WAGO I/O SYSTEM 750

Modular I/O-System

Fieldbus Coupler

PROFINET IO

750-340

Manual

Technical description,
installation and
configuration

Version 1.0.0

WAGO®
INNOVATIVE CONNECTIONS

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Every conceivable measure has been taken to ensure the correctness and completeness of this documentation. However, as errors can never be fully excluded we would appreciate any information or ideas at any time.

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We wish to point out that the software and hardware terms as well as the trademarks of companies used and/or mentioned in the present manual are generally trademark or patent protected.

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1 Important Notes

This section provides only a summary of the most important safety requirements and notes which will be mentioned in the individual sections. To protect your health and prevent damage to the devices, it is essential to read and carefully follow the safety guidelines.

1.1 Legal Principles

1.1.1 Copyright

This manual including all figures and illustrations contained therein is subject to copyright. Any use of this manual which infringes the copyright provisions stipulated herein, is not permitted. Reproduction, translation and electronic and phototechnical archiving and amendments require the written consent of WAGO Kontakttechnik GmbH & Co. KG, Minden. Non-observance will entail the right of claims for damages.

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All rights developing from the issue of a patent or the legal protection of utility patents are reserved to WAGO Kontakttechnik GmbH & Co. KG. Third-party products are always indicated without any notes concerning patent rights. Thus, the existence of such rights must not be excluded.

1.1.2 Personnel Qualification

The use of the product described in this manual requires special qualifications, as shown in the following table:

Activity	Electrical specialist	Instructed personnel*)	Specialists**) having qualifications in PLC programming
Assembly	X	X	
Commissioning	X		X
Programming			X
Maintenance	X	X	
Troubleshooting	X		
Disassembly	X	X	

*) Instructed persons have been trained by qualified personnel or electrical specialists.

**) A specialist is someone who, through technical training, knowledge and experience, demonstrates the ability to meet the relevant specifications and identify potential dangers in the mentioned field of activity.

All personnel must be familiar with the applicable standards.
WAGO Kontakttechnik GmbH & Co. KG declines any liability resulting from

improper action and damage to WAGO products and third party products due to non-observance of the information contained in this manual.

1.1.3 Conforming Use of Series 750

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

The device is designed for IP20 protection class. It is protected against finger touch and solid impurities up to 12.5mm diameter, but not against water penetration. Unless otherwise specified, the device must not be operated in wet and dusty environments.

1.1.4 Technical Condition of the Devices

For each individual application, the components are supplied from the factory with a dedicated hardware and software configuration. Changes in hardware, software and firmware are only admitted within the framework of the possibilities documented in the manuals. All changes to the hardware or software and the non-conforming use of the components entail the exclusion of liability on the part of WAGO Kontakttechnik GmbH & Co. KG.

Please direct any requirements pertaining to a modified and/or new hardware or software configuration directly to WAGO Kontakttechnik GmbH & Co. KG.

1.2 Standards and Regulations for Operating the 750 Series

Please observe the standards and regulations that are relevant to your installation:

- The data and power lines must be connected and installed in compliance with the standards to avoid failures on your installation and eliminate any danger to personnel.
- For installation, startup, maintenance and repair, please observe the accident prevention regulations of your machine (e.g. BGV A 3, "Electrical Installations and Equipment").
- Emergency stop functions and equipment must not be made ineffective. See relevant standards (e.g. DIN EN 418).
- Your installation must be equipped in accordance to the EMC guidelines so that electromagnetic interferences can be eliminated.
- Operating 750 Series components in home applications without further measures is only permitted if they meet the emission limits (emissions of interference) according to EN 61000-6-3. You will find the relevant information in the section on "WAGO-I/O-SYSTEM 750" → "System Description" → "Technical Data".

- Please observe the safety measures against electrostatic discharge according to DIN EN 61340-5-1/-3. When handling the modules, ensure that the environment (persons, workplace and packing) is well grounded.
- The relevant valid and applicable standards and guidelines concerning the installation of switch cabinets are to be observed.

1.3 Symbols

Danger
Always observe this information to protect persons from injury.

Warning
Always observe this information to prevent damage to the device.

Attention
Marginal conditions that must always be observed to ensure smooth and efficient operation.

ESD (Electrostatic Discharge)
Warning of damage to the components through electrostatic discharge. Observe the precautionary measure for handling components at risk of electrostatic discharge.

