

WAGO I/O System 750



750-862

**Controller Modbus TCP; G4; 2ETH; ECO
Controller Modbus TCP; Generation 4;
2 x ETHERNET; ECO**

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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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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 “Controller Modbus TCP; G4; 2ETH; ECO” (750-862).

The product “Controller Modbus TCP; G4; 2ETH; ECO” (750-862) shall only be installed and operated according to the instructions in this manual and the system description for the WAGO I/O System 750.

NOTICE

Consider power layout of the WAGO I/O System 750!

In addition to these operating instructions, you will also need the system description for the WAGO I/O System 750, 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

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1.4 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).

1.5 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 (.)

1.6 Font Conventions

Table 2: Font Conventions

Font Type	Indicates
<i>italic</i>	Names of paths and data files are marked in italic-type. e.g.: <i>C:\Program Files\WAGO Software</i>
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 of 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.

This product fulfills the requirements of protection type IP20 and is designed for use in dry interior spaces. There is protection against finger injury and solid impurities up to 12.5 mm diameter is assured; protection against water damage is not ensured.

The product represents an open-type device. It may only be installed in enclosures (tool-secured enclosures or operating rooms) which fulfil the listed requirements specified in the safety instructions in chapter "Safety Advice (Precautions)". Use without additional protective measures in environments within which dust, corrosive fumes, gases or ionized radiation can occur is considered improper use.

The product is intended for installation in automation systems. It does not have its own integrated separator. A suitable separator must therefore be created on the plant side.

The operation of the product in residential areas without further measures is only permitted if the product complies with the emission limits (interference emissions) according to EN 61000-6-3.

Operating the product in home applications without further measures is only permitted if it meets the emission limits (emissions of interference) according to EN 61000-6-3. Please observe the installation regulations!

You will find the relevant information in the section "Device Description" > "Standards and Guidelines" in the manual for the used product.

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

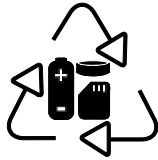
2.1.4.1.1 Electrical and Electronic Equipment



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 fieldbus coupler/controller (750-862) must be powered from SELV/PELV power supply(s)!



⚠ CAUTION

Inadequate wire cross sections can cause temperature increases!

To avoid increasing thermal risks, only use conductor cross-sections sufficient for the required maximum load current. The conductor cross-sections specified in the technical data refer exclusively to the mechanical connection capacity of the clamping points.



⚠ 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

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.

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.

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.
- In the control components (e.g., for WAGO I/-CHECK and CODESYS) close all ports and services not required by your application to minimize the risk of cyber attacks and to enhance cyber security. Only open ports and services during commissioning and/or configuration.
- 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 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.

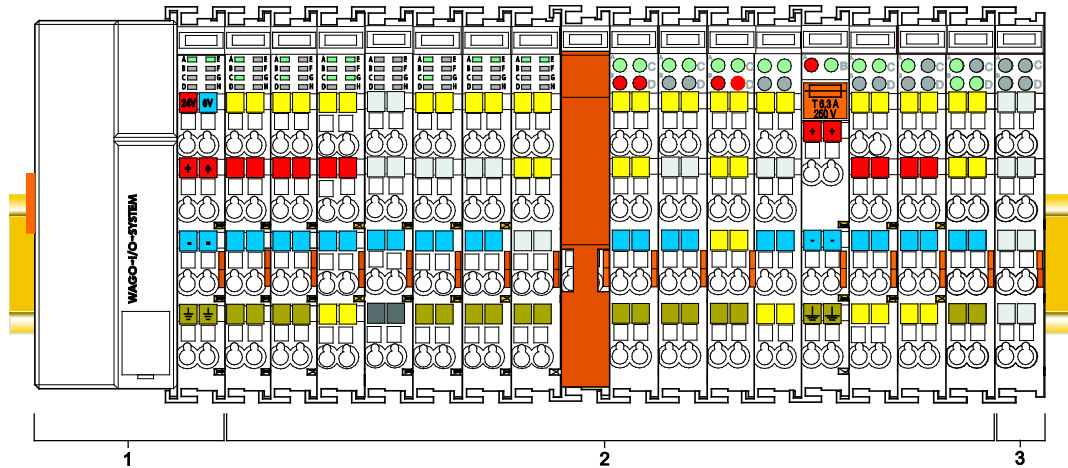


Figure 1: Fieldbus Node (Example)

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.

3.1 Labeling

The front labeling includes:

- Device designation
- Name of the display elements, connections and control elements
- Serial number with hardware and firmware version











The side labeling includes:

- Manufacturer's identification
- Connector pin assignment
- Serial number
- Approval information

3.1.1 Labeling Symbols

Some general information and the respective product approvals are shown in the labeling as symbols.

Table 3: Labeling Symbols

Symbol	Meaning	Description
General Symbols		
	Manufacturer's identification	Manufacturer name and address
	Data matrix code	One-to-one product identification by means of UII (Unique Item Identifier)
	General warning label	Read this manual carefully for safe use and proper handling
	ESD danger sign	Avoid electrostatic discharge! → See chapter "Safety Advice (Precautions)"
	WEEE label	Note on disposal → See chapter „Disposal“
Symbols of Approvals (Examples)		
	Conformity marking	Approval information → See chapter "Approvals"
	Korean Certificate	
	Ex approvals	
	Ship approvals	
	TÜV symbol	

3.1.2 Manufacturing Number

The serial number indicates the delivery status directly after production.

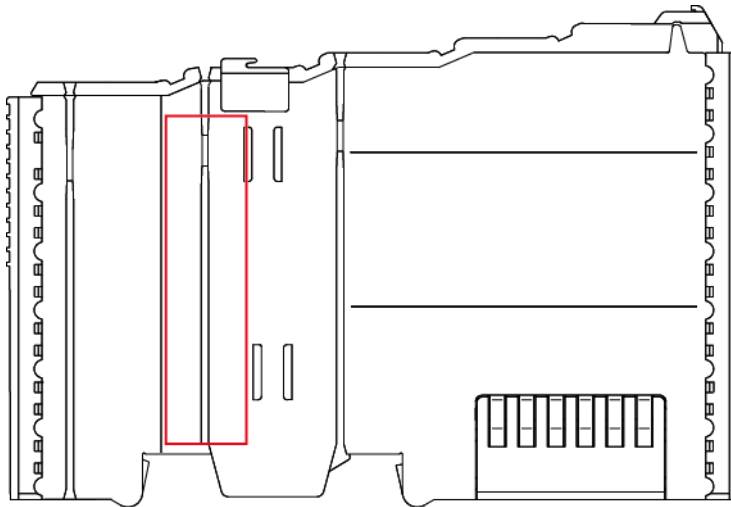


Figure 2: Marking Area for Serial Numbers

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.

3.1.3 Hardware Address (MAC-ID)

Each **Controller Modbus TCP; G4; 2ETH; ECO** 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.

In addition, the MAC ID is located on the paper strip with two self-adhesive peel-off strips on its left side.

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.

3.1.4 Update Matrix

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

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 3: Update Matrix from 2016

Table 4: 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.

3.2 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.

3.3 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

3.4 Power Supply

3.4.1 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 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 have no internal overcurrent protection. Therefore, appropriate overcurrent protection 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.

For 24 V system supply input voltage an external fuse, rated max. 2 A, slow acting, min. 30 VDC shall be used.

NOTICE

Field supply only with appropriate fuse protection!

Without overcurrent protection, the electronics can be damaged.

For 24V field supply input voltage an external fuse, rated max. 10 A, slow acting, min. 30 VDC shall be used.

3.4.2 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.

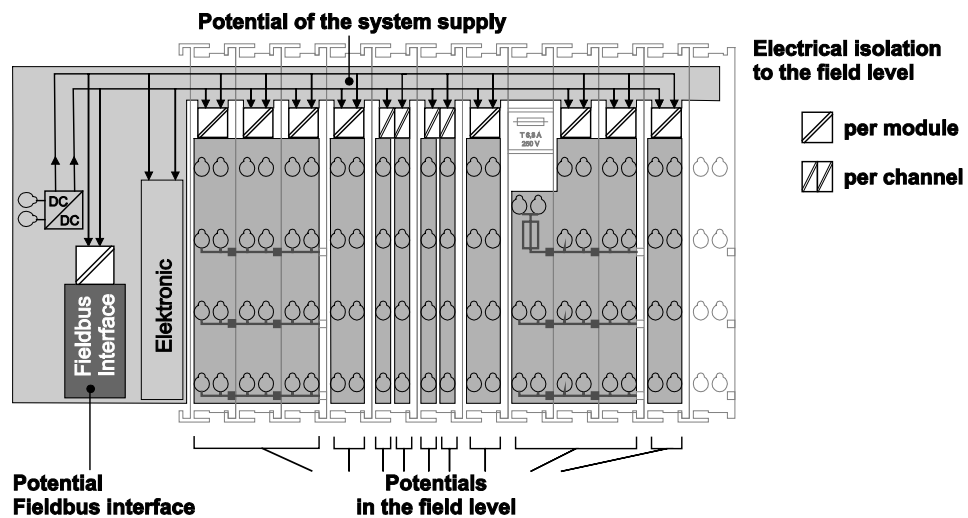


Figure 4: Isolation (Example)

3.4.3 System Supply

3.4.3.1 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 750-613. 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.

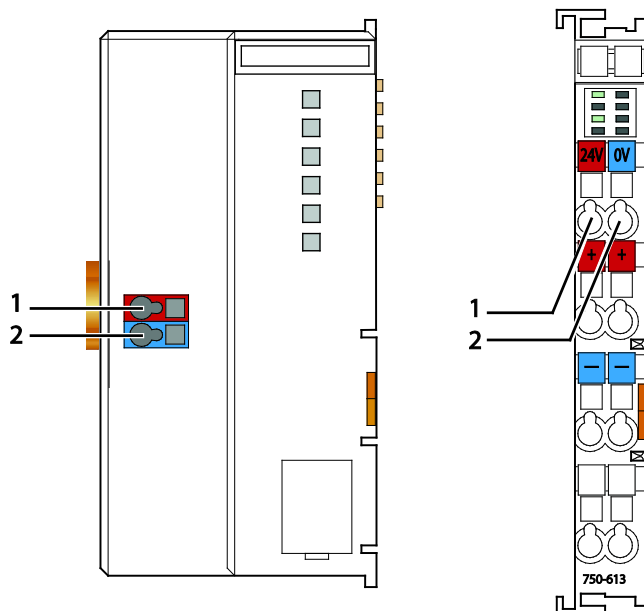


Figure 5: System Supply

Table 5: Legend for Figure "System Supply"

Pos.	Description
1	System supply 24 VDC (-15% / +20%)
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.

NOTICE

System supply only with appropriate fuse protection!

Without overcurrent protection, the electronics can be damaged.

For 24 V system supply input voltage an external fuse, rated max. 2 A, slow acting, min. 30 VDC shall be used.

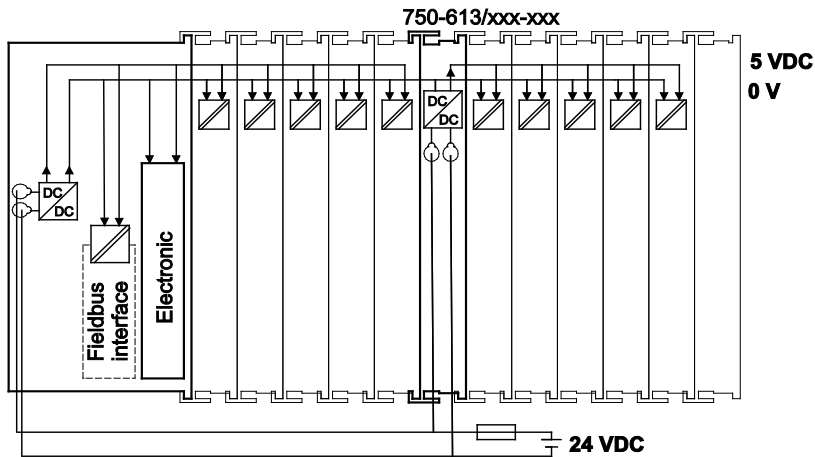


Figure 6: System Voltage (Example)

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.

3.4.3.2 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 6: 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
<u>Residual current for bus modules</u>	<u>700 mA at 5 V</u>
Sum $I_{(5\text{ V})}$ 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	$10 * 90\text{ mA} =$	900 mA
	$20 * 2\text{ mA} =$	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.

Note



Recommendation

Utilize the **smartDESIGNER** feature WAGO ProServe® software to configure fieldbus node assembly. You can test the configuration via the integrated plausibility check.

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

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

Internal system supply module

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

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

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.

3.4.4 Field Supply**3.4.4.1 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 fuse holder and diagnostic capability are available for the power supply of other field potentials (24 VDC, 0 ... 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.

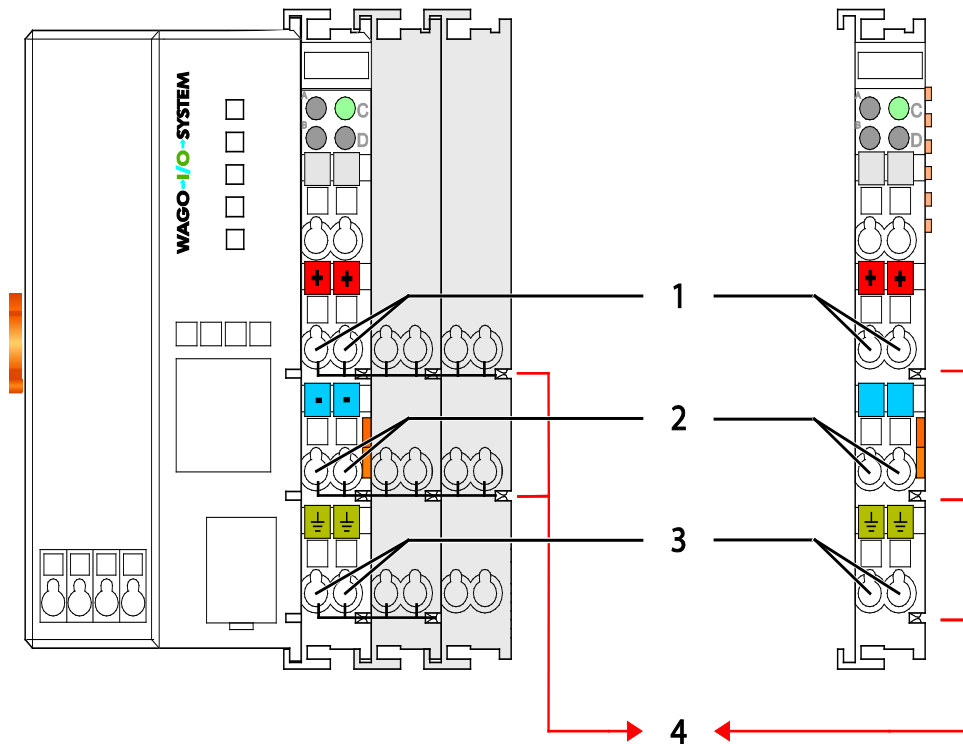


Figure 7: Field Supply (Sensor/Actuator)

Table 7: Legend for Figure “Field Supply (Sensor/Actuator) for ECO Fieldbus Coupler”

Field supply	
1	24 V (-15 % / +20 %)
2	0 V
3	Optional ground potential (functional earth)
Power jumper contacts	
4	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.

3.4.4.2 Fusing via Power Supply Module

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

Table 8: Power Supply Modules

Order No.	Field Voltage
750-601	24 V DC, Supply/Fuse
750-609	230 V AC, Supply/Fuse
750-615	120 V AC, Supply/Fuse
750-617	24 V AC, Supply/Fuse
750-610	24 V DC, Supply/Fuse/Diagnosis
750-611	230 V AC, Supply/Fuse/Diagnosis
750-606	Supply Module 24 V DC, 1,0 A, Ex i
750-625/000-001	Supply Module 24 V DC, 1,0 A, Ex i (without diagnostics)

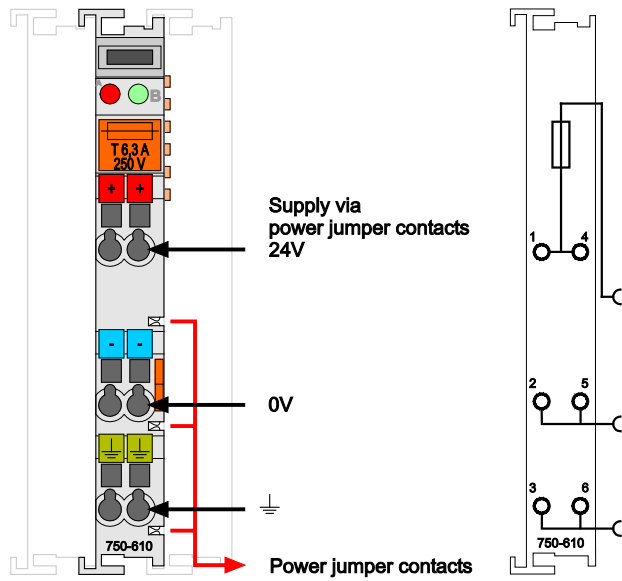


Figure 8: Supply Module with Fuse Carrier (Example 750-610)

NOTICE

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 9: Removing the Fuse Carrier

Lifting the cover to the side opens the fuse carrier.

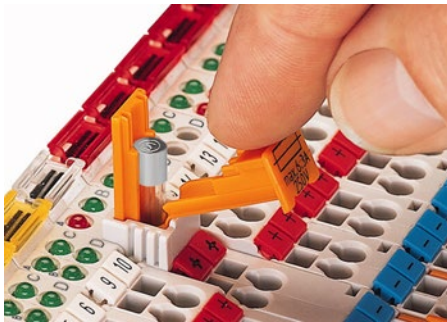


Figure 10: Opening the Fuse Carrier



Figure 11: Changing the Fuse

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

3.4.4.3 Fusing external

NOTICE

Field supply only with appropriate fuse protection!

Without overcurrent protection, the electronics can be damaged.

For 24V field supply input voltage an external fuse, rated max. 10 A, slow acting, min. shall be used.

The 24V input voltage for the field supply is provided with an external fuse with max. 10 A slow acting, min. 30 VDC, to be secured.

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

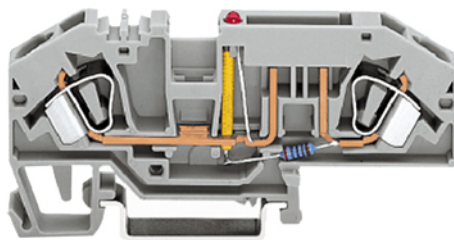


Figure 12: Fuse Modules for Automotive Fuses, Series 282

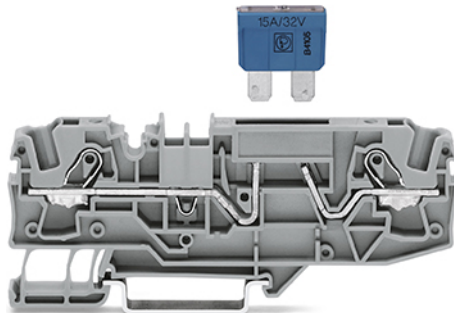


Figure 13: Fuse Modules for Automotive Fuses, Series 2006

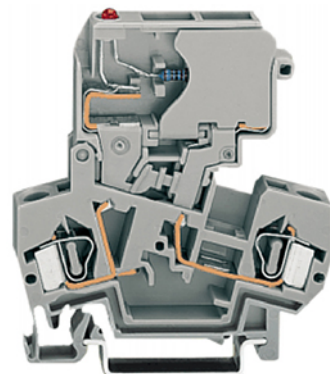


Figure 14: Fuse Modules with Pivotable Fuse Carrier, Series 281

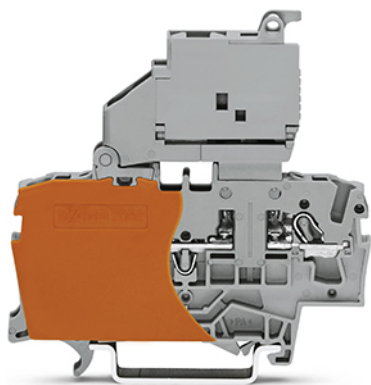


Figure 15: Fuse Modules with Pivotable Fuse Carrier, Series 2002

3.4.5 Supplementary Power Supply Regulations

The WAGO-I/O-SYSTEM 750 can also be used in shipbuilding or offshore and onshore areas of work (e. g. working platforms, loading plants). This is demonstrated by complying with the standards of influential classification companies such as Germanischer Lloyd and Lloyds Register.

Filter modules for 24 V supply are required for the certified operation of the system.

Table 9: Filter Modules for 24 V Supply

Order No.	Name	Description
750-626	Supply Filter	Filter module for system supply and field supply (24 V, 0 V), i. e. for fieldbus coupler/controller and bus power supply (750-613)
750-624	Supply Filter	Filter module for the 24 V field supply (750-602, 750-601, 750-610)

Therefore, the following power supply concept must be absolutely complied with.

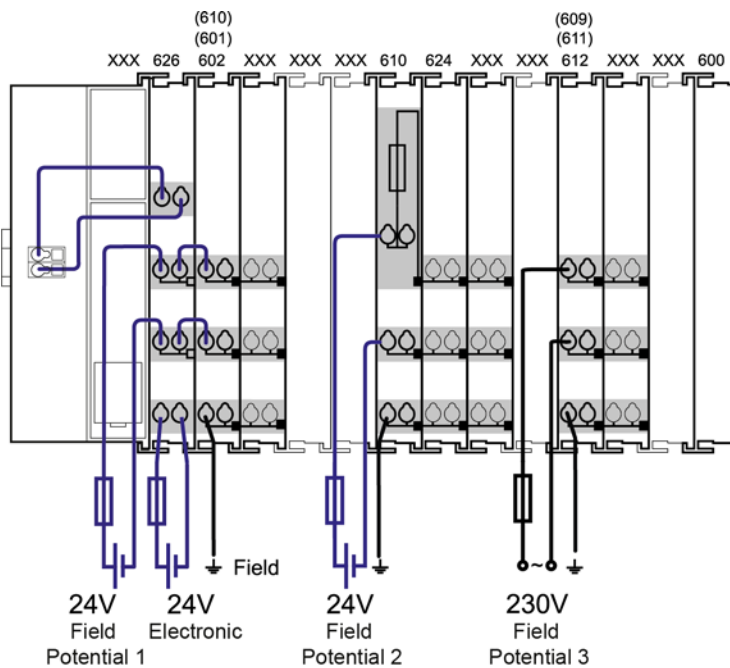


Figure 16: Power Supply Concept

Note



Use a supply module for equipotential bonding!

Use an additional 750-601/ 602/ 610 Supply Module behind the 750-626 Filter Module if you want to use the lower power jumper contact for equipotential bonding, e.g., between shielded connections and require an additional tap for this potential.

3.4.6 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.

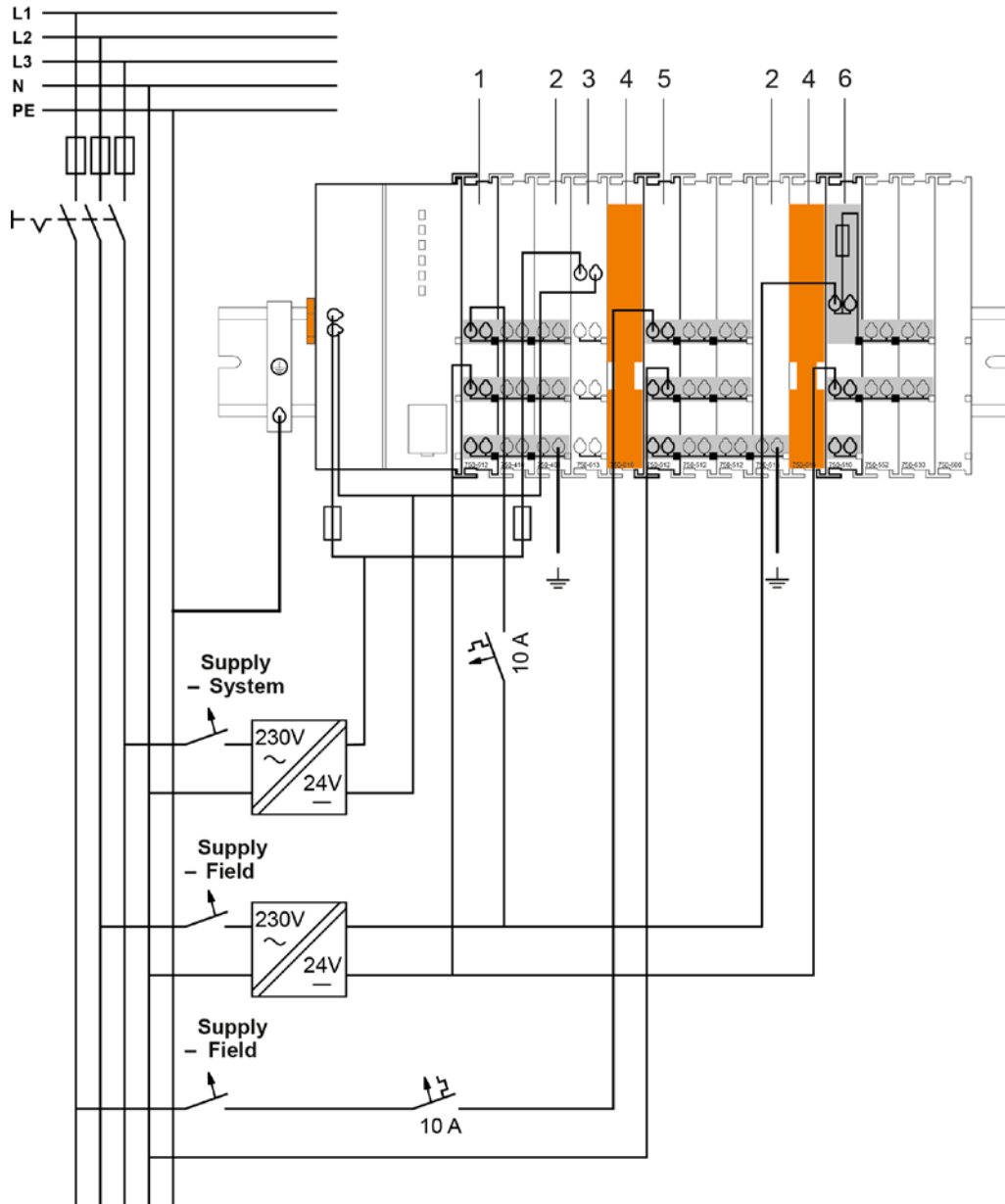


Figure 17: Supply Example

Table 10: Legend for Figure "Supply Example for Fieldbus Coupler/Controller"

Pos.	Description
1	Power Supply on fieldbus coupler/controller via external Supply Module
2	Power Supply with optional ground
3	Internal System Supply Module
4	Separation Module recommended
5	Supply Module passive
6	Supply Module with fuse carrier/diagnostics

3.4.7 Power Supply Unit

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

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.

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.

3.5 Grounding

3.5.1 Grounding the DIN Rail

3.5.1.1 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.

3.5.1.2 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 11: 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 mm ² ... 16 mm ² Note: Also order the end and intermediate plate (283-320).

3.5.2 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.

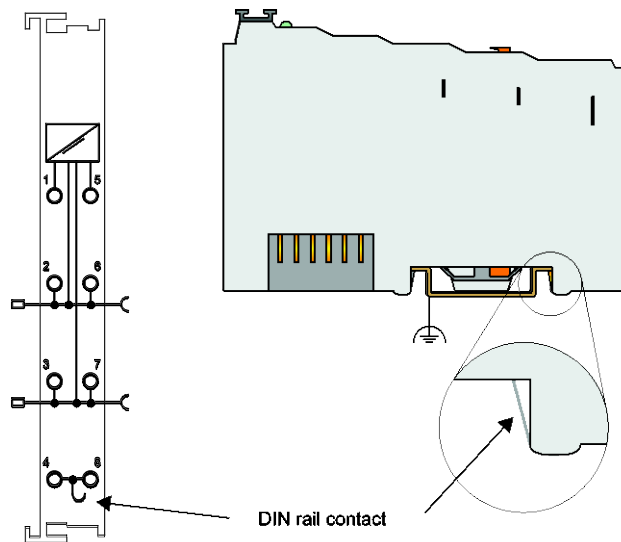


Figure 18: Carrier Rail Contact (Example)



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.

3.6 Shielding

3.6.1 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.

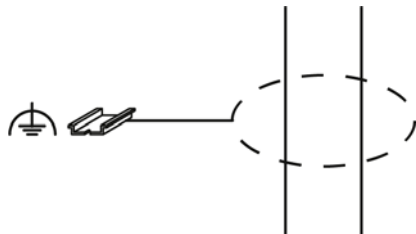


Figure 19: Cable Shield at Ground Potential

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).

3.6.2 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.

3.6.3 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.

3.6.4 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 20: Examples of the WAGO Shield Connecting System

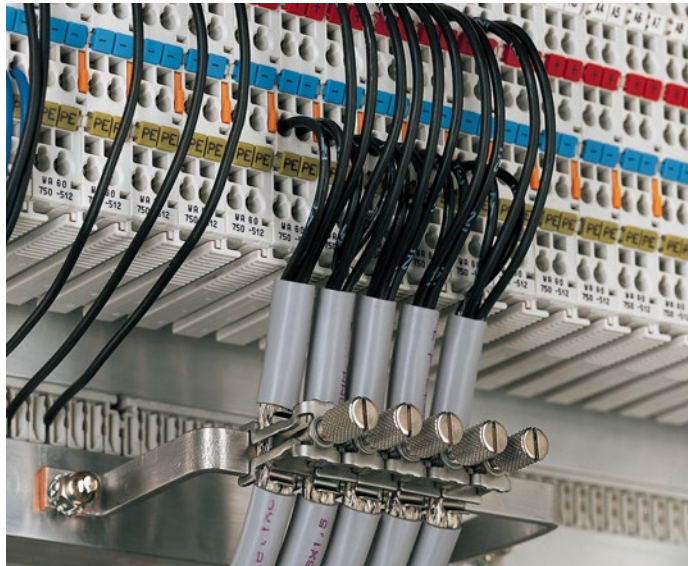


Figure 21: Application of the WAGO Shield Connecting System

4 Device Description

The 750-862 programmable Fieldbus Controller (PFC) combines the functionality of an ETHERNET-based Fieldbus Coupler, as the head station of the node assembly, with the functionality of a Programmable Logic Controller (PLC).

The 750-862 can be used for applications in machine and plant construction as well as in the process industry and building technology.

The two ETHERNET interfaces with the integrated switch enable a line topology to be set up without additional infrastructure elements, such as switches or hubs.

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

In the controller, all input signals from the sensors are combined. After connecting the controller, the controller determines which I/O modules are on the node and creates a local process image from these. 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 controller.

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 controller automatically begins a new word.

According to IEC 61131-3 programming, data processing occurs in the Controller. The process results can be output directly on sensors/actuators or transmitted via fieldbus to the higher-order controller.

The fieldbus connection consists of two RJ-45 ETHERNET ports, which are connected to the head station via an integrated ETHERNET switch. Both ETHERNET ports independently support the following functions:

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

Durch die Unterstützung von Autonegotiation und Auto-MDI/MDI-X ist keine manuelle Konfiguration der Übertragungsrates notwendig und es können sowohl Patch- als auch Crossover-Kabel verwendet werden.

By supporting of auto-negotiation and auto-MDI/MDI-X, no manual configuration of the transmission rate is necessary and both patch and crossover cables can be used.

WAGO-I/O-PRO creates application programs that adhere to IEC 61131-3. CODESYS by 3S (the standard programming system) serves as the basis of WAGO-I/O-PRO, which was expanded specifically with the target files for all WAGO controllers.

The fieldbus controller has 2 MB program memory, 2 MB data memory and 16 kB retentive memory available for the IEC 61131-3 programming.

Depending on configuration the user can access all fieldbus and I/O data.

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

The Modbus TCP/UDP protocol is implemented for exchanging process data. 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.

The user can program clients and servers via an internal socket-API for all transport protocols (TCP, UDP, etc.) with functional modules. Library functions are available for function expansion.

This controller is based on a 32-bit CPU with multitasking capabilities, allowing several programs to be executed in a near-simultaneous manner.

The controller has an internal server for the configuration and administration of the system.

By default, the controller's built-in WBM pages of HTML contain information on the configuration and status of the controller, and can be read using a normal web browser. In addition, a file system is implemented that allows you to store custom HTML pages in the controller using FTP download or to store your own HTML pages or call up programs directly.

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.

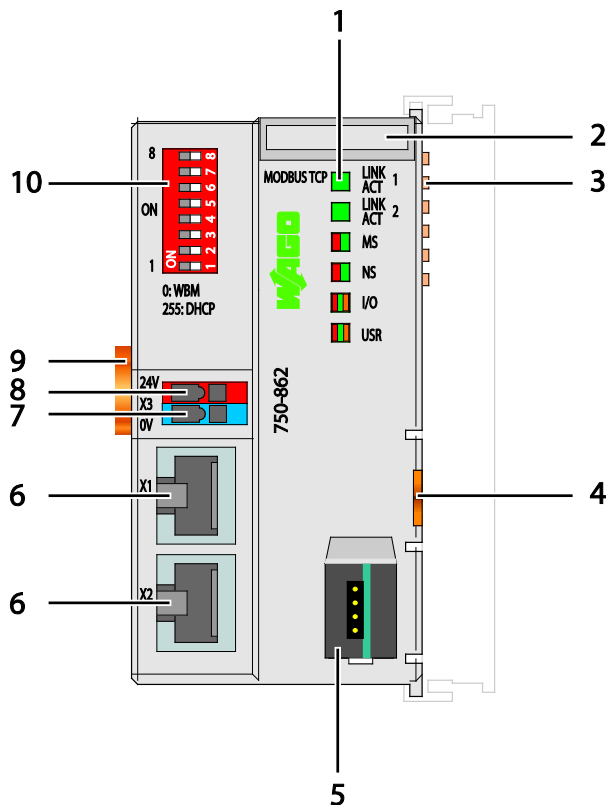


Abbildung 22: View Controller Modbus TCP; G4; 2ETH; ECO

Table 12: Legend for Figure "View"

Pos.	Designation	Meaning	Details see Section:
1	LINK ACT 1, 2, MS, NS, I/O, USR	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 System Supply 0 VDC	"System Description" > "Voltage Supply"
8	+	CAGE CLAMP® Connections System 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.

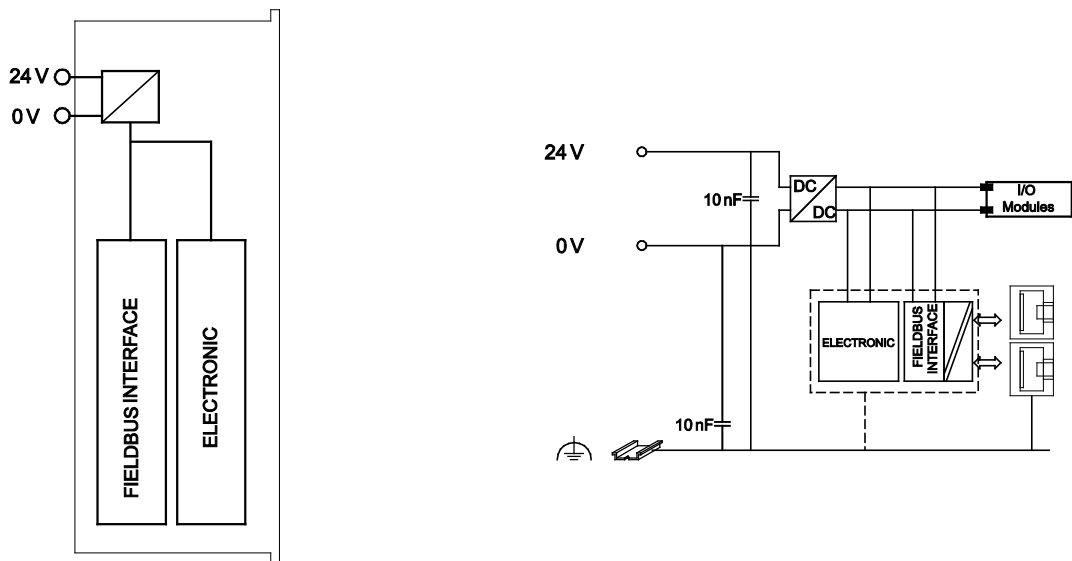


Figure 23: Device Supply

4.2.2 Fieldbus Connection

The connection to the ETHERNET based fieldbuses is made via two RJ-45 plugs (also called “Western 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.

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.

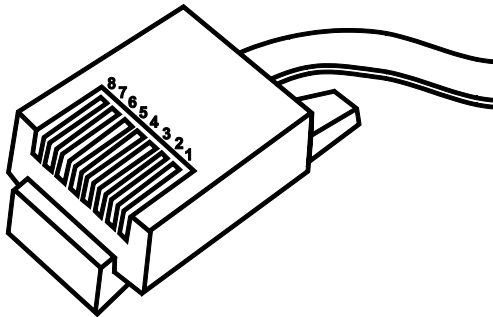


Figure 24: RJ-45 Connector

Table 13: 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.

NOTICE

Not for use with a PoE switch!

Do not connect the fieldbus controller to a PoE switch!

As the eight-pin "Power over Ethernet" connector is energized the fieldbus controller will be damaged.

4.3 Display Elements

The operating condition of the fieldbus controller 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 fibres. In some cases, these are multi-colored (red, green or orange).

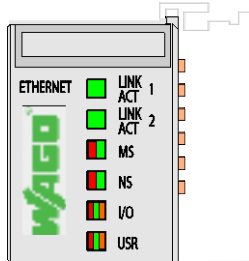


Figure 25: Display elements

For the diagnostics of the different domains fieldbus, node and supply voltage, the LEDs can be divided into three groups:

Table 14: 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 15: 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.
USR	red/green/ orange	indicates the state, which is programmed in the user program

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 *WAGO-I/O-CHECK*, *WAGO-I/O-PRO* and WAGO Ethernet Settings.

