 (Digital output value 1 up to 255)

Table 214: Discrete Output Point (66 hex) – Instance 1...255

Attribute ID	Access	Name	Data type	Description	Default value
1	Get	DopObj_Value	BYTE	Digital Output (only Bit 0 valid)	-

Common Services

Table 215: Discrete Output Point (66 hex) – Common service

Service code	Service available		Service-Name	Description
	Class	Instance		
0E hex	Yes	Yes	Get_Attribute_Single	Supplies contents of the appropriate attribute
10 hex	No	Yes	Set_Attribute_Single	Modifies an attribute value

11.3.5.18 Discrete Output Point Extended 1 (6A hex)

The extension of the “Discrete Output Point” class enables the exchange of data from a fieldbus node that contains over 255 digital output points (DOPs). The instance scope of the “Discrete Output Point Extended 1” class covers DOPs from 256 to 510 in the fieldbus node.

Instance 0 (Class Attributes)

Table 216: Discrete Output Point Extended 1 (6A hex) – Class

Attribute ID	Access	Name	Data type	Description	Default value
1	Get	Revision	UINT	Revision of this object	1 (0x0001)
2	Get	Max Instance	UINT	Max. number of instances	-

Instance 256 ... 510 (Digital output value 256 up to 510)

Table 217: Discrete Output Point Extended 1 (6A $_{hex}$) – Instance 256...510

Attribute ID	Access	Name	Data type	Description	Default value
1	Get	DopObj_Value	BYTE	Digital Output (only Bit 0 valid)	-

Common Services

Table 218: Discrete Output Point Extended 1 (6A $_{hex}$) – Common service

Service code	Service available		Service-Name	Description
	Class	Instance		
0E $_{hex}$	Yes	Yes	Get_Attribute_Single	Supplies contents of the appropriate attribute
10 $_{hex}$	No	Yes	Set_Attribute_Single	Modifies an attribute value

11.3.5.19 Discrete Output Point Extended 2 (6E $_{hex}$)

The extension of the “Discrete Output Point” class enables the exchange of data from a fieldbus node that contains over 510 digital output points (DOPs). This instance cope of the “Discrete Output Point Extended 1” class covers the DOPs from 511 to 765 in the fieldbus node.

Instance 0 (Class Attributes)

Table 219: Discrete Output Point Extended 2 (6E $_{hex}$) – Class

Attribute ID	Access	Name	Data type	Description	Default value
1	Get	Revision	UINT	Revision of this object	1 (0x0001)
2	Get	Max Instance	UINT	Max. number of instances	-

Instance 511 ... 765 (Digital output value 511 up to 765)

Table 220: Discrete Output Point Extended 2 (6E $_{hex}$) – Instance 511...765

Attribute ID	Access	Name	Data type	Description	Default value
1	Get	DopObj_Value	BYTE	Digital Output (only Bit 0 valid)	-

Common Services

Table 221: Discrete Output Point Extended 2 (6E $_{hex}$) – Common service

Service code	Service available		Service-Name	Description
	Class	Instance		
0E $_{hex}$	Yes	Yes	Get_Attribute_Single	Supplies contents of the appropriate attribute
10 $_{hex}$	No	Yes	Set_Attribute_Single	Modifies an attribute value

11.3.5.20 Discrete Output Point Extended 3 (72 hex)

The extension of the “Discrete Output Point” class enables the exchange of data from a fieldbus node that contains over 765 digital output points (DOPs). The instance scope of the “Discrete Output Point Extended 2” class covers DOPs from 766 to 1020 in the fieldbus node.

Instance 0 (Class Attributes)

Table 222: Discrete Output Point Extended 3 (72 hex) – Class

Attribute ID	Access	Name	Data type	Description	Default value
1	Get	Revision	UINT	Revision of this object	1 (0x0001)
2	Get	Max Instance	UINT	Max. number of instances	-

Instance 766 ... 1020 (Digital Output value 766 up to 1020)

Table 223: Discrete Output Point Extended 3 (72 hex) – Instance 766...1020

Attribute ID	Access	Name	Data type	Description	Default value
1	Get	DopObj_Value	BYTE	Digital Output (only Bit 0 valid)	-

Common Services

Table 224: Discrete Output Point Extended 2 (6E hex) – Common service

Service code	Service available		Service name	Description
	Class	Instance		
0E hex	Yes	Yes	Get_Attribute_Single	Supplies contents of the appropriate attribute
10 hex	No	Yes	Set_Attribute_Single	Modifies an attribute value

11.3.5.21 Analog Input Point (67 hex)

This class enables the reading of data of a particular analog input point (AIP). An analog input point is part of an analog input module.

Instance 0 (Class Attributes)

Table 225: Analog Input Point (67 hex) – Class

Attribute ID	Access	Name	Data type	Description	Default value
1	Get	Revision	UINT	Revision of this object	1 (0x0001)
2	Get	Max Instance	UINT	Max. number of instances	-

Instance 1 ... 255 (Analog input 1 up to 255)

Table 226: Analog Input Point (67 hex) – Instance 1 ... 255

Attribute ID	Access	Name	Data type	Description	Default value
1	Get	AipObj_Value	ARRAY of BYTE	Analog Input	-
2	Get	AipObj_Value_Length	USINT	Length of the output data AopObj_Value (in byte)	-

Common Services

Table 227: Analog Input Point (67 hex) – Common service

Service code	Service available		Service name	Description
	Class	Instance		
0E hex	Yes	Yes	Get_Attribute_Single	Supplies contents of the appropriate attribute

11.3.5.22 Analog Input Point Extended 1 (6B hex)

The extension of the “Analog Input Point” class enables the reading of data from a fieldbus node that contains over 255 analog outputs (AIPs). The instance scope of the “Analog Input Point Extended 1” class covers AIPs from 256 to 510 in the fieldbus node.

Instance 0 (Class Attributes)

Table 228: Analog Input Point Extended 1 (6B hex) – Class

Attribute ID	Access	Name	Data type	Description	Default value
1	Get	Revision	UINT	Revision of this object	1 (0x0001)
2	Get	Max Instance	UINT	Max. number of instances	-

Instance 256 ... 510 (Analog Input value 256 up to 510)

Table 229: Analog Input Point Extended 1 (6B hex) – Instance 256 ... 510

Attribute ID	Access	Name	Data type	Description	Default value
1	Get	AipObj_Value	ARRAY of BYTE	Analog Input	-
2	Get	AipObj_Value_Length	USINT	Length of the output data AopObj_Value (in byte)	-

Common Services

Table 230: Analog Input Point Extended 1 (6B $_{hex}$) – Common service

Service code	Service available		Service name	Description
	Class	Instance		
0E $_{hex}$	Yes	Yes	Get_Attribute_Single	Supplies contents of the appropriate attribute

11.3.5.23 Analog Input Point Extended 2 (6F $_{hex}$)

The extension of the “Analog Input Point” class enables the reading of data from a fieldbus node that contains over 510 analog outputs (AIPs). The instance scope of the “Analog Input Point Extended 2” class covers AIPs from 511 to 765 in the fieldbus node.

Instance 0 (Class Attributes)

Table 231: Analog Input Point Extended 2 (6F $_{hex}$) – Class

Attribute ID	Access	Name	Data type	Description	Default value
1	Get	Revision	UINT	Revision of this object	1 (0x0001)
2	Get	Max Instance	UINT	Max. number of instances	-

Instance 511 ... 765 (Analog Input 511 up to 765)

Table 232: Analog Input Point Extended 2 (6F $_{hex}$) – Instance 511 ... 765

Attribute ID	Access	Name	Data type	Description	Default value
1	Get	AipObj_Value	ARRAY of BYTE	Analog Input	-
2	Get	AipObj_Value_Length	USINT	Length of the output data AopObj_Value (in byte)	-

Common Services

Table 233: Analog Input Point Extended 2 (6F $_{hex}$) – Common service

Service code	Service available		Service name	Description
	Class	Instance		
0E $_{hex}$	Yes	Yes	Get_Attribute_Single	Supplies contents of the appropriate attribute

11.3.5.24 Analog Input Point Extended 3 (73 $_{hex}$)

The extension of the “Analog Input Point” class enables the reading of data from a fieldbus node that contains over 765 analog outputs (AIPs). The instance scope of the “Analog Input Point Extended 3” class covers AIPs from 766 to 1020 in the fieldbus node.

Instance 0 (Class Attributes)

Table 234: Analog Input Point Extended 3 (73 hex) – Class

Attribute ID	Access	Name	Data type	Description	Default value
1	Get	Revision	UINT	Revision of this object	1 (0x0001)
2	Get	Max Instance	UINT	Max. number of instances	-

Instance 766 ... 1020 (Analog input value 766 up to 1020)

Table 235: Analog Input Point Extended 3 (73 hex) – Instance 766 ... 1020

Attribute ID	Access	Name	Data type	Description	Default value
1	Get	AipObj_Value	ARRAY of BYTE	Analog Input	-
2	Get	AipObj_Value_Length	USINT	Length of the output data AopObj_Value (in byte)	-

Common Services

Table 236: Analog Input Point Extended 3 (73 hex) – Common service

Service code	Service available		Service name	Description
	Class	Instance		
0E hex	Yes	Yes	Get_Attribute_Single	Supplies contents of the appropriate attribute

11.3.5.25 Analog Output Point (68 hex)

This class enables the reading of data of a particular analog output point (AOP). An analog output point is part of an analog output module.