Note
Make important notes that are to be complied with so that a trouble-free and efficient device operation can be guaranteed.

Additional Information
References to additional literature, manuals, data sheets and INTERNET pages.

1.4 Safety Information

When connecting the device to your installation and during operation, the following safety notes must be observed:

Danger
The WAGO-I/O-SYSTEM 750 and its components are an open system. It must only be assembled in housings, cabinets or in electrical operation rooms. Access is only permitted via a key or tool to authorized qualified personnel.

Danger
All power sources to the device must always be switched off before carrying out any installation, repair or maintenance work.

Warning
Replace defective or damaged device/module (e.g. in the event of deformed contacts), as the functionality of fieldbus station in question can no longer be ensured on a long-term basis.

Warning
The components are not resistant against materials having seeping and insulating properties. Belonging to this group of materials is: e.g. aerosols, silicones, triglycerides (found in some hand creams). If it cannot be ruled out that these materials appear in the component environment, then the components must be installed in an enclosure that is resistant against the above mentioned materials. Clean tools and materials are generally required to operate the device/module.

Warning
Soiled contacts must be cleaned using oil-free compressed air or with ethyl alcohol and leather cloths.

Warning
Do not use contact sprays, which could possibly impair the functioning of the contact area.

Warning
Avoid reverse polarity of data and power lines, as this may damage the devices.

ESD (Electrostatic Discharge)
The devices are equipped with electronic components that may be destroyed by electrostatic discharge when touched.

1.5 Font Conventions

italic	Names of paths and files are marked in italic. e.g.: *C:\Programs\WAGO-IO-CHECK*
italic	Menu items are marked in bold italic. e.g.: ***Save***
\	A backslash between two names characterizes the selection of a menu point from a menu. e.g.: ***File \ New***
END	Press buttons are marked as bold with small capitals e.g.: **ENTER**
< >	Keys are marked bold within angle brackets e.g.: **<F5>**
`Courier`	The print font for program codes is Courier. e.g.: `END_VAR`

1.6 Number Notation

Number code	Example	Note
Decimal	100	Normal notation
Hexadecimal	0x64	C notation
Binary	'100' '0110.0100'	Within ', Nibble separated with dots

1.7 Scope

This manual describes the field bus independent WAGO-I/O-SYSTEM 750 with the fieldbus coupler for PROFINET IO.

Item.-No.	Description
750-340	Fieldbus Coupler PROFINET IO

1.8 Abbreviation

AI	Analog Input
AO	Analog Output
DI	Digital Input
DO	Digital Output
I/O	Input/Output
ID	Identifier

2 The WAGO-I/O-SYSTEM 750

2.1 System Description

The WAGO-I/O-SYSTEM 750 is a modular, fieldbus independent I/O system. It is comprised of a fieldbus coupler/controller (1) and connected fieldbus modules (2) for any type of signal. Together, these make up the fieldbus node. The end module (3) completes the node.

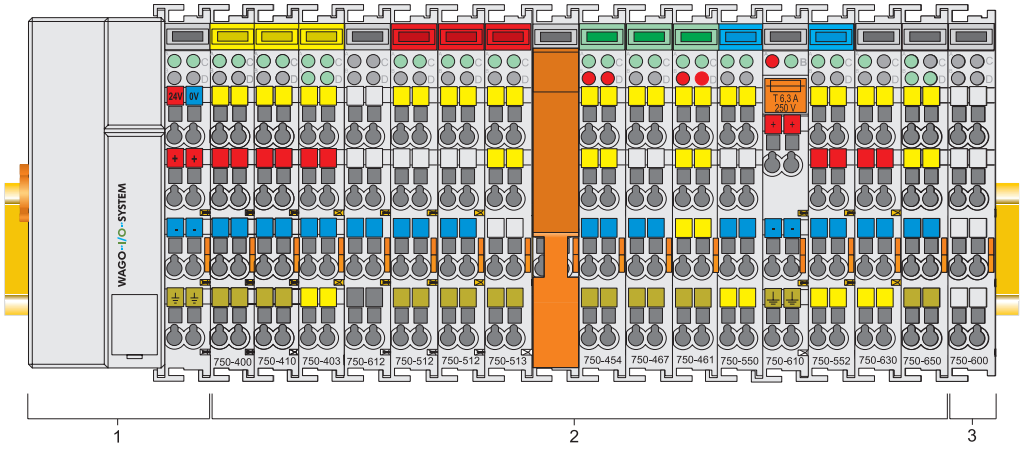


Fig. 2-1: Fieldbus node g0xxx00x

Couplers/controllers for fieldbus systems such as PROFIBUS, INTERBUS, ETHERNET TCP/IP, CAN (CANopen, DeviceNet, CAL), MODBUS, LON and others are available.