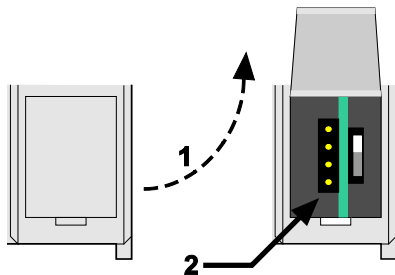


Figure 26: Service Interface (Closed and Opened Flap)

Table 16: Legend for Figure “Service Interface (Closed and Opened Flap)”

Number	Description
1	Open closed flap
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 numbers 750-920 and 750-923 or via the WAGO radio adapter with the item number 750-921.

4.4.2 Mode Selector Switch

The mode selector switch is located behind the cover flap.

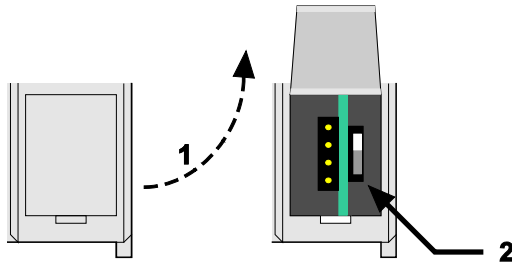


Figure 27: Mode Selector Switch (Closed and Open Damper of the Service Port)

Table 17: Legend for Figure „Mode Selector Switch“

Number	Description
1	Open the damper
2	Mode selector switch

The mode selector switch determines the loading, starting and stopping of the PLC-application by the fieldbus controller. This multifunction sliding switch features 3 slide lock positions and a push-button function.

The sliding switch is designed for a number of operations in compliance with EN61131T2.

NOTICE

Property damages due to set outputs!

Please note that set outputs remain set, when you switch the operating switch from “RUN” to “STOP” during the current operation. Since the program is no longer processed, software-related switch offs, i.e. by initiators, are ineffective. Therefore, program or define all outputs, so that these switch to a safe mode at a program stop.

Note



Defining the outputs for a program stop!

In order to switch the outputs to a safe mode at the program stop, define the status of the outputs at “STOP”.

1. For this, open in the web-based Management System (WBM) a website via the “PLC Application” link, on which you can define the function **Process image - Set outputs to zero, if user program is stopped**.
2. Now activate this function by placing a check mark in the control box, then all outputs are set to zero, if this function is not activated, the outputs remain at the last current value.



Note

The mode selector switch position does not affect software start/stop!

The position of the operating mode switch does not prevent the starting and stopping of the application program from WAGO I/O-PRO.

One of the following functions is active, depending on which of the three static positions — “top”, “center” or “bottom” — the switch is located at when energized or during a hardware or software reset:

Table 18: Mode Selector Switch Positions, Static Positions on PowerOn/Reset

Positions for the mode selector switch	Function
“Top” position	“RUN” – activate program processing, Boot project (if available) is started
“Center” position	“STOP” – stop program processing, PFC application is stopped
“Bottom” position	Do not use. This position is not relevant for the user.

The controller performs the following functions if the switch’s position is changed during operation:

Table 19: Mode Selector Switch Positions, Dynamic Positions During Ongoing Operation

Position change for the mode selector switch	Function
From the top to the center position	“STOP” – stop program processing, application program is stopped
From the center to the top position	“RUN” – activate program processing, Boot project (if available) is started
From the center to the bottom position	No reaction. The bootstrap loader is started after PowerOn/Reset
From the bottom to the center position	No reaction.
Press down (e.g., using a screwdriver)	Hardware reset. All outputs are reset; variables are set to 0, FALSE, or to an initial value. Retain variables or markers are not changed. A hardware reset can be executed on STOP or on RUN at any position of the mode selector switch! Restart of the Controller.

The operating mode is changed internally at the end of a controller cycle.

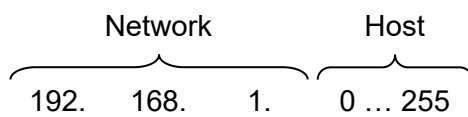
4.4.3 Address Selection Switch



Figure 28: Address Selection Switch (for example setting "0")

The 8-pole DIP switch is used to select the protocol for setting the IP address and as an address selection switch, to set the IP address.

The IP address is composed of a network component and a host component.



The network component is configurable and in delivery status 192.168.1.

The host component is set via the DIP switches of the address selection switch.

The coding with the DIP switches is bit-wise, starting with DIP switch 1 with the least significant bit (2^0) to DIP switch 8 with the most significant bit (2^7), corresponding to the values 0 to 255.

Table 20: Meaning of DIP Switch Positions

DIP Switch Positions (ON = 1)	Value	Meaning
00000000	0 (WBM)	The IP configuration set in the WBM on the "Port" WBM page is used (default DHCP, but can be changed to BootP or EEPROM).
00000001... 11111110	1-254 Host component	Host component by switch position Example of setting the DIP switch: For the IP address 192.168.1. 33 , the 1st and 6th switches must be set: 2^0 (1st switch) + 2^5 (6th switch) = 33
11111111	255 (DHCP)	The DHCP protocol is used to configure the IP parameters.

4.5 Technical Data

4.5.1 Device Data

Table 21: Technical data – Device data

Width	61.5 mm
Height	100 mm
Length	71.9 mm
Length (from upper-edge of DIN 35)	64.7 mm
Weight	151.8 g

4.5.2 System Data

Table 22: Technical data – System data

Number of controllers	Limited by ETHERNET specification
Transmission medium	Twisted Pair S/UTP, STP 100 Ω Cat 5
Bus coupler connection	2 x RJ-45
Max. cable length	100 m
Max. network length	2000 m
Baud rate	10/100 Mbit/s
Transmission performance	Class D acc. to EN 50173
Protocols	Modbus TCP/UDP, HTTP, HTTPS, BootP, DHCP, DNS, SNTP, (S)FTP, SNMP
Programming	WAGO-I/O-PRO V2.3
IEC-61131-3	AWL, KOP, FUP (CFC), ST, AS
Max. number of socket links	15 Modbus TCP
Number of I/O modules - with bus extension	64 250
Configuration	via PC
Program memory	2 Mbyte
Data memory	2 MByte
Non-volatile memory (retain)	16 kByte (Default: 8 kByte retain, 8 kByte flag, allocation variable)
Internal file system	1 GB

4.5.3 Supply

Table 23: Technical data – Supply

Voltage supply	DC 24 V (-25 % ... +30 %)
Max. input current at 24 V	300 mA
Power failure time acc. IEC 61131-2	Depending on external buffering
Efficiency of the power supply	90 %
Internal current consumption at 5 V	390 mA
Total current for I/O modules at 5 V	700 mA
Overvoltage category	II
Isolation	500 V system/supply



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 24: Technical data – Fieldbus Modbus TCP

Input process image _{max}	2040 Byte
Output process image _{max}	2040 Byte
Input variables _{max}	512 Byte
Output variables _{max}	512 Byte

4.5.5 Accessories

Table 25: Technical data – Accessories

Miniature WSB Quick marking system
WAGO-I/O-PRO 2.3

4.5.6 Connection Type

Table 26: Technical Data – Field Wiring

Connection technology	Push-in CAGE CLAMP®
Conductor cross-section	0.08 mm ² ... 1.5 mm ² / AWG 28 ... 16
Strip length	8 mm ... 9 mm / 0.33 in

Table 27: Technical Data – Data Contacts

Data contacts	Slide contact, hard gold plated, self-cleaning
---------------	------------------------------------------------

4.5.7 Climatic Environmental Conditions

Table 28: Technical Data – Climatic Environmental Conditions

Surrounding air temperature, operation	0 °C ... 55 °C
Surrounding air temperature, storage	-25 °C ... +85 °C
Operating altitude	0 ... 2000 m
Relative humidity	Max. 5 % ... 95 % without condensation
Pollution degree	2
Protection type	IP20
Resistance to harmful substances	Acc. to IEC 60068-2-42 and IEC 60068-2-43
Maximum pollutant concentration at relative humidity < 75 %	SO ₂ ≤ 25 ppm H ₂ S ≤ 10 ppm
Special conditions	<ul style="list-style-type: none"> • Ensure that additional measures for components are taken, which are used in an environment involving: <ul style="list-style-type: none"> – dust, caustic vapors or gases – ionizing radiation • The permissible temperature range of the connecting cable must be dimensioned based on the mounting position and current intensity, as the temperature of the terminal connection can be up to 25 °K above the maximum expected surrounding air temperature (at 10 A).

4.5.8 Mechanical Strength

Table 29: Technical Data – Mechanical Strength

Vibration resistance	Acc. to IEC 60068-2-6 Comment to the vibration resistance: a) Type of oscillation: sweep with a rate of change of 1 octave per minute 10 Hz ≤ f < 57 Hz, const. Amplitude 0,075 mm 57 Hz ≤ f < 150 Hz, const. Acceleration 1 g b) Period of oscillation: 10 sweep per axis in each of the 3 vertical axes
Shock resistance	Acc. to IEC 60068-2-27 Comment to the shock resistance: a) Type of impulse: half sinusoidal b) Intensity of impulse: 15 g peak value, 11 ms maintenance time c) Route of impulse: 3 impulses in each pos. And neg. direction of the 3 vertical axes of the test object, this means 18 impulses in all.
Free fall	Acc. IEC 60068-2-32 ≤ 1 m (module in original packing)

4.5.9 Software Compatibility

Table 30: Technical Data – Software Compatibility

Commissioning software	WAGO-I/O-CHECK 759-302 starting from version 3.18.1.2
Configuration software	WAGO Ethernet Settings 759-316 starting from version 6.9.9.16
Programming software IEC-61131-3	WAGO I/O-PRO 759-333 with CODESYS starting from version 2.3.9.57 and the target support package starting from "TSP_Setup_20190121_081618.exe"

4.6 Approvals

Information



More information about approvals.

Detailed references to the approvals are listed in the document “**Overview on WAGO I/O System 750 approvals**”, which you can find via the internet under: www.wago.com → DOWNLOADS → Documentation → System Description.

The following approvals have been granted to the “Controller Modbus TCP; G4; 2ETH; ECO” controller (750-862):



Conformity Marking



Ordinary Locations

UL61010-2-201



Korea Certification

MSIP-REM-W43-PFC750

The following Ex approvals have been granted to the “Controller Modbus TCP; G4; 2ETH; ECO” controller (750-862):



Hazardous Locations

UL 121201 for Use in Hazardous Locations
CI I Div 2



TÜV 14 ATEX 148929 X

II 3 G Ex ec IIC T4 Gc



IECEx TUN 14.0035 X

Ex ec IIC T4 Gc

The following ship approvals have been granted to the “Controller Modbus TCP; G4; 2ETH; ECO” controller (750-862):



ABS (American Bureau of Shipping)



DNV GL

[Temperature: B, Humidity: B, Vibration: B, EMC: B, Enclosure: A]



PRS (Polski Rejestr Statków)

4.7 Standards and Guidelines

750-862 meets the following requirements on emission and immunity of interference:

EMC CE-Immunity to interference	EN 61000-6-2
EMC CE-Emission of interference	EN 61000-6-3
EMC marine applications-Immunity to interference	acc. to DNV GL
EMC marine applications-Emission of interference	acc. to DNV GL

5 Mounting

5.1 Installation Position

Along with horizontal and vertical installation, all other installation positions are allowed.

Note



Use an end stop in the case of vertical mounting!

In the case of vertical assembly, an end stop has to be mounted as an additional safeguard against slipping.

WAGO order no. 249-116 End stop for DIN 35 rail, 6 mm wide

WAGO order no. 249-117 End stop for DIN 35 rail, 10 mm wide

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 and without using a 750-628 I/O Module (coupler module for internal data bus extension) may not exceed 780 mm.

Also note the limitations of individual fieldbus couplers/controllers.



Note

Increase the total length using a coupler module for internal data bus extension!

You can increase the total length of a fieldbus node by using a 750-628 I/O Module (coupler module for internal data bus extension). For such a configuration, attach a 750-627 I/O Module (end module for internal data bus extension) after the last I/O module of a module assembly. Use an RJ-45 patch cable to connect the I/O module to the coupler module for internal data bus extension of another module block.

This allows you to segment a fieldbus node into a maximum of 11 blocks with maximum of 10 I/O modules for internal data bus extension.

The maximum cable length between two blocks is five meters.

More information is available in the manuals for the 750-627 and 750-628 I/O Modules.

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 31: 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.

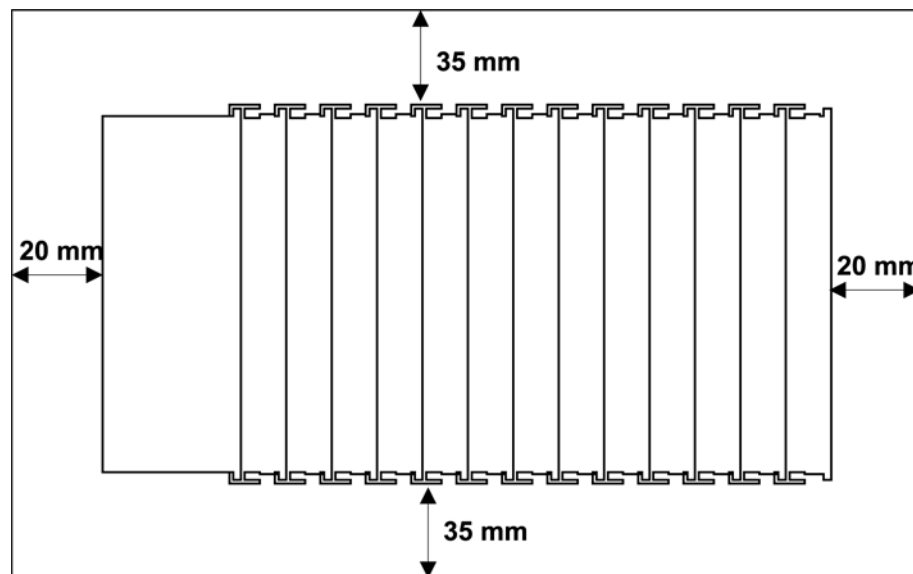


Figure 29: Spacing

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 (e.g. 750-600) onto the end of the fieldbus node! You must always use a bus end module at all fieldbus nodes with WAGO I/O System 750 fieldbus couplers or controllers to guarantee proper data transfer.

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.

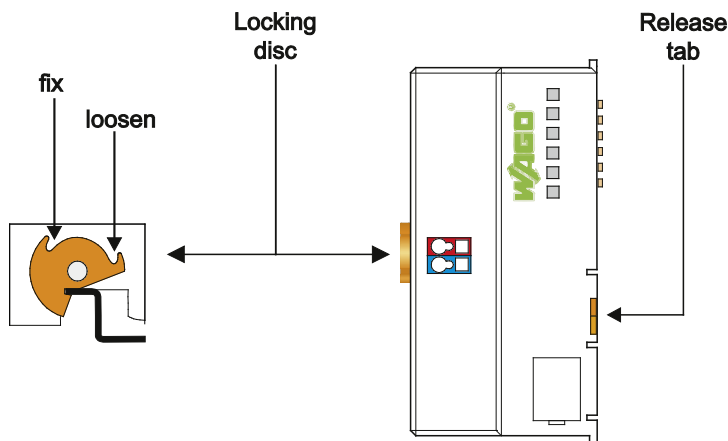


Figure 30: Release Tab

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 or controller or to the previous or possibly subsequent I/O module are engaged.

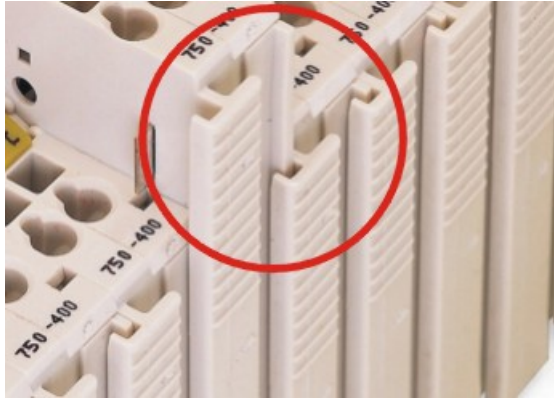


Figure 31: Insert I/O Module (Example)

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

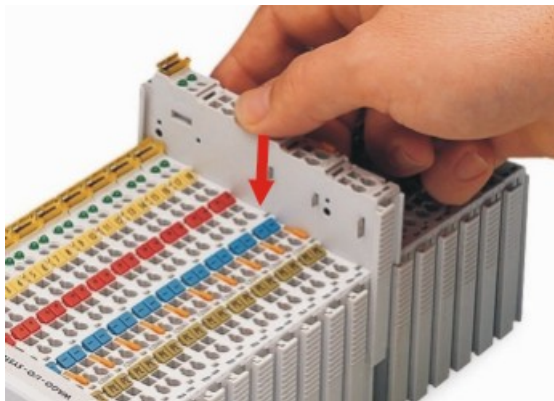


Figure 32: Snap the I/O Module into Place (Example)

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 or 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.

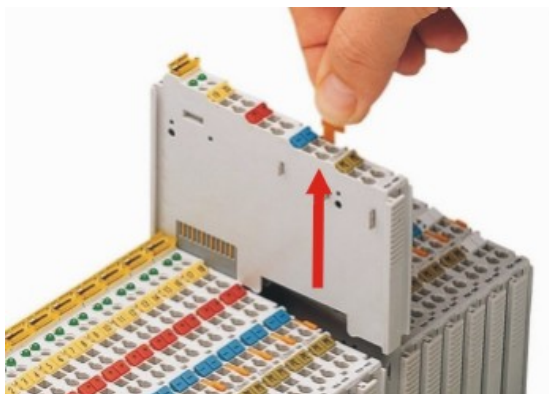


Figure 33: Removing the I/O Module (Example)

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.

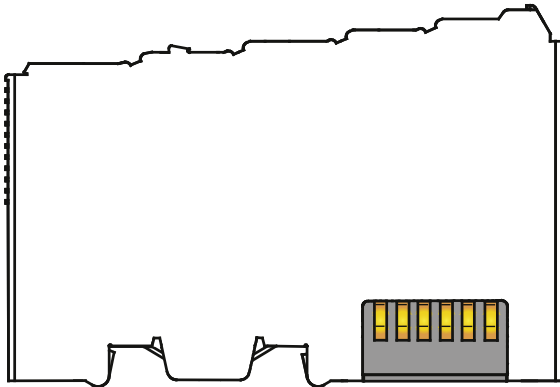


Figure 34: Data Contacts

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



Ensure that the environment is well grounded!

The devices are equipped with electronic components that may be destroyed by electrostatic discharge. When handling the devices, ensure that the environment (persons, workplace and packing) is well grounded. Avoid touching conductive components, 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.

Power jumper contacts

Blade	0	0	3	2
Spring		0	3	3

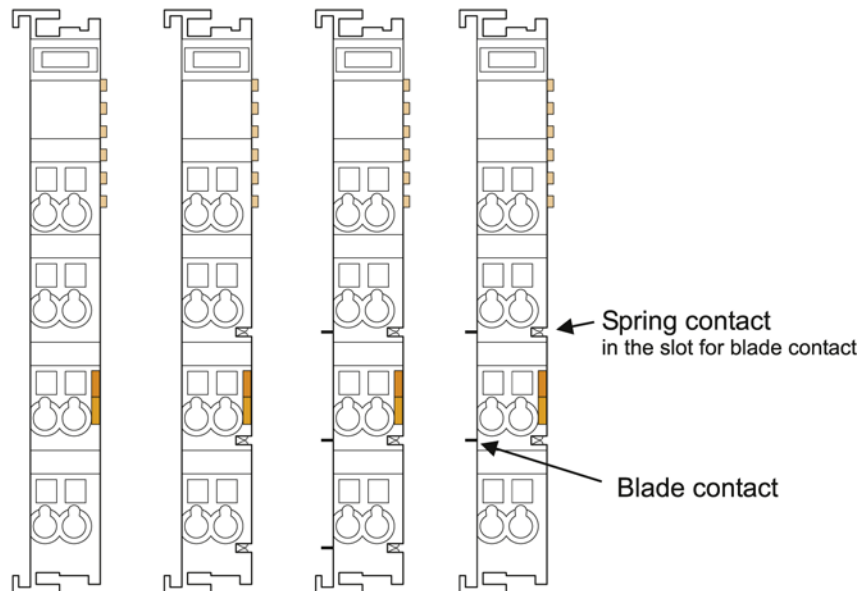


Figure 35: Example for the Arrangement of Power Contacts

Note



Field bus node configuration and test via smartDESIGNER

With the WAGO ProServe® Software smartDESIGNER, you can configure the structure of a fieldbus node. You can test the configuration via the integrated accuracy check.

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.

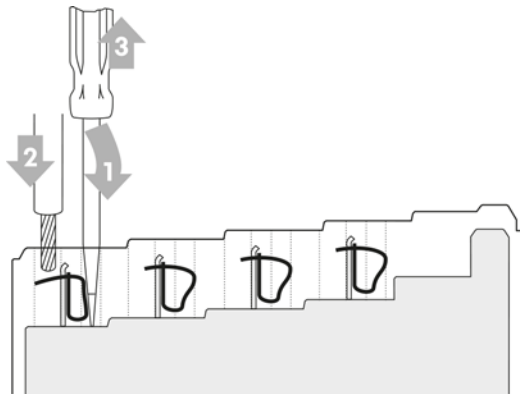


Figure 36: Connecting a Conductor to a CAGE CLAMP®

7 Function Description

7.1 Operating System

7.1.1 Start-up



Note

The mode selector switch may not be located in the lower position!
The mode selector switch may not be set at the bottom position during run-up!

The controller begins running up after switching on the power supply or after a reset. The internal application program is then transferred to the RAM.

During the initialization phase, the controller detects the I/O modules and the current configuration and sets the variables to 0 or FALSE, or to an initial value specified by the application program.

The flags retain their status.

During this phase the I/O LED will flash red.

When start-up is successful, the I/O LED then stays lit continuously in green.



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”.

7.1.2 Application Program Cycle

After error-free run-up, the application program cycle starts with the mode selector switch at the top position, or on a Start command from WAGO-I/O-PRO. The input and output data for the fieldbus, I/O modules and the timer values are read. The application program contained in the RAM is then processed, after which the output data for the fieldbus and I/O modules is written to the process image. At the end of the application program cycle, the operating system functions are executed for diagnostics and communication (among other things) and the timer values are updated. The new cycle begins by reading in of the input and output data and the timer values.

The operating mode is changed (“STOP”/“RUN”) at the end of a application program cycle.

The cycle time is the time from the beginning of the application program up to the next beginning of the cycle. If a loop is programmed within the application program, the application program runtime and the application program cycle time will be extended accordingly.

The inputs, outputs and timer values are not updated while the application program is being processed. Updating is performed only as defined at the end of the application program. As a result, it is not possible to wait on an event from the process or a set period to expire while a loop is in progress.

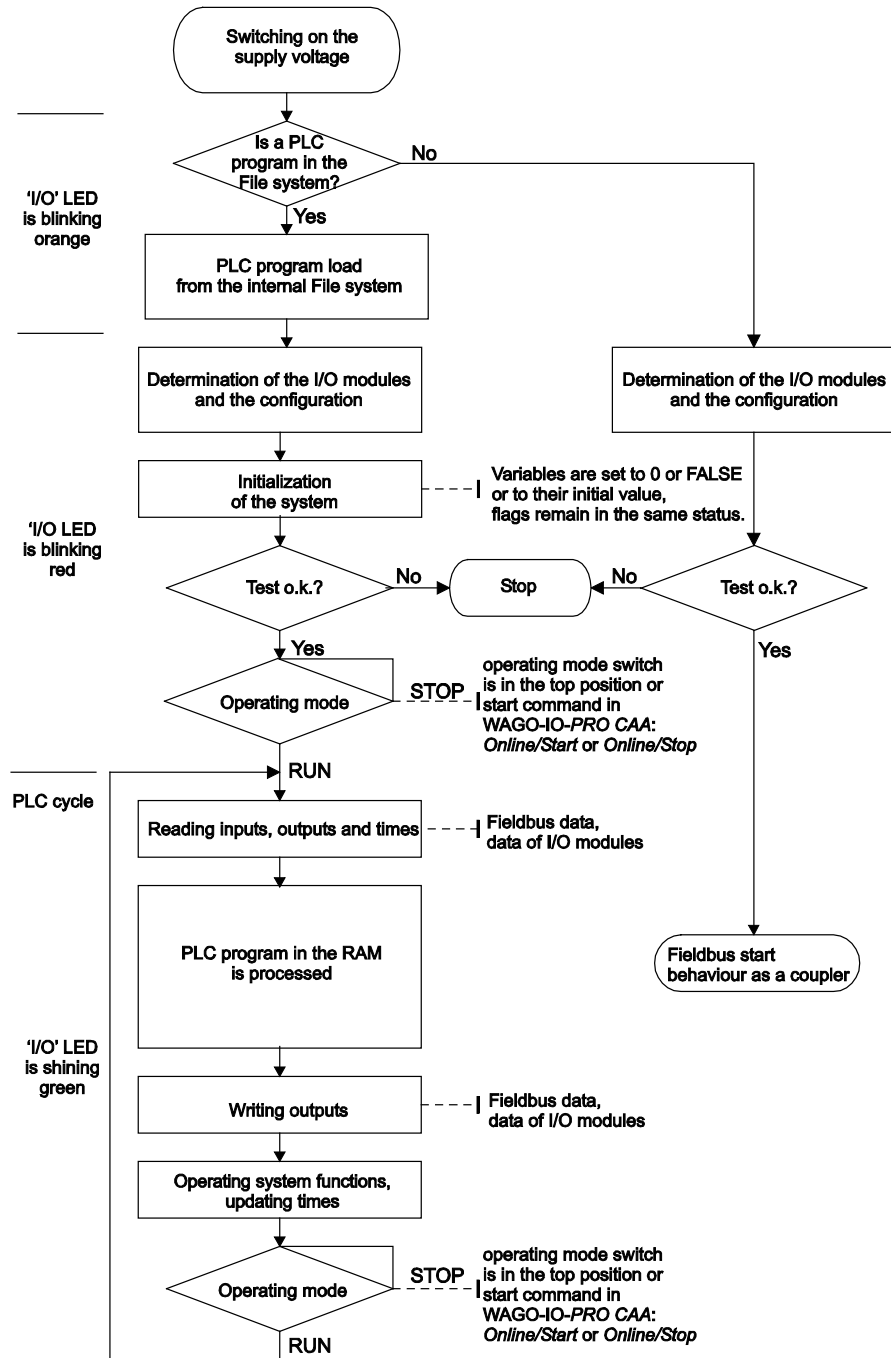


Figure 37: Run-up of the Controller

7.2 Process Data Architecture

7.2.1 Basic Structure

After switching on, the controller identifies all I/O modules connected with the node that send or receive data (data width/bit width > 0).

In a node can consist of a mixed arrangement of analog input/analog output modules and digital input/digital output modules and special modules.

Note



Up to 250 I/O modules can be connected with coupler module and end module.

Using the bus extension coupler module 750-628 and bus extension end module 750-627 for local bus extension it is possible to connect up to 250 I/O modules to the **Controller Modbus TCP; G4; 2ETH; ECO**.

Information



Additional Information

For the number of input and output bits or bytes of the individual I/O modules, refer to the corresponding description of the I/O modules.

The controller creates an internal local process image on the basis of the data width, the type of I/O module and the position of the module in the node. This process image is broken down into an input and an output data range.

The data of the digital I/O modules is bit-oriented; i.e., digital data is sent bit by bit. Analog I/O modules represent the group of byte-oriented modules – data is sent byte by byte.

Counter modules or angle and distance measurement modules, for example, are included in this group of modules.

For both, the local input and output process image, the I/O module data is stored in the corresponding process image depending on the order in which the modules are connected to the fieldbus controller.



Note

Hardware changes can result in changes of the process image!

If the hardware configuration is changed by adding, changing, removing or reparametrisation of I/O modules with a data width > 0 bit, this result in a new process image structure. The process data addresses would then change. If adding I/O modules, the process data of all previous I/O modules has to be taken into account.

A memory range of 256 words (word 0...255) is initially available in the controller for the process image of the physical input and output data.

For the image of the MODBUS/PFC variables, the memory range of words 256...511 is reserved; meaning the image for the MODBUS/PFC variables is created behind the process image for the I/O module data.

If the quantity of module data is greater than 256 words, all the physical input and output data above this value is added to the end of the current process image in a memory range; i.e., attached behind the MODBUS/PFC variables (word 512...1275).

For protocol extensions in future the following memory range is reserved starting from word 1276 ... 1532 for further PFC variables.

Access by the PLC to process data is made independently from the fieldbus system in all WAGO controllers; access is always conducted through an application-related IEC-61131-3 program.

How the data is accessed from the fieldbus side depends on the fieldbus however.

For the fieldbus controller, a MODBUS/TCP master can access the data via implemented MODBUS functions, whereby decimal or hexadecimal MODBUS addresses are used



Information

Additional Information:

For a detailed description of these fieldbus-specific data access methods, refer to the section "MODBUS Functions".



Information

Additional Information:

For the fieldbus-specific process image of any WAGO I/O module, please refer to the section "I/O Modules" > ... > "Structure of the process data".

7.2.2 Example of an Input Process Image

The following figure is an example of an input process image. The configuration comprises 16 digital and 8 analog inputs. The input process image thus has a data length of 8 words for the analog modules and 1 word for the digital modules; i.e., 9 words in total.

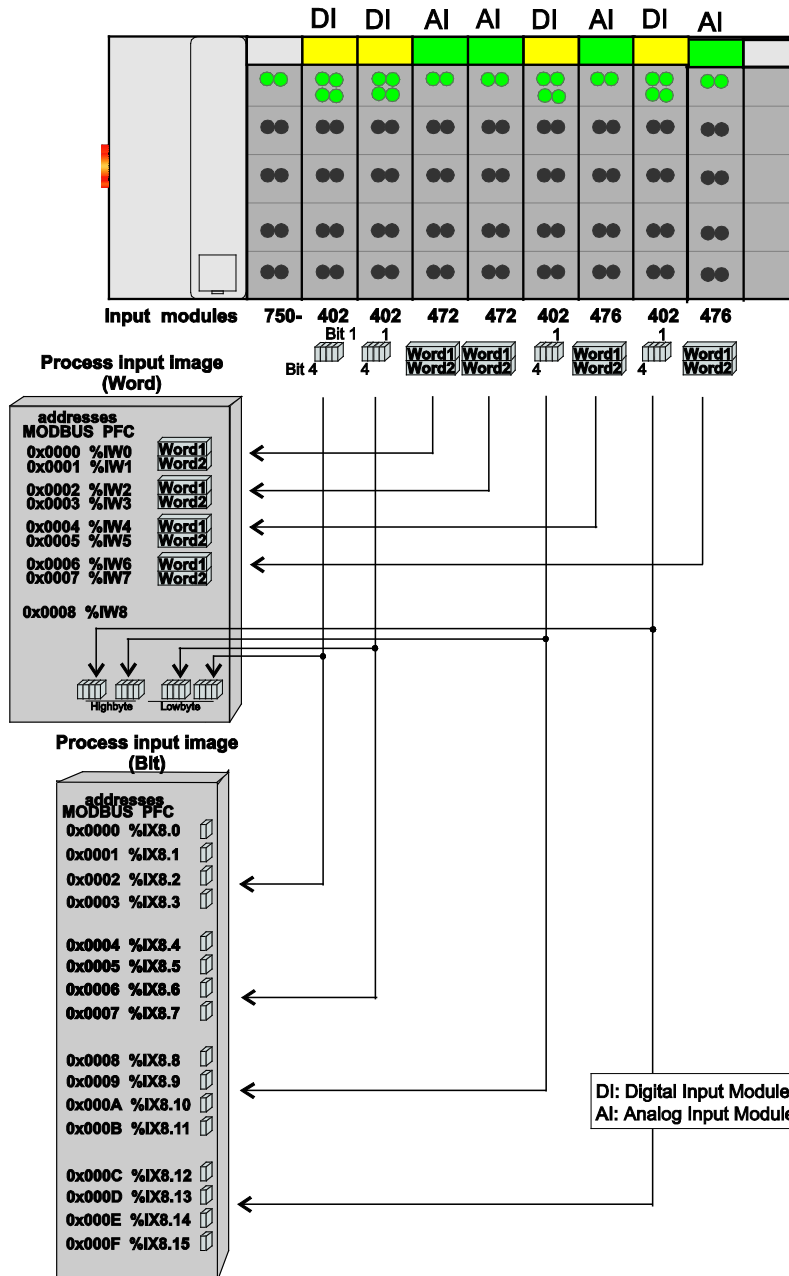


Figure 38: Example of Process Image for Input Data

7.2.3 Example of an Output Data Process Image

The following example for the output process image comprises 2 digital and 4 analog outputs. It comprises 4 words for the analog outputs and 1 word for the digital outputs; i.e., 5 words in total.

In addition, the output data can also be read back with an offset of 200_{hex} (0x0200) added 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 6000_{hex} (0x6000) to 66F9_{hex} (0x66F9) can be read back with an offset of 1000_{hex} (0x1000) added to the MODBUS address.

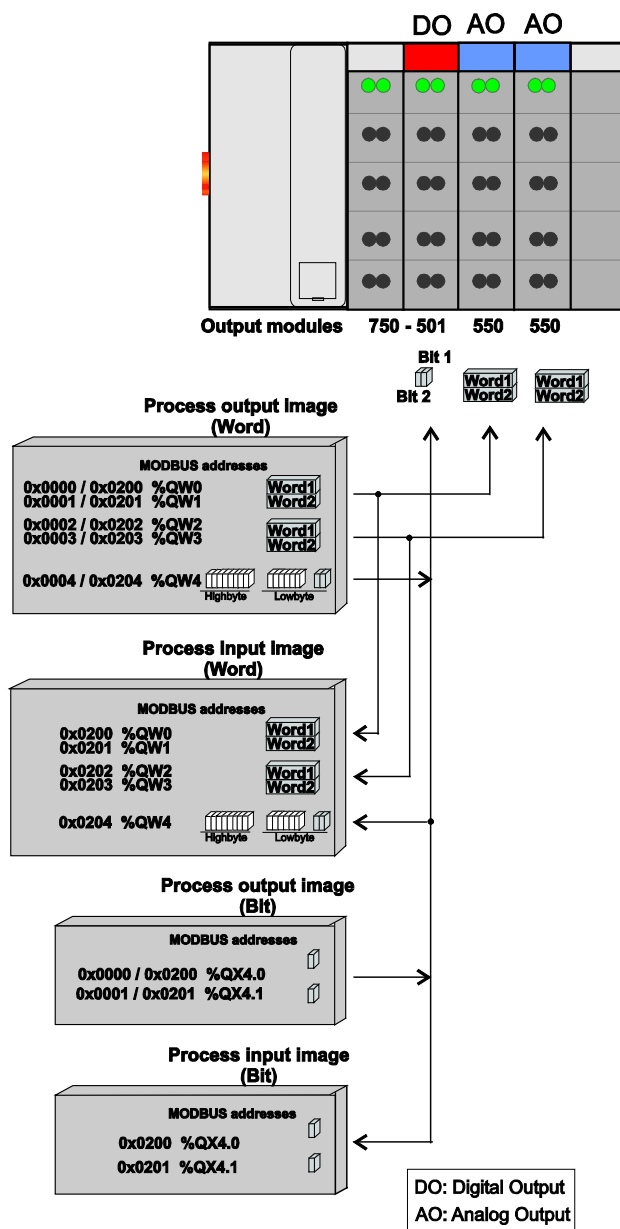


Figure 39: Example of Process Image for Output Data

7.2.4 Process Data MODBUS TCP

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

For the fieldbus controller with MODBUS, 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.

Information



Additional Information:

For the respective fieldbus-specific structure of the process values of any I/O module within the 750 or 753 Series of the WAGO-I/O-SYSTEM, refer to Section "Structure of Process Data for MODBUS/TCP".

7.3 Data Exchange

With the fieldbus controller, data is exchanged via the Modbus TCP protocol.

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

The fieldbus controllers of the WAGO I/O-SYSTEM 750 are usually slave devices. Thanks to the programming with IEC 61131-3, however, these controllers can also assume the master function.

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 controller can set up a defined number of simultaneous connections (socket connections) to other network subscribers:

- 3 connections for HTTP (to read HTML pages from the controller)
- 15 connections via Modbus TCP (to read or write input and output data of the controller)
- 5 connections (using the Ethernet.lib) via PFC (available in the PLC function for IEC 61131-3 application programs)
- 2 connections for WAGO-I/O-PRO (these connections are reserved for debugging the application program via ETHERNET. WAGO-I/O-PRO needs 2 connections at the same time for the debugging. However, only **one** programming tool can have access to the controller).
- 10 connections for FTP

The maximum number of simultaneous connections can not be exceeded. Existing connections must first be terminated before new ones can be set up. The Controller Modbus TCP; G4; 2ETH; ECO is essentially equipped with three interfaces for data exchange:

- the interface to the fieldbus (Master),
- the PLC function of the PFC (CPU) and
- the interface to the I/O modules.

Data exchange takes place between

- the fieldbus master and the I/O modules,
- the PLC function of the PFC (CPU) and the I/O modules
- between the fieldbus master and the PLC function of the PFC (CPU).

If Modbus is used as the fieldbus, the Modbus master accesses the data using the Modbus functions implemented in the controller.

Data access is carried out with the aid of an IEC-61131-3 application program.
Data addressing varies greatly here.