Instance 0 (Class Attributes)

Table 237: Analog Output Point (68 hex) – Class

Attribute ID	Access	Name	Data type	Description	Default value
1	Get	Revision	UINT	Revision of this object	1 (0x0001)
2	Get	Max Instance	UINT	Max. number of instances	-

Instance 1 ... 255 (Analog output value 1 up to 255)

Table 238: Analog Output Point (68 hex) – Instance 1...255

Attribute ID	Access	Name	Data type	Description	Default value
1	Get	AopObj_Value	ARRAY of BYTE	Analog Output	-
2	Get	AopObj_Value_Length	USINT	Length of the output data AopObj_Value (in byte)	-

Common Services

Table 239: Analog Output Point (68 $_{hex}$) – Common service

Service code	Service available		Service name	Description
	Class	Instance		
0E $_{hex}$	Yes	Yes	Get_Attribute_Single	Supplies contents of the appropriate attribute
10 $_{hex}$	No	Yes	Set_Attribute_Single	Modifies an attribute value

11.3.5.26 Analog Output Point Extended 1 (6C $_{hex}$)

The extension of the “Analog Output Point” class enables the exchange of data from a fieldbus node that contains over 255 analog output points (AOPs). The instance scope of the “Discrete Output Point Extended 1” class covers AOPs from 256 to 510 in the fieldbus node.

Instance 0 (Class Attributes)

Table 240: Analog Output Point Extended 1 (6C $_{hex}$) – Class

Attribute ID	Access	Name	Data type	Description	Default value
1	Get	Revision	UINT	Revision of this object	1 (0x0001)
2	Get	Max Instance	UINT	Max. number of instances	-

Instance 256 ... 510 (Analog output value 256 up to 510)

Table 241: Analog Output Point Extended 1 (6C $_{hex}$) – Instance 256...510

Attribute ID	Access	Name	Data type	Description	Default value
1	Get	AopObj_Value	ARRAY of BYTE	Analog Output	-
2	Get	AopObj_Value_ Length	USINT	Length of the output data AopObj_Value (in byte)	-

Common Services

Table 242: Analog Output Point Extended 1 (6C $_{hex}$) – Common service

Service code	Service available		Service name	Description
	Class	Instance		
0E $_{hex}$	Yes	Yes	Get_Attribute_Single	Supplies contents of the appropriate attribute
10 $_{hex}$	No	Yes	Set_Attribute_Single	Modifies an attribute value

11.3.5.27 Analog Output Point Extended 2 (70 $_{hex}$)

The extension of the “Analog Output Point” class enables the exchange of data from a fieldbus node that contains over 510 analog output points (AOPs). The instance scope of the “Discrete Output Point Extended 2” class covers AOPs from 511 to 765 in the fieldbus node.

Instance 0 (Class Attributes)

Table 243: Analog Output Point Extended 2 (70 hex) – Class

Attribute ID	Access	Name	Data type	Description	Default value
1	Get	Revision	UINT	Revision of this object	1 (0x0001)
2	Get	Max Instance	UINT	Max. number of instances	-

Instance 511 ... 765 (Analog output value 511 up to 765)

Table 244: Analog Output Point Extended 2 (70 hex) – Instance 511...765

Attribute ID	Access	Name	Data type	Description	Default value
1	Get	AopObj_Value	ARRAY of BYTE	Analog Output	-
2	Get	AopObj_Value_ Length	USINT	Length of the output data AopObj_Value (in byte)	-

Common Services

Table 245: Analog Output Point Extended 2 (70 hex) – Common service

Service code	Service available		Service name	Description
	Class	Instance		
0E hex	Yes	Yes	Get_Attribute_Single	Supplies contents of the appropriate attribute
10 hex	No	Yes	Set_Attribute_Single	Modifies an attribute value

11.3.5.28 Analog Output Point Extended 3 (74 hex)

The extension of the “Analog Output Point” class enables the exchange of data from a fieldbus node that contains over 765 analog output points (AOPs). The instance scope of the “Discrete Output Point Extended 3” class covers AOPs from 766 to 1020 in the fieldbus node.

Instance 0 (Class Attributes)

Table 246: Analog Output Point Extended 3 (74 hex) – Class

Attribute ID	Access	Name	Data type	Description	Default value
1	Get	Revision	UINT	Revision of this object	1 (0x0001)
2	Get	Max Instance	UINT	Max. number of instances	-

Instance 766 ... 1020 (Analog output value 766 up to 1020)

Table 247: Analog Output Point Extended 3 (74 hex) – Instance 766...1020

Attribute ID	Access	Name	Data type	Description	Default value
1	Get	AopObj_Value	ARRAY of BYTE	Analog Output	-
2	Get	AopObj_Value_ Length	USINT	Length of the output data AopObj_Value (in byte)	-

Common Services

Table 248: Analog Output Point Extended 3 (74 hex) – Common service

Service code	Service available		Service name	Description
	Class	Instance		
0E hex	Yes	Yes	Get_Attribute_Single	Supplies contents of the appropriate attribute
10 hex	No	Yes	Set_Attribute_Single	Modifies an attribute value

11.3.5.29 Module Configuration (80 hex)

Instance 0 (Class Attributes)

Table 249: Module Configuration (80 hex) – Class

Attribute ID	Access	Name	Data type	Description	Default value
1	Get	Revision	UINT	Revision of this object	1 (0x0001)
2	Get	Max Instance	UINT	Max. number of instances	-

Instance 1 … 255 (Clamp 0 up to 254)

Table 250: Module Configuration (80 hex) – Instance 1...255

Attribute ID	Access	Name	Data type	Description	Default value
1	Get	ModulDescription	WORD	Description of connected modules (module 0 = coupler/controller) Bit 0: Module has inputs Bit 1: Module has outputs Bit 8-14: Data width internally in bit 15: 0/1 Analog/digital module For analog modules, bits 0-14 identify the module type, e.g., 401 for module 750-401	-

Common Services

Table 251: Module Configuration (80 hex) – Common service

Service code	Service available		Service name	Description
	Class	Instance		
0E hex	Yes	Yes	Get_Attribute_Single	Supplies contents of the appropriate attribute

11.3.5.30 Module Configuration Extended (81 hex)

The same as “Module Configuration (80 hex)” but with a description of module 255.

Instance 0 (Class Attributes)

Table 252: Module Configuration Extended (81 hex) – Class

Attribute ID	Access	Name	Data type	Description	Default value
1	Get	Revision	UINT	Revision of this object	1 (0x0001)
2	Get	Max Instance	UINT	Max. number of instances	-

Instance 256 (Clamp 255)

Table 253: Module Configuration Extended (81 hex) – Instance 256

Attribute ID	Access	Name	Data type	Description	Default value
1	Get	ModulDescription	WORD	Description of connected modules (module 0 = coupler/controller) Bit 0: Module has inputs Bit 1: Module has outputs Bit 8-14: Data width internally in Bit 15: 0/1 Analog/digital module For analog modules, bits 0-14 identify the module type, e.g., 401 for module 750-401	-

Common Services

Table 254: Module Configuration Extended (81 hex) – Common service

Service code	Service available		Service-Name	Description
	Class	Instance		
0E hex	Yes	Yes	Get_Attribute_Single	Supplies contents of the appropriate attribute

12 I/O Modules

12.1 Overview

For modular applications with the WAGO-I/O-SYSTEM 750, different types of I/O modules are available

- Digital Input Modules
- Digital Output Modules
- Analog Input Modules
- Analog Output Modules
- Communication Modules, Supply and Segment Modules
- Function and Technology Modules

For detailed information on the I/O modules and the module variations, refer to the manuals for the I/O modules.

You will find these manuals on the WAGO web pages under www.wago.com.

Information

More Information about the WAGO-I/O-SYSTEM
Current information on the modular WAGO-I/O-SYSTEM is available in the Internet under: www.wago.com.

12.2 Process Data Architecture for Modbus-TCP

With some I/O modules, the structure of the process data is fieldbus specific.

Modbus-TCP process image uses a word structure (with word alignment). The internal mapping method for data greater than one byte conforms to the Intel format.

The following section describes the process image for various WAGO-I/O-SYSTEM 750 XTR I/O modules with Modbus-TCP.

NOTICE

Equipment damage due to incorrect address!
Depending on the specific position of an I/O module in the fieldbus node, the process data of all previous byte or bit-oriented modules must be taken into account to determine its location in the process data map.

12.2.1 Digital Input Modules

The digital input modules provide a process value of one bit per channel, which indicates the status of the respective channel. These bits are mapped into the input process image.

Some digital input modules have an additional diagnostic bit per channel in the input process image. The diagnostic bit detects faults (e.g., wire breakage, overloads and/or short circuits).

If analog input modules are in the node, the digital data is grouped in bytes and added to the analog input data in the process image.