The coupler/controller contains the fieldbus interface, electronics and a power supply terminal. 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. The 24 V system supply and the 24 V field supply are fed in via the integrated power supply terminal. The fieldbus coupler communicates via the relevant fieldbus. The programmable fieldbus controller (PFC) enables the implementation of additional PLC functions. Programming is done with the WAGO-I/O-PRO 32 in accordance with IEC 61131-3.

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

The WAGO-I/O-SYSTEM 750 has a clear port level with LEDs for status indication, insertable mini WSB markers and pullout group marker carriers. The 3-wire technology supplemented by a ground wire connection allows for direct sensor/actuator wiring.

2.2 Technical Data

Mechanic	
Material	Polycarbonate, Polyamide 6.6
Dimensions W x H* x L * from upper edge of DIN 35 rail - Coupler/Controller (Standard) - Coupler/Controller (ECO) - Coupler/Controller (FireWire) - I/O module, single - I/O module, double - I/O module, fourfold	 - 51 mm x 65 mm x 100 mm - 50 mm x 65 mm x 100 mm - 62 mm x 65 mm x 100 mm - 12 mm x 64 mm x 100 mm - 24 mm x 64 mm x 100 mm - 48 mm x 64 mm x 100 mm
Installation	on DIN 35 with interlock
modular by	double featherkey-dovetail
Mounting position	any position
Marking	marking label type 247 and 248 paper marking label 8 x 47 mm
Connection	
Connection type	CAGE CLAMP®
Wire range	0.08 mm² ... 2.5 mm², AWG 28-14
Stripped length	8 – 9 mm, 9 – 10 mm for components with pluggable wiring (753-xxx)
Contacts	
Power jumpers contacts	blade/spring contact self-cleaning
Current via power contacts$_{max}$	10 A
Voltage drop at I_{max}	< 1 V/64 modules
Data contacts	slide contact, hard gold plated 1.5 µm, self-cleaning
Climatic environmental conditions	
Operating temperature	0 °C ... 55 °C, -20 °C … +60 °C for components with extended temperature range (750-xxx/025-xxx)
Storage temperature	-20 °C ... +85 °C
Relative humidity	5 % to 95 % without condensation
Resistance to harmful substances	acc. to IEC 60068-2-42 and IEC 60068-2-43
Maximum pollutant concentration at relative humidity < 75%	$SO_2 \leq 25$ ppm $H_2S \leq 10$ ppm
Special conditions	Ensure that additional measures for components are taken, which are used in an environment involving: – dust, caustic vapors or gasses – ionization radiation.

Safe electrical isolation				
Air and creepage distance	acc. to IEC 60664-1			
Degree of pollution acc. To IEC 61131-2	2			
Degree of protection				
Degree of protection	IP 20			
Electromagnetic compatibility				
Immunity to interference for industrial areas acc. to EN 61000-6-2 (2001)				
Test specification	**Test values**		**Strength class**	**Evaluation criteria**
EN 61000-4-2 ESD	4 kV/8 kV (contact/air)		2/3	B
EN 61000-4-3 electromagnetic fields	10 V/m 80 MHz ... 1 GHz		3	A
EN 61000-4-4 burst	1 kV/2 kV (data/supply)		2/3	B
EN 61000-4-5 surge	Data:	-/- (line/line)		B
		1 kV (line/earth)	2	
	DC supply:	0.5 kV (line/line)	1	B
		0.5 kV (line/earth)	1	
	AC supply:	1 kV (line/line)	2	B
		2 kV (line/earth)	3	
EN 61000-4-6 RF disturbances	10 V/m 80 % AM (0.15 ... 80 MHz)		3	A
Emission of interference for industrial areas acc. to EN 61000-6-4 (2001)				
Test specification	**Limit values/[QP]*)**		**Frequency range**	**Distance**
EN 55011 (AC supply, conducted)	79 dB (µV)		150 kHz ... 500 kHz	
	73 dB (µV)		500 kHz ... 30 MHz	
EN 55011 (radiated)	40 dB (µV/m)		30 MHz ... 230 MHz	10 m
	47 dB (µV/m)		230 MHz ... 1 GHz	10 m
Emission of interference for residential areas acc. to EN 61000-6-3 (2001)				
Test specification	**Limit values/[QP]*)**		**Frequency range**	**Distance**
EN 55022 (AC supply, conducted)	66 ... 56 dB (µV)		150 kHz ... 500 kHz	
	56 dB (µV)		500 kHz ... 5 MHz	
	60 dB (µV)		5 MHz ... 30 MHz	
EN 55022 (DC supply/data, conducted)	40 ... 30 dB (µA)		150 kHz ... 500 kHz	
	30 dB (µA)		500 kHz ... 30 MHz	
EN 55022 (radiated)	30 dB (µV/m)		30 MHz ... 230 MHz	10 m
	37 dB (µV/m)		230 MHz ... 1 GHz	10 m