7.3.1 MODBUS Memory Areas

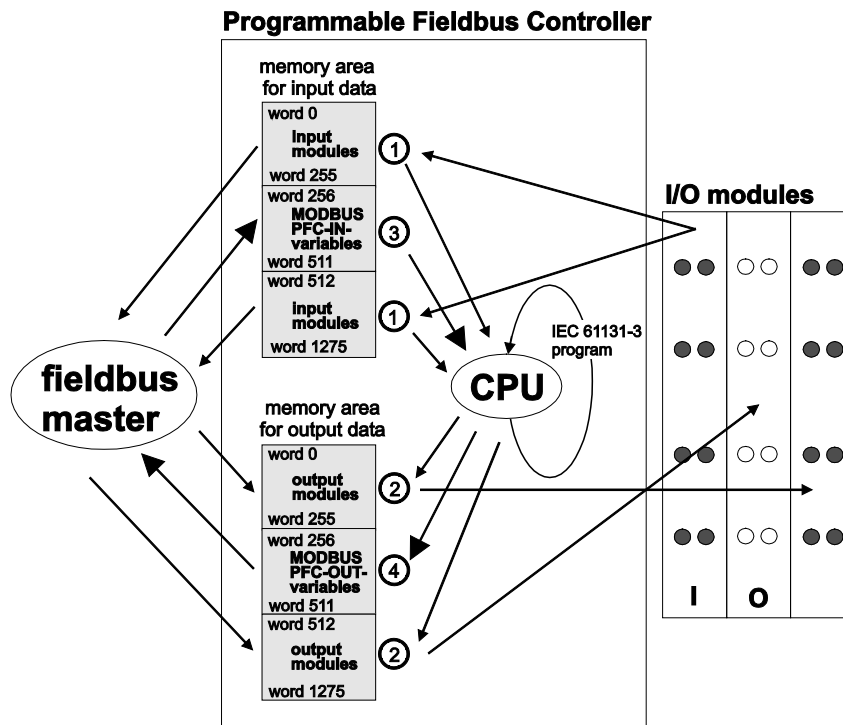


Figure 40: Memory Areas and Data Exchange

The controller 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.

The PFC variables are stored in each of the memory areas for word 256 ... 511 between these sides.

- ③ The PFC input variables are written to the input memory area from the fieldbus side and read in by the CPU for processing.
- ④ The variables processed by the CPU using the IEC-61131-3 program are placed in the output memory area, where they can be read out by the master.

The memory area for word 1276 ... 1531 is adjacent to the physical I/O module data. This area is reserved and may not be used.

The subsequent memory area, starting from word 1532, is reserved for future protocol expansion and other PFC variables.

In addition, all output data is mirrored in the Controller Modbus TCP; G4; 2ETH; ECO 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.

Other memory areas are also provided in the controller, some of which cannot be accessed by the fieldbus side, however:

- **Data memory (2 MByte)**
The data memory is a volatile RAM memory for creating variables that are not required for communication with the interfaces, but rather for internal processing procedures, such as calculation of results.
- **Program memory (2 MByte)**
The IEC-61131-3 program is stored in the program memory. The code memory is a Flash ROM. When power is switched on, the program is transferred from the flash to the RAM memory. After error-free run-up, the application program cycle starts with the mode selector switch at the top position, or on the Start command from the WAGO-I/O-PRO.
- **NOVRAM Remanent memory (16 kByte)**
The remanent memory is a non-volatile memory; i.e., all values of flags and variables, that are explicitly defined by "var retain", are retained even after a loss of power. Memory management is performed automatically. The 16 kByte memory area is normally divided into an 8 kByte addressable range for flags (%MW0 ... %MW4096) and a 8 kByte retain area for variables without memory area addressing, that are defined by "var retain".

Note



Markers are only remanent under "var retain"!

Please note that the bit memory is only retentive if you have declared it as such under "var retain".

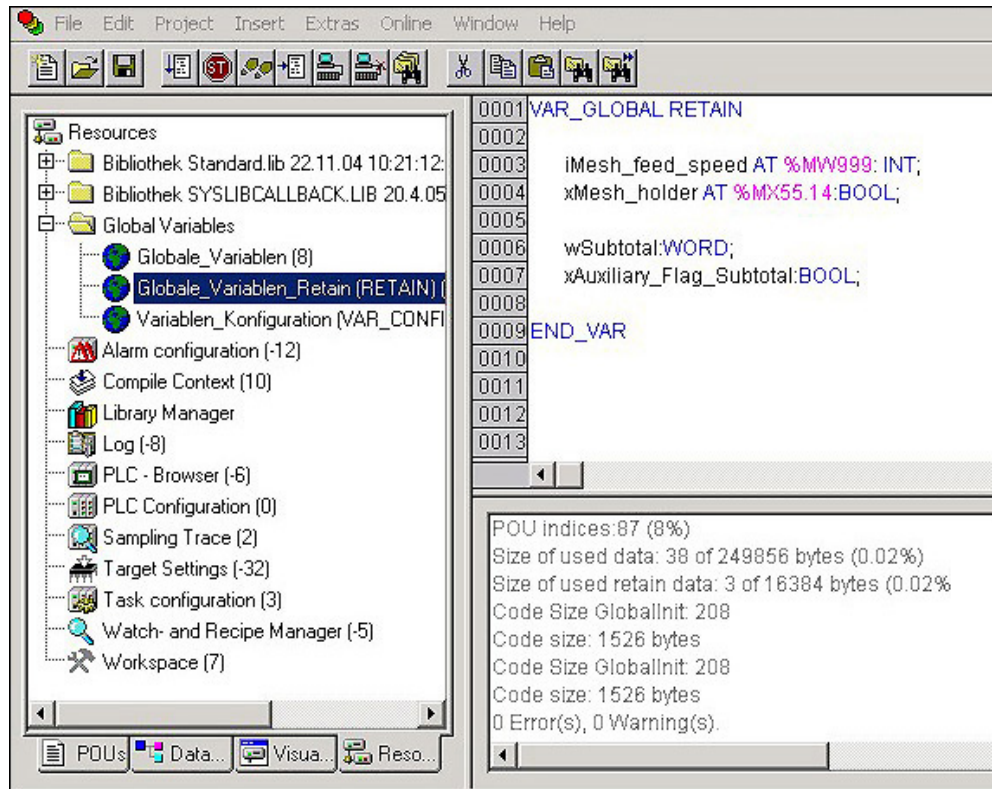


Figure 41: Example declaration of remanent flags by "var retain"

This breakdown can be varied (see following explanation).

Note



NOVRAM memory allocation can be changed in WAGO-I/O-PRO!

The breakdown of the NOVRAM can be modified when required in the programming software WAGO-I/O-PRO/Register "Resources"/Dialog window "Target system settings".

The start address for the flag area is fixed. The area sizes and the start address for the retain memory can be varied.

We do recommend keeping the standard settings, however, in order to avoid any overlapping of the areas.

In these default settings the size of the flag area is set at 16#1000, followed by the retain memory, with the size 16#1000

7.3.2 Addressing

Module inputs and outputs are addressed internally in a controller 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.

Note



Use various options for addressing the I/O modules!

This chapter explains the addressing and internal operation of a controller with inserted I/O modules.

It is essential that you understand these correlations in order to conduct conventional addressing by counting.

The **WAGO I/O Configurator** is also available as a further addressing option.

The Configurator can assist you in addressing and protocol assignment for the connected modules. You must select the connected modules in the I/O Configurator; the software then takes care of correct addressing.

The I/O Configurator is started from the *WAGO-I/O-PRO*.

For more details, refer to section “Programming the Controller using *WAGO-I/O-PRO*” > ... > “Configuring the Controller using the I/O Configurator”.

7.3.2.1 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!

If 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 32: 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	

7.3.2.2 Example of Addressing

A controller to which two digital input modules (2 DI), two digital output modules (2 DO) and two analog input modules (2 AI) and two analog output modules (2AO) are connected. The final element is an end module that is not taken into account for addressing.

Table 33: Example of Addressing

Counting order	Module	Function	Data width	Hardware Address
1.	750-467	2 AI / 0-10 Volt	2 x 16 bit	%IW0 u. %IW1
2.	750-400	2 DI	2 x 1 bit	%IX2.0 u. %IX2.1
3.	750-550	2 AO / 0-10 Volt	2 x 16 bit	%QW0 u. %QW1
4.	750-501	2 DO	2 x 1 bit	%QX2.0 u. %QX2.1
-	750-600	End module	none	-

Refer to the technical data for the specific modules for the data width. The analog input modules (AI) are mapped first in the process image. Analog modules are processed word-by-word (W).

Module 467 occupies 2 words here (1 word = 16 Bit); i.e.; the first word **%IW0** and the second word **%IW1** in the memory image. Note here that counting begins at "0".

The digital inputs (DI) are taken into account after this. These occupy 2 bits. Two complete words have been previously counted (Word 0 and 1). Now, counting is continued from Word 2 and 2 bits are added (Bit 0 and Bit 1). Words and bits are each separated by a decimal point. The hardware addresses are **%IX2.0** and **%IX2.1**.

The two analog output modules 750-550 (AO) are then processed. Each of these modules occupies 1 word; i.e., together they occupy 2 words. Counting for the output process image begins anew at "0". The hardware output addresses are then **%QW0** and **%QW1**.

Now the digital outputs (DO) are dealt with. These occupy 2 bits. Two complete words have been previously counted (Word 0 and 1). Now, counting is continued from Word 2 and 2 bits are added (Bit 0 and Bit 1). The hardware addresses are then **%QX2.0** and **%QX2.1**.

Note



Hardware changes can result in changes of the process image!

Changing or adding of digital, analog or complex modules (DALI, EnOcean, etc.) may result in a new process image being generated. The process data addresses would then also be changed. Therefore, the process data of all previous modules has to be taken into account when modules are added.

7.3.2.3 IEC-61131-3 Address Areas

Table 34: IEC-61131-3 Address Areas

Address area	MODBUS Access	PLC Access	Description
phys. inputs	read	read	Physical inputs (%IW0...%IW255 und %IW512...%IW1275)
phys. outputs	read/write	read/write	Physical outputs (%QW0...%QW255 und %QW512...%QW1275)
MODBUS/TCP PFC-IN variables	read/write	read	Volatile PLC input variables (%IW256...%IW511)
MODBUS/TCP PFC-OUT variables	read	read/write	Volatile PLC output variables (%QW256...%QW511)
Configuration register	read/write	-	see Section "Modbus Functions → Modbus Registers → Configuration Registers"
Firmware register	read	-	see Section "Modbus Functions → Modbus Registers → Firmware Information Registers"
Retain variables	read/write	read/write	Remanent memory (%MW0...%MW4096)

7.3.2.4 Absolute Addressing

Direct presentation of individual memory cells (absolute addresses) based on IEC-61131-3 is performed using character strings:

Table 35: Absolute Addressing

Position	Prefix	Designation	Comment
1	%	Introduces an absolute address	
2	I Q M	Input Output Flag	
3	X* B W D	Single bit Byte (8 bits) Word (16 bits) Doubleword (32 bits)	Data width
4		Address	

such as word-by-word: %QW27 (28th word), bit-by-bit: %IX1.9 (10th bit in the 2nd word)

* The designator "X" for bits can be omitted

Note



Enter character strings without spaces or special characters!

The character strings for absolute addresses must be entered connected, i.e. without spaces or special characters!

Addressing example:

Table 36: Addressing Example

		Inputs			
Bit		%IX14.0 ... 15		%IX15.0 ... 15	
Byte		%IB28	%IB29	%IB30	%IB31
Word		%IW14		%IW15	
Double word		%ID7			
		Outputs			
Bit		%QX5.0 ... 15		%QX6.0 ... 15	
Byte		%QB10	%QB11	%QB12	%QB13
Word		%QW5		%QW6	
Double word		%QD2 (top section)		%QD3 (bottom section)	

		Flags			
Bit		%MX11.0 ... 15		%MX12.0 ... 15	
Byte		%MB22	%MB23	%MB24	%MB25
Word		%MW11		%MW12	
Double word		%MD5 (top section)		%MD6 (bottom section)	

Calculating addresses (as a function of the word address):

Bit address: Word address .0 to .15

Byte address: 1st byte: 2 x word address
2nd byte: 2 x word address + 1

DWord address: Word address (even number) / 2
or Word address (uneven number) / 2, rounded down

7.3.3 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 37: 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.

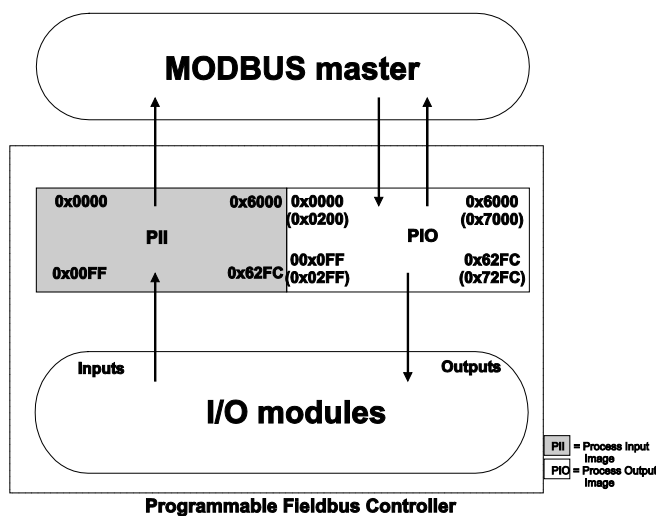


Figure 42: Data Exchange Between MODBUS Master and I/O Modules

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".

7.3.4 Data Exchange between PLC Function (CPU) and I/O Modules

The PLC function (CPU) of the controller uses direct addresses to access the I/O module data.

The controller uses absolute addresses to reference the input data. The data can then be processed internally in the controller using the IEC-61131-3 program. Flags are stored in a non-volatile memory area in this process. The results of linking can then be written directly to the output data employing absolute addressing.

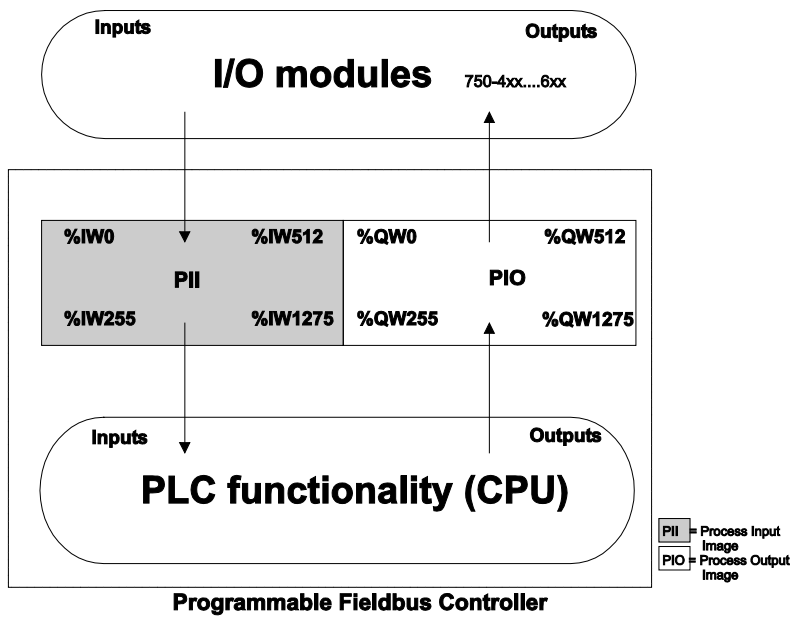


Figure 43: Data Exchange Between PLC Function (CPU) of the controller and the I/O Modules

7.3.5 Data Exchange between Master and PLC Function (CPU)

The fieldbus master and the PLC function (CPU) of the PFC have different perspectives on data.

Variable data generated by the master are routed as input variables to the PFC, where they are further processed.

Data created in the PFC are transmitted via fieldbus to the master as output variables.

In the PFC, access to the PFC variable data is possible starting from word address 256 to 511 (double-word address 128-255, byte address 512-1023), while access to the PFC variable data is possible starting from a word address of 1276 to 1531 (double-word address 638-765, byte address 2552-3063).

7.3.5.1 Example of MODBUS/TCP Master and PLC Function (CPU)

Data access by the MODBUS/TCP Master

Access to data by the MODBUS Master is always either by word or by bit. Addressing of the first 256 data words by the I/O modules begins with word-by-word and bit-by-bit access at 0.

Addressing of the data by the variables begins at 256 for word-based access; bit-by-bit access then takes place starting at:

4096 for bit 0 in word 256
4097 for bit 1 in word 256
...
8191 for bit 15 in word 511.

The bit number can be determined using the following equation:

$$\text{Bit No.} = (\text{word} * 16) + \text{Bit No. in word}$$

Example: 4097 = (256 * 16) + 1

Data Access by PLC Function (CPU)

The PLC function of the PFC employs a different type of addressing for accessing the same data. PLC addressing is identical with word-by-word addressing by the MODBUS Master for the declaration of 16-bit variables. However, a different notation is used for declaration of Boolean variables (1 bit) than that used by MODBUS. Here, the bit address is composed of the elements word address and bit number in the word, separated by a decimal point.

Example:

Bit access by MODBUS to bit number 4097 => Bit addressing in the PLC
<Word No.>.<Bit No.> = 256.1

The PLC function of the PFC can also access data by bytes and by doubleword access.

Addresses are calculated based on the following equations for byte-based access:

$$\begin{aligned}\text{High Byte address} &= \text{Word address} * 2 \\ \text{Low Byte address} &= (\text{Word address} * 2) + 1\end{aligned}$$

Addresses are calculated according to the following equation for double-word based access:

$$\begin{aligned}\text{Double-word address} &= \text{High word address} / 2 \text{ (rounded down)} \\ &\text{or} = \text{Low word address} / 2\end{aligned}$$

Information



Additional Information

There is a detailed description of the MODBUS and the corresponding IEC 61131 addressing in section “MODBUS Register Mapping”.

7.3.6 Application Example

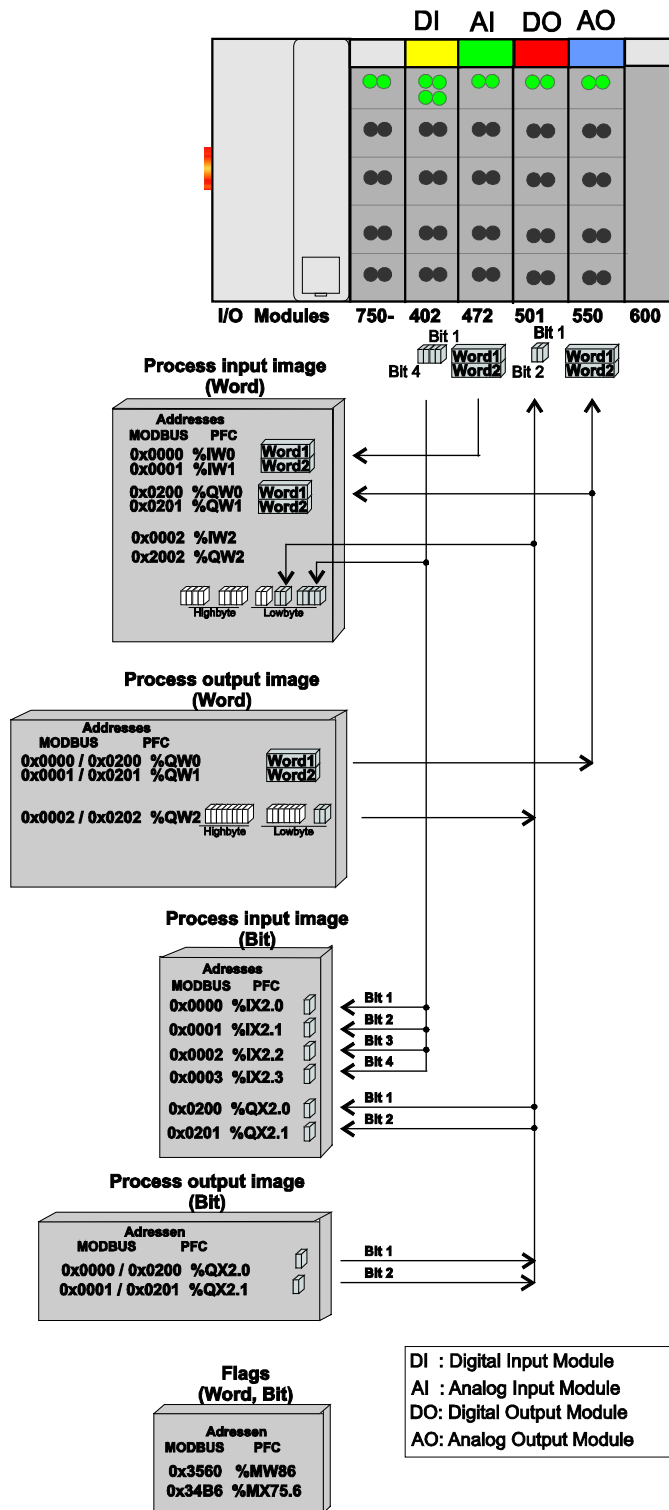


Figure 44: Example of Addressing for a Fieldbus Node

7.4 Logging

For diagnostic purposes, a message protocol can be recorded in the form of a log book via the head station.

The log messages can be sent to a syslog server or saved on the internal or, if available, on an external file system (e.g. memory card).

NOTICE

Rapid aging of the internal storage medium!

Note, when the log output is activated on the internal file system, excessive log output leads to faster aging of the storage medium.

In addition, by lowering the log level this is also favored.

Therefore You should only use the log output in a targeted manner (troubleshooting / support case) or use external / exchangeable storage media (if supported by the device).

Sending and saving of log messages is done by selecting the respective log level, which indicates the severity of the event (e.g. INFO, WARNING, ERROR). The log level defines the threshold for the log outputs on the network "Network log level" or for storage on the file system "File log level".

Example:

Log messages with the severity "INFO" are only recorded and displayed if at least one of the two log level options is set to "INFO".

The online log works as a ring buffer and shows the last 256 log entries in chronologically descending order.

For saving, the entries are downloaded in a single merged log file.

This log file in CSV format (comma-separated values) can be opened with a normal text editor or imported and processed with a spreadsheet program (e.g. Microsoft Excel).

The file name of the log file has the following structure:

Table 38: Log File Name Syntax

Syntax	Description
log_<MAC5:3>_<YYMMDDTHHMMSS>.csv	
<MAC5:3>	The last 3 digits of the MAC ID (MAC-ID without OUI part)
<YYMMDDTHHMMSS>	Date and time on the device

The fill level of the log memory can be limited by a limit value in%.

The maximum size results from the number and the maximum size of the log files.

With a set value between 1% and 100%, the current fill level of the log memory is monitored and a message is generated if the set limit value is exceeded (blink code and log message).

If the value is set to 0%, the level is not monitored.

When the saved log files are deleted on the device, any warning regarding the fill level of the log memory (blink code) is also reset.

To avoid data loss, the following points must be observed:

- The log files can only be called up via the WBM using the download function **[Download]** and emptying using the delete function **[Delete]**.

Direct access to the log directory "A:\log" or "S:\log" via FTP or SFTP as well as the renaming of log files is not permitted and can lead to access conflicts or inconsistent log information.

- No storage of user-specific files in the log directories "A:\log" or "S:\log".

The contents of the log directories "A:\log" or "S:\log" are not included in the Backup & Restore function.

8 Commissioning

Note



Close any ports and services that you do not need!

Unauthorized persons may gain access to your automation system through open ports.

To reduce the risk of cyber attacks and, thus, enhance your cyber security, close all ports and services in the control components (in particular Port 6626 for WAGO I/O-CHECK, Port 2455 for CODESYS 2 and Port 11740 for e!COCKPIT) not required by your application.

Only open ports and services during commissioning and/or configuration.

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 PC under Windows.

In principle, only a few steps are required for start-up.

To enable communication from your PC to the fieldbus coupler/controller over network, both must be in the same network. This requires that you first determine the IP address of the PC and then assign a corresponding IP address to the fieldbus node. There are several options being available for IP address assignment.

The description of these single work steps can be found in the corresponding following chapters.

- **Connecting PC and fieldbus node**
- **Determining IP address of the PC**
- **Assigning IP address to the fieldbus node**
- **Applying IP address permanently (option “static”)**

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 System Time**
- **Restoring Factory Settings**

After the topics specified above, you can find instructions for programming the head station with *WAGO-I/O-PRO* and the description of the internal HTML pages of the web-based Management System (WBM) for additional settings of the head station.

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" chapter.
2. Connect the 24 V power supply to the supply terminals.
3. Connect the PC's ETHERNET interface to the head station's ETHERNET interface (RJ-45) of your fieldbus node.
4. Turn the operating voltage on.

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 has occurred during initialization, it is red flashed with an error code 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), this indicates that an IP address has not been assigned yet.

8.2 Determining the IP Address of the PC

To determine the IP address of the PC (with Microsoft Windows operating system) using the MS DOS prompt, proceed as follows:

1. Go via "Start"> "Search programs/files".
2. Enter the command "cmd" in the input field.
3. Choose at
(Windows 7): "cmd.exe" and
(Windows 10): "Command Prompt".
4. Press **[Enter]** key to confirm the entry.

The MS DOS prompt window opens.

5. In the MS DOS prompt window enter the command "ipconfig".
6. Press **[Enter]** key to confirm the entry.

The IP address, subnet mask and the default gateway with the corresponding parameters of the PC are displayed.

8.3 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.

- 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 PLC program**
(Static IP address)
- **Assigning IP Address via BootP**
(IP address via the fieldbus)

8.3.1 Assigning IP Address via Address Selection Switch

Use the address selection switch to set the host ID, which is the last byte of the IP address, with values between 1 and 254 binary coded.

The first three bytes of the IP address are specified by the fieldbus coupler/controller. The fieldbus coupler/controller uses a static base IP address to assign the IP address via the address selector switch.

The basic IP address can be changed via the Web-based management or WAGO Ethernet settings (in the delivery state: **192.168.1.0**).

The subnet mask and default gateway values are taken from the static settings (as delivered: subnet mask = **255.255.255.0**, default gateway = **0.0.0.0**).

Example:

Base IP address:	192.168.1.0
Set DIP switch value:	50 (binary coded: 00110010)
Resulting IP address:	192.168.1. 50

Table 39: Address selection switch values (host ID)

Address selection switch	Description
1 ... 254	Address selection switch is enabled. The host ID is set to a fixed value between 1 ... 254. The IP address consists of the static base address and the set host ID. The IP address set via the current device configuration (DHCP, BootP, static) is disabled.
0	Address selection switch is disabled. The IP address set via the current device configuration (DHCP, BootP, static) is used.
255	Address selection switch is disabled. The IP address is obtained from a DHCP server.

Information



More information about changing the static base address

You can also change the static base address currently saved in the fieldbus coupler/controller as required. Proceed as described for example in the section "Assigning IP Address via "WAGO Ethernet Settings"".

- 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".
- 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).

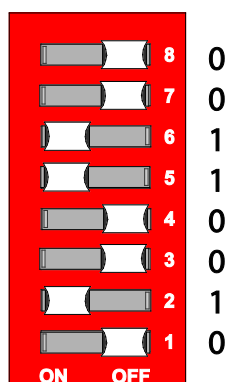


Figure 45: Address Selection Switch, for Example the Value Setting "50" ($2^1 + 2^4 + 2^5$)

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

8.3.2 Assigning IP Address via 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.

In delivery state of the head station, the dynamic assignment of the IP address is active by means of "Dynamic Host Configuration Protocol" (DHCP).

When the DHCP protocol is enabled the head station of fieldbus node expects the DHCP server to be permanently available. If there is no DHCP server available after a Power On reset, the network will remain inactive.

If DHCP is not active, it is necessary to enable DHCP, e. g. via "WAGO Ethernet Settings" or via the WBM (see chapters "Enable DHCP via "WAGO Ethernet Settings" (without existing IP address)" or "Enable DHCP via WBM (with existing IP address)").

Then the IP address assignment with DHCP takes place automatically via a DHCP server in the network.

If there is no DHCP server on your local PC, you can download a DHCP server free of charge from the Internet and install it on your PC.

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



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.

After the IP address was assigned by means of DHCP, it can be determined via the settings or outputs of the respective DHCP server, such as via the output of "Open DHCP", for example.

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!

In order to use the IP address permanently, change it to "static" (see chapter "Apply IP address permanently (option "static ")").

8.3.2.1 Enable DHCP via "WAGO Ethernet Settings" (without existing IP address)"

Note



Note Software Compatibility!

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

In the delivery state of the head station, the dynamic assignment of the IP address is active by means of "Dynamic Host Configuration Protocol" (DHCP).

However, if DHCP is not active and you do not have access to your fieldbus node via an IP address, you can enable DHCP via "WAGO Ethernet Settings" in the **Network** tab.

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!

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. Select the option "DHCP" in the field **Source**.
6. Click on the **[Write]** button to apply the settings in the fieldbus node.

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

7. Then You can use the **[Read]** button to read out the currently assigned IP address.
8. In order to use the IP address permanently, select on "TCP/IP" WBM page the option "static" in the field **Source** and apply the settings for "IP address", "Subnet mask" and "Gateway" from the currently used settings.
9. Click on the **[Write]** button to apply the settings.

8.3.2.2 Enable DHCP via WBM (with existing IP address)

In the delivery state of the head station, the dynamic assignment of the IP address is active by means of "Dynamic Host Configuration Protocol" (DHCP).

However, if DHCP is not active and you do already have access to your fieldbus node via an IP address, you can enable DHCP via WBM on "TCP/IP" WBM page.

1. Open the WBM (see chapter: "Configuring via the Web-Based Management System (WBM)" >> "Open WBM").
2. Change to the WBM page "TCP / IP".
3. Activate the "DHCP" option to assign a new IP address via DHCP.
4. Confirm the change with the **[SUBMIT]** button.
5. Select the WBM page "Administration".
6. Click the **[SOFTWARE RESET]** button to apply the changed setting.

Alternatively, you can restart the fieldbus node.

The fieldbus node then starts with the new IP address assigned via DHCP. The connection to the browser is interrupted.

7. If you want to call the WBM again, you must use now the changed IP address.
8. 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")").
9. In order to use the IP address permanently, select on "TCP/IP" WBM page the option "static" in the field **Source** and apply the settings for "IP address", "Subnet mask" and "Gateway" from the currently used settings.
10. Confirm the change with the **[SUBMIT]** button.
11. Click the **[SOFTWARE RESET]** button to apply the changed setting.

8.3.3 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.

8.3.4 Assigning the IP Address with a PLC program

A PLC program can be used to assign a fixed IP address.

When assigning an address using a PLC program, this can be realized by integrating the library "Ethernet.lib" in the WAGO software "WAGO-I/O-PRO". For this, the "Ethernet_Set_Network_Config" function block of the "Ethernet.lib" library is used.

Information



Additional Information about IP address assignment via a PLC program!

A detailed description of the library "Ethernet.lib" for the address assignment via a PLC program, refer to the manual for the WAGO-I/O-PRO library. This manual can be found on the WAGO website <http://www.wago.com> under https://www.wago.com/wagoweb/documentation/index_e.htm → WAGO Software → WAGO-I/O-PRO/CODESYS → Additional Information → Libraries → Ethernet.lib!

8.3.5 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 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.

By default, DHCP is active in the delivery state of the head station.

Therefore it is necessary to enable BootP for IP address assignment via BootP, e. g. via "WAGO Ethernet Settings" or via the WBM (see analog the chapters "Activate DHCP via "WAGO Ethernet Settings" (without existing IP address)" or "Activate DHCP via WBM (with existing IP address)").

Then the IP address assignment with BootP takes place automatically via a BootP server in the network.

If there is no BootP server on your local PC, you can download a BootP server free of charge from the Internet and install it on your PC.

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.

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.

When the BootP protocol is enabled the head station of fieldbus node 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.

In order to use the IP address permanently, change it to "static" (see chapter "Apply IP address permanently (option "static ")").

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 ")").

8.3.5.1 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

8.4 Apply IP address permanently (option “static“)



Note

For permanent address assignment, the IP stored in the EEPROM must be used!

To apply permanently the new IP address assigned via DHCP or BootP in the fieldbus coupler/controller, the assigned or desired settings for IP address, subnet mask and default gateway must be entered on the WBM “TCP/IP” page. In addition the option "IP configuration source: static" must be activated. Then, the IP address is stored in the EEPROM and used as static address.

You can enable the option “IP configuration source: static” in the Web-based Management System.

1. Open the WBM (see chapter: "Configuring in the Web-Based Management System (WBM)" >> "Open WBM").
2. Select the WBM page "TCP/IP".
3. Enter the assigned or desired settings for IP address, subnet mask and default gateway in the fields "IP address", "Subnet mask" and "Default gateway".
4. Enable the option “IP configuration source: "static".

At the same time, the use of the DHCP/BootP server is disabled.

5. Confirm your changes with button **[SUBMIT]**.
6. Select the “Administration” WBM page.
7. Click on the button **[Software Reset]** at the bottom of the page in order for the settings to take effect.

Alternatively restart the fieldbus node.

Then the fieldbus node starts with the configurations and the assigned IP address, which were previously loaded into the EEPROM. The connection to the browser is interrupted.

8. Now you must use the new IP address, if you want to access again on the WBM of this fieldbus node via browser.

8.5 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".

8.6 Preparing the Flash File System

The flash file system must be prepared in order to use the WBM of the fieldbus coupler/controller of the fieldbus node 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/controller 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 node.
2. Connect the communication cable 750-920 or 750-923 respectively the *Bluetooth*® Adapter 750-921 to the service interface of the head station of the fieldbus node and to your computer.
3. Switch on the supply voltage of 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”.

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.

8.7 Synchronizing the System Time

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

Note



System time will be reset when the fieldbus node is de-energized!

The head station 750-862 does not have a real-time clock. For this reason, the current system time will be reset when the fieldbus node 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**"
- Set 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 node.
2. Connect the communication cable 750-920 or 750-923 respectively the *Bluetooth*[®] Adapter 750-921 to the service interface of the head station of the fieldbus node and to your computer.
3. Switch on the supply voltage of 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".

4. Start the "**WAGO Ethernet Settings**" program.
5. Select the **Date and Time** tab.
6. Click on the **[Apply]** button.

Set 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.

8.8 Restoring Factory Settings

To restore the factory settings, proceed as follows:

1. Switch off the supply voltage of the fieldbus node.
2. Connect the communication cable 750-920 or 750-923 respectively the *Bluetooth*[®] Adapter 750-921 to the service interface of the head station of the fieldbus node and to your computer.
3. Switch on the supply voltage of the fieldbus node.
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 Programming the Controller using WAGO-I/O-PRO

Using IEC 61131-3 programming, the **Controller Modbus TCP; G4; 2ETH; ECO 750-862** can also utilize the function of a PLC in addition to the functions of a fieldbus coupler. Creation of an application program in line with IEC 61131-3 is performed using the programming tool *WAGO-I/O-PRO*.

Note



Note Software Compatibility!

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

Note



Activate option "CODESYS" in the web-based Management System for programming!

Pay attention, the IEC 61131-3 programming of the controller via ETHERNET requires that the check box **CODESYS** be activated at the Website "Port Configuration" (default).

You can, however, also connect the client PC and controller serially for programming using a programming cable.

Note



Log in with the administrator password to program the controller!

If you have activated password protection „Enable CODESYS port authentication“ on the "Administration" page of the WBM, you have to log into *WAGO-I/O-PRO* in the menu **Online > Log In** to obtain programming access to the controller (default password "wago").



Figure 46: Logging in for Programming Access

Note



Log in with the administrator user data to use the PLC browser!

To use the PLC browser functionality in WAGO-I/O-PRO, log into the PLC browser with the administrator user data (default: user “admin”, password “wago”). Enter “login admin wago” in the command line of the PLC browser.

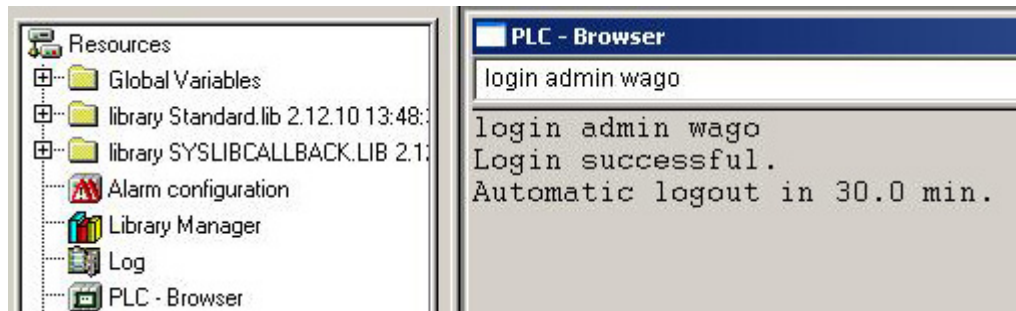


Figure 47: Logging Into the PLC Browser

A description of programming using WAGO-I/O-PRO is not included in this manual. The following sections, on the other hand, contain important information about creating projects in WAGO-I/O-PRO and about special modules that you can use explicitly for programming of the Controller Modbus TCP; G4; 2ETH; ECO.

Explanations are also provided as to how the IEC 61131-3 program is transferred and how suitable communication drivers are loaded.

Note



One WAGO-I/O-PRO/(CODESYS)-Instance per target system!

Note that a simultaneous connection of multiple WAGO-I/O-PRO/(CODESYS) Instances on one target system is not possible.

Note



Name Conventions for WAGO-I/O-PRO/(CODESYS) Projects!

Note that you do not use special characters for the name of your WAGO-I/O-PRO/(CODESYS) project and limit the name to a maximum of 8 characters.

This will ensure that not always, in case of the online change function is activated simultaneously, for each online change event a new TxT file is created, which contains the paths and the project ID, and that for this additional memory is consumed. With proper choice of the file name, the TxT file is only overwritten each time and does not consume additional memory space.

Information



Additional Information:

For a detailed description of using the software, refer to the manual for the “WAGO-I/O-PRO”. This manual is located in the Internet under <http://www.wago.com>.

1. Start the programming tool at **Start \ Programs \ WAGO-I/O-PRO**.
2. Under **File / New** create a new project

A dialog window then appears on which you can set the target system for programming.