12.2.1.1 2-Channel Digital Input Modules

Table 255: 2-Channel Digital Input Modules

Input Process Image							
Bit 7	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
						Data bit DI 2 Channel 2	Data bit DI 1 Channel 1

12.2.1.2 8-Channel Digital Input Modules

Table 256: 8-Channel Digital Input Modules

Input Process Image							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Data bit DI 8 Channel 8	Data bit DI 7 Channel 7	Data bit DI 6 Channel 6	Data bit DI 5 Channel 5	Data bit DI 4 Channel 4	Data bit DI 3 Channel 3	Data bit DI 2 Channel 2	Data bit DI 1 Channel 1

12.2.1.3 16-Channel Digital Input Modules

Table 257: 16-Channel Digital Input Modules

Input Process Image															
Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Data bit DI 16 Chan-nel 16	Data bit DI 15 Chan-nel 15	Data bit DI 14 Chan-nel 14	Data bit DI 13 Chan-nel 13	Data bit DI 12 Chan-nel 12	Data bit DI 11 Chan-nel 11	Data bit DI 10 Chan-nel 10	Data bit DI 9 Chan-nel 9	Data bit DI 8 Chan-nel 8	Data bit DI 7 Chan-nel 7	Data bit DI 6 Chan-nel 6	Data bit DI 5 Chan-nel 5	Data bit DI 4 Chan-nel 4	Data bit DI 3 Chan-nel 3	Data bit DI 2 Chan-nel 2	Data bit DI 1 Chan-nel 1

12.2.2 Digital Output Modules

The digital output modules provide one bit as the process value per channel that indicates the status of the respective channel. These bits are mapped into the output process image.

Some digital input modules have an additional diagnostic bit per channel in the input process image. The diagnostic bit detects faults (e.g., wire breakage, overloads and/or short circuits). For some I/O modules, the data bits also have be evaluated with the set diagnostic bit.

If analog output modules are in the node, the digital data is grouped in bytes and added after the analog output data in the output process image.

12.2.2.1 2-Channel Digital Output Modules

Table 258: 2-Channel Digital Output Modules

Output Process Image							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
						Controls DO 2 Channel 2	Controls DO 1 Channel 1

12.2.2.2 2-Channel Digital Output Modules with Diagnostics and Input Data

In addition to the 2-bit process values in the output process image, the digital output modules provide 2 bits of data in the input process image. A diagnostic bit for each output channel indicates an overload, short circuit or wire breakage.

Table 259: 2-Channel Digital Output Modules with Diagnostics and Input Data

Input Process Image							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
						Diag. bit S 2 Channel 2	Diag. bit S 1 Channel 1

Output Process Image							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
						Controls DO 2 Channel 2	Controls DO 1 Channel 1

12.2.2.3 4-Channel Digital Output Modules

Table 260: 4-Channel Digital Output Modules

Output Process Image							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
				Controls DO 4 Channel 4	Controls DO 3 Channel 3	Controls DO 2 Channel 2	Controls DO 1 Channel 1

12.2.3 4-Channel Digital Output Modules with Diagnostics and Input Data

In addition to the 4-bit process values in the output process image, the digital output modules provide 4 bits of data in the input process image. A diagnostic bit for each output channel indicates an overload, short circuit or wire breakage.

Table 261: 4-Channel Digital Output Modules with Diagnostics and Input Data

Input Process Image							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
				Diag. bit S 4 Channel 4	Diag. bit S 3 Channel 3	Diag. bit S 2 Channel 2	Diag. bit S 1 Channel 1

Diagnostic bit S = '0' no error
Diagnostic bit S = '1' wire break, short circuit or overload

Output Process Image							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
				Controls DO 4 Channel 4	Controls DO 3 Channel 3	Controls DO 2 Channel 2	Controls DO 1 Channel 1

12.2.3.1 8-Channel Digital Output Modules

Table 262: 8-Channel Digital Output Modules

Output Process Image							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Controls DO 8 Channel 8	Controls DO 7 Channel 7	Controls DO 6 Channel 6	Controls DO 5 Channel 5	Controls DO 4 Channel 4	Controls DO 3 Channel 3	Controls DO 2 Channel 2	Controls DO 1 Channel 1

12.2.3.2 8-Channel Digital Output Modules with Diagnostics and Input Data

In addition to the 8-bit process values in the output process image, the digital output modules provide 8 bits of data in the input process image. A diagnostic bit for each output channel indicates an overload, short circuit or wire breakage.

Table 263: 8-Channel Digital Output Modules with Diagnostics and Input Data

Input Process Image							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Diag. bit S 8 Channel 8	Diag. bit S 7 Channel 7	Diag. bit S 6 Channel 6	Diag. bit S 5 Channel 5	Diag. bit S 4 Channel 4	Diag. bit S 3 Channel 3	Diag. bit S 2 Channel 2	Diag. bit S 1 Channel 1

Diagnostic bit S = '0' no error
Diagnostic bit S = '1' wire break, short circuit or overload

Output Process Image							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Controls DO 8 Channel 8	Controls DO 7 Channel 7	Controls DO 6 Channel 6	Controls DO 5 Channel 5	Controls DO 4 Channel 4	Controls DO 3 Channel 3	Controls DO 2 Channel 2	Controls DO 1 Channel 1

12.2.3.3 16-Channel Digital Output Modules

Table 264: 16-Channel Digital Output Modules

Output Process Image															
Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Controls DO 16 Channel 16	Controls DO 15 Channel 15	Controls DO 14 Channel 14	Controls DO 13 Channel 13	Controls DO 12 Channel 12	Controls DO 11 Channel 11	Controls DO 10 Channel 10	Controls DO 9 Channel 9	Controls DO 8 Channel 8	Controls DO 7 Channel 7	Controls DO 6 Channel 6	Controls DO 5 Channel 5	Controls DO 4 Channel 4	Controls DO 3 Channel 3	Controls DO 2 Channel 2	Controls DO 1 Channel 1

12.2.4 Analog Input Modules

The hardware of an analog input module has 16 bits of measured analog data per channel and 8 bits of control/status.

However, the coupler/controller with MODBUS/TCP does not have access to the 8 control/status bits.

Therefore, the coupler/controller with MODBUS/TCP can only access the 16 bits of analog data per channel, which are grouped as words and mapped in Intel format in the Input Process Image.

When digital input modules are also present in the node, the analog input data is always mapped into the Input Process Image in front of the digital data.

Information

Information on the structure of control and status bytes
For detailed information on the structure of a particular I/O module's control/status bytes, please refer to that module's manual. Manuals for each module can be found on the Internet at www.wago.com.

12.2.4.1 2-Channel Analog Input Modules

Table 265: 2-Channel Analog Input Modules

Input Process Image			
Offset	Byte designation		Remark
	High byte	Low byte	
0	D1	D0	Measured value channel 1
1	D3	D2	Measured value channel 2

12.2.4.2 4-Channel Analog Input Modules

Table 266: 4-Channel Analog Input Modules

Input process image			
Offset	Byte designation		Remark
	High byte	Low byte	
0	D1	D0	Measured value channel 1
1	D3	D2	Measured value channel 2
2	D5	D4	Measured value channel 3
3	D7	D6	Measured value channel 4

12.2.4.3 3-Phase Power Measurement Module

The above Analog Input Modules have a total of 9 bytes of user data in both the Input and Output Process Image (6 bytes of data and 3 bytes of control/status). The following tables illustrate the Input and Output Process Image, which has a total of 6 words mapped into each image.
Word alignment is applied.

Table 267: 3-Phase Power Measurement Module

Input Process Image			
Offset	Byte Destination		Description
	High Byte	Low Byte	
0	-	S0	Status byte 0
1	D1	D0	Input data word 1
2	-	S1	Status byte 1
3	D3	D2	Input data word 2
4	-	S2	Status byte 2
5	D5	D4	Input data word 3

Output Process Image			
Offset	Byte Destination		Description
	High Byte	Low Byte	
0	-	C0	Control byte 0
1	D1	D0	Output data word 1
2	-	C1	Control byte 1
3	D3	D2	Output data word 2
4	-	C2	Control byte 2
5	D5	D4	Output data word 3

12.2.5 Analog Output Modules

The hardware of an analog output module has 16 bits of measured analog data per channel and 8 bits of control/status. However, the coupler/controller with MODBUS/TCP does not have access to the 8 control/status bits. Therefore, the coupler/controller with MODBUS/TCP can only access the 16 bits of analog data per channel, which are grouped as words and mapped in Intel format in the Output Process Image.

When digital output modules are also present in the node, the analog output data is always mapped into the Output Process Image in front of the digital data.

Information

Information on the structure of control and status bytes
For detailed information on the structure of a particular I/O module's control/status bytes, please refer to that module's manual. Manuals for each module can be found on the Internet at www.wago.com.

12.2.5.1 2 Channel Analog Output Modules

Table 268: 2 Channel Analog Output Modules

Output Process Image			
Offset	Byte Destination		Description
	High Byte	Low Byte	
0	D1	D0	Output Value Channel 1
1	D3	D2	Output Value Channel 2

12.2.5.2 4 Channel Analog Output Modules

Table 269: 4 Channel Analog Output Modules

Output Process Image			
Offset	Byte Destination		Description
	High Byte	Low Byte	
0	D1	D0	Output Value Channel 1
1	D3	D2	Output Value Channel 2
2	D5	D4	Output Value Channel 3
3	D7	D6	Output Value Channel 4

12.2.6 Specialty Modules

In addition to the data bytes, the control/status byte is also displayed for select I/O modules. This byte is used for the bi-directional data exchange of the I/O module with the higher-level control system.

The control byte controls the I/O module's behavior and operation. The status byte reports the I/O module's status. It is possible to set the counter with the control byte or indicate a range overflow/underflow with the status byte.

The control/status byte is always in the low byte in the process image.