Mechanical strength acc. to IEC 61131-2		
Test specification	**Frequency range**	**Limit value**
IEC 60068-2-6 vibration	5 Hz ≤ f < 9 Hz	1.75 mm amplitude (permanent) 3.5 mm amplitude (short term)
	9 Hz ≤ f < 150 Hz	0.5 g (permanent) 1 g (short term)
	Note on vibration test: a) Frequency change: max. 1 octave/minute b) Vibration direction: 3 axes	
IEC 60068-2-27 shock		15 g
	Note on shock test: a) Type of shock: half sine b) Shock duration: 11 ms c) Shock direction: 3x in positive and 3x in negative direction for each of the three mutually perpendicular axes of the test specimen	
IEC 60068-2-32 free fall		1 m (module in original packing)

*) QP: Quasi Peak

Note:
If the technical data of components differ from the values described here, the technical data shown in the manuals of the respective components shall be valid.

For Products of the WAGO-I/O-SYSTEM 750 with ship specific approvals, supplementary guidelines are valid:

Electromagnetic compatibility				
Immunity to interference acc. to Germanischer Lloyd (2003)				
Test specification	**Test values**		**Strength class**	**Evaluation criteria**
IEC 61000-4-2 ESD	6 kV/8 kV (contact/air)		3/3	B
IEC 61000-4-3 electromagnetic fields	10 V/m 80 MHz ... 2 GHz		3	A
IEC 61000-4-4 burst	1 kV/2 kV (data/supply)		2/3	A
IEC 61000-4-5 surge	AC/DC Supply:	0.5 kV (line/line)	1	A
		1 kV (line/earth)	2	
IEC 61000-4-6 RF disturances	10 V/m 80 % AM (0.15 ... 80 MHz)		3	A
Type test AF disturbances (harmonic waves)	3 V, 2 W		-	A
Type test high voltage	755 V DC 1500 V AC		-	-

Emission of interference acc. to Germanischer Lloyd (2003)			
Test specification	**Limit values**	**Frequency range**	**Distance**
Type test (EMC1, conducted) allows for ship bridge control applications	96 ... 50 dB (µV)	10 kHz ... 150 kHz	
	60 ... 50 dB (µV)	150 kHz ... 350 kHz	
	50 dB (µV)	350 kHz ... 30 MHz	
Type test (EMC1, radiated) allows for ship bridge control applications	80 ... 52 dB (µV/m)	150 kHz ... 300 kHz	3 m
	52 ... 34 dB (µV/m)	300 kHz ... 30 MHz	3 m
	54 dB (µV/m)	30 MHz ... 2 GHz	3 m
außer für:	24 dB (µV/m)	156 MHz ... 165 MHz	3 m

Mechanical strength acc. to Germanischer Lloyd (2003)		
Test specification	**Frequency range**	**Limit value**
IEC 60068-2-6 vibration (category A – D)	2 Hz ≤ f < 25 Hz	± 1.6 mm amplitude (permanent)
	25 Hz ≤ f < 100 Hz	4 g (permanent)
	Note on vibration test: a) Frequency change: max. 1 octave/minute b) Vibration direction: 3 axes	