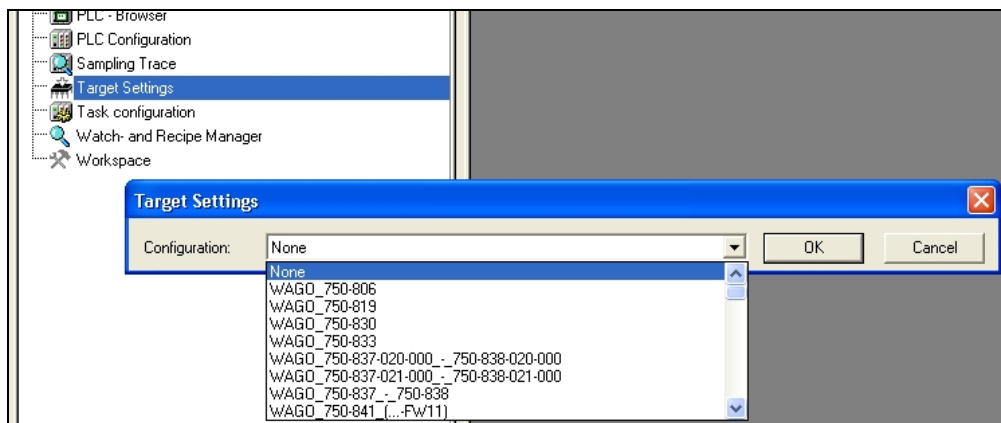


Figure 48: Dialog Window for Target System Settings

3. Select the respective entry in the select list for your fieldbus controller and then click **OK**.
4. In the dialog window that appears select the program type (AWL, KOP, FUP, AS, ST or CFC).

To ensure that you can access all I/O module data properly in your new project, first compile the I/O module configuration based on the existing fieldbus node hardware and map it in the configuration file “io-config.xml”.

This file defines whether write access is permitted to the modules from the IEC-61131-3 program or from the fieldbus.

As described below, this file can be generated via configuration using the WAGO I/O Configurator.

9.1 Configuring the Controller using the I/O Configurator

The I/O Configurator is a plug-in integrated into WAGO-I/O-PRO used to determine addresses for I/O modules at a controller.

1. In the left half of the screen for the WAGO-I/O-PRO interface, select the tab **Resources**.
2. To start the I/O Configurator, double-click in the tree structure on **Control system configuration**.
3. Expand the branch **Hardware configuration** in the tree structure.
4. Right-click on the entry **K-Bus** and then select **Edit** in the context menu.
5. In the “Configuration” window that then opens, click on **Add** to open the module selection window.
6. Select the I/O module you wish to add from the module catalog and attach it to the end of the local data bus structure by clicking on [**>>**] and **OK**.
7. Position all of the required I/O modules in their correct order until this arrangement matches the configuration of the physical node.

Arrange the tree structure in the hardware configuration in the same manner. Include all I/O modules which supply or receive data.

If you access your controller online, you can use the [**Start WAGO-I/O-CHECK and scan**] button in the “Configuration” window to read in the physically linked controllers with the series-connected I/O modules and display all of the components.

Note



The local data bus structure in the WAGO I/O Configurator must match the physical node structure!

The number of I/O modules that send or receive data must correspond to the existing hardware (except for supply modules, copying modules or end modules, for example). For the number of input and output bits or bytes of the individual I/O modules please refer to their corresponding descriptions.

Information



Additional information

To open the data sheet for an I/O module, click in the “Configuration” window on the corresponding I/O module and then click the **[Data sheet]** button. The data sheet is then shown in a separate window.

All current data sheets are available on our website <http://www.wago.com> under Documentation.

8. Click **[OK]** to accept the node configuration and close the dialog window.

The addresses for the control system configuration are then recalculated and the tree structure for the configuration is updated.

If required, you can also modify the authorization privileges for individual I/O modules if they are to be accessed via fieldbus. Initially, write access from the PLC is defined for each I/O module that is added. Proceed as follows to change this setting:

9. Click the “PI Assignment” tab in the “Configuration” dialog.
10. Define for each module from where access to the module data is to be carried out.

You can choose from the following settings in the column “PI Assignment” for this:

- PLC, PLC (standard setting) - Access from controller
- fieldbus 1 - Access from Modbus TCP

After completing these settings you can begin the IEC-61131-3 programming.

An “io-config.xml” configuration file is automatically generated and stored in the controller, when you transfer the project (Menu **project > transfer/transfer all**) and download it in the controller.

Note



Set “MODBUS TCP/UDP, fieldbus1”, when directly writing to a hardware address via Modbus!

Set “MODBUS TCP/UDP, fieldbus 1” if you wish to write directly to a hardware address via Modbus. Otherwise the modules will be allocated to the PLC, making writing from a different location impossible.

Information



Additional Information

For a detailed description of using the software WAGO-I/O-PRO and the I/O Configurator, refer to the online Help function for WAGO-I/O-PRO.

9.1.1 Configuration using the “io-config.xml” File

You can also create the file “io-config.xml” using an editor and store it in the controller directory “/etc” by means of FTP.

Configuration using the file “io-config.xml” that is already stored in the controller is described in this section.



Note

Configuration entries in WAGO I/O-PRO overwrite “i-config.xml” upon download!

If you wish to perform module assignment directly using the “io-config.xml” file stored in the controller, do not save any configuration data in WAGO I/O-PRO prior to this, as the file is overwritten by entries in the WAGO I/O-PRO on each download.

1. Establish an (S)FTP connection to your controller. To do this, use an FTP program or enter the following line in your browser:

[ftp://\[IP address of controller\]](ftp://[IP address of controller]), e.g. <ftp://192.168.1.201>

2. Then, enter **admin** as the user login and **wago** as the password.

The file “io-config.xml” is located in the “etc” folder.

3. Copy this file to a local directory on your PC and open it in an editor installed on your PC (e.g., “WordPad”).

The file already contains the following syntax:

```

EA-config.xml
File Display
<?xml version="1.0" encoding="ISO-8859-1"?>
<?xml-stylesheet type="text/xsl" href="\cplcfig\EA-config.xml" ?>
<WAGO>
<Module ARTIKELNR="" MAP="PLC" LOC="ALL"></Module>
</WAGO>

```

Figure 49: EA-config.xml

The fourth line contains the necessary information for the first I/O module.

The entry MAP=PLC assigns write access privileges to the IEC-61131-3 program for the first module.

4. If you wish to change the access rights, replace “PLC” with “FB1” as the access privileges from EtherNet/IP.

`<Module ARTIKELNR="" MAP="PLC" LOC="ALL"> </Module>`



`<Module ARTIKELNR="" MAP="FB1" LOC="ALL"> </Module>`

-
5. Then complete the fourth line for each individual module using this syntax and set the corresponding assigned access privileges.

Note



The number of line entries must correspond with the number of bus terminals used!

It is imperative that the number of line entries concurs with the number of existing hardware modules.

6. Save the file and reload it to the controller file system via FTP client.

You can then begin with IEC-61131-3 programming.

Information



Additional Information:

For a detailed description of how to use the software, refer to the WAGO-I/O-PRO manual. The manual is available in the Internet under:

<http://www.wago.com> → Documentation → WAGO Software → WAGO-I/O-PRO → 759-333

9.2 ETHERNET Libraries for WAGO-I/O-PRO

Various libraries are available in WAGO-I/O-PRO for different IEC 61131-3 programming tasks. These libraries contain function blocks that can be used universally to facilitate and accelerate the creation of programs.

Once the libraries have been integrated, function blocks, functions and data types will be available that you can use the same as ones you have specifically defined.

Information



Additional Information

All libraries are included on the installation CD for the software WAGO-I/O-PRO or in the Internet under <http://www.wago.com>.

The libraries described below are specific to ETHERNET projects with WAGO-I/O-PRO.

Table 40: ETHERNET libraries for WAGO-I/O-PRO

Library	Description
Ethernet.lib	Function blocks for communication via ETHERNET
WAGOLibEthernet_01.lib	Function blocks that can set up a link to a remote server or client via TCP protocol to exchange data with any potential UDP server or client via UDP protocol
WAGOLibModbus_IP_01.lib	Function blocks with MODBUS master function that set up links with one or more slaves to exchange data via UDP and TCP
SysLibSockets.lib	Function block for access to sockets for communication via TCP/IP and UDP.
WagoLibSockets.lib	Function blocks for access to sockets for communication via TCP/IP and UDP Contains additional functions in addition to SysLibSockets.lib.
Mail_02.lib	Function block for sending e-mails
WAGOLibMail_02.lib	Function block for sending e-mails
WagoLibSntp.lib	Function blocks for setting and using the simple network time protocol (SNTP)
WagoLibFtp.lib	Function blocks for setting and using the file transfer protocol (FTP)
WAGOLibTerminalDiag.lib	Function blocks for the output of module, channel and diagnostic data of I/O modules that provide diagnostic data

Information



Additional Information

For a detailed description of the function blocks and use of the software, refer to the online Help function for WAGO-I/O-PRO or the WAGO-I/O-PRO manual in the Internet under: <http://www.wago.com>.

9.3 Functional Restrictions and Limits

The basis of WAGO-I/O-PRO, the standard programming system CoDeSys by 3S, has an integrated visualization. Dependend on the target, this visualization can be used in the variants "HMI", "TargetVisu" and "WebVisu".

The fieldbus controller supports the process variant "HMI" only.

Several options for complex visualization objects as "Alarm" and "Trend" are provided by the "HMI" version. This applies, for example, to sending emails as a response to an alarm or for navigating through and generating historical trend data. The process variant "Web Visu" is not applicable.

In addition to the visualization, the following general restrictions are valid for the programming system:

File system (1 GB):

The overall size of the PLC program, log files, configuration files, etc. must fit into the file system.

The PLC browser delivers the amount of free disk space in response to the command "fds" (FreeDiscSpace).

The number of modules (1023/default):

The total size of the PLC program is determined, among other things, by the maximum number of modules. This value can be configured in the target system settings.

Computing power/processor time:

The 750-862 is based on a real-time operating system with pre-emptive multitasking. High-priority processes such as the PLC program will eliminate low-priority processes.

The PLC browser provides an overview of the real execution times for all CoDeSys tasks with the command "tsk".

If in a PLC program, operating system functions are used; e.g., for the handling of "sockets" or the "file system," these execution times are not taken into consideration covered by the command "tsk".

CTU counter:

The CTU counter operates in a value range of 0 to 32767.



Note

Note the maximum number of write cycles of the EEPROM!

Fieldbus couplers/controllers save some information such as IP addresses and IP parameters in the EEPROM to make it available after a restart. The memory cycles of an EEPROM are generally limited. Beyond a limit of approx. 1 million write cycles, memory can no longer be assured. A defective EEPROM only becomes apparent after a restart by software reset or power-on.

Due to a bad checksum, the fieldbus coupler/controller then always starts with the default parameters.

The following functions use the EEPROM:

- **WAGO-I/O-PRO**
 - **EthernetLib** SetNetworkConfig
 SetVariables
 - **MODBUS**
 - Register 0x1035 Time Offset
 - Register 0x100B Watchdog parameters
 - Register 0x1028 Network configuration
 - Register 0x1036 Daylight saving
 - Register 0x1037 Modbus response delay
 - Register 0x2035 PI parameter
 - Register 0x2043 Default configuration
 - **Parameter assignments**
 - **BootP** new parameters
 - **DHCP** new parameters
 - **WAGO MIB** write access
-

9.4 General Information about IEC Tasks

Please note the following information when programming your IEC tasks:



Note

Use different priorities for IEC tasks!

Give IEC tasks (in WAGO-I/O-PRO under the **Resources** tab > **Task Configuration**) different priorities to prevent an error from occurring when compiling the user program.

An interruption of IEC tasks is possible through tasks of higher priority!

An ongoing task may be interrupted by tasks with higher priorities. Execution of the task that has been interrupted is resumed only when there are no other higher-priority tasks to be executed.

Distortion of variables in overlapping areas of the process image!

If several IEC tasks utilize input or output variables with the same, or overlapping addresses in the process image, the values for the input or output variables may change while the IEC task is being executed!

Observe waiting periods of free-running tasks!

Running tasks are halted after each task cycle for half the time that the task proper requires (min. 1 ms). Execution of the task is then resumed.

Example: 1st Task 4 ms → Waiting period 2 ms
 2nd Task 2 ms → Waiting period 1 ms

The default task is created by default!

If no task has been defined in the task configuration, a running default task is created during translation. This task, called "Default task", is recognized by this name in the firmware, meaning that the name "Default task" cannot be used for other task names.

Observe the watchdog sensitivity for cyclic tasks!

The watchdog sensitivity indicates how many times the watchdog time is exceeded for an even to be triggered. You set the sensitivity in WAGO-I/O-PRO under Register **Resources > Task Configuration** for Cyclical Tasks. The values 1 and 0 are equivalent with regard to sensitivity. A sensitivity value of 0 or 1 results in the watchdog event being triggered when the watchdog time is exceeded on time. With a sensitivity value of 2, for instance, the watchdog time must be exceeded in two consecutive task cycles in order for the watchdog event to be triggered.

The following applies to cyclic tasks with watchdog activated:

Note



Reference for Watchdog Settings!

For each task created, a watchdog can be enabled that monitors the execution time of a task.

If the task runtime exceeds the specified watchdog time (e.g., $t\#200$ ms), then the watchdog event has occurred.

The runtime system stops the IEC program and reports an error.

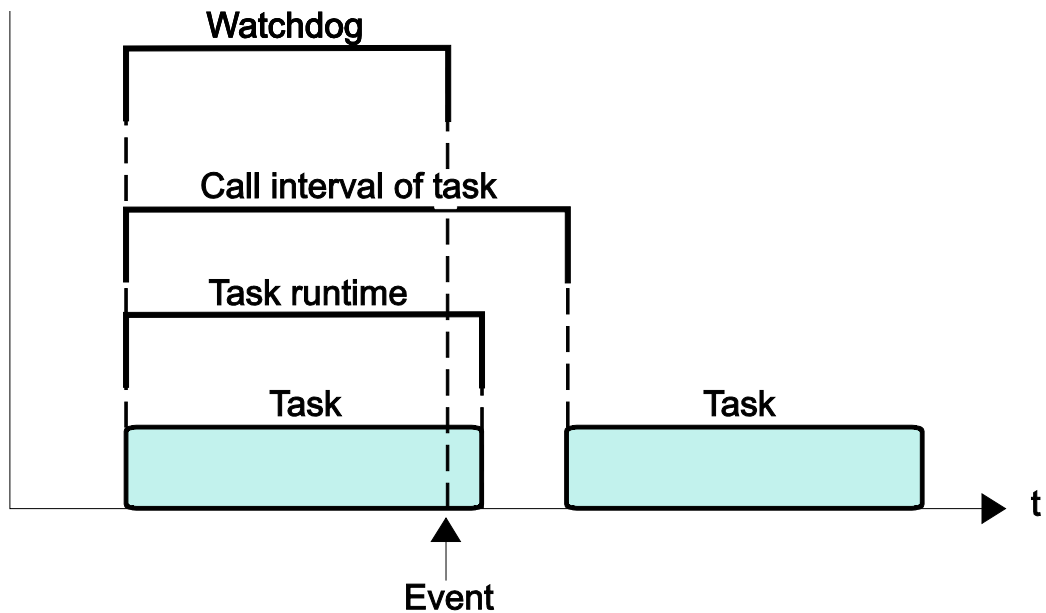


Figure 50: Watchdog Runtime is Less Than the Task Runtime

If the watchdog time set is greater than the call interval of the task, then the watchdog is restarted for each task call interval.

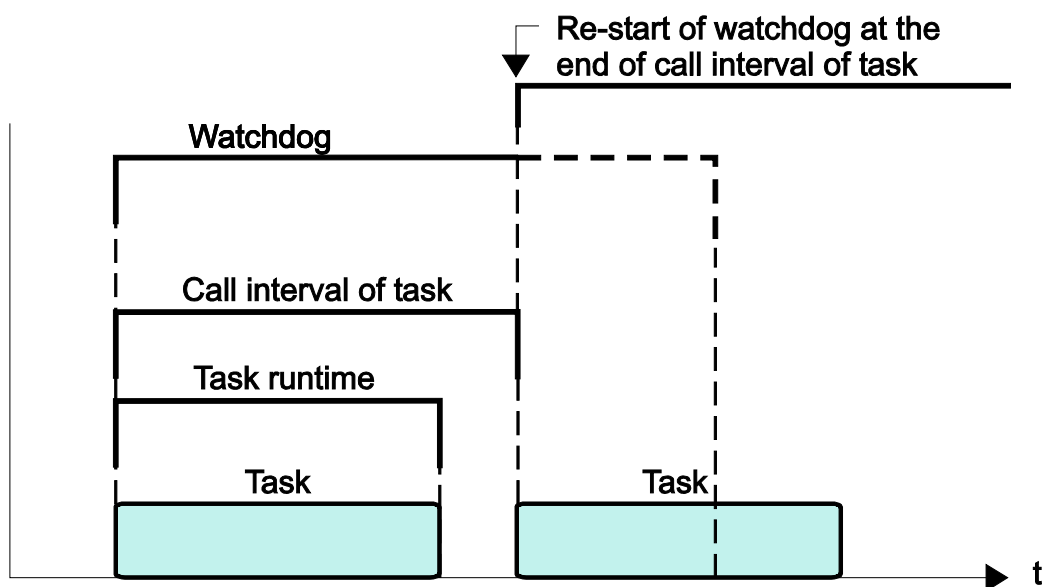


Figure 51: Watchdog Runtime Is Greater Than the Task Call Interval

To cyclic tasks applies:



Note

Cyclic tasks with > 30 min. call intervals not possible!

Cyclic tasks with a call interval of more than 30 minutes are not possible.

9.4.1 IEC Task Sequence

1. Determine the system time (tStart).
2. If no full local bus cycle has run since the last time the outputs were written:
→ Wait until the next local bus cycle is completed.
3. Reading of inputs and reading back of the outputs from the process image.
4. If the application program has been started:
→ Execute the program codes for this task.
5. Writing of the outputs to the process image.
6. Determine the system time (tEnd).
→ $tEnd - tStart = \text{runtime for the IEC task}$

9.4.2 Overview of Most Important Task Priorities

Table 41: Task Processing

Task	Importance of the Execution
Local bus task, fieldbus task	of priority before all others
Normal task	after the local bus and fieldbus tasks
PLC-Comm task	after the normal tasks
Background task	after the PLC-Comm tasks

Local bus task/fieldbus task (internal)

The local bus task matches the process image to the input/output data of the modules in defined cycles. The fieldbus tasks are performed as triggered by events and only require computing time when communication is performed via fieldbus.

Normal task (IEC task 1)

IEC tasks with this priority may be interrupted by the local bus tasks. Therefore, configuration for the connected modules and communication via fieldbus with the watchdog activated for the task call interval must be taken into account here.

PLC-Comm task (internal)

The PLC-Comm task is active when logged in and takes up communication with the CODESYS gateway.

Background task (IEC-Task priority 2 that can be set in CODESYS)

All internal tasks have a priority higher than that for the IEC background task. This task is therefore very well-suited for performing time-intensive and non-critical time tasks.

Note**Maximum number of IEC tasks!**

Note that the fieldbus controller supports a total of 30 tasks (task ID 0 ... 29), the two tasks (task ID 0 ... 1) are used by the runtime system in the Firmware. It will thus remain 28 tasks (task ID 2 ... 29) for your user program. The task ID of exceeding tasks than has task ID of an invalid handle (0xFFFFFFFF).

Information**Additional Information**

For a detailed description of using the software, refer to the manual for the "WAGO-I/O-PRO". This manual is located in the Internet under <http://www.wago.com>.

9.5 System Events

In place of a task, a system event can also call up a project module for processing.

The system events to be employed for this depend on the target system. These events consist of the list of supported standard system events for the control system and any other manufacturer-specific events which may have been added.

Possible events, for example: Stop, Start, Online change.

A complete list of all system events is provided at WAGO-I/O-PRO in tab **Resources > Task configuration > System events**.

9.5.1 Enabling/Disabling System Events

1. Open the register **resources > task configuration > system events** in WAGO-I/O-PRO (see the following Figure).
2. In order to call up a module via an event, activate the entries by setting a hatch mark in the respective control boxes.
3. Disable the control boxes by removing the hatch marks through a mouse click.

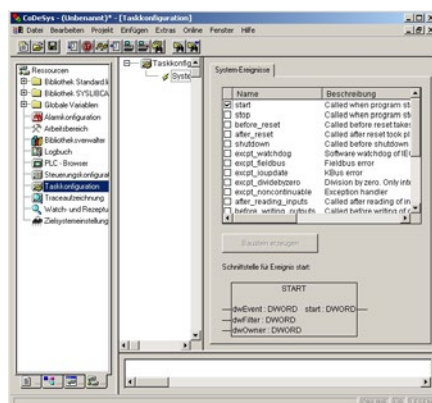


Figure 52: Enabling/Disabling System Events

Note



Only use global variables and functions (Fun)!

Note that the fetch of function blocks (FB) such as Timer modules, or the fetch of blocking functions such as file operations can lead to a malfunction of the system. Therefore use in system events exclusively Global variables and functions (Fun).



Information

Additional Information:

Allocation of the system events to the specific modules to be called up is clarified in the manual for the programming tool WAGO-I/O-PRO in the Internet under <http://www.wago.com>.

9.6 Transfer the IEC Program to the Fieldbus Controller

The program for the created IEC-61131-3 application can be transferred from the PC to the fieldbus controller in different ways, e.g. (see following sections):

- Direct transfer via serial port
- Transfer via fieldbus

Suitable communication drivers are required for transfer; these can be loaded and configured using *WAGO-I/O-PRO*.

Note



Check/adjust communications parameters of the driver

When selecting the desired driver, watch for the proper settings and adjustments of the communications parameters (see the following description).

Note



Transmission only on matching target!

Note that a boot project can generally be transferred only to fieldbus controllers whose item number has been set as target during compilation.

Note



“Reset” and “Start” are required to set the physical outputs!

The initialization values for the physical outputs are not set immediately after downloading. Select **Online > Reset** and subsequently **Online > Start** in the menu bar of *WAGO I/O-PRO* to set the values.

Note



Stop application before generating large boot projects!

Stop the *WAGO-I/O-PRO* application via **Online > Stop** before generating a very large boot project, since this may otherwise cause stopping the local bus. You can restart the application after creating the boot project.

Note



Handling persistent data affects the program start!

Depending on the variable type, the number and sizes of the persistent data and their combination, such as in function modules, handling with persistent data can delay the program start by an extended initialization phase.



Information

Additional Information

The following description is used for fast access. For details on installing missing communication drivers and using the software, refer to “WAGO-I/O-PRO” available in the Internet under <http://www.wago.com>.

9.6.1 Transfer via Serial Service Port



Note

Watch the position of the mode selector switch when accessing the controller!

Prerequisite for the access to the controller is that the operating mode switch of the controller, which is located behind the cover of the controller next to the service interface, is in the center or top position.

Use the WAGO communication cable to set up a physical connection via serial service port. This cable is included in the scope of supply for the IEC-61131-3 programming tool (order no. 759-333), or can be procured as an accessory item under order no. 750-920.

NOTICE

Do not connect Communication Cable when energized!

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

1. Switch off the controllers power supply.
2. Check that the controller mode selector switch is set to the center or top position.
If this is not the case, move the mode selector switch to the center or top position.
3. Use the WAGO communication cable to connect a COM port of your PC to the controller communication port.
4. Switch on the controllers power supply.

A communication driver is required for serial data transfer. This driver and its parameters must be entered in the WAGO-I/O-PRO in the dialog window "Communication parameters".

5. Start the WAGO-I/O-PRO software **under Start > Programs > WAGO Software > WAGO-I/O-PRO.**
6. In the menu **Online** select the item **Communication parameters.**

The dialog window "Communication parameters" then appears. The channels of the currently connected gateway servers are shown on the left side of the dialogue and the already installed communications drivers are shown below. This window is empty in its default settings.

7. Click **New** to set up a link and then enter a name, such as RS-232 Connection.

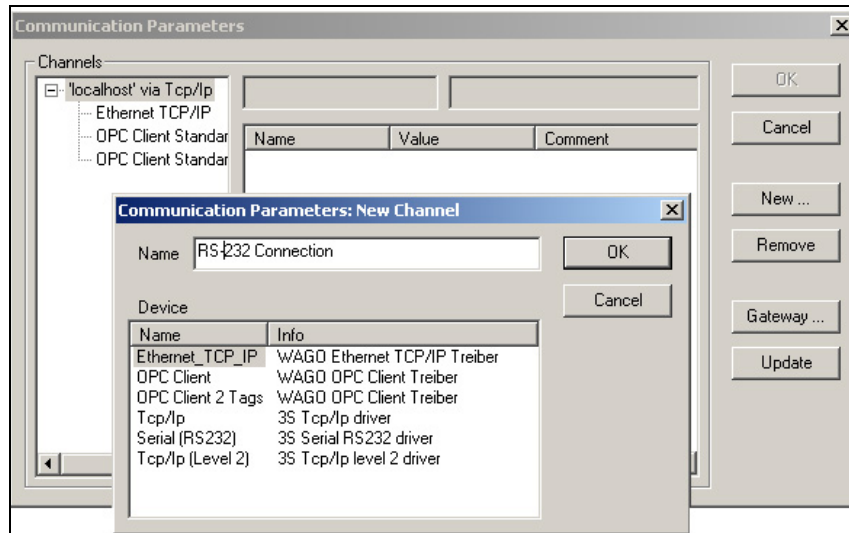


Figure 53: Dialog Window "Communication Parameters"

- In the selection window, mark the required driver in the right side of the window, Serial (RS-232) 3S Serial RS-232 driver, to configure the serial link between the PC and the controller.

The following properties for the serial port are shown in the center dialog window:

- Port: COM1
- Baud rate: 19200
- Parity: Even
- Stop-bits: 1
- Motorola byte order: No
- Flow Control: Off

- If necessary, change the entries according to the above values by clicking on the respective value and editing it.
- Confirm these settings by clicking **OK**.

The RS-232 port is now configured for transferring the application.

Note



Log in with the administrator password to program the controller!

If you have activated password protection „Enable CODESYS port authentication“ on the “Administration” page of the WBM, you have to log into WAGO-I/O-PRO in the menu **Online** > **Log In** to obtain programming access to the controller (default password “wago”).



Figure 54: Logging in for Programming Access

11. Under **Online**, click the menu item **Login** to log in to the fieldbus controller

The WAGO-I/O-PRO Server is active during online operation. The communication parameters can not be called up during this time.

Depending on whether a program is already present in the fieldbus controller, a window will appear asking whether a (new) program should be loaded.

12. Respond with **Yes** to load the current program.

13. In menu **Online**, click on **Create Boot project**.

Your compiled project will also be executed by this method, if you restart the fieldbus controller or if there is a power failure.

14. Once the program has been loaded, start program processing in the menu **Online**, menu item **Start**.

This command starts the processing of your program in the control system or in the simulation.

“ONLINE” and “RUNNING” will then appear at the right of the status bar.

15. To terminate only the online operation and not the program processing, click the menu item **Log off** in the menu **Online**.

The program will continue to be processed afterwards.

16. However, to terminate program processing, first click the menu item **Stop** in the menu **Online** and then click the menu item **Log off** in the menu **Online**.

This terminates program processing and the online operation.

9.6.2 Transfer via Fieldbus and ETHERNET

The physical link between the PC and the controller is set up via fieldbus. An appropriate communication driver is required for data transfer. The driver and its parameters must be entered in the WAGO-I/O-PRO in the dialog window "Communication parameters".

Note



Controller needs IP address for access!

The controller must have an IP address before it can be accessed. The operating mode switch, which is located behind the cover of the controller next to the service interface, must be in the center or top position.

1. Start the WAGO-I/O-PRO software under **Start / Programs / WAGO-I/O-PRO** or by clicking the program icon on the desktop).
2. In the menu **Online** select the item **Communication parameters**.

The dialog window "Communication parameters" then appears. The channels of the currently connected gateway servers are shown on the left side of the dialogue and the already installed communications drivers are shown below. This window is empty in its default settings.

3. Click **New** to set up a connection and then specify a name, e.g. TcpIp connection.
4. Mark the required TCP/IP driver in the right side of the dialog window to configure the link between the PC and the controller via ETHERNET. Use the new driver version "Tcp/Ip" (3S Tcp/Ip driver).

The following standard entries are shown in the center dialog window:

- Address: localhost (IP address of your controller)
- Port number: 2455
- Motorola byteorder: No

5. Change any entries as you may require by double-clicking on the respective value and edit it.
E.g. double click on "localhost" after the entry "Address" and then enter for example "192.168.1.123" for the IP address.
6. Confirm with **OK**.

You have now configured the TCP/IP link with the communication parameters/drivers.

7. Under **Online**, click the menu item **Login** to log in to the fieldbus controller

The WAGO-I/O-PRO Server is active during online operation. The

communication parameters can not be called up during this time.

Depending on whether a program is already present in the fieldbus controller, a window will appear asking whether a (new) program should be loaded.

8. Respond with **Yes** to load the current program.
9. In menu **Online**, click on **Create Boot project**.

Your compiled project will also be executed by this method, if you restart the fieldbus controller or if there is a power failure.

10. Once the program has been loaded, start program processing in the menu **Online**, menu item **Start**.

This command starts the processing of your program in the control system or in the simulation.

“ONLINE” and “RUNNING” will then appear at the right of the status bar.

11. To terminate only the online operation and not the program processing, click the menu item **Log off** in the menu **Online**.

The program will continue to be processed afterwards.

12. However, to terminate program processing, first click the menu item **Stop** in the menu **Online** and then click the menu item **Log off** in the menu **Online**.

This terminates program processing and the online operation.

10 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 WBM pages saved internally provide current information about the configuration and status of the device.

The configuration of the device can be changed via the special configuration pages. Authentication is required for this.

Also HTML pages created by yourself can be save via the implemented file system.

Note



After changes to the configuration, a restart may be necessary!

In order for changed configuration settings to take effect, it may be necessary for you to perform a system restart after your changes. This is then indicated in the description text on the respective WBM pages.

10.1 WBM User Groups

For authentication, 3 different password-protected user authorization groups are provided as standard:

Table 42: 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 "Administration"> "Security Settings"> "Enable CODESYS port authentication")
user	user	Read/write access to all WBM pages, but no write authorization on WBM-page "Administration"
guest	guest	Read only

10.2 Open WBM

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.

The first time a configuration page is called, 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. Click **[SUBMIT]** to confirm your changes or click **[UNDO]** to discard the changes.

At the first confirmation via the **[SUBMIT]** button, a login dialog appears again. Proceed as described under point 5.

8. To apply the settings, you may have to reboot afterwards if this is indicated in the description text on the respective WBM page.
You restart the system using WBM page "Administration", button **[SOFTWARE RESET]**.

10.3 WBM Pages

You can access the available WBM pages via the links given in the navigation bar on the left side.

The integrated configuration pages are following described.

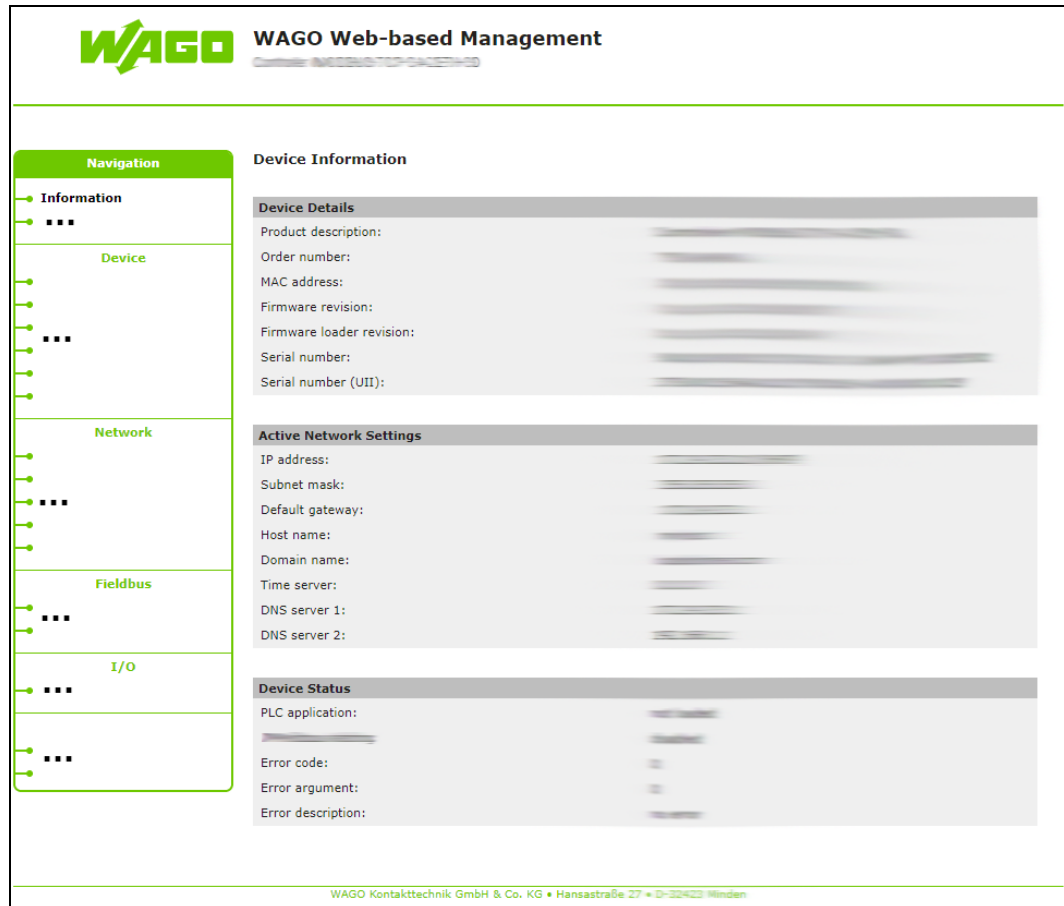


Figure 55: Example for a WBM page structure (simplified representation)

10.4 Information

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

Table 43: WBM Page “Information”

Device details			
Entry	Default	Value (example)	Description
Product description	Controller Modbus TCP; Generation 4; 2 x ETHERNET; ECO		Produkt description
Order number	750-862		Order number
Mac address	0030DEXXXXXX	0030DE000006	Hardware MAC address
Firmware revision	kk.ff.bb(rr)	01.01.14(01)	Firmware revision number (kk = compatibility, ff = functionality, bb = bugfix, rr = revision)
Firmware loader revision	kk.ff.bb(rr)	01.03.01(03)	Firmware loader revision number (kk = compatibility, ff = functionality, bb = bugfix, rr = revision)
Serial number	___	“ ”	Serial number of device (manufacturer-specific identification of device)
Serial number (UII)	___	“ ”	„Unique Item Identifier“ (world wide unique identification of device)

Active Network Settings			
Entry	Default	Value (example)	Description
IP address	0.0.0.0	172.29.233.123	IP address, Type of IP address assignment
Subnet mask	255.255.255.0	255.0.0.0	Subnet mask
Default gateway	0.0.0.0	192.168.2.1	Gateway
Host name	0030DEXXXXXX	0030DE000000	Host name
Domain name	___	___	Domain name (not assigned here)
Time server	0.0.0.0	0.0.0.0	Address of Time server
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
PLC application	not loaded	not loaded	Display if a PLC application is loaded.
State Modbus Watchdog	disabled	enabled [running]	Status of Modbus Watchdog
Error Code	0	10	Error code
Error Argument	0	5	Error argument
Error Description	no error	Mismatch in CODESYS IO-configuration	Error description

10.5 Administration

Use the “Administration” WBM page to set configuration options for basic administration purposes, such as boot behavior, authentication, and SSL certificate.

These configuration options are stored in non-volatile memory when the **[SUBMIT]** button is pressed. Changes to the configuration options take effect after the next power-on cycle or software reset.

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.

Table 44: WBM Page “Administration”

Security Settings		
Entry	Default	Description
Enable web-server authentication	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Enable password protection to access the Web interface
		<input type="checkbox"/> Disable password protection to access the Web interface
Enable CODESYS port authentication	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Enable password protection for access via the CODESYS service protocol and the runtime application. Note: Required for access with WAGOupload via the serial port.
		<input type="checkbox"/> Disable password protection for access via the CODESYS service protocol and the runtime application.

Enable CODESYS services without login	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Enables access to monitoring services without prior login (and password request).
		<input type="checkbox"/> Enables access to monitoring services only with prior login including a password request.
WebVisu allow random memory access	<input type="checkbox"/>	<p>Allows random access to application variables through the web visualization. Random access is used, among other things, to monitor complex application variables.</p> <div style="background-color: #0070C0; color: white; padding: 5px; text-align: center; font-weight: bold; font-size: 1.2em;">NOTICE</div> <p>Cyber attacks from outside possible! Note that activating this option makes the system vulnerable for cyber attacks from outside!</p>
		<input type="checkbox"/> Random access to application variables through the web visualization is denied.
TLS compatibility version for web-server	1.2	Specifies the TLS version used for secure communication with the web server (HTTPS).

User Settings		
Entry	Default	Description
User	guest	Select user permissions according to the default user group (→ see Chapter “WBM User Groups”).
Password	-	Enter desired password (max. 32 characters inclusive special characters).
Confirm Password	-	Enter desired password again to confirm.

*) The following default groups exist:

User: admin	Password: wago
User: user	Password: user
User: guest	Password: guest

SSL Certificates			
Entry	Button	Status (Example)	Description
Server certificate incl. private key	[UPLOAD]	NO FILE	Select and load the file with the server certificate and user key for secure Web server communication (HTTPS protocol) onto the device. The server certificate must be in *.pem, *.cer or *.crt format and contain the private key of the device.
Root certificate (CA)	[UPLOAD]	NO FILE	Select and load the file with the SSL root certificate onto the device. The root certificate must be in *.pem, *.cer or *.crt format.
Upload and installation status	-	Ready	Download and install status indicator
-	[INSTALL]	-	Installs the SSL server and/or root certificate previously loaded on the device and replaces the existing SSL certificates.
-	[DOWNLOAD]	-	Downloads the SSL root certificate stored in the device to the local PC.