Note

Information for the control/status byte development
Please refer to the corresponding description of the I/O modules for the structure of the control/status bytes. You can find a manual with the relevant I/O module description at: **http://www.wago.com**.

12.2.6.1 Serial Interfaces with Alternative Data Format

Note

The process image depends on the parameterized operating mode!
The operating mode of the configurable I/O module can be set. Based on the operating mode, the process image of these I/O modules is then the same as that of the respective version.

The I/O modules with serial interface that are set to the alternative data format occupy 4 bytes of user data in the input and output area of the process image, 3 data bytes and one additional control/status byte. Two words are assigned in the process image via word alignment.

Table 270: Serial interfaces with alternative data format

Input and Output Process Image				
Offset	Byte designation		Remark	
	High byte	Low byte		
0	D0	C/S	Data byte	Control/status byte
1	D2	D1	Data bytes	

12.2.6.2 SSI Transmitter Interface I/O Modules

Note

The process image depends on the parameterized operating mode!
The operating mode of the configurable I/O module can be set. Based on the operating mode, the process image of these I/O modules is then the same as that of the respective version.

In the input process image, SSI transmitter interface modules with status occupy 4 data bytes. Two words are assigned in the process image via word alignment.

Table 271: SSI transmitter interface modules with alternative data format

Input process image			
Offset	Byte designation		Remark
	High byte	Low byte	
0	D1	D0	Data bytes
1	D3	D2	

12.2.6.3 Distance and Angle Measurement

The incremental encoder interface module occupies 6 bytes of user data in the input and output area of the process image, 4 data bytes and two additional control/status bytes. Four words are assigned in the process image via word alignment.

Table 272: Incremental Encoder Interface

Input and Output Process Image			
Offset	Byte designation		Remark
	High byte	Low byte	
0	-	C0/S0	Control/status byte of channel 1
1	D1	D0	Data values of channel 1
2	-	C1/S1	Control/status byte of channel 2
3	D3	D2	Data values of channel 2

12.2.6.4 Counter Modules

Operating modes:
- “Up/Down Counter / 100 kHz”,
- “Up Counter / Enable Input”,
- “Peak Time Counter”
- “Frequency Counter”
- “Up/Down Counter / Signal Outputs (DO)”

The above Counter Modules have a total of 5 bytes of user data in both the Input and Output Process Image (4 bytes of counter data and 1 byte of control/status). The counter value is supplied as 32 bits. The following tables illustrate the Input and Output Process Image, which has a total of 3 words mapped into each image. Word alignment is applied.

Table 273: Counter Modules

Input Process Image			
Offset	**Byte Designation**		**Description**
	High Byte	**Low Byte**	
0	-	S	Status byte
1	D1	D0	Counter value
2	D3	D2	

Output Process Image			
Offset	**Byte Designation**		**Description**
	High Byte	**Low Byte**	
0	-	C	Control byte
1	D1	D0	Counter setting value
2	D3	D2	

Special case: Operating mode “2 Up Counter / 16 Bit / 5 kHz”

The above Counter Modules have a total of 5 bytes of user data in both the Input and Output Process Image (4 bytes of counter data and 1 byte of control/ status). The two counter values are supplied as 32 bits. The following tables illustrate the Input and Output Process Image, which has a total of 3 words mapped into each image. Word alignment is applied.

Table 274: Counter Module, Operating mode “2 Up Counter/16 Bit / 5 kHz”

Input Process Image			
Offset	**Byte Designation**		**Description**
	High Byte	**Low Byte**	
0	-	S	Status byte
1	D1	D0	Counter Value of Counter 1
2	D3	D2	Counter Value of Counter 2

Output Process Image			
Offset	**Byte Designation**		**Description**
	High Byte	**Low Byte**	
0	-	C	Control byte
1	D1	D0	Counter Setting Value of Counter 1
2	D3	D2	Counter Setting Value of Counter 2

12.2.6.5 CAN Gateway

The process image size of the CAN Gateway can be set in the specified sizes of 8, 12, 16, 20, 24, 32, 40 or 48 bytes.
The CAN Gateway has an acyclic communication channel (Mailbox) in the process image.
This is used to transmit configuration, parameterization and diagnostic data.
The length of the first acyclic channel can be set between 2 and a maximum of x bytes (x = total PA size - 3). This is followed by the CAN user data area, where CAN telegrams are transmitted via the "Mailbox 2.0" communication mechanism in the operating modes "Sniffer Mode" and "Transparent Mode". In the operating mode "Mapped Mode", in this area transmitted and received CAN telegrams can be mapped to the process image without using any protocoll.

The operating mode and also the mailbox and the process image sizes are set with the startup tool WAGO-I/O-*CHECK*.

Table 275: CAN Gateway

Input and Output Process Image					
Process image size	**Offset**	**Byte Designation**		**Descrition**	
		High Byte	**Low Byte**		
8 bytes	0	C/D_MBX	C0/S0	Config/Diag Mailbox	Control/ Status byte
	1	C/D_MBX / CAN_X	C/D_MBX	Config/Diag Mailbox (1 … 44 bytes)/ CAN user data Mailbox (5 … 45 bytes) **) bzw. Toggle-Byte +CAN-Nutzdaten (4-44 Byte) ***)	
	2	C/D_MBX / CAN_X	C/D_MBX / CAN_X		
	3	C/D_MBX / CAN_X	C/D_MBX / CAN_X		
12 bytes	4	C/D_MBX / CAN_X	C/D_MBX / CAN_X		
	5	C/D_MBX / CAN_X	C/D_MBX / CAN_X		
16 bytes	6	C/D_MBX / CAN_X	C/D_MBX / CAN_X		
	7	C/D_MBX / CAN_X	C/D_MBX / CAN_X		
20 bytes	8	C/D_MBX / CAN_X	C/D_MBX / CAN_X		
	9	C/D_MBX / CAN_X	C/D_MBX / CAN_X		
24 bytes *	10	C/D_MBX / CAN_X	C/D_MBX / CAN_X		
	11	C/D_MBX / CAN_X	C/D_MBX / CAN_X		
32 bytes	12	C/D_MBX / CAN_X	C/D_MBX / CAN_X		
	…				
	15	C/D_MBX / CAN_X	C/D_MBX / CAN_X		
40 bytes	16	C/D_MBX / CAN_X	C/D_MBX / CAN_X		
	…				
	19	C/D_MBX / CAN_X	C/D_MBX / CAN_X		
48 bytes	20	C/D_MBX / CAN_X	C/D_MBX / CAN_X		
	21	C/D_MBX / CAN_X	C/D_MBX / CAN_X		
	22	C/D_MBX / CAN_X	C/D_MBX / CAN_X		
	23	CAN_X	CAN_X		

*) Factory Setting
**) Operating mode „Sniffer Mode“ and operating mode „Transparent Mode“
***) Operating mode „Mapped Mode“

12.2.7 System Modules

12.2.7.1 System Modules with Diagnostics

The intrinsically safe supply modules provide 2 bits of diagnostics in the Input Process Image for monitoring of the internal power supply.

Table 276: Intrinsically Safe Supply Modules with Diagnostics

Input Process Image							
Bit 7	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
						Diagnostics bit S_out	Diagnostics bit S_in

The supply modules with fuse carrier and diagnostics provide 2 bits of diagnostics in the Input Process Image for monitoring of the internal power supply.

Table 277: Supply Modules with fuse Carrier and Diagnostics

Input Process Image							
Bit 7	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
						Diagnostics bit S 2 Fuse	Diagnostics bit S 1 Fuse

12.3 Process Data Architecture for EtherNet/IP

With some I/O modules, the structure of the process data is fieldbus specific.

In the case of a fieldbus controller with EtherNet/IP, the process image uses a word structure (with word alignment). The internal mapping method for data greater than one byte conforms to the Intel format.

The following section describes the process image for various WAGO-I/O-SYSTEM 750 and 753 I/O modules when using a fieldbus coupler with EtherNet/IP.

NOTICE

Equipment damage due to incorrect address!
To prevent any damage to the device in the field, you must always take the process data for all previous byte or bit-oriented I/O modules into account when addressing an I/O module at any position in the fieldbus node.

12.3.1 Digital Input Modules

The digital input modules provide a process value of one bit per channel, which indicates the status of the respective channel. These bits are mapped into the input process image.

Some digital input modules have an additional diagnostic bit per channel in the input process image. The diagnostic bit detects faults (e.g., wire breakage, overloads and/or short circuits).

If analog input modules are in the node, the digital data is grouped in bytes and added to the analog input data in the process image. 1 sub-index is assigned for each 8 bit.

Each input channel occupies on instance in the “Discrete Input Point Object” (Class 0x65).

12.3.1.1 1-Channel Digital Input Modules with Diagnostics

Table 278: 1-channel digital input modules with diagnostics

Input process image							
Bit 7	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
						Diagnostic bit S 1	Data bit DI 1

The input modules occupy 2 instances in class (0x65).

12.3.1.2 2-Channel Digital Input Modules

Table 279: 2-channel digital input modules

Input process image							
Bit 7	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
						Data bit DI 2 Channel 2	Data bit DI 1 Channel 1

The input modules occupy 2 instances in class (0x65).

12.3.1.3 2-Channel Digital Input Modules with Diagnostics

Table 280: 2-channel digital input modules with diagnostics

Input process image							
Bit 7	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
				Diag. bit S 2 Channel 2	Diag. bit S 1 Channel 1	Data bit DI 2 Channel 2	Data bit DI 1 Channel 1

The input modules occupy 4 instances in class (0x65).