Button	Description
[SOFTWARE RESET]	Restart the software.
[RESTORE SETTINGS]	Reset the device to the delivery status. <div style="background-color: #0070C0; color: white; padding: 2px; text-align: center; font-weight: bold; font-size: 1.2em;">NOTICE</div> Data will be deleted! All user settings and user-specific files and an existing boot application (only for controllers) are deleted.

10.6 System Status

On the WBM "System Status" page, you can collect status information about the system in log files, save it and make settings for it.

These configuration options are saved in non-volatile memory when the **[SUBMIT]** button is pressed.

Changes to the configuration options take effect after the next power-up cycle or software reset.

You can use the icons to customize the view of the sections with the log entries:

- **[+]** Expand
- **[-]** Minimize
- **[↻]** Update

NOTICE

Rapid aging of the internal storage medium!

Note, when the log output is activated on the internal file system, excessive log output leads to faster aging of the storage medium.

In addition, by lowering the log level this is also favored.

Therefore You should only use the log output in a targeted manner

(troubleshooting / support case) or use external / exchangeable storage media (if supported by the device).

Table 45: WBM Page "System Status"

Device details		
Entry	Default	Description

Log storage threshold [%]	80	(0 ... 100%, 0 = disable) Defines the limit value for the fill level of the log memory in%.
Network log level	INFO	(INFO, WARNING, ERROR, DEBUG) Specifies (together with the "File log level" option) the threshold for the log outputs on the network. This setting affects the log messages that are sent to the syslog server.
File log level	INFO	(INFO, WARNING, ERROR, DEBUG) Specifies (together with the "Network log level" option) the threshold for the log outputs for storage on the file system. This setting affects the log messages that are stored in log files.

Button	Description
[DOWNLOAD]	Downloads the saved log files as a single merged file (CSV format).
[DELETE]	Deletes the log files stored on the device. A possibly existing warning regarding the filling level of the log memory is hereby reset (blink code).

System Log			
Entry	Default	Value (example)	Description
Time (UTC); Severity; Facility; Module; Description	-	20210322T073715; notice; user; PARAM; Configuration changed. ID = 3	Online logbook, shows the most recent log entries in chronologically descending order.

System Load			
Entry	Default	Value (example)	Description
Current CPU load	___%	17,3%	Shows the current CPU utilization in %.

System Memory			
Entry	Default	Value (example)	Description
Pool Name; Pool Size; Memory Available; Tasks Waiting; Task Name	-	SYSTEMEM; 33554432 31488620; 0; -	Shows the current memory usage. The display shows the internal status of the memory pools in RAM.

System Tasks			
Entry	Default	Value (example)	Description
Name; Priority; Preemptable; Time Slice; Stack Size; Status	-	DevDisc; 3; no; 0; 10240; suspend (event)	Displays the current task configuration. The display shows the internal status of the system tasks.

10.7 Backup & Restore

On the “Backup & Restore” WBM page, you can back up and restore device data and settings.

Please consider the following remarks when using the backup and restore service:

- Ensure that any file transfer connection (FTP or SFTP) is closed, the PLC application is stopped and all engineering tools are disconnected.
- Is necessary, the restore service automatically performs a software reset in order to adopt the restored configuration.
- The upload and download service is limited to the totally available memory of the device. If the upload and download service fails, please use the FTP or SFTP protocol instead.

The size information for the backup image file is specified in units of 1 kB = 1024 Byte.

Table 46: WBM Page „Backup & Restore“

Service Control / Status		
Entry	Button	Description
Backup device settings to internal disk	[BACKUP]	Creates a full backup image of the fieldbus controller on the internal disk. The current status and progress is displayed under "Status".
Restore all device settings from internal disk	[RESTORE]	Restores all or part of a previously created backup image. During recovery, the options selected under "Backup & Restore Settings" are taken into account. The current status and progress is displayed under "Status".
Save a previously created backup image file	[DOWNLOAD]	Downloads a previously created backup image to the local PC. The name of the downloaded file is structured according to the following scheme: backup_ <ARTICLE> _ <VERSION> _ <INDEX> _ <MAC> .img <ARTICLE> = article number <VERSION> = firmware version <INDEX> = release index <MAC> = The last 3 digits of the MAC address (00-30-DE-xx-xx-xx) Example: "backup_075008xx_010103_03_123456.img"
Upload a backup image file	[UPLOAD]	Selection of a backup image (*.img) saved in the local file system (PC) and load it onto the device.

Entry	Value	Description
Status	READY	Function ready for execution.
	CHECK	Function is currently being executed. Required data is collected and checked.
	RUN (x%)	The function is currently being executed and is x% complete.
	DONE (100%)	Function successfully completed.
	RESET...	The function is completed and the system is restarted automatically.
	INVALID STATE	Function cannot be executed because the application is running or an active FTP connection to the fieldbus controller exists.
	INVALID VERSION	The selected backup image is incompatible.
	NO IMAGE	There is no backup image on the internal disk.
	IMAGE BROKEN	The selected backup image is defect.
	NO DISK	The internal disk is not available.
	NO DISK SPACE	There is sufficient storage space on the internal disk.
	NO DISK ACCESS	The internal disk is not writeable.
	ERROR(x)	Internal error x.

Backup & Restore Settings		
Entry	Default value	Description

Restore contents:	Auswahl der Inhalte für die Wiederherstellung.	
Ethernet settings (embedded switch, MAC filter, bandwidth limitation, etc.)	<input type="checkbox"/>	<input checked="" type="checkbox"/> The settings for the network interface of the fieldbus controller are restored.
		<input type="checkbox"/> The settings for the network interface of the fieldbus controller are not restored.
Network configuration (IP address, host/domain name, DNS server, etc.)	<input type="checkbox"/>	<input checked="" type="checkbox"/> The settings for the IP-based network parameters are restored.
		<input type="checkbox"/> The settings for the IP-based network parameters are not restored.
Device configuration (password settings, clock/time-zone, local bus, etc.)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> The settings for the general device configuration are restored.
		<input type="checkbox"/> The general device configuration settings are not restored.
Application protocols (field bus, SNMP, SNTIP, etc.)	<input type="checkbox"/>	<input checked="" type="checkbox"/> The settings for the TCP / IP-based application protocols are restored.
		<input type="checkbox"/> The settings for the TCP / IP-based application protocols are not restored.
PLC (settings, folders, boot project, web-visu, etc.)	<input type="checkbox"/>	<input checked="" type="checkbox"/> The settings for the runtime system and the boot project are restored.
		<input type="checkbox"/> The settings for the runtime system and the boot project are not restored.
SSL (device and root certificate, private key, etc.)	<input type="checkbox"/>	<input checked="" type="checkbox"/> The settings for the SSL connections (devices/root certificate and private key) are restored.
		<input type="checkbox"/> The settings for the SSL connections (devices/root certificate and private key) are not restored.
Non-volatile memory (merker/retain memory)	<input type="checkbox"/>	<input checked="" type="checkbox"/> The content of the NVRAM (flag / retain variable) is restored.
		<input type="checkbox"/> The content of the NVRAM (flag / retain variable) is not restored.
File system (internal file system contents)	<input type="checkbox"/>	<input checked="" type="checkbox"/> The content of the internal file system is restored.
		<input type="checkbox"/> The content of the internal file system is not restored.

10.8 Clock

On the WBM "Clock" page, you make settings for the internal system time. Enter the current time and date here and select a time zone deviation, 12h or 24h display and automatic daylight saving time as required.

At start-up, the system time has to be synchronized with the computer's current time.

Note



System time will be reset when the controller is de-energized!

The head station 750-862 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. and has to synchronize with the computer's current time.

Note



Use a WAGO RTC module for time synchronization!!

You can use a WAGO 750-640 RTC Module for your node to utilize the actual encoded time (Real-time – RTC) in your higher-level control system.

Table 47: WBM Page „Clock“

Clock Settings			
Entry	Default	Value (example)	Description
Device local time (HH:MM:SS)	00:00:00	08:30:38	Set current time
Device local date (YYYY-MM-DD)	2000-01-01	2018-07-19	Set current date
Device time zone (+/- HH:MM)	0:00	+1:00	Set time zone offset from the Coordinated Universal Time (UTC)
Time display mode	<input checked="" type="radio"/> 24h		<input checked="" type="radio"/> Enable 24-hour display
			<input type="radio"/> Disable 24-hour display
	<input type="radio"/> 12h (AM/PM)		<input checked="" type="radio"/> Enable 12-hour display
			<input type="radio"/> Disable 12-hour display
Automatic daylight saving time (DST)	<input checked="" type="radio"/> off	<input type="radio"/>	<input checked="" type="radio"/> Disable manual summer/winter time
			<input type="radio"/> Enable manual summer/winter time
	<input type="radio"/> EU	<input checked="" type="radio"/>	<input checked="" type="radio"/> Enable automatic Daylight Saving Time (EU) (last Sunday in March, clocks are advanced from 02:00 AM to 03:00 AM / last Sunday in October, clocks are set back from 03:00 AM to 02:00 AM)
			<input type="radio"/> Disable automatic Daylight Saving Time (EU)
	<input type="radio"/> US	<input type="radio"/>	<input checked="" type="radio"/> Enable automatic Daylight Saving Time (US) (second Sunday in March, clocks are advanced from 02:00 AM to 03:00 AM / first Sunday in November, clocks are set back from 02:00 AM to 01:00 AM)
			<input type="radio"/> Disable automatic Daylight Saving Time (US)
	<input type="radio"/> AU	<input type="radio"/>	<input checked="" type="radio"/> Enable automatic Daylight Saving Time (AU) (first Sunday in October, clocks are advanced from 02:00 AM to 03:00 AM / first Sunday in April, clocks are set back from 03:00 AM to 02:00 AM)
			<input type="radio"/> Disable automatic Daylight Saving Time (AU)
DST current status	not active	not active	Status display for the current DST status

10.9 Miscellaneous

On the Miscellaneous WBM page, you can set configuration options for various features and compatibility options.

These configuration options are stored in non-volatile memory when the **[SUBMIT]** button is pressed. Changes to the configuration options take effect after the next power-on cycle or software reset.

Table 48: WBM Page “Miscellaneous”

Global Settings		
Entry	Default	Description
Autoreset on fatal error	<input type="checkbox"/>	<input checked="" type="checkbox"/> Enables an automatic software reset to be conducted when a system error occurs
		<input type="checkbox"/> Disables an automatic software reset to be conducted when a system error occurs
BootP request before static IP	<input type="checkbox"/>	<input checked="" type="checkbox"/> 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. This process can take a few minutes. With the setting "DHCP" this function has no effect.
		<input type="checkbox"/> 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 local bus interval	<input type="checkbox"/>	<input checked="" type="checkbox"/> Enables a fixed sampling interval of the local bus and statically sets the pause time to 14 ms. As a result, possibly the sampling interval of the local bus is extended and more computing power is available for the PLC application.
		<input type="checkbox"/> Enables the dynamic sampling interval of the local bus (default). The pause time between two local bus cycles is dynamically adjusted. This shortens the sampling interval of the local bus and less computing power is available for the PLC application.
Local bus extension installed	<input type="checkbox"/>	<input checked="" type="checkbox"/> Indicates, that the bus extension (750-627/-628) is installed.
		<input type="checkbox"/> Indicates, that no bus extension is installed.

10.10 Storage Media

Information about the available storage devices and active drives which are currently mounted within the file system of the device is given on the “Storage Media” WBM page.

This page will be refreshed every 5 s.

This size information for the storage devices listed below are specified in units of 1 kB with 1 kB = 1024 Byte.

Table 49: WBM page "Storage Media"

Local Disks		
Entry	Value (Example)	Description
Drive Letter	A	Directory
Total Size [kB]	1050184 kB	Total size of the file system
Used Size [kB]	295560 kB	Used memory capacity
Free Size [kB]	754624 kB	Free memory capacity
File System	FAT	File system (File Allocation Table)

10.11 Update

Use the "Update" WBM page to update the firmware of the device. To do this, the associated firmware image is first selected from the PC's local file system and downloaded to the device. Afterwards, the update will be executed and the device will be restarted automatically.

After the firmware update, the WBM pages will also be updated, self-created HTML pages or settings will be remained save.

Note



Stop fieldbus application and finish FTP connections before the update !

Please ensure, that the superordinate fieldbus application has been stopped and possibly existing FTP connections has been finished before starting the update process. When the software reset is beeing executed, the connection to the web-based management will be lost and the web-page has to be reloaded.

Table 50: WBM Page "Update"

Firmware Selection / Upload			
Entry	Button	Value (example)	Description
Firmware image	[UPLOAD]	OK	Use this button to select the firmware image file (*.bin) on your local file system (PC) and upload this file onto the device.
Update Status	-	Verification of firmware image is done	Status display for the update.

10.12 Ethernet

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

Table 51: WBM Page „Ethernet“

PHY Settings			
Entry	Default value	Description	
Enable port	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Enable Port X1 or Port X2
		<input type="checkbox"/>	Disable Port X1 or Port X2
Enable auto-negotiation	<input checked="" type="radio"/>	<input checked="" type="radio"/>	Enable Autonegotiation for Port X1 or Port X2. Automatically handling the best possible transmission mode and baud rate with the communication partner.
		<input type="radio"/>	Enable Autonegotiation for Port X1 or Port X2.
10 MBit Half Duplex	<input type="radio"/>	Use a fixed transmission mode and baud rate for Port X1 or Port X2.	
10 MBit Full Duplex	<input type="radio"/>		
100 MBit Half Duplex	<input type="radio"/>		
100 MBit Full Duplex	<input type="radio"/>		
Enable Auto-MDI/MDI-X	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Enable Auto-MDI/MDI-X for Port X1 or Port X2
		<input type="checkbox"/>	Disable Auto-MDI/MDI-X for Port X1 or Port X2
MDI	<input type="radio"/>	<input checked="" type="radio"/>	Transceiver of Port X1 or Port X2 sends on Tx wire pair.
MDI-X	<input type="radio"/>	<input checked="" type="radio"/>	Port X1 or Port X2 sends an Rx wire pair.

MAC Address Filter Settings		
Entry	Default value	Description
Enable filter	<input type="checkbox"/>	<input checked="" type="checkbox"/> Activate MAC address filter. Depending on the operating mode of the MAC address filter (whitelist / blacklist), the subsequently entered MAC addresses are blocked or permitted.
		<input type="checkbox"/> Deactivate MAC address filter.
Filter mode	Whitelist <input checked="" type="radio"/>	<input checked="" type="radio"/> Chose Whitelist. Only the following registered MAC addresses have network access to the fieldbus coupler/controller, others are blocked
	Blacklist <input type="radio"/>	<input checked="" type="radio"/> Chose Blacklist. Only the following registered MAC addresses are blocked, others have network access to the fieldbus coupler/controller.
Allow WAGO devices	<input type="checkbox"/>	<input checked="" type="checkbox"/> Activate MAC address filter. The WAGO devices with the MAC address 00:30:EN:XX:XX:XX always have network access to the fieldbus coupler/controller, independent of the other settings of the MAC address filter.
		<input type="checkbox"/> Deactivate MAC address filter. Only devices whose MAC address is entered in the list have network access to the fieldbus coupler / controller. The settings of the MAC address filter apply.
MAC address 1	00:00:00:00:00:00	Filter for the first MAC address (hexadecimal).
MAC address 2	00:00:00:00:00:00	Filter for the second MAC address (hexadecimal).
MAC address 3	00:00:00:00:00:00	Filter for the third MAC address (hexadecimal).
MAC address 4	00:00:00:00:00:00	Filter for the fourth MAC address (hexadecimal).
MAC address 5	00:00:00:00:00:00	Filter for the fifth MAC address (hexadecimal).

Switch Settings			
Entry	Default value		Description
Enable fast aging	<input type="checkbox"/>		<input checked="" type="checkbox"/> 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.
			<input type="checkbox"/> Disable "Fast Aging". The time to discard the cache entries is five minutes.
Enable port mirroring	<input type="checkbox"/>		<input checked="" type="checkbox"/> Enable port mirroring Port Mirroring is used for network diagnostics. Packets are mirrored from one port (mirror port) to another (sniffer port).
			<input type="checkbox"/> Disable port mirroring
Ethernet MTU	1500		Maximum packet size of a protocol, which can be transferred without fragmentation ("Maximum Transmission Unit" - MTU).
	Port		
	1	2	internal
Input data rate limit	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 data rate limit	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.
Enable broadcast storm protection	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/> Activate broadcast storm protection. The maximum number of incoming broadcast telegrams is limited and packets affected by the limitation are discarded.
			<input type="checkbox"/> Broadcast storm protection disabled.
Sniffer Port	<input type="radio"/>	<input checked="" type="radio"/>	
Mirror Port	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>

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.

10.13 Protocols

Use the “Protocols” WBM page to enable or disable ports for the services available.

Note




Close any ports and services that you do not need!

Unauthorized persons may gain access to your automation system through open ports.

To reduce the risk of cyber attacks and, thus, enhance your cyber security, close all ports and services in the control components (in particular Port 6626 for WAGO I/O-CHECK, Port 2455 for CODESYS 2 and Port 11740 for e!COCKPIT) not required by your application.

Only open ports and services during commissioning and/or configuration.

Table 52: WBM page „Protocols“

Protocol Settings		
Entry	Default Value	Description
FTP (Port 21)	<input type="checkbox"/>	<input checked="" type="checkbox"/> Enable "File Transfer Protocol"
		<input type="checkbox"/> Disable "File Transfer Protocol"
SFTP (Port 22)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Enable "SSH File Transfer Protocol"
		<input type="checkbox"/> Disable "SSH File Transfer Protocol"
HTTP (Port __)	80	Port number setting for HTTP (1 ... 65535)
	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Disable "Hypertext Transfer Protocol"
HTTPS (Port 443)	<input type="checkbox"/>	<input type="checkbox"/> Enable "Hypertext Transfer Protocol over SSL-encrypted connection"
		<input checked="" type="checkbox"/> Disable "Hypertext Transfer Protocol over SSL-encrypted connection"
		Operate WebVisu via HTTPS! You can operate WebVisu via HTTPS protocol, provided HTTPS is activated and you use a WAGO-I/O-PRO version >= .42.
SNTP (Port 123)	<input type="checkbox"/>	<input checked="" type="checkbox"/> Enable "Simple Network Time Protocol"
		<input type="checkbox"/> Disable "Simple Network Time Protocol"
SNMP (Port 161, 162)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Enable "Simple Network Management Protocol"
		<input type="checkbox"/> Disable "Simple Network Management Protocol"
Modbus UDP (Port 502)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Enable Modbus-UDP protocol
		<input type="checkbox"/> Disable Modbus-UDP protocol
Modbus TCP (Port 502)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Enable Modbus-TCP protocol
		<input type="checkbox"/> Disable Modbus-TCP protocol
WAGO service protocol (Port 6626)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Enable WAGO services
		<input type="checkbox"/> Disable WAGO services
Syslog UDP (Port 514)	<input type="checkbox"/>	<input checked="" type="checkbox"/> Enable Syslog protocol (via UDP)
		<input type="checkbox"/> Disable Syslog protocol (via UDP)
CODESYS (Port 2455)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Activating CODESYS
		<input type="checkbox"/> Deactivating CODESYS

10.14 SNMP

On the HTML pages „SNMP“, you can perform the settings for the Simple Network Management Protocol (SNMP v1/v2c and v3).

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 controller supports SNMP in versions 1, 2c and 3.

The SNMP of the ETHERNET TCP/IP controller 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 “Protocols”, so that the fieldbus coupler/controller 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 html 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 controller.

10.14.1 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 53: WBM Page "SNMP v1/v2"

SNMP Settings		
Entry	Value (Default)	Description
Description	Controller Modbus TCP; G4; 2ETH; ECO 750-862	Device description (sysDescription)
Physical location	LOCAL	Location of device (sysLocation)
Contact address	support@wago.com	E-mail contact address (sysContact)

SNMP v1/v2c Manager Settings		
Entry	Default value	Description
Enable protocol	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Activating SNMP Version 1/2c
		<input type="checkbox"/> Deactivating SNMP-Version 1/2c
Local community name	public	used community name

SNMP v1/v2c Trap Receiver 1 Settings		
Entry	Default value	Description
Trap receiver	0.0.0.0	IP address of 1. used SNMP manager
Community name	public	1. Community name of the network community used
Trap version	v1 <input checked="" type="radio"/>	v1 <input checked="" type="radio"/> v2 <input type="radio"/> Activating Traps Version 1
	v2 <input type="radio"/>	v1 <input type="radio"/> v2 <input checked="" type="radio"/> Activating Traps Version 2

SNMP v1/v2c Trap Receiver 2 Settings		
Entry	Default value	Description
Trap receiver	0.0.0.0	IP address of 2. used SNMP manager
Community name	public	2. Community name of the network community used
Trap version	v1 <input checked="" type="radio"/>	v1 <input checked="" type="radio"/> v2 <input type="radio"/> Activating Traps Version 1
	v2 <input type="radio"/>	v1 <input type="radio"/> v2 <input checked="" type="radio"/> Activating Traps Version 2

10.14.2 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 controller.

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 SNMP users can be defined and activated (User 1 and User 2).

Table 54: WBM Page "SNMP V3"

SNMP v3 User 1 / 2 Settings		
Entry	Value (Example)	Description
Enable user	activate <input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Activating user 1 or 2
		<input type="checkbox"/> Deactivating user 1 or 2
Authentication type	None <input type="radio"/>	None <input checked="" type="radio"/> MD5 <input type="radio"/> SHA1 <input type="radio"/> No encryption of the authentication
	MD5 <input checked="" type="radio"/>	None <input type="radio"/> MD5 <input checked="" type="radio"/> SHA1 <input type="radio"/> Encryption of the authentication with MD5
	SHA1 <input type="radio"/>	None <input type="radio"/> MD5 <input type="radio"/> SHA1 <input checked="" type="radio"/> Encryption of the authentication with SHA1
Authentication name	Security Name	Enter the name, if the "Authentication type" MD5 or SHA1 has been selected
Authentication key (min. 8 characters)	Authentication Key	Enter the password with at least 8 characters, if "Authentication type" MD5 or SHA1 has been selected
Privacy enable (DES)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Activate the DES encryption of the data
		<input type="checkbox"/> Deactivate the DES encryption of the data
Privacy key (min. 8 characters)	Privacy Key	Enter the password of at least 8 characters in the encryption with DES
Enable v3 notification/trap enable	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Activate the notification traps of the SNMP version 3
		<input type="checkbox"/> Deactivate the notification traps of the SNMP version 3
Notification receiver (IP address)	192.168.1.10	IP address of the notification manager

10.15 SNTP

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

The SNTP client supports configuration of static time servers. Two additional servers may be assigned by dynamic network configuration (e. g. DHCP or BootP). The selection of the active time server used to synchronize the current time is done automatically by the SNTP client. The SNTP client queries all time servers listed below and determines the most precise server to synchronize the device clock with. This takes into account whether the respective time server can be reached and how short the transmission distance between the time server and the SNTP client is.

Table 55: WBM Page “SNTP”

SNMP Settings		
Entry	Value (Example)	Description
Protocol status	enabled	Display the protocol status. „enabled“ SNTP protocol ist activated. „disabled“ SNTP protocol ist deactivated.
Active time server	de.pool.ntp.org	Hostname or IP address of the active time server, which is currently used to synchronize the time.

SNTP Client Settings		
Entry	Value (Example)	Description
Server update interval [s] (60 ... 65535 s)	3600	Polling interval for synchronizing the device clock with the active time server.
First time server	de.pool.ntp.org	Host name or IP address of the first user-defined time server.
Second time server	0.0.0.0	Host name or IP address of the second user-defined time server.
Additional time servers	- -	List of up to 2 time servers dynamically allocated via BootP or DHCP.

10.16 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 static IP configuration source!

Before you change parameters on this page, set the DIP switch to value “0” and enable the option “IP configuration source static”!

If these conditions are not met, the DIP switch settings are applied instead.

Table 56: WBM page „TCP/IP“

Network Settings (non-volatile)			
Entry	Default Value	Value (Example)	Description
IP configuration source	<input type="radio"/> BootP	<input type="radio"/>	<input checked="" type="radio"/> Activate “Bootstrap Protocol”. <input type="radio"/> Deactivate “Bootstrap Protocol”.
	<input checked="" type="radio"/> DHCP	<input checked="" type="radio"/>	<input checked="" type="radio"/> Activate “Dynamic Host Configuration Protocol”. <input type="radio"/> Deactivate “Dynamic Host Configuration Protocol”
			<input checked="" type="radio"/> Use IP address from EEPROM. <input type="radio"/> Do not use IP address from EEPROM.
	<input type="radio"/> static	<input type="radio"/>	
IP address	0.0.0.0	192.168.1.180	Enter IP address.
Subnet mask	255.255.255.0	255.255.255.0	Enter subnet mask.
Default gateway	0.0.0.0	0.0.0.0	Enter gateway.
Host name	0030DEXXX XX	0030DE000000	Enter host name.
Domain name	localdomain.co m		Enter domain name.
DNS server 1	0.0.0.0	0.0.0.0	Enter IP address of the first DNS server.
DNS server 2	0.0.0.0	0.0.0.0	Enter optional IP address of the second DNS server.
DIP switch base IP address	192.168.1	192.168.5	Network address for the configuration of the IP address with DIP switch.
Syslog UDP server	0.0.0.0	192.168.1.96	Host name or IP address of the Syslog UDP server
IP Fragment TTL [s] (max.255)	60	60	Life of a packet (Time to Live).

10.17 Modbus

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

Table 57: WBM page “MODBUS”

Modbus UDP Multicast Address Setup		
Entry	Default value	Description
Enable multicast addressing	<input type="checkbox"/>	<input checked="" type="checkbox"/> Enable Multicast for Modbus® UDP transmission. In addition to its own IP address, the fieldbus controller receives Modbus® commands for the following registered MCAST addresses.
		<input type="checkbox"/> Multicast for Modbus® UDP transmission is not enabled. The fieldbus controller receives Modbus® commands only for the own IP address.
Do not reply to Modbus UDP multicast messages	<input type="checkbox"/>	<input checked="" type="checkbox"/> The reply to Modbus® UDP multicast messages is deactivated.
		<input type="checkbox"/> 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.



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.

Modbus Configuration Registers		
Entry	Default value	Description
Range	Enabled	
0x1029 – 0x1037	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Enable Modbus configuration register range.
0x2040 – 0x2043	<input checked="" type="checkbox"/>	<input type="checkbox"/> Disable Modbus configuration register range.

Blocked Modbus Flag Registers		
Entry 1 ... 5	Default value	Description
Range Start	0x0000	Start address for the blocked Modbus TCP register range.
Range End	0x0000	End address for the blocked Modbus TCP register range.
Enabled	<input type="checkbox"/>	<input checked="" type="checkbox"/> Requests to the blocked addresses of Modbus TCP flag register range are answered with the exception code 0x02 "Illegal Data Address". If a request is partially in the valid and partially in the restricted range, this is also answered with an exception.
		<input type="checkbox"/> The respective table entry is not considered.

Connection Watchdog		
Entry	Default	Description
Connection timeout value (x 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
Status of Modbus watchdog	disabled	"disabled" – Watchdog is disabled "enabled [running]" – Watchdog is activated, Timeout monitoring is running "enabled [expired]" – Watchdog is activated, Timeout occurred
Watchdog type	Standard <input checked="" type="radio"/>	The watchdog can only be activated for the first time by writing to register 0x1001 or 0x1003.
	Alternative <input type="radio"/>	The watchdog is activated for the first time with each function code that is enabled in the coding mask (watchdog trigger mask).
Watchdog timeout value (x 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".
Close modbus socket after watchdog timeout	<input type="checkbox"/>	<input type="checkbox"/> The Modbus TCP connection remains opened when the watchdog timeout has expired.
		<input checked="" type="checkbox"/> The Modbus TCP connection is closed when the watchdog timeout has expired.
Watchdog trigger mask (FC1 to FC16)	0xFFFF	Coding mask for certain Modbus telegrams (Function Code FC1 ... FC16)
Watchdog trigger mask (FC17 to FC32)	0xFFFF	Coding mask for certain Modbus telegrams (Function Code FC17 ... FC32)

10.18 Modbus Mapping

The WBM page “Modbus Mapping“ contains an overview of the current Assignment of the Modbus registers for the I/O modules plugged into the local bus as well as the general division of the register areas.

Table 58: WBM page “Modbus Mapping”

I/O Mapping			
Modbus Register [word addresses]			
Entry	Default	Value (example)	Description
I/O Module	1 ... n	1	Position of the I/O module on the local bus, starting with 1 behind the front-end station
Order Number	750-XXX	750-4xx	WAGO item number of the I/O module
Input (RO)	-	2.0 - 2.7	Address of the input data in format <SR>[.<SO>] - <ER>[.<EO>], with: <SR> = Start register address <ER> = End register address <SO> = Start bit offset inside the start register <EO> = End bit offset inside the end register The bit offset is only specified for digital I/O modules
output (WO)	-	2.0 - 2.7	Address of the output data in format <SR>[.<SO>] - <ER>[.<EO>], with: <SR> = Start register address <ER> = End register address <SO> = Start bit offset inside the start register <EO> = End bit offset inside the end register The bit offset is only specified for digital I/O modules
output (RW)	-	514.0 - 514.7	Address of the read back output data in format <SR>[.<SO>] - <ER>[.<EO>], with: <SR> = Start register address <ER> = End register address <SO> = Start bit offset inside the start register <EO> = End bit offset inside the end register The bit offset is only specified for digital I/O modules
I/O access	-	RO	Read/write rights on the I/O module: RO = Read only, RW = Read and write

Modbus Coils [bit addresses]			
Entry	Default	Value (example)	Description
I/O Module	1 ... n	2	Position of the digital I/O module on the local bus, starting with 1 behind the front-end station
Order Number	750-XXX	750-5xx	WAGO item number of the digital I/O module
Input (RO)	-	0 - 7	Bit address of the digital input data in format [<SO>] – [<EO>], with: <SO> = Start bit offset <EO> = End bit offset
output (WO)	-	0 - 7	Bit address of the digital output data in format [<SO>] – [<EO>], with: <SO> = Start bit offset <EO> = End bit offset
output (RW)	-	512 - 519	Bit address of the read back digital output data in format [<SO>] – [<EO>], with: <SO> = Start bit offset <EO> = End bit offset
I/O access	-	RW	Read/write rights on the I/O module: RO = Read only, RW = Read and write

General Modbus Mapping			
Input Register (FC3, FC4, FC23)			
Entry	Default	Value (example)	Description
Modbus address	0xXXXX – 0xYYYY	0x0000 – 0x00FF	Register address area of the associated input data register
Description	-	physical input data	Description of the content for the specified register address range

Output Register (FC6, FC7, FC22, FC23)			
Entry	Default	Value (example)	Description
Modbus address	0xXXXX – 0xYYYY	0x0000 – 0x00FF	Register address area of the associated output data register
Description	-	physical output data	Description of the content for the specified register address range

Digital Input (FC1, FC2)			
Entry	Default	Value (example)	Description
Modbus address	0xXXXX – 0xYYYY	0x0000 – 0x01FF	Coil address area of the associated digital input data register
Description	-	physical input data	Description of the content for the specified coil address range

Digital Output (FC5, FC15)			
Entry	Default	Value (example)	Description
Modbus address	0XXXXX – 0YYYYY	0x0000 – 0x01FF	Coil address area of the associated digital output data register
Description	-	physical output data	Description of the content for the specified coil address range

10.19 I/O Data

Click the link "I/O Data" to view the configuration and/or write access privileges for the outputs of your fieldbus node.

The node structure created using the "WAGO-I/O-PRO I/O Configurator" hardware configuration tool is displayed in the window. If no modules are shown in this window, no hardware configuration and, thus, no allocation of write access privileges have been assigned. In this case, the handling defined at the WBM page "PLC Application" by the function "I/O configuration - Compatible handling for io-config.xml" will be applied to assign the write privileges for all outputs either to the standard fieldbus, or to the PLC.

Information



Additional Information

For more detailed information about the WAGO-I/O-PRO I/O Configurator, refer to the Section "Startup of Fieldbus Node".

When the function "I/O configuration Insert monitoring entries into io_config.xml" is also activated at the WBM page "PLC Application", the current process values will also be shown for the data channels that are displayed.

Table 59: WBM page „I/O Data“

Configuration Summary		
Entry	Value (Example)	Description
Number of modules on terminal bus	6	Number of I/O modules (hardware)
Number of modules in I/O configuration	0	Number of I/O modules in the hardware configuration, which is performed in software. If it is "0", the hardware configuration in the I/O Configurator of WAGO-I/O-PRO is missing.

Button	Description
[SAVE CONFIG]	With this button, the current status of the I/O configuration on the local bus is read in, displayed and stored on the device.

I/O Mapping		
Entry	Value (Example)	Description
Position	1	Position of the I/O module in the hardware
Module	750-5xx M001Ch1 M001Ch2	Product number of the integrated I/O module M = module, 001 = position 1, Ch1 = channel 1 M = module, 002 = position 2, Ch2 = channel 2
Type	8DO	I/O module type, e.g. 8DO (8 Channel Digital Output Module)

Assigned Fieldbus	Fieldbus 1	Mapping via PLC, fieldbus 1 etc. (Entries depend on the coupler/controller, see WAGO-I/O-PRO under control parameters/module parameters)
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Note



Enter I/O modules in the I/O Configurator!

Enter the I/O modules used in the I/O configurator of WAGO-I/O-PRO. Here, open the **Control Configuration** in the **Resources** register and add your I/O modules to the I/O module figure.

The added I/O modules must match the hardware in sequence and quantity. The entries "Number of modules on terminal bus" and "Number of modules in I/O configuration" on the WBM page "I/O Data" serve as control.

10.20 PLC Application

Click the "PLC Application" link to access a WBM page where you can get information about the current CODESYS project and make settings for the PLC functionality of your fieldbus controller.

Prerequisite for the display of the project information is that they were previously entered in CODESYS under the menu "**Project**" >> menu item "**Project information**".

Table 60: WBM Page „PLC Application“

Application Information		
Entry	Default	Description
Title	-	Title of the WAGO I/O-PRO project
Version	-	Version of the WAGO I/O-PRO project
Date	-	Date of creation of the WAGO I/O-PRO project
Description	-	Description of the WAGO I/O-PRO project
Author	-	Author/creator of the WAGO I/O-PRO project
ID	-	ID of the WAGO I/O-PRO project
Checksum	-	Title of the WAGO I/O-PRO project



Note

Return from “WebVisu” page via the IP address of the fieldbus controller!

The WBM page “Webvisu” does not have any hyperlinks to the other WBM pages. To deactivate this starting page function, or to go to other WBM pages, enter the IP address for your controller and the address for the original starting page in the URL line of your browser with the following syntax:

<http://IP address of your controller/wbm/index.ssi>

Application Settings		
Function	Default	Description
Process image	Set outputs to zero, if user program is stopped <input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Activate, if all outputs must be set at zero when stopping the user program
		<input type="checkbox"/> Disable, if all outputs must remain at the last current value when stopping the user program
WebVisu	Set 'webvisu.htm' as default <input type="radio"/>	<input checked="" type="radio"/> Calling up the WBM, the WBM page "Webvisu" is set as the start page and opened (default: "Information"). Disable via browser entry of the syntax: http://IP address of your controller/wbm/index.ssi .
	Open 'webvisu.htm' in frame <input type="radio"/>	<input checked="" type="radio"/> Calling up the WBM page "Webvisu", it will open in the active window. <input checked="" type="radio"/> Return back via browser button "Back" or via browser entry of the syntax: http://IP address of your controller/wbm/index.ssi .
	Open 'webvisu.htm' in new window <input checked="" type="radio"/>	<input checked="" type="radio"/> Calling up the WBM page "Webvisu", it will open in an additional window.

I/O configuration	Compatible handling for 'io_config.xml' <input type="checkbox"/>	Activate, if the write authorizations must be assigned to the outputs of all bus terminals based on an existing file "io_config.xml". <input checked="" type="checkbox"/> Here, note whether a control system configuration has already been created and, if so, whether this configuration is correct or incorrect (see the following table). The current process values are displayed on the WBM page "IO Data", in addition to the displayed data channels.		
		Disable, if the write authorizations must be assigned to the outputs of all bus terminals of the PLC <input type="checkbox"/> Here, note whether a control system configuration has already been created and, if so, whether this configuration is correct or incorrect (see the following table).		
			I/O configuration (function activated)	I/O configuration (function deactivated, standard setting):
		No control system configuration has been created in the project	Writing privileges to the outputs of all modules are assigned on the basis of an existing io_config.xml. The io_config.xml file must be completely error-free; otherwise the writing privileges for all modules will be assigned to the standard fieldbus.	The outputs for all modules are assigned to the PLC. Any io_config.xml file that may already be present is ignored and overwritten.
		Correct control system configuration has been created in the project	Writing privileges to the module outputs is taken from the control system configuration. A corresponding io_config.xml file is generated in the file system.	
	Incorrect control system configuration has been created in the project	The standard fieldbus is granted writing privileges to the outputs of all the modules.		
Insert monitoring entries into 'io_config.xml' <input type="checkbox"/>	<input checked="" type="checkbox"/> Activate to also display the current process values on the WBM page "IO Data" for the displayed data channels.			
	<input type="checkbox"/> Disable, if no process values must be displayed on the WBM page "IO Data".			

10.21 WebVisu

The visualization of your programmed application is displayed on the WBM page "WebVisu" as an HTML page.

The prerequisite for this is that you have previously created this HTML page for your application with the visualization editor in WAGO-I/O-PRO and loaded it into the fieldbus controller.

10.21.1 Generate WebVisu-HTML

Perform the following settings in WAGO-I/O-PRO, to automatically generate at the transmission of your project an HTML page of your created visualization:

1. Double click to open the **Target System Settings** in the **Resource** register.
2. Open the **Visualization** register.
3. Select the **Web Visualization** option with a hatch mark.
4. Confirm with **[OK]**.

If the page has been generated, it will be displayed in the browser window, when you click in the navigation list on the link for the WBM page "WebVisu".

10.21.2 Set WebVisu as Start Page

In order to have access to the web visualization of your application directly at the WBM call, you can specify the WBM page "WebVisu" as the WBM start page. Please note, then the navigation bar will no longer be available for you to change to the other WBM pages.

1. Call up the WBM page "PLC Application".
2. Under **Application Settings** for **WebVisu** activate the option "Set 'webvisu.htm' as default".

For the call up of the WBM page "WebVisu" you can also specify with the other options whether you want this page in the active browser window (Open 'webvisu.htm' in frame) or in an additional browser window (Open 'webvisu.htm' in new window).

Note



Return from “WebVisu” page via the IP address of the fieldbus controller!

The WBM page “Webvisu” does not have any hyperlinks to the other WBM pages.

To deactivate this starting page function, or to go to other WBM pages, enter the IP address for your controller and the address for the original starting page in the URL line of your browser with the following syntax:

<http://IP address of your controller/wbm/index.ssi>

11 Diagnostics

11.1 LED Signaling

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

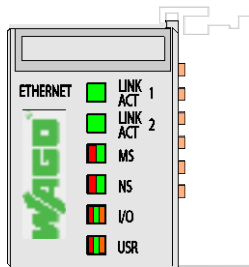


Figure 56: Display elements

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 61: LED Assignment for Diagnostics

Diagnostics area	LEDs
Fieldbus status	<ul style="list-style-type: none"> LINK ACT Port 1 LINK ACT Port 2 MS NS
Node status	<ul style="list-style-type: none"> I/O USR

11.1.1 Evaluating Fieldbus Status

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

The two-colored LEDs 'MS' (module status) and 'NS' (network status) are used to display the status of the system and the fieldbus connections.

Table 62: 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 flashing	The system indicates a remediable error	1. Check the display of the I/O LED (see chapter "Evaluating Node Status – I/O LED (Blink Code Table)"). 2. If the error cannot be localized via the status of the I/O LED, please contact the I/O support.
off	No system supply voltage	1. Check the supply voltage.
NS		
green	At least one Modbus TCP connection is developed.	-
green flashing	No Modbus TCP connection.	-
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 Modbus TCP connection 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.
off	No IP address is assigned to the system.	1. Assign to the system an IP address by BootP, DHCP or the Ethernet Settings tool.

11.1.2 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 63: 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.

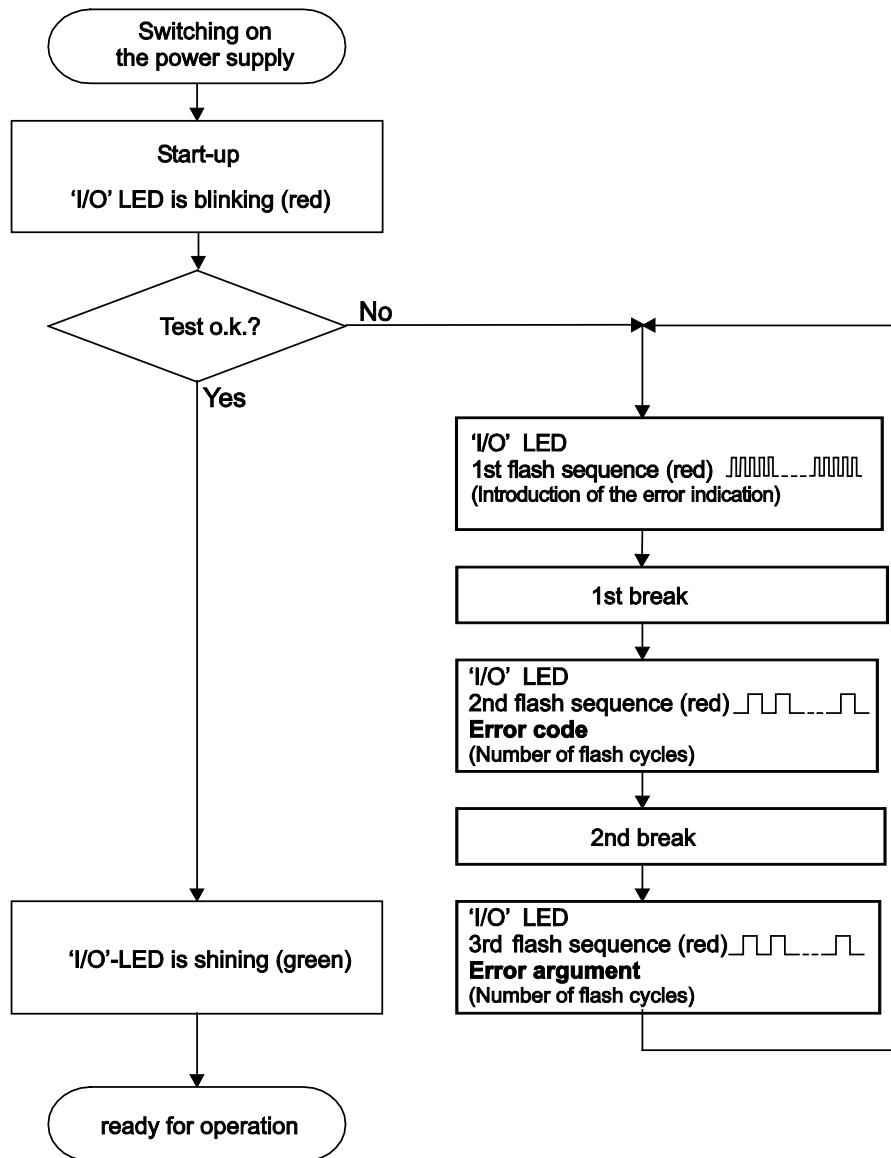


Figure 57: Node Status – I/O LED Signaling

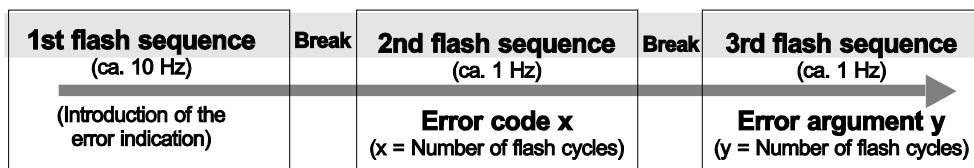


Figure 58: Error Message Coding

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 64: 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.	<ol style="list-style-type: none"> 1. Turn off the power supply of the node. 2. Reduce the number of I/O modules. 3. Turn on again the power supply of the node. 4. If the error persists, replace the head station.
2	I/O module(s) with unknown data type	<ol style="list-style-type: none"> 1. Determine the faulty I/O module. First turn off the power supply of the node. 2. Plug the end module into the middle of the node. 3. Turn on again the power supply of the node. 4. - LED continues to flash? - Turn off the power supply of the node and plug the end module into the middle of the first half of the node (toward the head station). - LED not flashing? - Turn off the power supply of the node and plug the end module into the middle of the second half of the node (away from the head station). 5. Turn on again the power supply of the node. 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. Contact I/O support and inquire about a firmware update for the head station.
3	Invalid check sum in the parameter area of the head station.	<ol style="list-style-type: none"> 1. Turn off the power supply of the node. 2. Replace the head station. 3. Turn on again the power supply of the node.
4	Fault when writing in the serial EEPROM.	<ol style="list-style-type: none"> 1. Turn off the power supply of the node. 2. Replace the head station. 3. Turn on again the power supply of the node.
5	Fault when reading the serial EEPROM	<ol style="list-style-type: none"> 1. Turn off the power supply of the node. 2. Replace the head station. 3. Turn on again the power supply of the node.
6	The I/O module configuration after AUTORESET differs from the configuration determined the last time the head station was powered up.	<ol style="list-style-type: none"> 1. Restart the head station by turning the power supply off and on.
7	Invalid hardware-firmware combination.	<ol style="list-style-type: none"> 1. Turn off the power supply of the node. 2. Replace the head station. 3. Turn on again the power supply of the node.
8	Timeout during serial EEPROM access.	<ol style="list-style-type: none"> 1. Turn off the power supply of the node. 2. Replace the head station. 3. Turn on again the power supply of the node.

Table 64: Blink code- table for the I/O LED signaling, error code 1

Error code 1: "Hardware and configuration error"		
Error Argument	Error Description	Solution
9	Head station initialization error	<ol style="list-style-type: none"> 1. Turn off the power supply of the node. 2. Replace the head station. 3. Turn on again the power supply of the node.
10 ... 13	not used	
14	Maximum number of gateway or mailbox modules exceeded	<ol style="list-style-type: none"> 1. Turn off the power supply of the node. 2. Reduce the number of corresponding modules to a valid number. 3. Turn on again the power supply of the node.
15	Firmware loader was loaded from backup.	<ol style="list-style-type: none"> 1. Execute the last firmware update again. 2. If the error persists, contact I/O support.
16	Firmware was loaded from backup.	<ol style="list-style-type: none"> 1. Execute the last firmware update again. 2. If the error persists, contact I/O support.

Table 65: Blink Code Table for the I/O LED Signaling, Error Code 2

Error Code 2: „Process image exceeded“		
Error Argument	Error Description	Solution
1	Not used	-
2	Maximum process image size exceeded	<ol style="list-style-type: none"> 1. Turn off the power supply of the node. 2. Reduce number of I/O modules. 3. Turn on again the power supply of the node.
3	Process image generation error	<ol style="list-style-type: none"> 1. Turn off the power supply of the node. 2. Remove unsupported I/O modules. 3. Turn on again the power supply of the node.
4	Configuration error detected for output of log files	<ol style="list-style-type: none"> 1. Check the configuration settings on the WBM page "System Status".
5	Configured threshold ("Log storage threshold") exceeded for the log storage.	<ol style="list-style-type: none"> 1. Delete the log memory or increase the threshold value settings ("Log storage threshold") on the WBM page "System Status".
6	Error when accessing the log storage medium.	<ol style="list-style-type: none"> 1. Integrate the log medium or remove the write protection. 2. Close the log files that were opened via (S) FTP.
7	Error sending messages to the syslog server.	<ol style="list-style-type: none"> 1. Check whether the configured IP address is valid and can be reached (within the subnet). 2. Check whether the configured host name of the syslog server can be resolved (valid DNS configuration).

Table 66: Blink Code Table for the I/O LED Signaling, Error Code 3

Error Code 3: „Protocoll error, local bus“		
Error Argument	Error Description	Solution
-	Local bus communication defective, incorrect module not identifiable	<p>-- Are there power supply modules with the bus power supply (750-613) in the node? ---</p> <ol style="list-style-type: none"> 1. Check that these I/O modules are supplied correctly with power. 2. Determine this by the state of the associated status LEDs. --- Are all I/O modules connected correctly or are there any 750-613 I/O modules in the node? --- 3. Determine the faulty I/O module. First turn off the power supply of the node. 4. Plug the end module into the middle of the node. 5. Turn on again the power supply of the node. 6. - LED continues to flash? - Turn off the power supply of the node and plug the end module into the middle of the first half of the node (toward the head station). - LED not flashing? - Turn off the power supply of the node and plug the end module into the middle of the second half of the node (away from the head station). 7. Turn on again the power supply of the node. 8. Repeat the procedure described in step 4 while halving the step size until the faulty I/O module is detected. 9. Replace the faulty I/O module. 10. If there is only one I/O module left on the head station and the LED is flashing, either this I/O module or the head station is defective. 11. Replace the faulty component.

Table 67: Blink Code Table for the I/O LED Signaling, Error Code 4

Error Code 4: „Physical error, local bus“		
Error Argument	Error Description	Solution
-	Local bus data transmission error or interruption of the local bus at the head station	<ol style="list-style-type: none"> 1. Turn off the power supply of the node. 2. Plug in an I/O module with process data behind the head station. 3. Turn on again the power supply of the node. 4. Observe the error argument signaled. 5. --- Is no error argument indicated in the I/O LED?--- Replace the head station. 6. --- Is an error argument indicated by the I/O LED? --- 6. Determine the faulty I/O module. First turn off the power supply of the node. 7. Plug the end module into the middle of the node. 8. Turn on again the power supply of the node. 9. - LED continues to flash? - Turn off the power supply of the node and plug the end module into the middle of the first half of the node (toward the head station). - LED not flashing? - Turn off the power supply of the node and plug the end module into the middle of the second half of the node (away from the head station). 10. Turn on again the power supply of the node. 11. Repeat the procedure described in step 4 while halving the step size until the faulty I/O module is detected. 12. Replace the faulty I/O module. 13. If there is only one I/O module left on the head station and the LED is flashing, either this I/O module or the head station is defective. 14. Replace the faulty component.
n*	Interruption of the local bus behind the nth I/O module with process data.	<ol style="list-style-type: none"> 1. Turn off the power supply for the node. 2. Replace the (n+1) I/O module with process data or reduce the number of I/O modules until the (n+1) I/O module. 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 68: Blink Code Table for the I/O LED Signaling, Error Code 5

Error Code 5: „Initialization error, local bus“		
Error Argument	Error Description	Solution
n*	Error in register communication during local bus initialization	<ol style="list-style-type: none"> 1. Turn off the power supply for the node. 2. Replace the (n+1) I/O module with process data or reduce the number of I/O modules until the (n+1) I/O module. 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 69: Blink Code Table for the I/O LED Signaling, Error Code 6

Error Code 6: " Configuration error, node configuration"		
Error Argument	Error Description	Solution
1	Invalid MAC ID	<ol style="list-style-type: none"> 1. Turn off the power supply of the node. 2. Replace the head station. 3. Turn on again the power supply of the node.
2	Ethernet Hardware initialization error	<ol style="list-style-type: none"> 1. Restart the head station by turning the power supply off and on again. 2. If the error still exists, replace the head station.
3	TCP/IP initialization error	<ol style="list-style-type: none"> 1. Restart the head station by turning the power supply off and on again. 2. If the error still exists, replace the head station.
4	Network configuration error (no IP Address)	<ol style="list-style-type: none"> 1. Check the settings of DHCP/BootP server or if a static IP address is used.
5	Application protocol initialization error	<ol style="list-style-type: none"> 2. Restart the head station by turning the power supply off and on again. 3. If the error still exists, replace the head station.
6	Maximum process image size exceeded	<ol style="list-style-type: none"> 1. Turn off the power supply of the node. 2. Reduce number of I/O modules. 3. Turn on again the power supply of the node.
7	Double IP address in network	<ol style="list-style-type: none"> 1. Change configuration. Use another IP address, which is not yet present in network. 2. Restart the head station by turning the power supply off and on again.
8	Error when building the process image	<ol style="list-style-type: none"> 1. Turn off the power supply of the node. 2. Reduce number of I/O modules. 3. Restart the head station by turning the power supply off and on again. 4. If the error still exists, replace the head station.
9	Error when mapping the I/O modules to a fieldbus	<ol style="list-style-type: none"> 1. Check the file „io_config.xml“ on the head station.

Table 70: Blink Code Table for the I/O LED Signaling, Error Code 7

Error Code 7: „Not supported I/O module“		
Error Argument	Error Description	Solution
n	First not supported I/O module at position n	<ol style="list-style-type: none"> 1. Turn off the power supply for the node. 2. Replace the (n+1) I/O module with process data or reduce the number of I/O modules until the (n+1) I/O module. 3. Turn the power supply on.

Table 71: Blink Code Table for the I/O LED Signaling, Error Code 8 ... 9

Error code 8 ... 9 – not used –		
Error Argument	Error Description	Solution
-	not used	-

Table 72: Blink code table for the 'I/O' LED signaling, error code 10

Error code 10: "PLC program fault"		
Error Argument	Error Description	Solution
1	Error when implementing the PLC run time system	<ol style="list-style-type: none"> 1. Restart the fieldbus node by turning the power supply off and on again. 2. If the error still exists, please contact the I/O Support.
2	Error when generating the PLC inline code	<ol style="list-style-type: none"> 1. Restart the fieldbus node by turning the power supply off and on again. 2. If the error still exists, please contact the I/O Support.
3	An IEC task exceeded the maximum running time or the sampling interval of the IEC task could not be kept (Watchdog)	<ol style="list-style-type: none"> 1. Check the task configuration concerning the adjusted sampling intervals and watchdog times.
4	Error when initialization the PLC web visualization	<ol style="list-style-type: none"> 1. Restart the fieldbus node by turning the power supply off and on again. 2. If the error still exists, execute a reset (origin) in WAGO I/O-PRO. 3. Compile the project again. 4. Transfer the project to the controller.
5	Error when synchronizing the PLC configuration with the local bus	<ol style="list-style-type: none"> 1. Check the information of the connected modules in the PLC configuration of WAGO-I/O-PRO. 2. Compare this information with the modules that are actually connected. 3. Compile the project again. 4. Transfer the project to the controller.

Table 73: Blink Code Table for the 'I/O' LED Signaling, Error Code 11

Error code 11: "Gateway-Mailbox I/O module fault"		
Error Argument	Error Description	Solution
1	Maximum number of Gateway modules exceeded	<ol style="list-style-type: none"> 1. Reduce number of Gateway modules.
2	Maximum size of Mailbox exceeded	<ol style="list-style-type: none"> 1. Reduce the Mailbox size.
3	Maximum size of process image exceeded due to the put Gateway modules	<ol style="list-style-type: none"> 1. Reduce the data width of the Gateway modules.

* 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 module without diagnosis)

Table 74: Blink code table for I/O LED signaling, error code 12

Error code 12 "System Error"		
Error Argument	Error description	Solution
1	General error of the operating system	1. Restart the fieldbus node by turning the power supply off and on again. 3. If the error still exists, please contact the I/O Support.
2	General error of the file system	1. Reset the file system using "WAGO Ethernet Settings", button [Reset File System] in the menu above. 2. Restart the fieldbus node by turning the power supply off and on again. 3. If the error still exists, please contact the I/O Support.
3	Insufficient system memory	1. Restart the fieldbus node by turning the power supply off and on again. 2. If the error still exists, please contact the I/O Support.

Table 75: Blink code table for I/O LED signaling, error code 13

Error code 13 – not used -		
Error Argument	Error description	Solution
-	Not used	-

Table 76: Blink Code Table for the I/O LED Signaling, Error Code 14

Error code 14: "Error in external storage (memory card)"

Error Argument	Error Description	Solution
3	The space on the internal drive A is exhausted.	<ol style="list-style-type: none"> 1. Remove unnecessary files on the internal drive A. 2. Restart the canceled function.
5	Saving parameters in non-volatile memory failed.	<ol style="list-style-type: none"> 1. Restart the fieldbus node. 2. Restart the canceled function. 3. If the problem persists, contact support.
6	The backup function failed due to an internal error.	<ol style="list-style-type: none"> 1. Restart the fieldbus node. 2. Restart the canceled function. 3. If the problem persists, contact support.
7	The restore function failed due to an internal error.	<ol style="list-style-type: none"> 1. Restart the fieldbus node. 2. Restart the canceled function. 3. If the problem persists, contact support.
10	The version of the selected backup image is not compatible.	<ol style="list-style-type: none"> 1. Use backup image files created by a compatible controller (part number, firmware version). 2. Repeat the last action. 3. If the problem persists, contact support.
11	The selected backup image is defective / can not be interpreted.	<ol style="list-style-type: none"> 1. Create a new backup image. 2. Repeat the last action. 3. If the problem persists, contact support.
12	There is no backup image file on the selected backup media.	<ol style="list-style-type: none"> 1. Copy a backup image file to the backup file: A:\backup. 2. Repeat the last action. 3. If the problem persists, contact support.
13	The executed action can not currently be executed.	<ol style="list-style-type: none"> 1. Disconnect all active FTP / SFTP and fieldbus connections. 2. Stop an application running on the controller. 3. Repeat the last action. 4. If the problem persists, contact support.

11.1.2.1 USR LED

The bottom indicator LED ("USR") is provided for visual output of information.

Control of the LED from the application program is conducted using the functions from the WAGO-I/O-PRO library "Visual.lib".

11.2 Fault Behavior

11.2.1 Fieldbus Failure

Irrespective of the fieldbus protocol used, faults on the ETHERNET bus can lead to sporadic or permanent interruptions in the fieldbus communication.

This can show up e.g. through loss of telegrams, retransmissions or through a complete link failure.

A fieldbus and thus a connection failure occurs if the set time-out time of the watchdog has elapsed without being triggered by the higher-level controller.

The Modbus Watchdog monitors the Modbus communication running via the Modbus protocol. If the Modbus watchdog has been configured and activated, a fieldbus failure is indicated by the red I/O LED lighting up. All subsequent Modbus TCP/IP requests are answered with the exception code 0x0004 (Slave Device Failure).



Information

Further Information

For detailed information on the Watchdog see Chapter "Modbus Functions" >...> "Modbus Watchdog".

11.2.2 Local Bus Failure

I/O LED indicates a local bus failure.

When a local bus failure occurs, the head station generates an error message (error code and error argument) via the red-flashing I/O LED (see chapter "Diagnostics" => "Evaluating Node Status - I/O LED (Blink Code Table)").

If the local bus completely fails, output modules switch to defined states, e.g. "Off" or "0 V".

Example:

A fieldbus node consists of head station, five I/O modules with process data and the end module.

The output of one digital output module is activated.

If the end module is removed of the fieldbus node during operation, the local bus is interrupted. The output of the digital output module is automatically deactivated and the I/O LED flashes red and indicates with it error message 4/5.

The flashing code table provides for error code 4: "Physical error, local bus" with error argument 5: "Interruption of the local bus behind the nth I/O module with process data".

If the end module is re-inserted into the fieldbus node, the local bus will restart after a few seconds. After the initialization blink code is completely, the I/O LED lights up again in a steady green and the transmission of the process data is resumed. Also the output of the digital output module is re-activated.

If the local bus error is caused by a defective module, it must be replaced, as described in the blink code table for error code 4 under "Solution".

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)
'FAILADDRESS'		= Position of the I/O module after which the local bus interruption arose, similar to the flashed error argument of the I/O LED)

12 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.

12.1 Implemented Protocols

12.1.1 Communication Protocols

12.1.1.1 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 77: 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 78: Network Class A

e. g. 101 . 16 . 232 . 22

01100101	00010000	11101000	00010110
0	Net ID	Host ID	

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 79: Network Class B

e. g. 181 . 16 . 232 . 22

10110101	00010000	11101000	00010110
10	Net ID	Host ID	

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 80: Network Class C

e. g. 201 . 16 . 232 . 22

11000101	00010000	11101000	00010110
110	Net ID	Host ID	

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 81: Key Data Class A, B and C

Network Class	Address range of the subnetwork	Possible number of	
		Networks	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 InterNIC (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 82: 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 83: Subnet Mask for Class A Network

255	.0	.0	.0
-----	----	----	----

- **Class B Subnet mask:**

Table 84: Subnet Mask for Class B Network

255	.255	.0	.0
-----	------	----	----

- **Class C Subnet mask:**

Table 85: 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 86: 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.

12.1.1.2 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.

12.1.1.3 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.

12.1.2 Configuration and Diagnostics Protocols

12.1.2.1 BootP (Bootstrap Protocol)

The "Bootstrap Protocol" (BootP) can be used to assign an IP address and other parameters to the head station of the fieldbus node in a TCP/IP network.

The BootP protocol can be enabled in the WBM on "TCP/IP" WBM page (the option "DHCP" is enabled by default).

The protocol communication consists of a client request from the head station and a response from the BootP server. If no BootP server is available, in the default configuration the head station will periodically send client requests at irregular intervals until a server responds.

The protocol sends a broadcast request on port 67 (BootP server) containing the hardware address (MAC ID) of the head station. The BootP server receives the message. It contains a database in which MAC ID and IP addresses are assigned to one another. If the MAC address is found, a broadcast response is transmitted via the network. The head station "listens" at the specified Port 68 for the response of the BootP server. Incoming packets contain information such as the IP address and the MAC address of the head station. A head station recognizes by the MAC address whether the message is intended for it and, if it matches, transfers the sent IP address to its network interface.

In contrast to DHCP, the head station keeps the IP address with BootP, as long as it is not switched off. This means that the head station can only receive a new IP address after the next power on reset (or a software reset).

Note



IP addresses can be assigned via BootP under Windows and Linux!

You can use BootP to assign an IP address under the Windows and Linux operating systems.

Information



More information about IP address assigning with BootP

The process for assigning addresses using BootP is described in detail in the section "Commissioning".

The head station supports the following options in addition to the default "IP address" option:

Table 87: 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 WBM page "Miscellaneous" can also be used to select the "BootP Request before static IP" option. To do this, static network parameters must be stored in the EEPROM on the "TCP/IP" WBM page. After the restart, 7 BootP requests are sent. If there is no response to any of these requests, the head station configures itself with the IP parameters stored in the EEPROM.

If the head station does not receive a valid IP address, the I/O LED indicates an error code (see chapter "Diagnostics").

12.1.2.2 DHCP (Dynamic Host Configuration Protocol)

The Dynamic Host Configuration Protocol (DHCP) allows you to assign an IP address and other parameters to the head station of a fieldbus node in a TCP/IP network.

The DHCP protocol can be activated in the WBM on the "TCP/IP" WBM page (this option is already enabled by default).

DHCP is an advancement of BootP. The difference between BootP and DHCP is that both use different mapping methods and the configuration is limited in time with DHCP.

The DHCP client must re-request the configuration at the end of the server-supplied time ("lease time"). Normally, the DHCP server returns the same configuration, but it can be changed at any time.

If there is no response from a server on a DHCP request, the request is repeated continuously: first after 4 seconds, another after 8 seconds, the third after 16 seconds. After that follow more and more requests at longer intervals. If requests remain without an answer, the network configuration is discarded after the lease time has expired and a flash code is displayed via the I/O LED. Then the head station no longer has a valid IP address (IP 0.0.0.0).

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 head station supports the following options in addition to the default “IP address” option:

Table 88: 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.

12.1.2.3 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.

12.1.2.4 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.

12.1.2.5 SNTP-Client (Simple Network Time Protocol)

The SNTP client is used for synchronization of the time of day between a time server (NTP and SNTP server Version 3 and 4 are supported) and the internal system time in the (programmable) fieldbus coupler or controller. The protocol is executed via a UDP port. Only unicast addressing is supported.

Configuration of the SNTP client

The configuration of the SNTP client is performed via the web-based management system. The following parameters must be set:

Table 89: Meaning of the SNTP Parameters

Parameter	Meaning
WBM page "TCP/IP" → "(S)NTP Server"	The address assignment can be made over an IP address.
WBM page "TCP/IP" → „SNTP Update Time (sec, max. 65535) ”	The update time indicates the interval in seconds, in which the synchronization with the time server is to take place.
WBM page "Clock" → "Timezone (+/- hour:minute)"	To operate the ETHERNET couplers/controllers with SNTP in various countries, you must specify a time zone. The time zone relative to GMT (Greenwich Mean time). A range of -12 to +14 hours is acceptable.
WBM page "Port" → "SNTP"	It indicates whether the SNTP Client is to be activated or deactivated.

12.1.2.6 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 1 GB is available for the internal 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.

12.1.2.7 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.

12.1.2.7.1 MIB II Description

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

Table 90: 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

12.1.2.7.2 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 91: 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

12.1.2.8 Syslog Client

The network protocol "syslog" (RFC5424) enables the transmission of event-controlled log messages in an IP-based network. Communication takes place according to the client-server principle, with a "syslog" client sending log messages to a "syslog" server via TCP or UDP.

WAGO fieldbus couplers/controllers provide a "syslog" client that sends log messages via UDP to a "syslog" server that can be configured by the user.

With the "syslog" protocol, a message consists of a short free text message with additional information for classifying the log message.

Priority Selector (PRI)

The priority selector contains information about the source and the severity of a log message. This allows log messages to be displayed or filtered on a "syslog" server according to their urgency and origin.

The **facility** field describes the source or the device component that triggered the log message. Various values are predefined for this in RFC5124:
e.g. 0 = kernel, 1 = user, 4 = security.

The **severity** field describes the severity of a log message in the range from 0 to 7.
Examples: 0 = critical error, 3 = normal error, 4 = warning and 6 = information.

Header (HEADER)

The header of a "syslog" message contains the following information:

- Protocol version used (VERSION)
- Time stamp at which the log message was created (TIMESTAMP)
- Network name (FQDN) or the IP address of the device (HOSTNAME)
- Application that created the log message (APP-NAME)
- Process ID for the assignment of log messages (PROCID)
- Message ID for typing the log message (MSGID)

Structured Data (STRUCTURED-DATA)

Currently the WAGO fieldbus couplers/controllers do not support structured data.

Structured data is optional and enables the transmission of a list of name-value pairs (e.g. JSON) within a "syslog" message.

Message Text (MSG)

The message text of a "syslog" message is free text in the "Unicode" or "UTF-8" format.

12.1.2.8.1 Syslog Messages

WAGO fieldbus couplers/controllers currently support the following "syslog" messages:

Table 92: Supported Syslog Messages

Facility	Severity	Application (APP-NAME)	Description
0 (Kernel)	4 (Warning)	Core	CPU utilization over 80%
0 (Kernel)	3 (Error)	SEL (System Error Logger)	An error has occurred (see "Diagnostics" >> ... >> "Evaluating Node Status - I/O LED (Blink Code Table))
0 (Kernel)	3 (Error)	SEL (System Error Logger)	An error has been fixed (see "Diagnostics" >> ... >> "Evaluating Node Status - I/O LED (Blink Code Table))
1 (User)	5 (Note)	Parameter	A parameter of the head station was changed
1 (User)	5 (Note)	Modbus	Maximum number of Modbus TCP connections exceeded
1 (User)	5 (Note)	EIP (EtherNet/IP)	Maximum number of EIP connections exceeded
1 (User)	5 (Note)	BAR (Backup & Restore)	A backup image was successfully created
1 (User)	5 (Note)	BAR (Backup & Restore)	A backup image was successfully restored
4 (Security)	5 (Note)	FTP	Authentication via FTP was successful
4 (Security)	4 (Warning)	FTP	Authentication via FTP failed
4 (Security)	5 (Note)	SSH	Authentication via SSH was successful
4 (Security)	4 (Warning)	SSH	Authentication via SSH failed
4 (Security)	5 (Note)	WBM (Web-based-Management)	Authentication via web server was successful
4 (Security)	4 (Warning)	WBM (Web-based-Management)	Authentication via web server failed

12.1.2.8.2 Configuration

The configuration for the "syslog" client takes place via the web-based management (see "Configuring via the Web-Based Management System (WBM)"> "Protocols" and> "TCP/IP").

12.1.3 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.

12.2 Modbus Functions

12.2.1 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 93: 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 94: 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 95: List of the MODBUS Functions in the Fieldbus Coupler

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

FC23	0x17	Read/Write Multiple Registers	Reading and writing of several output registers	R/W: Process image, PFC variables, NOVRAM
-------------	------	-------------------------------------	----------------------------------------------------	--------------------------------------------------------

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.

12.2.2 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.

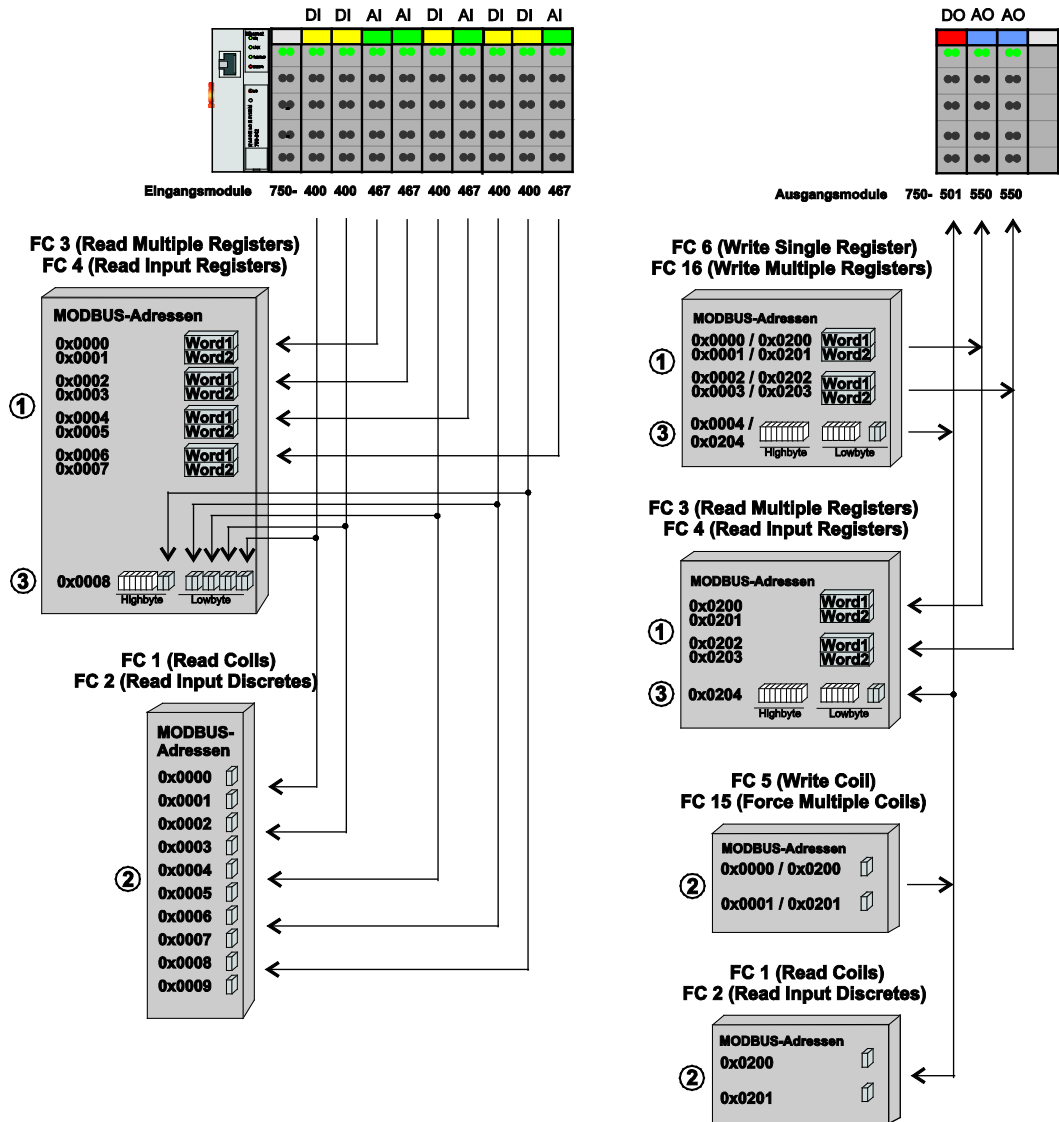


Figure 59: Use of the MODBUS Functions



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.

12.2.3 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 96: Exception Codes

Exception code	Meaning
0x01	Illegal function
0x02	Illegal data address
0x03	Illegal data value
0x04	Slave device failure

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 200_{hex} (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}].

12.2.3.1 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 97: 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 98: 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 99: 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 100: Exception of Function Code FC1

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

12.2.3.2 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 101: 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 102: 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 103: 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 104: Exception of Function Code FC2

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

12.2.3.3 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 105: 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 106: 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 107: Exception of Function Code FC3

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

12.2.3.4 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 108: 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 109: 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 110: Exception of Function Code FC4

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

12.2.3.5 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 111: 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 112: 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 113: Exception of Function Code FC5

Byte	Field name	Example
...		
Byte 7	MODBUS function code	0x85
Byte 8	Exception code	0x01, 0x02 or 0x03

12.2.3.6 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 114: 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 115: 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 116: Exception of Function Code FC6

Byte	Field name	Example
...		
Byte 7	MODBUS function code	0x85
Byte 8	Exception code	0x01 or 0x02

12.2.3.7 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 117: 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 118: 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 119: Exception of Function Code FC 11

Byte	Field name	Example
...		
Byte 7	MODBUS function code	0x85
Byte 8	Exception code	0x01 or 0x02

12.2.3.8 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 120: 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 121: 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 122: Exception of Function Code FC15

Byte	Field name	Example
...		
Byte 7	MODBUS function code	0x8F
Byte 8	Exception code	0x01 or 0x02

12.2.3.9 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 123: 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 124: 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 125: Exception of Function Code FC16

Byte	Field name	Example
...		
Byte 7	MODBUS function code	0x85
Byte 8	Exception code	0x01 or 0x02

12.2.3.10 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 126: 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 127: 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 128: Exception of Function Code FC22

Byte	Field name	Example
...		
Byte 7	MODBUS function code	0x85
Byte 8	Exception code	0x01 or 0x02

12.2.3.11 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 129: 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 130: 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 131: 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.

12.2.4 MODBUS Register Mapping

The following tables display the MODBUS addressing and the corresponding IEC61131 addressing for the process image, the PFC variables, the NOVRAM data, and the internal variables is represented.

Via the register services the states of the complex and digital I/O modules can be determined or changed.