12.3.1.4 2-Channel Digital Input Modules with Diagnostics and Output Data

In addition to process values for input process image, the digital input modules provide 4 bits of data in the output process image.

Table 281: 2-channel digital input modules with diagnostics and output data

Input process image							
Bit 7	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
				Diag. bit S 2 Channel 2	Diag. bit S 1 Channel 1	Data bit DI 2 Channel 2	Data bit DI 1 Channel 1

The input modules occupy 4 instances in class (0x65).

Output process image							
Bit 7	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
				Acknow-ledgement bit Q 2 Channel 2	Acknow-ledgement bit Q 1 Channel 1	0	0

The input modules occupy 4 instances in class (0x66).

12.3.1.5 4-Channel Digital Input Modules

Table 282: 4-channel digital input modules

Input process image							
Bit 7	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
				Data bit DI 4 Channel 4	Data bit DI 3 Channel 3	Data bit DI 2 Channel 2	Data bit DI 1 Channel 1

The input modules occupy 4 instances in class (0x65).

12.3.1.6 8-Channel Digital Input Modules

Table 283: 8-channel digital input modules

Input process image							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Data bit DI 8 Channel 8	Data bit DI 7 Channel 7	Data bit DI 6 Channel 6	Data bit DI 5 Channel 5	Data bit DI 4 Channel 4	Data bit DI 3 Channel 3	Data bit DI 2 Channel 2	Data bit DI 1 Channel 1

The input modules occupy 8 instances in class (0x65).

12.3.1.7 16-Channel Digital Input Modules

Table 284: 16-channel digital input modules

Input process image															
Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Data bit DI 16 Chan-nel 16	Data bit DI 15 Chan-nel 15	Data bit DI 14 Chan-nel 14	Data bit DI 13 Chan-nel 13	Data bit DI 12 Chan-nel 12	Data bit DI 11 Chan-nel 11	Data bit DI 10 Chan-nel 10	Data bit DI 9 Chan-nel 9	Data bit DI 8 Chan-nel 8	Data bit DI 7 Chan-nel 7	Data bit DI 6 Chan-nel 6	Data bit DI 5 Chan-nel 5	Data bit DI 4 Chan-nel 4	Data bit DI 3 Chan-nel 3	Data bit DI 2 Chan-nel 2	Data bit DI 1 Chan-nel 1

12.3.2 Digital Output Modules

The digital output modules provide one bit as the process value per channel that indicates the status of the respective channel. These bits are mapped into the output process image.

Some digital output modules have an additional diagnostic bit per channel in the input process image. The diagnostic bit detects faults (e.g., wire breakage, overloads and/or short circuits). For some I/O modules, the data bits also have be evaluated with the set diagnostic bit.

If analog output modules are in the node, the digital data is grouped in bytes and added after the analog output data in the output process image. 1 sub-index is assigned for each 8 bit.

Each output channel occupies one instance in the “Discrete Output Point Object” (Class 0x66).

12.3.2.1 1-Channel Digital Output Modules with Input Data

In addition to the process value bit in the output process image, the digital output modules also provides 1 bit that is represented in the input process image. This status image shows “Manual operation”.

Table 285: 1-channel digital output modules with input data

Input process image							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
						Not used	Status bit "Manual operation"

The output modules occupy 2 instances in class (0x65).

Output process image							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
						Not used	Controls DO 1 Channel 1

The output modules occupy 2 instances in class (0x66).

12.3.2.2 2-Channel Digital Output Modules

Table 286: 2-channel digital output modules

Output process image							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
						Controls DO 2 Channel 2	Controls DO 1 Channel 1

The output modules occupy 2 instances in class (0x66).

12.3.2.3 2-Channel Digital Output Modules with Diagnostics and Input Data

In addition to the 2-bit process values in the output process image, the digital output modules provide 2 bits of data in the input process image. A diagnostic bit for each output channel indicates an overload, short circuit or wire breakage.

Table 287: 2-channel digital output modules with diagnostics and input data

Input process image							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
						Diag. bit S 2 Channel 2	Diag. bit S 1 Channel 1

The output modules occupy 2 instances in class (0x65).

Output process image							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
						Controls DO 2 Channel 2	Controls DO 1 Channel 1

The output modules occupy 2 instances in class (0x66).

12.3.2.4 4-Channel Digital Output Modules

Table 288: 4-channel digital output modules

Output process image							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
				Controls DO 4 Channel 4	Controls DO 3 Channel 3	Controls DO 2 Channel 2	Controls DO 1 Channel 1

The output modules occupy 4 instances in class (0x66).

12.3.2.5 4-Channel Digital Output Modules with Diagnostics and Input Data

In addition to the 4-bit process values in the output process image, the digital output modules provide 4 bits of data in the input process image. A diagnostic bit for each output channel indicates an overload, short circuit or wire breakage.

Table 289: 4-channel digital output modules with diagnostics and input data

Input process image							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
				Diag. bit S 4 Channel 4	Diag. bit S 3 Channel 3	Diag. bit S 2 Channel 2	Diag. bit S 1 Channel 1
Diagnostic bit S = '0' Diagnostic bit S = '1'		no error wire break, short circuit or overload					

The output modules occupy 4 instances in class (0x65).

Output process image							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
				Controls DO 4 Channel 4	Controls DO 3 Channel 3	Controls DO 2 Channel 2	Controls DO 1 Channel 1

The output modules occupy 4 instances in class (0x66).

12.3.2.6 8-Channel Digital Output Modules

Table 290: 8-channel digital output modules

Output process image							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Controls DO 8 Channel 8	Controls DO 7 Channel 7	Controls DO 6 Channel 6	Controls DO 5 Channel 5	Controls DO 4 Channel 4	Controls DO 3 Channel 3	Controls DO 2 Channel 2	Controls DO 1 Channel 1

The output modules occupy 8 instances in class (0x66).

12.3.2.7 8-Channel Digital Output Modules with Diagnostics and Input Data

In addition to the 8-bit process values in the output process image, the digital output modules provide 8 bits of data in the input process image. A diagnostic bit for each output channel indicates an overload, short circuit or wire breakage.

Table 291: 8-channel digital output modules with diagnostics and input data

Input process image							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Diag. bit S 8 Channel 8	Diag. bit S 7 Channel 7	Diag. bit S 6 Channel 6	Diag. bit S 5 Channel 5	Diag. bit S 4 Channel 4	Diag. bit S 3 Channel 3	Diag. bit S 2 Channel 2	Diag. bit S 1 Channel 1
Diagnostic bit S = '0' no error Diagnostic bit S = '1' wire break, short circuit or overload							

The output modules occupy 8 instances in class (0x65).

Output process image							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Controls DO 8 Channel 8	Controls DO 7 Channel 7	Controls DO 6 Channel 6	Controls DO 5 Channel 5	Controls DO 4 Channel 4	Controls DO 3 Channel 3	Controls DO 2 Channel 2	Controls DO 1 Channel 1

The output modules occupy 8 instances in class (0x66).

12.3.2.8 16-Channel Digital Output Modules

Table 292: 16-channel digital output modules

Output process image															
Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Con-trols DO 16 Chan-nel 16	Con-trols DO 15 Chan-nel 15	Con-trols DO 14 Chan-nel 14	Con-trols DO 13 Chan-nel 13	Con-trols DO 12 Chan-nel 12	Con-trols DO 11 Chan-nel 11	Con-trols DO 10 Chan-nel 10	Con-trols DO 9 Chan-nel 9	Con-trols DO 8 Chan-nel 8	Con-trols DO 7 Chan-nel 7	Con-trols DO 6 Chan-nel 6	Con-trols DO 5 Chan-nel 5	Con-trols DO 4 Chan-nel 4	Con-trols DO 3 Chan-nel 3	Con-trols DO 2 Chan-nel 2	Con-trols DO 1 Chan-nel 1

The output modules occupy 16 instances in class (0x66).

12.3.2.9 8-Channel Digital Input/Output Modules

Table 293: 8-channel digital input/output modules

Input process image							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Data bit DI 8 Channel 8	Data bit DI 7 Channel 7	Data bit DI 6 Channel 6	Data bit DI 5 Channel 5	Data bit DI 4 Channel 4	Data bit DI 3 Channel 3	Data bit DI 2 Channel 2	Data bit DI 1 Channel 1

The input/output modules occupy 8 instances in class (0x65).

Output process image							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Controls DO 8 Channel 8	Controls DO 7 Channel 7	Controls DO 6 Channel 6	Controls DO 5 Channel 5	Controls DO 4 Channel 4	Controls DO 3 Channel 3	Controls DO 2 Channel 2	Controls DO 1 Channel 1

The input/output modules occupy 8 instances in class (0x66).

12.3.3 Analog Input Modules

The analog input modules provide 16-bit measured data and 8 control/status bits per channel.

EtherNet/IP does not use the 8 control/status bits, i.e., it does not access or evaluate them.

Therefore, only the 16-bit measured values for each channel are in Intel format and are mapped by word in the input process image for the fieldbus coupler/controller with EtherNet/IP.

If digital input modules are in the node, the analog input data is mapped first into the input process image, followed by the digital input data.

Each input channel occupies one instance in the “Analog Input Point Object” (Class 0x67).