Register Access Reading (with FC3, FC4 and FC23)

Table 132: Register access reading (with FC3, FC4 and FC23)

MODBUS address		IEC 61131	Memory range
[dec]	[hex]	address	
0...255	0x0000...0x00FF	%IW0...%IW255	Physical input area (1) First 256 words of physical input data
256...511	0x0100...0x01FF	%QW256...%QW511	PFC OUT area Volatile PFC output variables
512...767	0x0200...0x02FF	%QW0...%QW255	Physical output area (1) First 256 words of physical output data
768...1023	0x0300...0x03FF	%IW256...%IW511	PFC IN area Volatile PFC input variables
1024...4095	0x0400...0x0FFF	-	MODBUS exception: "Illegal data address"
4096...12287	0x1000...0x2FFF	-	Configuration register (see following chapter "Configuration Functions") Not with FC23!
12288...24575	0x3000...0x5FFF	%MW0...%MW12287	NOVRAM 24 kB retain memory *) *) In Target settings RETAIN on 0, flags on MAX (24 kB)
24576...25340	0x6000...0x62FC	%IW512...%IW1275	Physical input area (2) Additional 764 words physical input data
25341...28671	0x62FD...0x6FFF	-	MODBUS exception: "Illegal data address"
28672...29435	0x7000...0x72FB	%QW512...%QW1275	Physical output area (2) Additional 764 words physical output data
29436...32767	0x72FC...0x7FFF	-	MODBUS exception: "Illegal data address"
32768...36863	0x8000...0x8FFF	-	NOVRAM "8 kB retain memory *) *) In Target settings RETAIN on 0, flags on MAX (32 kB)
36864...65535	0x9000...0xFFFF	-	MODBUS exception: "Illegal data address"

Register Access Writing (with FC6, FC16, FC22 and FC23)

Table 133: Register access writing (with FC6, FC16, FC22 and FC23)

MODBUS address		IEC 61131	Memory range
[dec]	[hex]	address	
0...255	0x0000...0x00FF	%QW0...%QW255	Physical output area (1) First 256 words of physical output data
256...511	0x0100...0x01FF	%QW256...%QW511	PFC OUT area Volatile PFC input variables
512...767	0x0200...0x02FF	%QW0...%QW255	Physical output area (1) First 256 words of physical output data
768...1023	0x0300...0x03FF	%IW256...%IW511	PFC IN area Volatile PFC input variables
1024...4095	0x0400...0x0FFF	-	MODBUS exception: "Illegal data address"
4096...12287	0x1000...0x2FFF	-	Configuration register (see following chapter „Configuration Functions“) Not with FC22 and FC23!
12288...24575	0x3000...0x5FFF	%MW0...%MW12287	NOVRAM 24 kB retain memory *) *) In Target settings RETAIN on 0, flags on MAX (24 kB)
24576...25340	0x6000...0x62FC	%QW512...%QW1275	Physical output area (2) Additional 764 words physical output data
25341...28671	0x62FD...0x6FFF	-	MODBUS exception: "Illegal data address"
28672...29435	0x7000...0x72FB	%QW512...%QW1275	Physical output area (2) Additional 764 words physical output data
29436...32767	0x72FC...0x7FFF	-	MODBUS exception: "Illegal data address"
32768...36863	0x8000...0x8FFF	-	NOVRAM "8 kB retain memory *) *) In Target settings RETAIN on 0, flags on MAX (32 kB)
36864...65535	0x9000...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 134: 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...4095	0x0400...0x0FFF	-	MODBUS exception: "Illegal data address"
4096...8191	0x1000...0x1FFF	%QX256.0...%QX511.15	PFC OUT area Volatile PFC output variables
8192...12287	0x2000...0x2FFF	%IX256.0...%IX511.15	PFC IN area Volatile PFC input variables
12288...32767	0x3000...0x7FFF	%MX0...%MX1279.15	NOVRAM 2 kB retain memory (max. 24 kB)
32768...34295	0x8000...0x85F7	Physical input area (2)	Starts with the 513 th and ends with the 2039 th digital input
34296...36863	0x85F8...0x8FFF	-	MODBUS exception: "Illegal data address"
36864...38391	0x9000...0x95F7	Physical output area (2)	Starts with the 513 th and ends with the 2039 th digital output
38392...65535	0x95F8...0xFFFF	-	MODBUS exception: "Illegal data address"

Bit Access Writing (with FC5 and FC15)

Table 135: 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...4095	0x0400...0x0FFF	-	MODBUS exception: "Illegal data address"
4096...8191	0x1000...0x1FFF	%QX256.0...%QX511.15	PFC OUT area Volatile PFC input variables
8192...12287	0x2000...0x2FFF	%IX256.0...%IX511.15	PFC IN area Volatile PFC input variables
12288...32767	0x3000...0x7FFF	%MX0...%MX1279.15	NOVRAM 2 kB retain memory
32768...34295	0x8000...0x85F7	Physical output area (2)	Starts with the 513 th and ends with the 2039 th digital input
34296...36863	0x85F8...0x8FFF	-	MODBUS-Exception: "Illegal data address"
36864...38391	0x9000...0x95F7	Physical output area (2)	Starts with the 513 th and ends with the 2039 th digital output
38392...65535	0x95F8...0xFFFF	-	MODBUS-Exception: "Illegal data address"

12.2.5 Modbus Registers

Table 136: 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)
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)
0x1038		1	Modbus TOS
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
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)
0x2035	R/W	1	Process image settings
0x2036	R		Fieldbus coupler/controller diagnostics
0x2040	W	1	Software reset (Write sequence 0x55AA or 0xAA55)
0x2043	W	1	Factory settings

12.2.5.1 Accessing Register Values

You can use any den 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 the Modbus watchdog and how to access both the registers and their values.

12.2.5.2 Modbus-Watchdog

With the aid of the Modbus watchdog, it is possible to monitor whether communication takes place with Modbus function codes with a specific regularity. If the communication lapses for a given time, it is called a "time-out", which is considered fieldbus failure. In general, the Modbus watchdog ensures that all analog output modules in the fieldbus node are set to "0" and all digital output modules are set to logical "Off". At the same time, the user is informed about the time-out via the WBM as well as via a status register (0x1006).

An internal timer is used to monitor the time-out. This timer is set to a certain maximum time (register 0x1000) and started at the beginning of the monitoring. If communication with a Modbus function code to be monitored occurs before

reaching the maximum time, the timer starts again at "0". However, only the function codes selected in the coding mask (0x1001) are monitored (respective bit = '1'). All other function codes keep the timer running or, unlike the selected function codes, do not restart the watchdog after a time-out.

The head station's behavior after a time-out is defined by the initial choice of two possible operating modes ("Standard"/"Alternative") and by an additional parameter for the TCP interface (register 0x1009, "MODBUS and HTTP close for Modbus Watchdog time-out").

- **Behavior 1 (lowest restriction):**

After a Modbus watchdog time-out, all analog and digital output modules are set to "0" or "Off", however, the Modbus watchdog is immediately restarted the next time a function code is sent (provided the function code in the coding mask (0x1001) is selected).

=> Select the operating mode "Alternative",
=> Set register 0x1009 to the value '0'.

When reading the status register (0x1006), the correct value is read first: "2" = "Watchdog expired". Because this restarts the Modbus watchdog, the next read would result in "1" = "watchdog active".

- **Behavior 2 (medium restriction):**

Further communication in relation to process data should be prevented. Any attempt to access process data via Modbus function codes should be answered with an error.

=> Select the operating mode "Standard" for this.

However, the Modbus TCP connection will still work to access the Modbus configuration and status registers.

=> Set the register 0x1009 to the value '0'.

Access to the Modbus watchdog registers is still possible after a Modbus watchdog time-out, although Modbus function codes are also sent in this case.

For all other Modbus TCP/IP requests, the head station responds with the exception code 0x0004 ("Slave Device Failure").

- **Behavior 3 (highest restriction):**

Further communication in relation to process data should be prevented. Any attempt to access process data via Modbus function codes should be answered with an error.

=> Select the operating mode "Standard" for this.

In addition, the TCP connection should also be closed to prevent access to the Modbus watchdog registers. For example thereby a restart of the Modbus watchdog is not possible without a previous TCP reconnection.

=> Set the register 0x1009 to the value '1'.

After renewed TCP connection, in the "Standard" operating mode the Modbus watchdog is still in the "expired" status and must be restarted (register 0x1003 or 0x1007).

12.2.5.3 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 137: 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 138: 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 139: 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	<p>Same function as above, however, with the function codes 17 to 32.</p> <p>FC 17 Bit 0 FC 18 Bit 1 ... FC 32 Bit 15</p> <p>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.</p>

Table 140: Register Address 0x1003

Register address 0x1003 (4099 _{dec})	
Value	Watchdog trigger, WD_TRIGGER
Access	Read/write
Standard	0x0000
Description	<p>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.</p>

Table 141: 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 142: 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 143: 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 144: 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 145: 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 146: 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 147: 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 148: 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 = 6000_{dec} = 1770_{hex})
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 149: 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.

12.2.5.4 Diagnostic Registers

The following registers can be read to determine errors in the node:

Table 150: Register Address 0x1020

Register address 0x1020 (4128 _{dec})	
Value	LedErrCode
Access	Read
Description	Declaration of the error code

Table 151: Register Address 0x1021

Register address 0x1021 (4129 _{dec})	
Value	LedErrArg
Access	Read
Description	Declaration of the error argument

12.2.5.5 Configuration Registers

The following registers contain configuration information of the connected modules:

Table 152: 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 153: 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 154: Register Address 0x1024

Register address 0x1024 (4132 _{dec})	
Value	CnfLen.DigitalOut
Access	Read
Description	Number of digital output bits in the process image

Table 155: Register Address 0x1025

Register address 0x1025 (4133 _{dec})	
Value	CnfLen.DigitalInp
Access	Read
Description	Number of digital input bits in the process image

Table 156: 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 157: 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 158: 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 159: 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 160: 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 161: 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 162: Register Address 0x1038

Register address 0x1038 (4152_{dez}) with a word count of 4	
Value	Configuration of Modbus TOS
Access	Read/write
Default	0x0000
Description	This register saves the value for the Modbus Response Delay Time for a Modbus TCP connection. The time base is 1 ms. On the Modbus TCP connection, the response will be delayed by the inscribed time. Range 0 ... 63

Table 163: 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 Mapping Diagnosis (Word 3) Bit 0: Underrange Bit 1: Overrange Bit 2: User underrange Bit 3: User overrange Bit 4: Short circuit Bit 5: Wire break Bit 6: Collective failure

12.2.5.6 Constant Registers

The following registers contain constants, which can be used to test communication with the master:

Table 164: Register Address 0x2000

Register address 0x2000 (8192_{dec})	
Value	Zero, GP_ZERO
Access	Read
Description	Constant with zeros

Table 165: 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 166: 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 167: 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 168: 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 169: 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 170: 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 171: 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 172: 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

12.2.5.7 Firmware Information Registers

The following registers contain information on the firmware of the controller:

Table 173: 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 174: 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 175: 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 176: 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 177: 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 178: 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 179: 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 180: 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 181: 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

Table 182: 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. 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 183: 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 184: 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 185: 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	<p>Length 1...63 words</p> <p>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:</p> <p>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</p>

Table 186: Register Address 0x2035

Register address 0x2035 (8245_{dec})	
Value	Process image settings
Access	Read/Write
Description	<p>For internal use only.</p> <div style="background-color: #0070C0; color: white; text-align: center; padding: 5px;">NOTICE</div> <p>No access to I/O data when changes are made! Note that this register is intended for internal use only. Changes can mean that access to the I/O data is no longer possible!</p>

Table 187: Register Address 0x2036

Register address 0x2036 (8246 _{dec}) with a word count of up to 17							
Value	Fieldbus coupler/controller diagnostics						
Access	Read						
Description	Register allocation	0.0	Fieldbus error		0/1	0	
		0.1	Internal bus error		0/1	0	
		0.2	I/O module error		0/1	0	
		0.3	Fieldbus coupler/controller error		0/1	0	
	Register number	1	Error code in the event of a configuration error		0 - 65535		
	Register number	2	0.1=0	Bit length of Internal bus		0 - 65535	
			0.1=1	Error code in the event of an internal bus error			
	Register number	3	0.1=0 0.1=1	Number of I/O modules I/O module number, at which the error occurred			
	Register number	4	Error code in the event of an internal bus error				
	Register number	5	Internal bus command error Counter				
		6	Internal bus command error „Quality“				
		7	Internal bus command error „Quality-Overall“				
	Register number	8	Internal bus timeout error Counter				
		9	Internal bus timeout error „Quality“				
10		Internal bus timeout error „Quality-Overall“					
Register number	11	Internal bus input data error Counter					
	12	Internal bus input data error „Quality“					
	13	Internal bus input data error „Quality -Overall“					
Register number	14	Internal bus output data error Counter					
	15	Internal bus output data error „Quality“					
	16	Internal bus output data error „Quality-Overall“					

Table 188: 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 189: Register Address 0x2043

Register address 0x2043 (8259 _{dec})	
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.

Table 190: Register Addresses 0x3000 to 0x5FFF

Register addresses 0x3000 to 0x5FFF (12288_{dec} to 24575_{dec})	
Value	Retain range
Access	Read/write
Description	These registers can be accessed as the flag/retain range

13 I/O Modules

13.1 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.

13.2 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 and 753 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.

The structure of the process data mapping is identical for the PFC process image of the programmable fieldbus controller.

13.2.1 Digital Input Modules

Digital input modules supply one bit of data per channel to specify the signal state for the corresponding channel. These bits are mapped into the Input Process Image.

Some digital modules have an additional diagnostic bit per channel in the Input Process Image. The diagnostic bit is used for detecting faults that occur (e.g., wire breaks and/or short circuits).

When analog input modules are also present in the node, the digital data is always appended after the analog data in the Input Process Image, grouped into bytes.

13.2.1.1 1 Channel Digital Input Module with Diagnostics

750-435

Table 191: 1 Channel Digital Input Module 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

13.2.1.2 2 Channel Digital Input Modules

750-400, -401, -405, -406, -407, -410, -411, -412, -427, -438, (and all variations),
753-400, -401, -405, -406, -410, -411, -412, -427, -429

Table 192: 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

13.2.1.3 2 Channel Digital Input Module with Diagnostics

750-419, -421, -424, -425,
753-421, -424, -425

Table 193: 2 Channel Digital Input Module with Diagnostics

Input Process Image							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
				Diagnostic bit S 2 Channel 2	Diagnostic bit S 1 Channel 1	Data bit DI 2 Channel 2	Data bit DI 1 Channel 1

13.2.1.4 2 Channel Digital Input Module with Diagnostics and Output Process Data

750-418,
753-418

The digital input module supplies a diagnostic and acknowledge bit for each input channel. If a fault condition occurs, the diagnostic bit is set. After the fault condition is cleared, an acknowledge bit must be set to re-activate the input. The diagnostic data and input data bit is mapped in the Input Process Image, while the acknowledge bit is in the Output Process Image.

Table 194: 2 Channel Digital Input Module with Diagnostics and Output Process Data

Input Process Image							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
				Diagnostic bit S 2 Channel 2	Diagnostic bit S 1 Channel 1	Data bit DI 2 Channel 2	Data bit DI 1 Channel 1

Output Process Image							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
				Acknowledge- ment bit Q 2 Channel 2	Acknowledge- ment bit Q 1 Channel 1	0	0

13.2.1.5 4 Channel Digital Input Modules

750-402, -403, -408, -409, -414, -415, -422, -423, -428, -432, -433, -1420, -1421,
-1422, -1423
753-402, -403, -408, -409, -415, -422, -423, -428, -432, -433, -440

Table 195: 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

13.2.1.6 8 Channel Digital Input Modules

750-430, -431, -436, -437, -1415, -1416, -1417, -1418,
753-430, -431, -434, -436, -437

Table 196: 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

13.2.1.7 8 Channel Digital Input Module NAMUR with Diagnostics and Output Process Data

750-439

The digital input module NAMUR provides via one logical channel 2 byte for the input and output process image.

The signal state of NAMUR inputs DI1 ... DI8 is transmitted to the fieldbus coupler/controller via input data byte D0.

The fault conditions are transmitted via input data byte D1.

The channels 1 ... 8 are switched on or off via the output data byte D1.

The output data byte D0 is reserved and always has the value "0".

Table 197: 8 Channel Digital Input Module NAMUR with Diagnostics and Output Process Data

Input Process Image							
Input byte D0							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Signal status DI 8	Signal status DI 7	Signal status DI 6	Signal status DI 5	Signal status DI 4	Signal status DI 3	Signal status DI 2	Signal status DI 1
Channel 8	Channel 7	Channel 6	Channel 5	Channel 4	Channel 3	Channel 2	Channel 1
Input byte D1							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Wire break /short circuit Data bit DI 8	Wire break /short circuit Data bit DI 7	Wire break /short circuit Data bit DI 6	Wire break /short circuit Data bit DI 5	Wire break /short circuit Data bit DI 4	Wire break /short circuit Data bit DI 3	Wire break /short circuit Data bit DI 2	Wire break /short circuit Data bit DI 1
Channel 8	Channel 7	Channel 6	Channel 5	Channel 4	Channel 3	Channel 2	Channel 1

Output Process Image							
Output byte D0							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	0	0	0	0	0	0	0
Output byte D1							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
DI Off 8 Channel 8)	DI Off 7 Channel 7)	DI Off 6 Channel 6)	DI Off 5 Channel 5)	DI Off 4 Channel 4)	DI Off 3 Channel 3)	DI Off 2 Channel 2)	DI Off 1 Channel 1)

*) 0: Channel ON
1: Channel OFF

13.2.1.8 8 Channel Digital Input Module PTC with Diagnostics and Output Process Data

750-1425

The digital input module PTC provides via one logical channel 2 byte for the input and output process image.

The signal state of PTC inputs DI1 ... DI8 is transmitted to the fieldbus coupler/controller via input data byte D0.

The fault conditions are transmitted via input data byte D1.

The channels 1 ... 8 are switched on or off via the output data byte D1.

The output data byte D0 is reserved and always has the value "0".

Table 198: 8 Channel Digital Input Module PTC with Diagnostics and Output Process Data

Input Process Image							
Input Byte D0							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Signal status DI 8	Signal status DI 7	Signal status DI 6	Signal status DI 5	Signal status DI 4	Signal status DI 3	Signal status DI 2	Signal status DI 1
Channel 8	Channel 7	Channel 6	Channel 5	Channel 4	Channel 3	Channel 2	Channel 1
Input Byte D1							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Wire break /short circuit Data bit DI 8	Wire break /short circuit Data bit DI 7	Wire break /short circuit Data bit DI 6	Wire break /short circuit Data bit DI 5	Wire break /short circuit Data bit DI 4	Wire break /short circuit Data bit DI 3	Wire break /short circuit Data bit DI 2	Wire break /short circuit Data bit DI 1
Channel 8	Channel 7	Channel 6	Channel 5	Channel 4	Channel 3	Channel 2	Channel 1

Output Process Image							
Output Byte D0							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	0	0	0	0	0	0	0
Output Byte D1							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
DI Off 8 Channel 8)	DI Off 7 Channel 7)	DI Off 6 Channel 6)	DI Off 5 Channel 5)	DI Off 4 Channel 4)	DI Off 3 Channel 3)	DI Off 2 Channel 2)	DI Off 1 Channel 1)

*) 0: Channel ON
 1: Channel OFF

13.2.1.9 16 Channel Digital Input Modules

750-1400, -1402, -1405, -1406, -1407

Table 199: 16 Channel Digital Input Modules

Input Process Image							
Input Byte D0							
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
Channel 8	Channel 7	Channel 6	Channel 5	Channel 4	Channel 3	Channel 2	Channel 1
Input Byte D1							
Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8
Data bit DI 16	Data bit DI 15	Data bit DI 14	Data bit DI 13	Data bit DI 12	Data bit DI 11	Data bit DI 10	Data bit DI 9
Channel 16	Channel 15	Channel 4	Channel 13	Channel 12	Channel 11	Channel 10	Channel 9

13.2.2 Digital Output Modules

Digital output modules use one bit of data per channel to control the output of the corresponding channel. These bits are mapped into the Output Process Image.

Some digital modules have an additional diagnostic bit per channel in the Input Process Image. The diagnostic bit is used for detecting faults that occur (e.g., wire breaks and/or short circuits). For modules with diagnostic bit is set, also the data bits have to be evaluated.

When analog output modules are also present in the node, the digital image data is always appended after the analog data in the Output Process Image, grouped into bytes.

13.2.2.1 1 Channel Digital Output Module with Input Process Data

750-523

The digital output module delivers 1 bit via a process value Bit in the output process image, which is illustrated in the input process image. This status image shows "manual mode".

Table 200: 1 Channel Digital Output Module with Input Process 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"

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

13.2.2.2 2 Channel Digital Output Modules

750-501, -502, -509, -512, -513, -514, -517, -535, -538, (and all variations),
 753-501, -502, -509, -512, -513, -514, -517

Table 201: 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

13.2.2.3 2 Channel Digital Input Modules with Diagnostics and Input Process Data

750-507 (-508), -522,
753-507

The digital output modules have a diagnostic bit for each output channel. When an output fault condition occurs (i.e., overload, short circuit, or broken wire), a diagnostic bit is set. The diagnostic data is mapped into the Input Process Image, while the output control bits are in the Output Process Image.

Table 202: 2 Channel Digital Input Modules with Diagnostics and Input Process Data

Input Process Image							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
						Diagnostic bit S 2 Channel 2	Diagnostic 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

750-506,
753-506

The digital output module has 2-bits of diagnostic information for each output channel. The 2-bit diagnostic information can then be decoded to determine the exact fault condition of the module (i.e., overload, a short circuit, or a broken wire). The 4-bits of diagnostic data are mapped into the Input Process Image, while the output control bits are in the Output Process Image.

Table 203: 2 Channel Digital Input Modules with Diagnostics and Input Process Data 75x-506

Input Process Image							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
				Diagnostic bit S 3 Channel 2	Diagnostic bit S 2 Channel 2	Diagnostic bit S 1 Channel 1	Diagnostic bit S 0 Channel 1

Diagnostic bits S1/S0, S3/S2: = '00' standard mode
 Diagnostic bits S1/S0, S3/S2: = '01' no connected load/short circuit against +24 V
 Diagnostic bits S1/S0, S3/S2: = '10' Short circuit to ground/overload

Output Process Image							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
				not used	not used	controls DO 2 Channel 2	controls DO 1 Channel 1

13.2.2.4 4 Channel Digital Output Modules

750-504, -515, -516, -519, -531,
753-504, -516, -531, -540

Table 204: 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

13.2.2.5 4 Channel Digital Output Modules with Diagnostics and Input Process Data

750-532, -539

The digital output modules have a diagnostic bit for each output channel. When an output fault condition occurs (i.e., overload, short circuit, or broken wire), a diagnostic bit is set. The diagnostic data is mapped into the Input Process Image, while the output control bits are in the Output Process Image.

Table 205: 4 Channel Digital Output Modules with Diagnostics and Input Process Data

Input Process Image							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
				Diagnostic bit S 4 Channel 4	Diagnostic bit S 3 Channel 3	Diagnostic bit S 2 Channel 2	Diagnostic bit S 1 Channel 1

Diagnostic bit S = '0' no Error
Diagnostic bit S = '1' overload, short circuit, or broken wire

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

13.2.2.6 8 Channel Digital Output Module

750-530, -536, -1515, -1516,
753-530, -534, 536

Table 206: 8 Channel Digital Output Module

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

13.2.2.7 8 Channel Digital Output Modules with Diagnostics and Input Process Data

750-537,
753-537

The digital output modules have a diagnostic bit for each output channel. When an output fault condition occurs (i.e., overload, short circuit, or broken wire), a diagnostic bit is set. The diagnostic data is mapped into the Input Process Image, while the output control bits are in the Output Process Image.

Table 207: 8 Channel Digital Output Modules with Diagnostics and Input Process Data

Input Process Image							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Diagnostic bit S 8 Channel 8	Diagnostic bit S 7 Channel 7	Diagnostic bit S 6 Channel 6	Diagnostic bit S 5 Channel 5	Diagnostic bit S 4 Channel 4	Diagnostic bit S 3 Channel 3	Diagnostic bit S 2 Channel 2	Diagnostic bit S 1 Channel 1

Diagnostic bit S = '0' no Error
Diagnostic bit S = '1' overload, short circuit, or broken wire

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

13.2.2.8 16 Channel Digital Output Modules

750-1500, -1501, -1504, -1505

Table 208: 16 Channel Digital Output Modules

Output Process Image							
Output Byte D0							
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
Output Byte D1							
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

13.2.2.9 8 Channel Digital Input/Output Modules

750-1502, -1506

Table 209: 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	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
Channel 8	Channel 7	Channel 6	Channel 5	Channel 4	Channel 3	Channel 2	Channel 1

Output Process Image							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
controls DO 8	controls DO 7	controls DO 6	controls DO 5	controls DO 4	controls DO 3	controls DO 2	controls DO 1
Channel 8	Channel 7	Channel 6	Channel 5	Channel 4	Channel 3	Channel 2	Channel 1

13.2.3 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.

13.2.3.1 1 Channel Analog Input Modules

750-491, (and all variations)

Table 210: 1 Channel Analog Input Modules

Input Process Image			
Offset	Byte Destination		Description
	High Byte	Low Byte	
0	D1	D0	Measured Value U_D
1	D3	D2	Measured Value U_{ref}

13.2.3.2 2 Channel Analog Input Modules

750-452, -454, -456, -461, -462, -464 (2-Channel Operation) -465, -466, -467, -469, -470, -472, -473, -474, -475, 476, -477, -478, -479, -480, -481, -483, -485, -487, -492, (and all variations),

753-452, -454, -456, -461, -465, -466, -467, -469, -472, -474, -475, -476, -477, -478, -479, -483, -492, (and all variations)

Table 211: 2 Channel Analog Input Modules

Input Process Image			
Offset	Byte Destination		Description
	High Byte	Low Byte	
0	D1	D0	Measured Value Channel 1
1	D3	D2	Measured Value Channel 2

13.2.3.3 2 Channel Analog Input Modules HART

750-482, -484, (and all variations),
753-482

The HART I/O module provides two different process images depending on the set operating mode.

For the pure analog values 4 mA ... 20 mA, the HART I/O module transmits 16 bit measured values per channel as an analog input module, which are mapped by word.

In operating mode "6 Byte Mailbox", the HART I/O module provides the fieldbus coupler / controller with a 12-byte input and output process image via a logical channel. For the control/status byte and the dummy byte, an acyclic channel (mailbox) for the process value communication is embedded in the process image, which occupies 6 bytes of data. This is followed by the measured values for channels 1 and 2.

HART commands are executed via the WAGO-IEC function blocks of the "WagoLibHart_0x.lib" library. The data is tunneled to the application via the mailbox and decoded by means of the library, so that the evaluation and processing takes place directly at the application level.

The operating mode is set using the WAGO-I / O-CHECK commissioning tool.

Table 212: 2-Channel Analog Input Modules HART

Input Process Image			
Offset	Byte Destination		Description
	High Byte	Low Byte	
0	D1	D0	Measured Value Channel 1
1	D3	D2	Measured Value Channel 2

Table 213:: 2 Channel Analog Input Modules HART + 6 bytes Mailbox

Input Process Image			
Offset	Byte Destination		Description
	High Byte	Low Byte	
0	Internal Use	S0	Internal used Status byte
1	MBX_RES	MBX_RES	Response data from mailbox
2	MBX_RES	MBX_RES	
3	MBX_RES	MBX_RES	
4	D1	D0	Measured Value Channel 1
5	D3	D2	Measured Value Channel 2

Output Process Image			
Offset	Byte Destination		Description
	High Byte	Low Byte	
0	-	C0	Control byte
1	MBX_REQ	MBX_REQ	Request data from mailbox
2	MBX_REQ	MBX_REQ	
3	MBX_REQ	MBX_REQ	
4	-	-	Not used
5	-	-	

13.2.3.4 4 Channel Analog Input Modules

750-450, -453, -455, -457, -459, -460, -463, -464 (4-Channel Operation), -468, -471, -468, (and all variations),
753-453, -455, -457, -459

Table 214: 4 Channel Analog Input Modules

Input Process Image			
Offset	Byte Destination		Description
	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

13.2.3.5 8 Channel Analog Input Modules

750-451, 750-458, 750-496, 750-497

Table 215: 8 Channel Analog Input Modules

Input Process Image			
Offset	Byte Destination		Description
	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
4	D9	D8	Measured Value Channel 5
5	D11	D10	Measured Value Channel 6
6	D13	D12	Measured Value Channel 7
7	D15	D14	Measured Value Channel 8

13.2.3.6 3-Phase Power Measurement Module

750-493

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 216: 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

750-494, -495, (and all variations)

The 3-Phase Power Measurement Modules 750-494, -495, (and all variations) have a total of 24 bytes of user data in both the Input and Output Process Image (16 bytes of data and 8 bytes of control/status).

Table 217: 3-Phase Power Measurement Modules 750-494, -495, (and all variations)

Input Process Image			
Offset	Byte Destination		Description
	High Byte	Low Byte	
0	S1	S0	Status word
1	S3	S2	Extended status word 1
2	S5	S4	Extended status word 2
3	S7	S6	Extended status word 3
4	D1	D0	Process value 1
5	D3	D2	
6	D5	D4	Process value 2
7	D7	D6	
8	D9	D8	Process value 3
9	D11	D10	
10	D13	D12	Process value 4
11	D15	D14	

Output Process Image			
Offset	Byte Destination		Description
	High Byte	Low Byte	
0	S1	S0	Control word
1	S3	S2	Extended control word 1
2	S5	S4	Extended control word 2
3	S7	S6	Extended control word 3
4	-	-	-
5	-	-	
6	-	-	
7	-	-	-
8	-	-	
9	-	-	
10	-	-	-
11	-	-	

13.2.4 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.

13.2.4.1 2 Channel Analog Output Modules

750-550, -552, -554, -556, -560, -562, 563, -585, -586, (and all variations),
753-550, -552, -554, -556

Table 218: 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

13.2.4.2 4 Channel Analog Output Modules

750-553, -555, -557, -559,
753-553, -555, -557, -559

Table 219: 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

13.2.4.3 8 Channel Analog Output Modules

750-597

Table 220: 8 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
4	D9	D8	Output Value Channel 5
5	D11	D10	Output Value Channel 6
6	D13	D12	Output Value Channel 7
7	D15	D14	Output Value Channel 8

13.2.5 Specialty Modules

WAGO has a host of Specialty I/O modules that perform various functions. With individual modules beside the data bytes also the control/status byte is mapped in the process image.

The control/status byte is required for the bidirectional data exchange of the module with the higher-ranking control system. The control byte is transmitted from the control system to the module and the status byte from the module to the control system.

This allows, for example, setting of a counter with the control byte or displaying of overshooting or undershooting of the range with the status byte.

The control/status byte always is in the process image in the Low byte.



Information

Information about the structure of the Control/Status byte

For detailed information about the structure of a particular module's control/status byte, please refer to that module's manual. Manuals for each module can be found on the Internet under: www.wago.com.

13.2.5.1 Counter Modules

750-404, (and all variations except of /000-005),
753-404, -404/000-003

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 221: Counter Modules 750-404, (and all variations except of /000-005),
753-404, -404/000-003

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	

750-404/000-005,
 753-404/000-005

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 222: Counter Modules 750-404/000-005, 753-404/000-005

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

750-633

The above Counter Module has 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 following tables illustrate the Input and Output Process Image, which has a total of 3 words mapped into each image. Word alignment is applied.

The meaning of the output data depends on the set operating mode:

- 1 Up counter with enable input
- 2 Up/down counter with U/D input
- 3 Frequency counter
- 4 Gate time counter

Table 223: Counter Modules 750-633

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 ^{1,2)} watchdog time ³⁾ reserved ⁴⁾
2	D3	D2	Counter Setting Value ^{1,2)} reserved ³⁾ reserved ⁴⁾

^{1,2)} Up counter with enable input, Up /down counter with U / D input

³⁾ Frequency counter

⁴⁾ Gate time counter

750-638,
753-638

The above Counter Modules have a total of 6 bytes of user data in both the Input and Output Process Image (4 bytes of counter data and 2 bytes of control/status). The two counter values are supplied as 16 bits. The following tables illustrate the Input and Output Process Image, which has a total of 4 words mapped into each image. Word alignment is applied.

Table 224: Counter Modules 750-638, 753-638

Input Process Image			
Offset	Byte Designation		Description
	High Byte	Low Byte	
0	-	S0	Status byte of Counter 1
1	D1	D0	Counter Value of Counter 1
2	-	S1	Status byte of Counter 2
3	D3	D2	Counter Value of Counter 2

Output Process Image			
Offset	Byte Designation		Description
	High Byte	Low Byte	
0	-	C0	Control byte of Counter 1
1	D1	D0	Counter Setting Value of Counter 1
2	-	C1	Control byte of Counter 2
3	D3	D2	Counter Setting Value of Counter 2

13.2.5.2 Pulse Width Modules

750-511, (and all variations),
753-511

The above Pulse Width modules have a total of 6 bytes of user data in both the Input and Output Process Image (4 bytes of channel data and 2 bytes of control/status). The two channel values are supplied as 16 bits. Each channel has its own control/status byte. The following table illustrates the Input and Output Process Image, which has a total of 4 words mapped into each image. Word alignment is applied.

Table 225: Pulse Width Modules 750-511, /xxx-xxx, 753-511

Input and Output Process			
Offset	Byte Designation		Description
	High Byte	Low Byte	
0	-	C0/S0	Control/Status byte of Channel 1
1	D1	D0	Data Value of Channel 1
2	-	C1/S1	Control/Status byte of Channel 2
3	D3	D2	Data Value of Channel 2

13.2.5.3 Serial Interface Modules with Alternative Data Format

750-650, (and the variations /000-002, -004, -006, -009, -010, -011, -012, -013),
750-651, (and the variations /000-001, -002, -003),
750-653, (and the variations /000-002, -007),
753-650, -653

Note



The process image of the / 003-000-variants depends on the parameterized operating mode!

With the freely parameterizable variations /003 000 of the serial interface modules, the desired operating mode can be set. Dependent on it, the process image of these modules is then the same, as from the appropriate variation.

The above Serial Interface Modules with alternative data format have a total of 4 bytes of user data in both the Input and Output Process Image (3 bytes of serial data and 1 byte of control/status). The following table illustrates the Input and

Output Process Image, which have a total of 2 words mapped into each image. Word alignment is applied.

Table 226: Serial Interface Modules with Alternative Data Format

Input and Output Process Image				
Offset	Byte Designation		Description	
	High Byte	Low Byte		
0	D0	C/S	Data byte	Control/status byte
1	D2	D1	Data bytes	

13.2.5.4 Serial Interface Modules with Standard Data Format

750-650/000-001, -014, -015, -016,
750-651/000-001,
750-653/000-001, -006

The above Serial Interface Modules with Standard Data Format have a total of 6 bytes of user data in both the Input and Output Process Image (5 bytes of serial data and 1 byte of control/status). The following table illustrates the Input and Output Process Image, which have a total of 3 words mapped into each image. Word alignment is applied.

Table 227: Serial Interface Modules with Standard Data Format

Input and Output Process Image				
Offset	Byte Designation		Description	
	High Byte	Low Byte		
0	D0	C/S	Data byte	Control/status byte
1	D2	D1	Data bytes	
2	D4	D3		

13.2.5.5 Serial Interface Modules

750-652,
753-652

The size of the process image for the Serial Interface Module can be adjusted to 12, 24 or 48 bytes.

It consists of two status bytes (input) or control bytes (output) and the process data with a size of 6 to 46 bytes.

Thus, each Serial Interface Module uses between 8 and 48 bytes in the process image. The sizes of the input and output process images are always the same.

The process image sizes are set with the startup tool *WAGO-I/O-CHECK*.

Table 228: Serial Interface Modules 750-652, 753-652

Input and Output Process Image					
Process image size	Offset	Byte Designation		Description	
		High Byte	Low Byte		
8 bytes	0	C1/S1	C0/S0	Control/Status byte C1/S1	Control/Status byte C0/S0
	1	D1	D0	Prozess data (6-46 bytes)	
	2	D3	D2		
	3	D5	D4		
4	D7	D6			
24 bytes*	...				
	11	D21	D20		
48 bytes	12	D23	D22		
	...				
	23	D45	D44		

*) Factory setting

13.2.5.6 Data Exchange Module

750-654, -654/000-001

The Data Exchange modules have a total of 4 bytes of user data in both the Input and Output Process Image. The following tables illustrate the Input and Output Process Image, which has a total of 2 words mapped into each image. Word alignment is applied.

Table 229: Data Exchange Module 750-654, -654/000-001

Input and Output Process Image			
Offset	Byte Designation		Description
	High Byte	Low Byte	
0	D1	D0	Data bytes
1	D3	D2	

13.2.5.7 SSI Transmitter Interface Modules

750-630, and the variations /000-001, -002, -006, -008, -009, -011, -012, -013



Note

The process image of the / 003-000-variants depends on the parameterized operating mode!

The operating mode of the configurable /003-000 I/O module versions 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 above SSI Transmitter Interface modules have a total of 4 bytes of user data in the Input Process Image, which has 2 words mapped into the image. Word alignment is applied.

Table 230: SSI Transmitter Interface Modules

Input Process Image			
Offset	Byte Designation		Description
	High Byte	Low Byte	
0	D1	D0	Data bytes
1	D3	D2	

750-630/000-004, -005, -007

In the input process image, SSI transmitter interface modules with status occupy 5 usable bytes, 4 data bytes, and 1 additional status byte. A total of 3 words are assigned in the process image via word alignment.

Table 231: SSI Transmitter Interface I/O Modules with an Alternative Data Format (/000-004, -005, -007)

Input Process Image				
Offset	Byte Destination		Description	
	High Byte	High Byte		
0	-	S	not used	Status byte
1	D1	D0	Data bytes	
2	D3	D2		

13.2.5.8 Incremental Encoder Interface Modules

Incremental Encoder Interface Modules

750-631/000-004, -010, -011

The above Incremental Encoder Interface modules have 5 bytes of input data and 3 bytes of output data. The following tables illustrate the Input and Output Process Image, which have 4 words into each image. Word alignment is applied.

Table 232: Incremental Encoder Interface Modules 750-631/000-004, -010, -011

Input Process Image				
Offset	Byte Designation		Description	
	High Byte	Low Byte		
0	-	S	not used	Status byte
1	D1	D0	Counter word	
2	-	-	not used	
3	D4	D3	Latch word	

Output Process Image				
Offset	Byte Designation		Description	
	High Byte	Low Byte		
0	-	C	not used	Control byte
1	D1	D0	Counter setting word	
2	-	-	not used	
3	-	-	not used	

750-634

The above Incremental Encoder Interface module has 5 bytes of input data (6 bytes in cycle duration measurement mode) and 3 bytes of output data. The following tables illustrate the Input and Output Process Image, which has 4 words mapped into each image. Word alignment is applied.

Table 233: Incremental Encoder Interface Modules 750-634

Input Process Image				
Offset	Byte Designation		Description	
	High Byte	Low Byte		
0	-	S	not used	Status byte
1	D1	D0	Counter word	
2	-	(D2) *	not used	(Periodic time)
3	D4	D3	Latch word	

*) If cycle duration measurement mode is enabled in the control byte, the cycle duration is given as a 24-bit value that is stored in D2 together with D3/D4.