Information

Information for the control/status byte development
Please refer to the corresponding description of the I/O modules for the structure of the control/status bytes. You can find a manual with the relevant I/O module description at: http://www.wago.com.

12.3.3.1 1-Channel Analog Input Modules

Table 294: 1-channel analog input modules

Input process image			
Instance	Byte designation		Remark
	High byte	Low byte	
n	D1	D0	Measured value U_D
n+1	D3	D2	Measured value U_{ref}

These input modules represent 2x2 bytes and occupy 2 instances in class (0x67).

12.3.3.2 2-Channel Analog Input Modules

Table 295: 2-channel analog input modules

Input process image			
Instance	Byte designation		Remark
	High byte	Low byte	
n	D1	D0	Measured value channel 1
n+1	D3	D2	Measured value channel 2

These input modules represent 2x2 bytes and occupy 2 instances in class (0x67).

12.3.3.3 4-Channel Analog Input Modules

Table 296: 4-channel analog input modules

Input process image			
Instance	Byte designation		Remark
	High byte	Low byte	
n	D1	D0	Measured value channel 1
n+1	D3	D2	Measured value channel 2
n+2	D5	D4	Measured value channel 3
n+3	D7	D6	Measured value channel 4

These input modules represent 4x2 bytes and occupy 4 instances in class (0x67).

12.3.4 Analog Output Modules

The analog output modules provide 16-bit output values and 8 control/status bits per channel. EtherNet/IP does not use the 8 control/status bits, i.e., it does not access or evaluate them.

Therefore, only the 16-bit output values for each channel are in Intel format and are mapped by word in the output process image for the fieldbus coupler/controller with EtherNet/IP.

If digital output modules are in the node, the analog output data is mapped first into the output process image, followed by the digital output data.

Each output channel occupies one instance in the “Analog Output Point Object” (Class 0x68).

Information

Information for the control/status byte development
Please refer to the corresponding description of the I/O modules for the structure of the control/status bytes. You can find a manual with the relevant I/O module description at: http://www.wago.com.

12.3.4.1 2-Channel Analog Output Modules

Table 297: 2-channel analog output modules

Output process image			
Instance	Byte designation		Remark
	High byte	Low byte	
n	D1	D0	Output value channel 1
n+1	D3	D2	Output value channel 2

These output modules represent 2x2 bytes and occupy 2 instances in class (0x68).

12.3.4.2 4-Channel Analog Output Modules

Table 298: 4-channel analog output modules

Output process image			
Instance	Byte designation		Remark
	High byte	Low byte	
n	D1	D0	Output value channel 1
n+1	D3	D2	Output value channel 2
n+2	D5	D4	Output value channel 3
n+3	D7	D6	Output value channel 4

These output modules represent 4x2 bytes and occupy 4 instances in class (0x68).

12.3.5 Specialty Modules

In addition to the data bytes, the control/status byte is also displayed for select I/O modules. This byte is used for the bi-directional data exchange of the I/O module with the higher-level control system.

The control byte controls the I/O module's behavior and operation. The status byte reports the I/O module's status. It is possible to set the counter with the control byte or indicate a range overflow/underflow with the status byte.

The control/status byte always lies in the low byte for the fieldbus coupler/controller with EtherNet/IP.

Information

Information for the control/status byte development
Please refer to the corresponding description of the I/O modules for the structure of the control/status bytes. You can find a manual with the relevant I/O module description at: http://www.wago.com.

The specialty modules represent analog input/output modules.

Therefore, their process input values also occupy one instances per channel in the “Analog Input Point Object” (class 0x67) and their process output values one instance per channel in the “Analog Input Point Object” (class 0x68).

12.3.5.1 Serial Interfaces with Alternative Data Format

Note

The process image depends on the parameterized operating mode!
The operating mode of the configurable I/O module can be set. Based on the operating mode, the process image of these I/O modules is then the same as that of the respective version.

The I/O modules with serial interface that are set to the alternative data format occupy 4 bytes of user data in the input and output area of the process image, 3 data bytes and one additional control/status byte. Two words are assigned in the process image via word alignment.

Table 299: Serial interfaces with alternative data format

Input and Output Process Image				
Instance	Byte designation		Remark	
	High byte	Low byte		
n	D0	C/S	Data byte	Control/status byte
n+1	D2	D1	Data bytes	

The specialty modules represent 2x2 bytes and occupy 2 instances in class (0x67) and 2 instances in class (0x68).

12.3.5.2 SSI Transmitter Interface I/O Modules

Note

The process image depends on the parameterized operating mode!
The operating mode of the configurable I/O module can be set. Based on the operating mode, the process image of these I/O modules is then the same as that of the respective version.

In the input process image, SSI transmitter interface modules with status occupy 4 data bytes. Two words are assigned in the process image via word alignment.

Table 300: SSI transmitter interface modules with alternative data format

Input process image			
Instance	**Byte designation**		**Remark**
	High byte	**Low byte**	
n	D1	D0	Data bytes
n+1	D3	D2	

These specialty modules represent 2x2 bytes and occupy 2 instances in class (0x67).

12.3.5.3 Distance and Angle Measurement

The incremental encoder interface I/O module appears with 6 bytes of reference data in the input and output area of the process image, 4 data bytes and two additional control/status bytes. Four words are assigned in the process image via word alignment.

Table 301: Incremental Encoder Interface I/O module

Input and Output Process Image			
Instance	**Byte designation**		**Remark**
	High byte	**Low byte**	
n	-	C0/S0	Control/status byte of channel 1
	D1	D0	Data values of channel 1
n+1	-	C1/S1	Control/status byte of channel 2
	D3	D2	Data values of channel 2

These specialty modules represent 2x3 bytes and occupy 2 instances in class (0x67) and 2 instances in class (0x68).

12.3.6 System Modules

12.3.6.1 Binary Space Module

The Binary Space Modules behave alternatively like 2 channel digital input modules or output modules and seize depending upon the selected settings 1, 2, 3 or 4 bits per channel. According to this, 2, 4, 6 or 8 bits are occupied then either in the process input or the process output image.

Table 302: Binary Space Module (with behavior like 2 channel digital input)

Input and Output Process Image							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
(Data bit DI 8)	(Data bit DI 7)	(Data bit DI 6)	(Data bit DI 5)	(Data bit DI 4)	(Data bit DI 3)	Data bit DI 2	Data bit DI 1

The Binary Space Modules seize 2, 4, 6 or 8 Instances in class (0x65) or in Class (0x66).

13 Application Examples

13.1 Test of Modbus protocol and fieldbus nodes

You require a Modbus master to test the function of your fieldbus node. For this purpose, various manufacturers offer a range of PC applications that you can, in part, download from the Internet as free of charge demo versions.

One of the programs which is particularly suitable to test your ETHERNET TCP/IP fieldbus node, is for instance **ModScan** from Win-Tech.

Information

Additional Information
A free of charge demo version from ModScan32 and further utilities from Win-Tech can be found in the Internet under:
http://www.win-tech.com/html/demos.htm

ModScan32 is a Windows application that works as a Modbus master.

This program allows you to access the data points of your connected ETHERNET TCP/IP fieldbus node and to proceed with the desired changes.

Information

Additional Information
For a description example relating to the software operation, refer to:
http://www.win-tech.com/html/modscan32.htm

13.2 Visualization and Control using SCADA Software

This chapter is intended to give insight into how the WAGO ETHERNET fieldbus coupler/controller can be used for process visualization and control using standard user software.

There is a wide range of process visualization programs, called SCADA Software, from various manufacturers.

SCADA is the abbreviation for Supervisory Control and Data Acquisition.

It is a user-orientated tool used as a production information system in the areas of automation technology, process control and production monitoring.

The use of SCADA systems includes the areas of visualization and monitoring, data access, trend recording, event and alarm processing, process analysis and targeted intervention in a process (control).

The WAGO ETHERNET fieldbus node provides the required process input and output values.

Note

SCADA software has to provide a Modbus device driver and support Modbus TCP functions!
When choosing suitable SCADA software, ensure that it provides a Modbus device driver and supports the Modbus TCP functions in the coupler.

Visualization programs with Modbus device drivers are available from i.e. Wonderware, National Instruments, Think&Do or KEPware Inc., some of which are available on the Internet as demo versions.

The operation of these programs is very specific.
However, a few essential steps are described to illustrate the way an application can be developed using a WAGO ETHERNET fieldbus node and SCADA software in principle:

1. Load the Modbus ETHERNET driver and select Modbus ETHERNET

2. Enter the IP address for addressing the fieldbus node

At this point, some programs allow the user to give the node an alias name, i.e. to call the node “Measuring data”. The node can then be addressed with this name.

3. Create a graphic object, such as a switch (digital) or a potentiometer (analog)

This object is displayed on the work area.

4. Link the object to the desired data point on the node by entering the following data:

    - Node address (IP address or alias name)
    - The desired Modbus function codes (register/bit read/write)
    - The Modbus address of the selected channel

Entry is program specific.

Depending on the user software the Modbus addressing of a bus module can be represented with up to 5 digits.

Example of the Modbus Addressing

In the case of SCADA Software Lookout from National Instruments the Modbus function codes are used with a 6 digit coding, whereby the first digit represents the Modbus table (0, 1, 3 or 4) and implicit the function code (see following table):

Table 303: Modbus Table and Function Codes

Modbus table	Modbus function code	
0	FC1 or FC15	Reading of input bits or writing of several output bits
1	FC2	Reading of several input bits
3	FC4 or FC 16	Reading of several input registers or writing of several output registers
4	FC3	Reading of several input registers

The following five digits specify the channel number (beginning with 1) of the consecutively numbered digital or analog input and/or output channels.

Examples:

- Reading/writing the first digital input: i.e. 0 0000 1
- Reading/writing the second analog input: i.e. 3 0000 2

Application Example:

Thus, the digital input channel 2 of the above node “Measuring data” can be read out with the input: “Measuring data. 0 0000 2”.

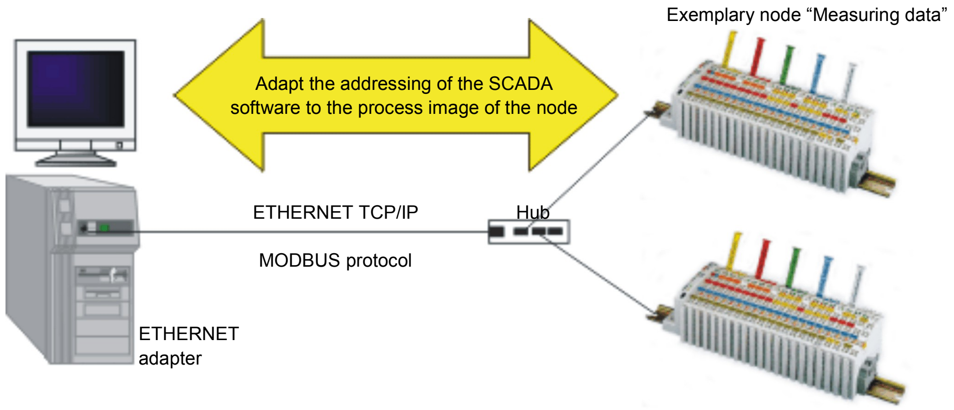


Figure 56: Example SCADA Software with Modbus Driver

Information

Additional Information
Please refer to the respective SCADA product manual for a detailed description of the particular software operation.

14 Use in Hazardous Environments

The **WAGO-I/O-SYSTEM 750** (electrical equipment) is designed for use in Zone 2 hazardous areas and shall be used in accordance with the marking and installation regulations.

The following sections include both the general identification of components (devices) and the installation regulations to be observed. The individual subsections of the “Installation Regulations” section must be taken into account if the I/O module has the required approval or is subject to the range of application of the ATEX directive.

14.1 Marking Configuration Examples

14.1.1 Marking for Europe According to ATEX and IECEx

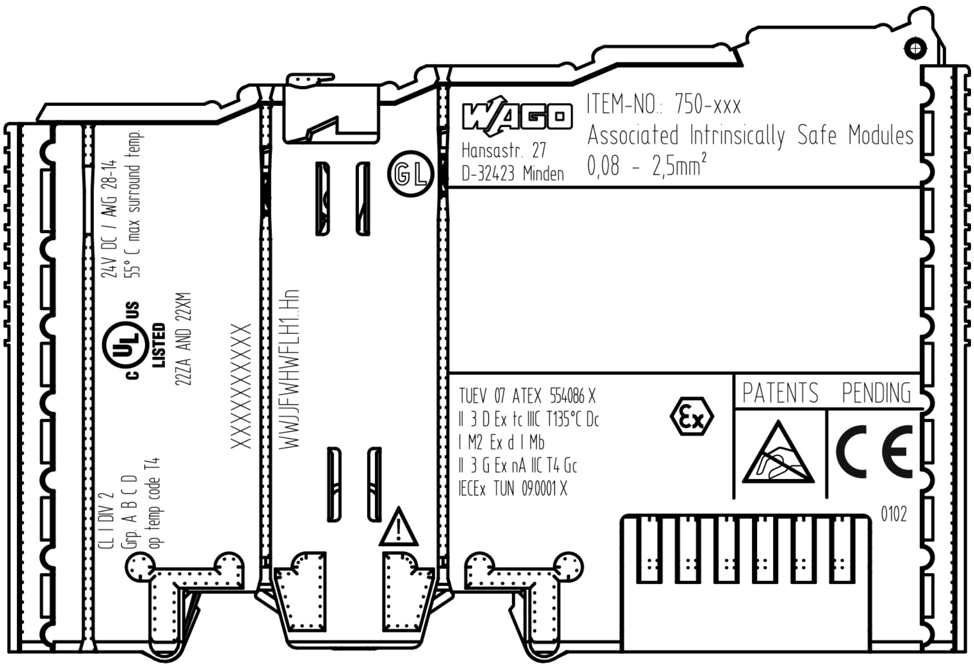


Figure 57: Marking Example According to ATEX and IECEx

TUEV 07 ATEX 554086 X
II 3 D Ex tc IIIC T135°C Dc
I M2 Ex d I Mb
II 3 G Ex nA IIC T4 Gc
IECEx TUN 09.0001 X

Figure 58: Text Detail – Marking Example According to ATEX and IECEx

Table 304: Description of Marking Example According to ATEX and IECEx

Marking	Description
TUEV 07 ATEX 554086 X IECEx TUN 09.0001 X	Approving authority resp. certificate numbers
Dust	
II	Equipment group: All except mining
3 D	Category 3 (Zone 22)
Ex	Explosion protection mark
tc	Type of protection: Protection by enclosure
IIIC	Explosion group of dust
T135°C	Max. surface temperature of the enclosure (without a dust layer)
Dc	Equipment protection level (EPL)
Mining	
I	Equipment group: Mining
M2	Category: High level of protection
Ex	Explosion protection mark
d	Type of protection: Flameproof enclosure
I	Explosion group for electrical equipment for mines susceptible to firedamp
Mb	Equipment protection level (EPL)
Gases	
II	Equipment group: All except mining
3 G	Category 3 (Zone 2)
Ex	Explosion protection mark
nA	Type of protection: Non-sparking equipment
IIC	Explosion group of gas and vapours
T4	Temperature class: Max. surface temperature 135 °C
Gc	Equipment protection level (EPL)

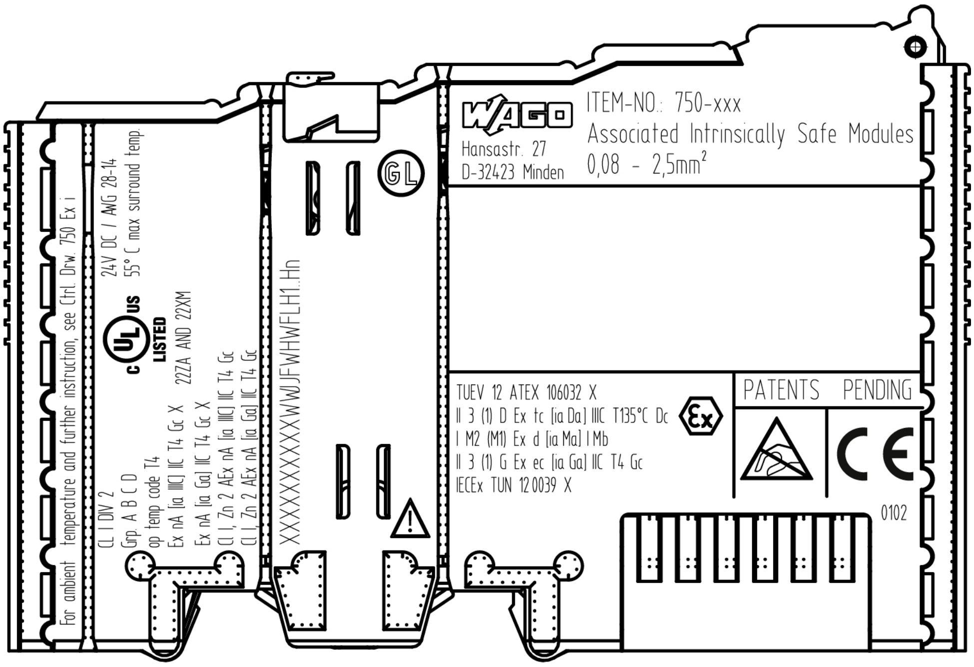


Figure 59: Marking Example for Approved Ex i I/O Module According to ATEX and IECEx

TUEV 12 ATEX 106032 X
II 3 (1) D Ex tc [ia Da] IIIC T135°C Dc
I M2 (M1) Ex d [ia Ma] I Mb
II 3 (1) G Ex ec [ia Ga] IIC T4 Gc
IECEx TUN 12.0039 X

Figure 60: Text Detail – Marking Example for Approved Ex i I/O Module According to ATEX and IECEx

Table 305: Description of Marking Example for Approved Ex i I/O Module According to ATEX and IECEx