Output Process Image				
Offset	Byte Designation		Description	
	High Byte	Low Byte		
0	-	C	not used	Control byte
1	D1	D0	Counter setting word	
2	-	-	not used	
3	-	-		

750-637, (and all variations)

The above Incremental Encoder Interface Module has a total of 6 bytes of user data in both the Input and Output Process Image (4 bytes of encoder data and 2 bytes of control/status). The following table illustrates the Input and Output Process Image, which have 4 words mapped into each image. Word alignment is applied.

Table 234: Incremental Encoder Interface Modules 750-637, (and all variations)

Input and Output Process Image				
Offset	Byte Designation		Description	
	High Byte	Low Byte		
0	-	C0/S0	Control/Status byte of Channel 1	
1	D1	D0	Data Value of Channel 1	
2	-	C1/S1	Control/Status byte of Channel 2	
3	D3	D2	Data Value of Channel 2	

Digital Pulse Interface module750-635,
753-635

The above Digital Pulse Interface module has a total of 4 bytes of user data in both the Input and Output Process Image (3 bytes of module data and 1 byte of control/status). The following table illustrates the Input and Output Process Image, which have 2 words mapped into each image. Word alignment is applied.

Table 235: Digital Pulse Interface Modules 750-635, 753-635

Input and Output Process Image				
Offset	Byte Designation		Description	
	High Byte	Low Byte		
0	D0	C0/S0	Data byte	Control/status byte
1	D2	D1	Data bytes	

13.2.5.9 DC-Drive Controller

750-636, -636/000-700, -636/000-800

The DC-Drive Controller maps 6 bytes into both the input and output process image. The data sent and received are stored in up to 4 input and output bytes (D0 ... D3). Two control bytes (C0, C1) and two status bytes (S0/S1) are used to control the I/O module and the drive.

In addition to the position data in the input process image (D0 ... D3), it is possible to display extended status information (S2 ... S5). Then the three control bytes (C1 ... C3) and status bytes (S1 ... S3) are used to control the data flow.

Bit 3 of control byte C1 (C1.3) is used to switch between the process data and the extended status bytes in the input process image (Extended Info_ON). Bit 3 of status byte S1 (S1.3) is used to acknowledge the switching process.

Table 236: DC-Drive Controller 750-636, -636/000-700, -636/000-800

Input Process Image				
Offset	Byte Designation		Description	
	High Byte	Low Byte		
0	S1	S0	Status byte S1	Status byte S0
1	D1*) / S3**)	D0*) / S2**)	Actual position*) / Extended status byte S3**)	Actual position (LSB) / Extended status byte S2**)
2	D3*) / S5**)	D2*) / S4**)	Actual position (MSB) / Extended status byte S3**)	Actual position*) / Extended status byte S4**)

*) ExtendedInfo_ON = '0'.

**) ExtendedInfo_ON = '1'.

Output Process Image				
Offset	Byte Designation		Description	
	High Byte	Low Byte		
0	C1	C0	Control byte C1	Control byte C0
1	D1	D0	Setpoint position	Setpoint position (LSB)
2	D3	D2	Setpoint position (MSB)	Setpoint position

13.2.5.10 Stepper Controller

750-670, -671, -672

The Stepper controller provides the fieldbus coupler/controller 12 bytes input and output process image via 1 logical channel. The data to be sent and received are stored in up to 7 output bytes (D0 ... D6) and 7 input bytes (D0 ... D6), depending on the operating mode.

Output byte D0 and input byte D0 are reserved and have no function assigned.

One I/O module control and status byte (C0, S0) and 3 application control and status bytes (C1 ... C3, S1 ... S3) provide the control of the data flow.

Switching between the two process images is conducted through bit 5 in the control byte (C0 (C0.5)). Activation of the mailbox is acknowledged by bit 5 of the status byte S0 (S0.5).

Table 237: Stepper Controller 750-670, -671, -672

Input and Output Process Image				
Offset	Byte Designation		Description	
	High Byte	Low Byte		
0	Reserviert	C0/S0	reserved	Control/Status byte C0/S0
1	D1	D0	Process data*) / Mailbox**)	
2	D3	D2		
3	D5	D4		
4	S3	D6	Control/Status byte C3/S3	Process data*) / reserved**)
5	C1/S1	C2/S2	Control/Status byte C1/S1	Control/Status byte C2/S2

*) Cyclic process image (Mailbox disabled)

**) Mailbox process image (Mailbox activated)

13.2.5.11 RTC Module

750-640

The RTC Module has a total of 6 bytes of user data in both the Input and Output Process Image (4 bytes of module data and 1 byte of control/status and 1 byte ID for command). The following table illustrates the Input and Output Process Image, which have 3 words mapped into each image. Word alignment is applied.

Table 238: RTC Module 750-640

Input and Output Process Image				
Offset	Byte Designation		Description	
	High Byte	Low Byte		
0	ID	C/S	Command byte	Control/status byte
1	D1	D0	Data bytes	
2	D3	D2		

13.2.5.12 DALI/DSI Master Module

750-641

The DALI/DSI Master module has a total of 6 bytes of user data in both the Input and Output Process Image (5 bytes of module data and 1 byte of control/status). The following tables illustrate the Input and Output Process Image, which have 3 words mapped into each image. Word alignment is applied.

Table 239: DALI/DSI Master Module 750-641

Input Process Image				
Offset	Byte Designation		Description	
	High Byte	Low Byte		
0	D0	S	DALI Response	Status byte
1	D2	D1	Message 3	DALI Address
2	D4	D3	Message 1	Message 2

Output Process Image				
Offset	Byte Designation		Description	
	High Byte	Low Byte		
0	D0	C	DALI command, DSI dimming value	Control byte
1	D2	D1	Parameter 2	DALI Address
2	D4	D3	Command extension	Parameter 1

13.2.5.13 DALI Multi-Master Module

753-647

The DALI Multi-Master module occupies a total of 24 bytes in the input and output range of the process image.

The DALI Multi-Master module can be operated in "Easy" mode (default) and "Full" mode. "Easy" mode is used to transmit simply binary signals for lighting control. Configuration or programming via DALI master module is unnecessary in "Easy" mode.

Changes to individual bits of the process image are converted directly into DALI commands for a pre-configured DALI network. 22 bytes of the 24-byte process image can be used directly for switching of electronic ballasts (ECG), groups or scenes in "Easy" mode. Switching commands are transmitted via DALI and group addresses, where each DALI and each group address is represented by a 2-bit pair.

In full mode, the 24 bytes of the process image are used to tunnel a protocol using a mailbox interface. The process image consists of 1 byte for control / status and 23 bytes for the acyclic data.

The structure of the process data is described in detail in the following tables.

Table 240: DALI Multi-Master Module 753-647 in the "Easy" Mode

Input Process Image				
Offset	Byte Designation		Note	
	High Byte	Low Byte		
0	-	S	res.	Status, activate broadcast Bit 0: 1-/2-button mode Bit 2: Broadcast status ON/OFF Bit 1,3-7: -
1	DA4...DA7	DA0...DA3	Bit pair for DALI address DA0: Bit 1: Bit set = ON Bit not set = OFF Bit 2: Bit set = Error Bit not set = No error Bit pairs DA1 ... DA63 similar to DA0.	
2	DA12...DA15	DA8...DA11		
3	DA20...DA23	DA16...DA19		
4	DA28...DA31	DA24...DA27		
5	DA36...DA39	DA32...DA35		
6	DA44...DA47	DA40...DA43		
7	DA52...DA55	DA48...DA51		
8	DA60...DA63	DA56...DA59		
9	GA4...GA7	GA0...GA3	Bit pair for DALI group address GA0: Bit 1: Bit set = ON Bit not set = OFF Bit 2: Bit set = Error Bit not set = No error Bit pairs GA1 ... GA15 similar to GA0.	
10	GA12...GA15	GA8...GA11		
11	-	-		

DA = DALI address
GA = Group address

Output Process Image			
Offset	Byte Designation		Note
	High Byte	Low Byte	
0	-	C	res. Bit 0: Broadcast ON Bit 1: Broadcast OFF Bit 2: (1 button operation): - short: Broadcast ON/OFF - long: Broadcast dimming brighter/darker Bit 2: (2 buttons operation): - short: Broadcast ON/OFF - long: Broadcast dimming brighter Bit 3: (1 button operation): Broadcast ON/OFF Bit 3: (2 buttons operation): - short: Broadcast ON/OFF - long: Broadcast dimming darker Bit 4: Watchdog toggling (starting from FW06 of the DALI Multi-Master) Bit 5...7: reserved
1	DA4...DA7	DA0...DA3	Bit pair for DALI address:
2	DA12...DA15	DA8...DA11	Bit 1 (1 button operation):
3	DA20...DA23	DA16...DA19	- short: DA switch ON/OFF
4	DA28...DA31	DA24...DA27	- long: dimming brighter/darker
5	DA36...DA39	DA32...DA35	Bit 1 (2 buttons operation):
6	DA44...DA47	DA40...DA43	- short: DA switch ON
7	DA52...DA55	DA48...DA51	- long: dimming brighter
8	DA60...DA63	DA56...DA59	Bit 2 (1 button operation): DA switch ON/OFF Bit 2 (2 buttons operation): - short: DA switch OFF - long: dimming darker
9	GA4...GA7	GA0...GA3	Bit pair for DALI group address:
10	GA12...GA15	GA8...GA11	Bit 1 (1 button operation): - short: GA switch ON/OFF - long: dimming brighter/darker Bit 1 (2 buttons operation): - short: GA switch ON - long: dimming brighter Bit 2 (1 button operation): GA switch ON/OFF Bit 2 (2 buttons operation): - short: GA switch OFF - long: dimming darker
11	Bit 8...15	Bit 0...7	Switch scene 0...15

DA = DALI address
GA = Group address

Table 241: DALI Multi-Master Module 753-647 in the "Full" Mode

Input and Output Process Image				
Offset	Byte Designation		Note	
	High Byte	Low Byte		
0	MBX_C/S	C0/S0	Mailbox control/status byte	control/status byte
1	MBX1	MBX0	Mailbox	
2	MBX3	MBX2		
3	MBX5	MBX4		
4	MBX7	MBX6		
5	MBX9	MBX8		
6	MBX11	MBX10		
7	MBX13	MBX12		
8	MBX15	MBX14		
9	MBX17	MBX16		
10	MBX19	MBX18		
11	MBX21	MBX20		

13.2.5.14 LON[®] FTT Module

753-648

The process image of the LON[®] FTT module consists of a control/status byte and 23 bytes of bidirectional communication data that is processed by the WAGO-I/O-PRO function block "LON_01.lib". This function block is essential for the function of the LON[®] FTT module and provides a user interface on the control side.

Table 242: LON[®] FTT Module 753-648

Input and Output Process Image				
Offset	Byte Designation		Note	
	High Byte	Low Byte		
0	MBX_C/S	C0/S0	Mailbox control/status byte	control/status byte
1	MBX1	MBX0	Mailbox	
2	MBX3	MBX2		
3	MBX5	MBX4		
4	MBX7	MBX6		
5	MBX9	MBX8		
6	MBX11	MBX10		
7	MBX13	MBX12		
8	MBX15	MBX14		
9	MBX17	MBX16		
10	MBX19	MBX18		
11	MBX21	MBX20		

13.2.5.15 EnOcean Radio Receiver

750-642

The EnOcean radio receiver has a total of 4 bytes of user data in both the Input and Output Process Image (3 bytes of module data and 1 byte of control/status). The following tables illustrate the Input and Output Process Image, which have 2 words mapped into each image. Word alignment is applied.

Table 243: EnOcean Radio Receiver 750-642

Input Process Image				
Offset	Byte Destination		Description	
	High Byte	Low Byte		
0	D0	S	Data byte	Status byte
1	D2	D1	Data bytes	

Output Process Image				
Offset	Byte Destination		Description	
	High Byte	Low Byte		
0	-	C	not used	Control byte
1	-	-	not used	

13.2.5.16 MP Bus Master Module

750-643

The MP Bus Master Module has a total of 8 bytes of user data in both the Input and Output Process Image (6 bytes of module data and 2 bytes of control/status). The following table illustrates the Input and Output Process Image, which have 4 words mapped into each image. Word alignment is applied.

Table 244: MP Bus Master Module 750-643

Input and Output Process Image				
Offset	Byte Destination		Description	
	High Byte	Low Byte		
0	C1/S1	C0/S0	Extended Control/Status byte	Control/status byte
1	D1	D0	Data bytes	
2	D3	D2		
3	D5	D4		

13.2.5.17 Bluetooth® RF-Transceiver

750-644

The size of the process image for the *Bluetooth*® module can be adjusted to 12, 24 or 48 bytes.

It consists of one control byte (input) or status byte (output); an empty byte; an overlay able mailbox with a size of 6, 12 or 18 bytes (mode 2); and the *Bluetooth*® process data with a size of 4 to 46 bytes.

Thus, each *Bluetooth*® module uses between 12 and 48 bytes in the process image. The sizes of the input and output process images are always the same.

The first byte contains the control/status byte; the second contains an empty byte.

Process data attach to this directly when the mailbox is hidden. When the mailbox is visible, the first 6, 12 or 18 bytes of process data are overlaid by the mailbox data, depending on their size. Bytes in the area behind the optionally visible mailbox contain basic process data. The internal structure of the *Bluetooth*® process data can be found in the documentation for the *Bluetooth*® 750-644 RF Transceiver.

The mailbox and the process image sizes are set with the startup tool WAGO-I/O-CHECK.

Table 245: *Bluetooth*® RF-Transceiver 750-644

Input and Output Process Image					
Process image size	Offset	Byte Destination		Description	
		High Byte	Low Byte		
12 bytes	0	-	C0/S0	not used	Control/status byte
	1	D1	D0	Mailbox (0, 6, 12 or 18 words)/ Process data (4 ... 46 words)	
		
5	D9	D8			
24 bytes	6	D11	D10		
		
11	D21	D20			
48 bytes*)	12	D23	D22		
		
	23	D45	D44		

*) Factory Setting

13.2.5.18 Vibration Velocity/Bearing Condition Monitoring VIB I/O

750-645

The Vibration Velocity/Bearing Condition Monitoring VIB I/O has a total of 12 bytes of user data in both the Input and Output Process Image (8 bytes of module data and 4 bytes of control/status). The following table illustrates the Input and Output Process Image, which have 8 words mapped into each image. Word alignment is applied.

Table 246: Vibration Velocity/Bearing Condition Monitoring VIB I/O 750-645

Input and Output Process Image				
Offset	Byte Destination		Description	
	High Byte	Low Byte		
0	-	C0/S0	not used	Control/status byte (log. Channel 1, Sensor input 1)
1	D1	D0	Data bytes (log. Channel 1, Sensor input 1)	
2	-	C1/S1	not used	Control/status byte (log. Channel 2, Sensor input 2)
3	D3	D2	Data bytes (log. Channel 2, Sensor input 2)	
4	-	C2/S2	not used	Control/status byte (log. Channel 3, Sensor input 1)
5	D5	D4	Data bytes (log. Channel 3, Sensor input 3)	
6	-	C3/S3	not used	Control/status byte (log. Channel 4, Sensor input 2)
7	D7	D6	Data bytes (log. Channel 4, Sensor input 2)	

13.2.5.19 KNX/EIB/TP1 Module

753-646

The KNX/TP1 module appears in router and device mode with a total of 24-byte user data within the input and output area of the process image, 20 data bytes and 2 control/status bytes. Even though the additional bytes S1 or C1 are transferred as data bytes, they are used as extended status and control bytes. The opcode is used for the read/write command of data and the triggering of specific functions of the KNX/EIB/TP1 module. Word-alignment is used to assign 12 words in the process image. Access to the process image is not possible in router mode. Telegrams can only be tunneled.

In device mode, access to the KNX data can only be performed via special function blocks of the IEC application. Configuration using the ETS engineering tool software is required for KNX.

Table 247: KNX/EIB/TP1 Module 753-646

Input and Output Process Image				
Offset	Byte Destination		Description	
	High Byte	Low Byte		
0	-	C0/S0	not used	Control/Status byte
1	C1/S1	OP	extended Control/Status byte	Opcode
2	D1	D0	Data byte 1	Data byte 0
3	D3	D2	Data byte 3	Data byte 2
4	D5	D4	Data byte 5	Data byte 4
5	D7	D6	Data byte 7	Data byte 6
6	D9	D8	Data byte 9	Data byte 8
7	D11	D10	Data byte 11	Data byte 10
8	D13	D12	Data byte 13	Data byte 12
9	D15	D14	Data byte 15	Data byte 14
10	D17	D16	Data byte 17	Data byte 16
11	D19	D18	Data byte 19	Data byte 18

13.2.5.20 Proportional Valve Module

750-632, -632/000-100

The size of the process image of the proportional valve modules depends on the set operating mode. The operating mode with one valve occupies has a total of 6 data bytes in both the Input and Output Process Image, and the operating mode with two valves occupies has a total of 12 data bytes in both the Input and Output Process Image. The following tables illustrate the Input and Output Process Images, which have 3 words mapped into each image for operating mode with one valve and 6 words for operating mode with two valves. Word alignment is applied.

Table 248: Proportional valve module operating mode with one valve 750-632, 753-632/000-100

Input Process Image				
Offset	Byte Designation		Description	
	High Byte	Low Byte		
0	MBX_ST	S0	Mailbox Status byte	Status byte S0
1	V1	MBX_DATA	Status byte V1	Mailbox
2	V1_ACTUAL_H	V1_ACTUAL_L	Process data	

Output Process Image				
Offset	Byte Designation		Description	
	High Byte	Low Byte		
0	MBX_CTRL	C0	Mailbox control byte	Control byte C0
1	V1	MBX_DATA	Control byte V1	Mailbox
2	V1_SETPOINTVALUE_H	V1_SETPOINTVALUE_L	Process data	

Table 249: Proportional valve module operating mode with two valves 750-632, 753-632/000-100

Input Process Image				
Offset	Byte Designation		Description	
	High Byte	Low Byte		
0	MBX_ST	S0	Mailbox Status byte	Status byte S0
1	MBX_DATA2	MBX_DATA1	Mailbox	
2	MBX_DATA4	MBX_DATA3		
3	V2	V1	Status byte V2	Status byte V1
4	V1_ACTUAL_H	V1_ACTUAL_L	Process data	
5	V2_ACTUAL_H	V2_ACTUAL_L		

Output Process Image				
Offset	Byte Designation		Description	
	High Byte	Low Byte		
0	MBX_CTRL	C0	Mailbox control byte	Control byte C0
1	MBX_DATA2	MBX_DATA1	Mailbox	
2	MBX_DATA4	MBX_DATA3		
3	V2	V1	Control byte V2	Control byte V1
4	V1_SETPOINTVALUE_H	V1_SETPOINTVALUE_L	Process data	
5	V2_SETPOINTVALUE_H	V2_SETPOINTVALUE_L		

13.2.5.21 M-Bus Master Module

753-649

The M-Bus master 753-649 has a cyclic 24 byte process image for the local bus in both the Input and Output Process Image.

In addition to the control/status byte and the empty byte, an acyclic channel that occupies 22 bytes of data is embedded in the process image for the process communication.

For data access, the WAGO-IEC function blocks are available of the library „MBUS_649_01.lib“.

The input and output data exchange is event-driven.

Table 250: M-BUS Master Module 753-649

Input and Output Process Image				
Offset	Byte Designation		Description	
	High Byte	Low Byte		
0	-	C0/S0	Not used	Control/Status byte
1	MBX0	MBX_C/S	Mailbox	Mailbox Control/Status byte
2	MBX2	MBX1	Mailbox	
3	MBX4	MBX3		
4	MBX6	MBX5		
5	MBX8	MBX7		
6	MBX10	MBX9		
7	MBX12	MBX11		
8	MBX14	MBX13		
9	MBX16	MBX15		
10	MBX18	MBX17		
11	MBX20	MBX19		

13.2.5.22 IO-Link Master

750-657

The process image size of the IO-Link master can be adjusted to the devices (switches, IO-Link compatible devices, etc.) attached to the IO-Link ports.

Process image sizes of 4, 6, 8, 10, 12, 16, 20 or 24 bytes can be set.

As process data is exchanged, the process image has a fixed structure of a control/status byte, Mailbox bytes and SIO byte regardless of the current configuration.

The mailbox starts in the process image with an offset of 1 (after the control / status byte) and occupies at least 2 bytes (FC0, MB0). The mailbox size can be set to a maximum of x bytes ($x = \text{total PA size} - 1 \text{ SIO byte} - 1 \text{ control / status byte}$) to configure the IO-Link master.

Depending on the set mailbox size, another data storage area is available behind the SIO byte in which cyclical process data can be transferred from IO-Link devices.

The mailbox and the process image sizes are set with the startup tool WAGO-I/O-CHECK.

Table 251: IO-Link Master 750-657

Input and Output Process Image					
Process image size	Offset	Byte Designation		Description	
		High Byte	Low Byte		
4 bytes	0	FC0	C0/S0	Acyclic channel	Control/Status byte
	1	SIO	MB0	SIO byte	Mailbox byte
6 bytes	2	D1	D0	Mailbox (0 ... 20 bytes)/ Process data (0 ... 20 bytes)	
8 bytes	3	D3	D2		
10 bytes	4	D5	D4		
12 bytes	5	D7	D6		
16 bytes	6	D9	D8		
	7	D11	D10		
20 bytes	8	D13	D12		
	9	D15	D14		
24 bytes*	10	D17	D16		
	11	D19	D18		

*) Factory Setting

13.2.5.23 CAN Gateway

750-658

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 protocol.

The operating mode and also the mailbox and the process image sizes are set with the startup tool WAGO-I/O-CHECK.

Table 252: CAN Gateway 750-658

Input and Output Process Image					
Process image size	Offset	Byte Designation		Description	
		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 (44 Bytes) ***	
	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	Toggle-Byte +CAN-Nutzdaten (44 Bytes) ***	
	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“

13.2.5.24 Servo Stepper Controller

750-673

The stepper servo provides the fieldbus coupler / controller with a 12-byte input and output process image via 1 logical channel.

The data to be sent and received is stored in up to 7 output bytes (D0 ... D6) and 7 input bytes (D0 ... D6) depending on the operating mode. The output byte D0 and the input byte D0 are reserved and without function.

A local bus control and status byte (C0, S0) as well as 3 control and status bytes for the application (C1 ... C3, S1 ... S3) are used to control the data flow.

The changeover between both process images takes place via bit 5 in control byte C0 (C0.5). Bit 5 of the status byte S0 (S0.5) acknowledges the activation of the mailbox.

Table 253: Servo Stepper Controller 750-673

Input and Output Process Image				
Offset	Byte Designation		Description	
	High Byte	Low Byte		
0	reserved	C0/S0	reserved	Control/status byte C0/S0
1	D1	D0	Process data*) / Mailbox**)	
2	D3	D2		
3	D5	D4		
4	C3/S3	D6	Control/status byte C3/S3	Process data*) / reserved**)
5	C1/S1	C2/S2	Control/status byte C1/S1	Control/status byte C2/S2

*) Cyclic process image (Mailbox deactivated)

**) Mailbox process image (Mailbox activated)

13.2.5.25 SMI Master Module

753-1630, -1631

The 753-1630 I/O module has a cyclic 12 byte process image for the local bus in both the Input and Output Process Image.

Process data communication with the SMI master module is conducted in fieldbus coupler mode via a cyclic process image and in Full mode via the Mailbox 2.0 protocol.

Byte 0 of the process image contains the control/status byte and byte 1 the extended control/status byte. Depending on the control/status byte, bytes 2 to 11 contain data from Mailbox 2.0 or the cyclic process image.

The changeover between Mailbox 2.0 and the cyclic process image takes place via bit 5 in control byte C0 (C0.5). Bit 5 of the status byte S0 (S0.5) acknowledges the activation of the mailbox.

Tabelle 254: SMI Master Module 753-1630, -1631 in Fieldbus Coupler Mode

Input Process Image				
Offset	Byte Designation		Description	
	High Byte	Low Byte		
0	S1	S0	Extended status byte	Status byte
1	-	-	Not used	
2	-	-		
3	D5	D4	Reflection of the group mask bit 0...15	
4	D7	D6	Response to the command	
5	D9	D8	Shutter actual position	Slat actual position

Output Process Image				
Offset	Byte Designation		Description	
	High Byte	Low Byte		
0	C1	C0	Extended control byte	Control byte
1	D1	D0	2-button operation upwards	2-button operation upwards
			Bit 0: Address 8 ... Bit 7: Address 15	Bit 0: Address 0 ... Bit 7: Address 7
2	D3	D2	2-button operation downwards	2-button operation downwards
			Bit 0: Address 8 ... Bit 7: Address 15	Bit 0: Address 0 ... Bit 7: Address 7
3	D5	D4	Group mask bit 0...15	
4	D7	D6	Commands	
5	D9	D8	Shutter target position	Slat target position

Table 255: SMI Master Module 753-1630, -1631 in „Full Mode“

Input and Output Process Image				
Offset	Byte Designation		Description	
	High Byte	Low Byte		

0	S1/C1	S0/C0	Extended Control/Status byte	Control/Status byte
1	MBX0	MBX_C/S	Mailbox	Mailbox Control/Status byte
2	MBX2	MBX1	Mailbox	
3	MBX4	MBX3		
4	MBX6	MBX5		
5	MBX8	MBX7		
6	MBX10	MBX9		
7	MBX12	MBX11		
8	MBX14	MBX13		
9	MBX16	MBX15		
10	MBX18	MBX17		
11	MBX20	MBX19		

13.2.5.26 AS-interface Master Module

750-655,
753-655

The length of the process image of the AS-interface master module can be set to fixed sizes of 12, 20, 24, 32, 40 or 48 bytes.

It consists of a control or status byte, a mailbox with a size of 0, 6, 10, 12 or 18 bytes and the AS-interface process data, which can range from 0 to 46 bytes.

The AS-interface master module has a total of 6 to maximally 24 words data in both the Input and Output Process Image. Word alignment is applied.

The first Input and output word, which is assigned to an AS-interface master module, contains the status / control byte and one empty byte.

Subsequently the mailbox data are mapped, when the mailbox is permanently superimposed (Mode 1).

In the operating mode with suppressible mailbox (Mode 2), the mailbox and the cyclical process data are mapped next.

The following words contain the remaining process data.

The mailbox and the process image sizes are set with the startup tool *WAGO-I/O-CHECK*.

Table 256: AS-interface Master Module 750-655, 753-655

Input and Output Process Image					
Process image size	Offset	Byte Designation		Description	
		High Byte	Low Byte		
12 bytes	0	-	C0/S0	Not used	Control-/Status byte
	1	D1	D0	Mailbox (0, 6, 10, 12 or 18 bytes)/ Process data (0-46 bytes)	
	...				
5	D9	D8			
20 bytes	6	D11	D10		
	...				
	9	D17	D16		

24 bytes *	10	D19	D18
	11	D21	D20
32 bytes	12	D23	D22
	...		
	15	D29	D28
40 bytes	16	D31	D30
	...		
	19	D37	D36
48 bytes	12	D39	D38
	...		
	23	D45	D44

*) Factory Setting

13.2.6 System Modules

13.2.6.1 System Modules with Diagnostics

750-606

The modules provide 2 bits of diagnostics in the Input Process Image for monitoring of the internal power supply.

Table 257: System Modules with Diagnostics 750-606, -611

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

750-610, -611

The modules provide 2 bits of diagnostics in the Input Process Image for monitoring of the internal power supply.

Table 258: System Modules with Diagnostics 750-610, -611

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

13.2.6.2 Filter Module

750-624/020-002, -626/020-002

The Filter Module 750-624/020-002 and 750-626/020-002 equipped with surge suppression for the field side power supply have a total of 8 bits in both the Input and Output Process Image.

Table 259: Filter Modules 750-624/020-002, 750-626/020-002

Input Process Image							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0V_MA	0V_PA	24V_MA	24V_PA	not used	PWR_DIAG	not used	VAL

Output Process Image							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
not used	not used	not used	not used	not used	not used	not used	GFT

13.2.6.3 Binary Space Module

750-622

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 260: Binary Space Module 750-622 (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

14 Application Examples

14.1 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>

14.2 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 261: 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”.

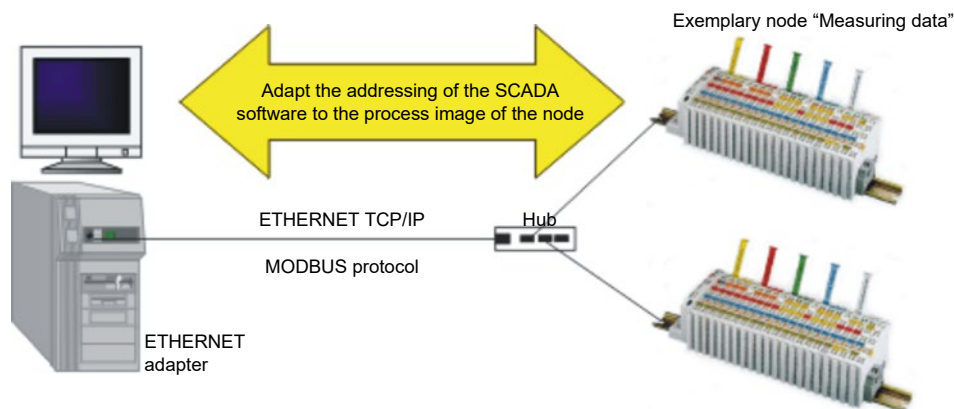


Figure 60: Example SCADA Software with Modbus Driver

Information



Additional Information

Please refer to the respective SCADA product manual for a detailed description of the particular software operation.

15 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.

15.1 Marking Configuration Examples

15.1.1 Marking for Europe According to ATEX and IECEx

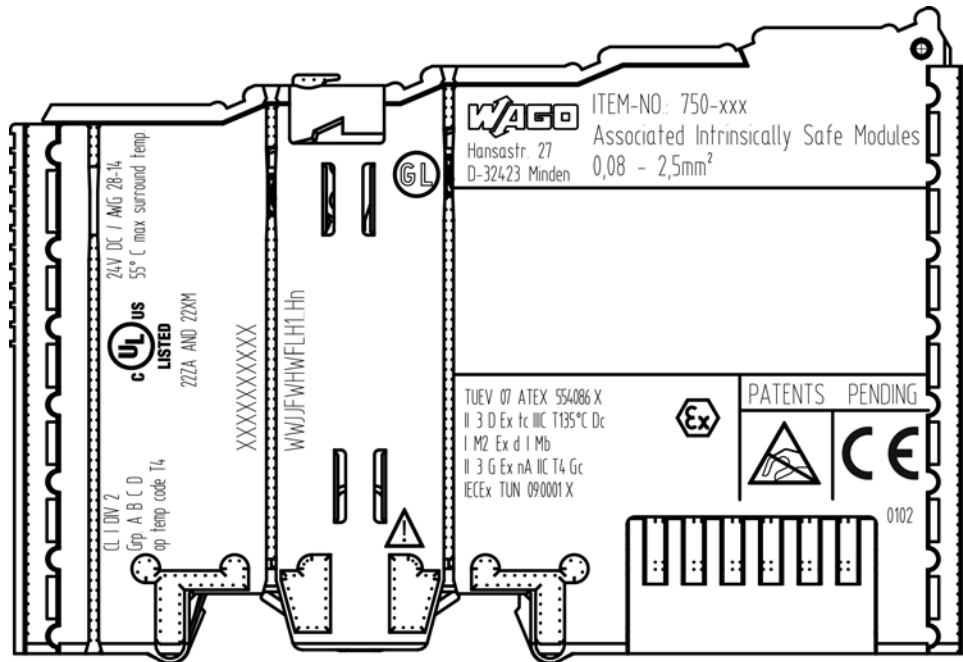


Figure 61: Marking Example According to ATEX and IECEx


TUEV 07 ATEX 554086 X 
 II 3 D Ex tc IIC T135°C Dc
 I M2 Ex d I Mb
 II 3 G Ex nA IIC T4 Gc
 IECEx TUN 090001 X

Figure 62: Text Detail – Marking Example According to ATEX and IECEx

Table 262: 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)

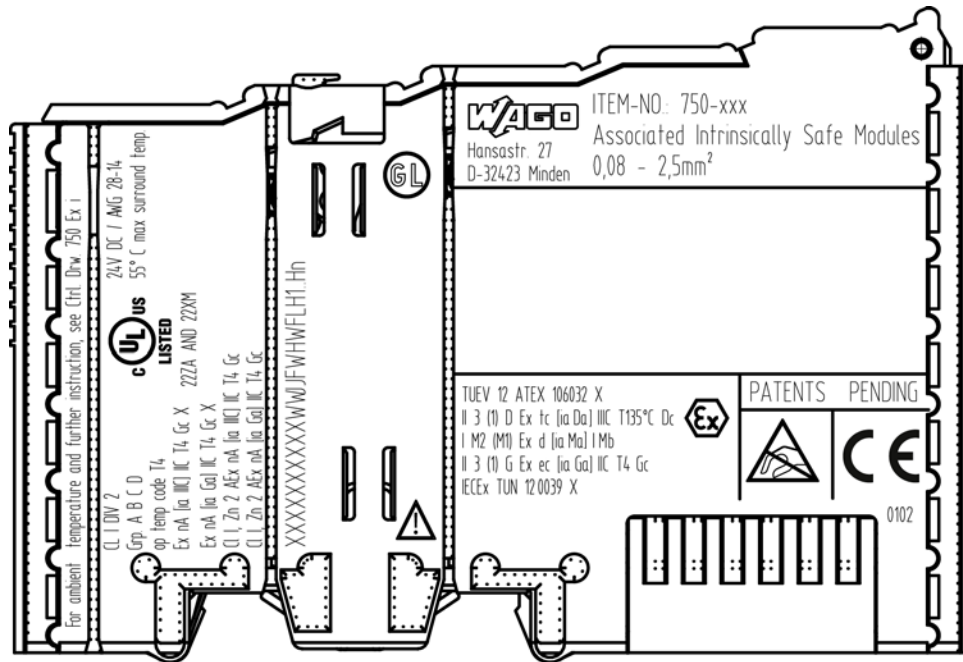


Figure 63: Marking Example for Approved I/O Module Ex i According to ATEX and IECEx

TUEV 12 ATEX 106032 X
 II 3 (1) D Ex tc [ia Da] IIC 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 64: Text Detail – Marking Example for Approved I/O Module Ex i According to ATEX and IECEx

Table 263: Description of Marking Example for Approved I/O Module Ex I 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)

15.1.2 Marking for the United States of America (NEC) and Canada (CEC)

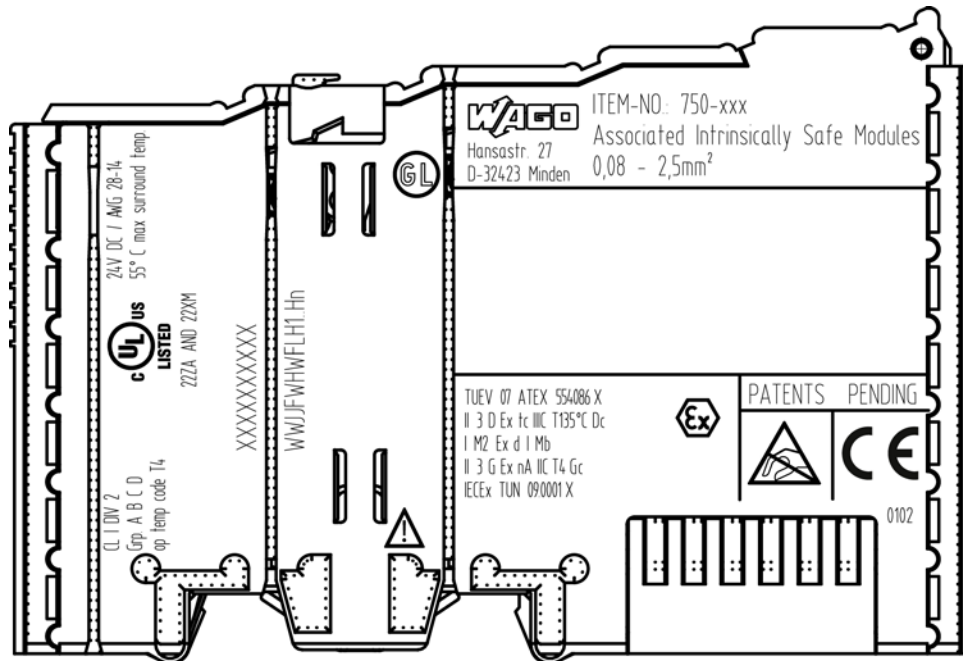


Figure 65: Marking Example According to NEC

CL I DIV 2
 Grp. A B C D
 op temp code T4

Figure 66: Text Detail – Marking Example According to NEC 500

Table 264: 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

CI I, Zn 2 AEx nA [ia Ga] IIC T4 Gc

Figure 67: Text Detail – Marking Example for Approved I/O Module Ex i According to NEC 505

Table 265: Description of Marking Example for Approved I/O Module Ex i According to NEC 505

Marking	Description
CI 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)

CI I, Zn 2 AEx nA [ia IIIC] IIC T4 Gc

Figure 68: Text Detail – Marking Example for Approved I/O Module Ex i According to NEC 506

Table 266: Description of Marking Example for Approved I/O Module Ex i According to NEC 506

Marking	Description
CI 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 69: Text Detail – Marking Example for Approved I/O Module Ex i According to CEC 18 attachment J

Table 267: Description of Marking Example for Approved I/O Module Ex i 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

15.2 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.

15.2.1 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 $0\text{ °C} \leq T_a \leq +55\text{ °C}$ or $-20\text{ °C} \leq T_a \leq +60\text{ °C}$ for components with extension number .../025-xxx or $-40\text{ °C} \leq T_a \leq +70\text{ °C}$ 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.

15.2.2 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.

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