Marking	Description
TUEV 12 ATEX 106032 X IECEx TUN 12 0039 X	Approving authority resp. certificate numbers
Dust	
II	Equipment group: All except mining
3 (1) D	Category 3 (Zone 22) equipment containing a safety device for a category 1 (Zone 20) equipment
Ex	Explosion protection mark
tc	Type of protection: Protection by enclosure
[ia Da]	Type of protection and equipment protection level (EPL): Associated apparatus with intrinsic safety circuits for use in Zone 20
IIIC	Explosion group of dust
T135°C	Max. surface temperature of the enclosure (without a dust layer)
Dc	Equipment protection level (EPL)
Mining	
I	Equipment Group: Mining
M2 (M1)	Category: High level of protection with electrical circuits which present a very high level of protection
Ex	Explosion protection mark
d	Type of protection: Flameproof enclosure
[ia Ma]	Type of protection and equipment protection level (EPL): Associated apparatus with intrinsic safety electrical circuits
I	Explosion group for electrical equipment for mines susceptible to firedamp
Mb	Equipment protection level (EPL)
Gases	
II	Equipment group: All except mining
3 (1) G	Category 3 (Zone 2) equipment containing a safety device for a category 1 (Zone 0) equipment
Ex	Explosion protection mark
ec	Equipment protection by increased safety “e”
[ia Ga]	Type of protection and equipment protection level (EPL): Associated apparatus with intrinsic safety circuits for use in Zone 0
IIC	Explosion group of gas and vapours
T4	Temperature class: Max. surface temperature 135 °C
Gc	Equipment protection level (EPL)

14.1.2 Marking for the United States of America (NEC) and Canada (CEC)

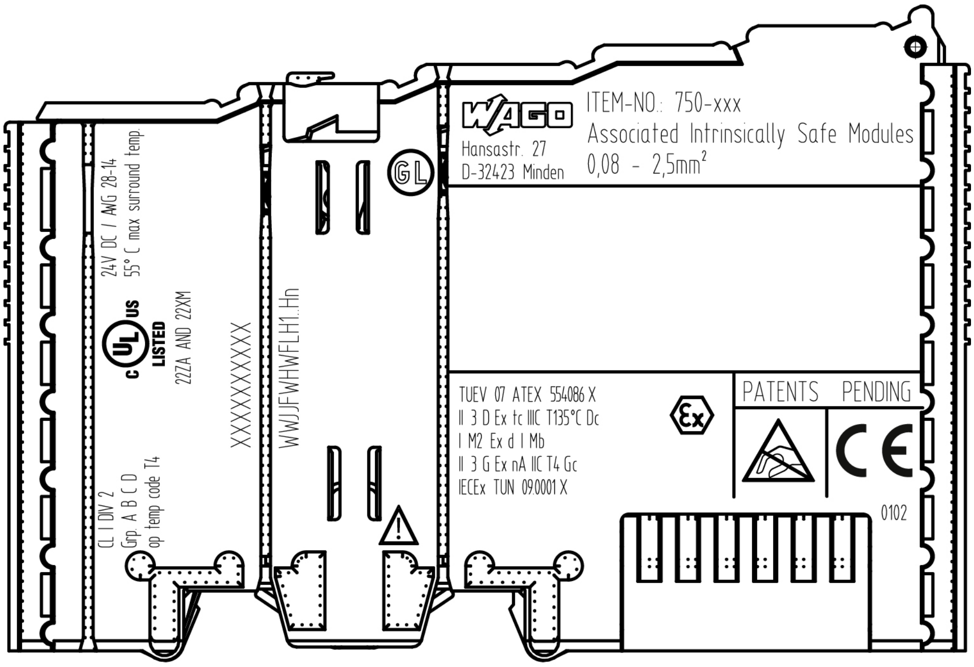


Figure 61: Marking Example According to NEC

CL I DIV 2
Grp. A B C D
op temp code T4

Figure 62: Text Detail – Marking Example According to NEC 500

Table 306: Description of Marking Example According to NEC 500

Marking	Description
CL I	Explosion protection (gas group)
DIV 2	Area of application
Grp. A B C D	Explosion group (gas group)
op temp code T4	Temperature class

Cl I, Zn 2 AEx nA [ia Ga] IIC T4 Gc

Figure 63: Text Detail – Marking Example for Approved Ex i I/O Module According to NEC 505

Table 307: Description of Marking Example for Approved Ex i I/O Module According to NEC 505

Marking	Description
Cl I,	Explosion protection group
Zn 2	Area of application
AEx	Explosion protection mark
nA	Type of protection
[ia Ga]	Type of protection and equipment protection level (EPL): Associated apparatus with intrinsic safety circuits for use in Zone 20
IIC	Group
T4	Temperature class
Gc	Equipment protection level (EPL)

Cl I, Zn 2 AEx nA [ia IIIC] IIC T4 Gc

Figure 64: Text Detail – Marking Example for Approved Ex i I/O Module According to NEC 506

Table 308: Description of Marking Example for Approved Ex i I/O Modules According to NEC 506

Marking	Description
Cl I,	Explosion protection group
Zn 2	Area of application
AEx	Explosion protection mark
nA	Type of protection
[ia IIIC]	Type of protection and equipment protection level (EPL): Associated apparatus with intrinsic safety circuits for use in Zone 20
IIC	Group
T4	Temperature class
Gc	Equipment protection level (EPL)

Ex nA [ia IIIC] IIC T4 Gc X
Ex nA [ia Ga] IIC T4 Gc X

Figure 65: Text Detail – Marking Example for Approved Ex i I/O Modules According to CEC 18 attachment J

Table 309: Description of Marking Example for Approved Ex i I/O Modules According to CEC 18 attachment J

Marking	Description
Dust	
Ex	Explosion protection mark
nA	Type of protection
[ia IIIC]	Type of protection and equipment protection level (EPL): Associated apparatus with intrinsic safety circuits for use in Zone 20
IIC	Group
T4	Temperature class
Gc	Equipment protection level (EPL)
X	Symbol used to denote specific conditions of use
Gases	
Ex	Explosion protection mark
nA	Type of protection
[ia Ga]	Type of protection and equipment protection level (EPL): Associated apparatus with intrinsic safety circuits for use in Zone 0
IIC	Group
T4	Temperature class
Gc	Equipment protection level (EPL)
X	Symbol used to denote specific conditions of use

14.2 Installation Regulations

For the installation and operation of electrical equipment in hazardous areas, the valid national and international rules and regulations which are applicable at the installation location must be carefully followed.

14.2.1 Special Notes including Explosion Protection

The following warning notices are to be posted in the immediately proximity of the WAGO-I/O-SYSTEM 750 (hereinafter “product”):

WARNING – DO NOT REMOVE OR REPLACE FUSED WHILE ENERGIZED!

WARNING – DO NOT DISCONNECT WHILE ENERGIZED!

WARNING – ONLY DISCONNECT IN A NON-HAZARDOUS AREA!

Before using the components, check whether the intended application is permitted in accordance with the respective printing. Pay attention to any changes to the printing when replacing components.

The product is an open system. As such, the product must only be installed in appropriate enclosures or electrical operation rooms to which the following applies:

- Can only be opened using a tool or key
- Inside pollution degree 1 or 2
- In operation, internal air temperature within the range of 0 °C ≤ Ta ≤ +55 °C or −20 °C ≤ Ta ≤ +60 °C for components with extension number …/025-xxx or −40 °C ≤ Ta ≤ +70 °C for components with extension number …/040-xxx
- Minimum degree of protection: min. IP54 (acc. to EN/IEC 60529)
- For use in Zone 2 (Gc), compliance with the applicable requirements of the standards EN/IEC/ABNT NBR IEC 60079-0, -7, -11, -15
- For use in Zone 22 (Dc), compliance with the applicable requirements of the standards EN/IEC/ABNT NBR IEC 60079-0, -7, -11, -15 and -31
- For use in mining (Mb), minimum degree of protection IP64 (acc. EN/IEC 60529) and adequate protection acc. EN/IEC/ABNT NBR IEC 60079-0 and -1
- Depending on zoning and device category, correct installation and compliance with requirements must be assessed and certified by a “Notified Body” (ExNB) if necessary!

Explosive atmosphere occurring simultaneously with assembly, installation or repair work must be ruled out. Among other things, these include the following activities

- Insertion and removal of components
- Connecting or disconnecting from fieldbus, antenna, D-Sub, ETHERNET or USB connections, DVI ports, memory cards, configuration and programming interfaces in general and service interface in particular:
  - Operating DIP switches, coding switches or potentiometers
  - Replacing fuses

Wiring (connecting or disconnecting) of non-intrinsically safe circuits is only permitted in the following cases

- The circuit is disconnected from the power supply.
- The area is known to be non-hazardous.

Outside the device, suitable measures must be taken so that the rated voltage is not exceeded by more than 40 % due to transient faults (e.g., when powering the field supply).

Product components intended for intrinsically safe applications may only be powered by 750-606 or 750-625/000-001 bus supply modules.

Only field devices whose power supply corresponds to overvoltage category I or II may be connected to these components.

14.2.2 Special Notes Regarding ANSI/ISA Ex

For ANSI/ISA Ex acc. to UL File E198726, the following additional requirements apply:

- Use in Class I, Division 2, Group A, B, C, D or non-hazardous areas only
- ETHERNET connections are used exclusively for connecting to computer networks (LANs) and may not be connected to telephone networks or telecommunication cables
- **WARNING** – The radio receiver module 750-642 may only be used to connect to external antenna 758-910!
- **WARNING** – Product components with fuses must not be fitted into circuits subject to overloads!
  These include, e.g., motor circuits.
- **WARNING** – When installing I/O module 750-538, “Control Drawing No. 750538” in the manual must be strictly observed!

Information

Additional Information
Proof of certification is available on request.
Also take note of the information given on the operating and assembly instructions.
The manual, containing these special conditions for safe use, must be readily available to the user.

List of Figures

List of Tables

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