Range of application	Required specification emission of interference	Required specification immunity to interference
Industrial areas	EN 61000-6-4 (2001)	EN 61000-6-2 (2001)
Residential areas	EN 61000-6-3 (2001)*)	EN 61000-6-1 (2001)

*) The system meets the requirements on emission of interference in residential areas with the fieldbus coupler/controller for:

ETHERNET 750-342/-841/-842/-860

LonWorks 750-319/-819

CANopen 750-337/-837

DeviceNet 750-306/-806

MODBUS 750-312/-314/ -315/ -316
750-812/-814/ -815/ -816

With a special permit, the system can also be implemented with other fieldbus couplers/controllers in residential areas (housing, commercial and business areas, small-scale enterprises). The special permit can be obtained from an authority or inspection office. In Germany, the Federal Office for Post and Telecommunications and its branch offices issues the permit.

It is possible to use other field bus couplers/controllers under certain boundary conditions. Please contact WAGO Kontakttechnik GmbH & Co. KG.

Maximum power dissipation of the components	
Bus modules	0.8 W / bus terminal (total power dissipation, system/field)
Fieldbus coupler/controller	2.0 W / coupler/controller

Warning
The power dissipation of all installed components must not exceed the maximum conductible power of the housing (cabinet).

When dimensioning the housing, care is to be taken that even under high external temperatures, the temperature inside the housing does not exceed the permissible ambient temperature of 55 °C.

Dimensions

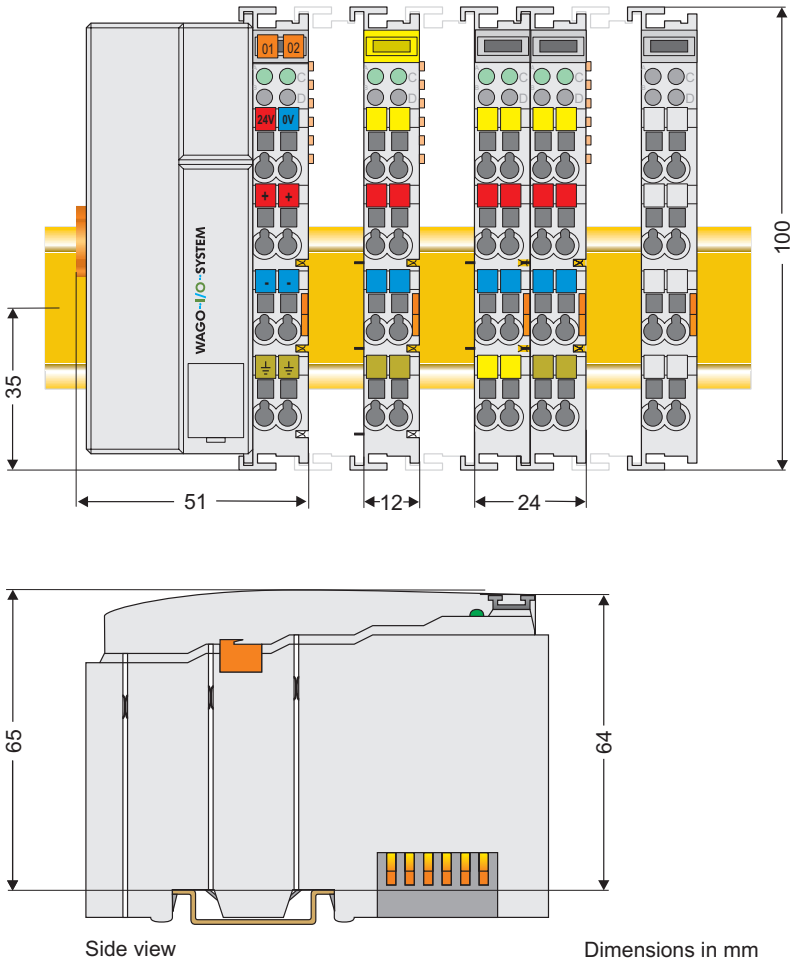


Fig. 2-2: Dimensions

g01xx05e

Note:
The illustration shows a standard coupler. For detailed dimensions, please refer to the technical data of the respective coupler/controller.

2.3 Manufacturing Number

The manufacturing number indicates the delivery status directly after production.
This number is part of the lateral marking on the component.
In addition, starting from calender week 43/2000 the manufacturing number is also printed on the cover of the configuration and programming interface of the fieldbus coupler or controller.

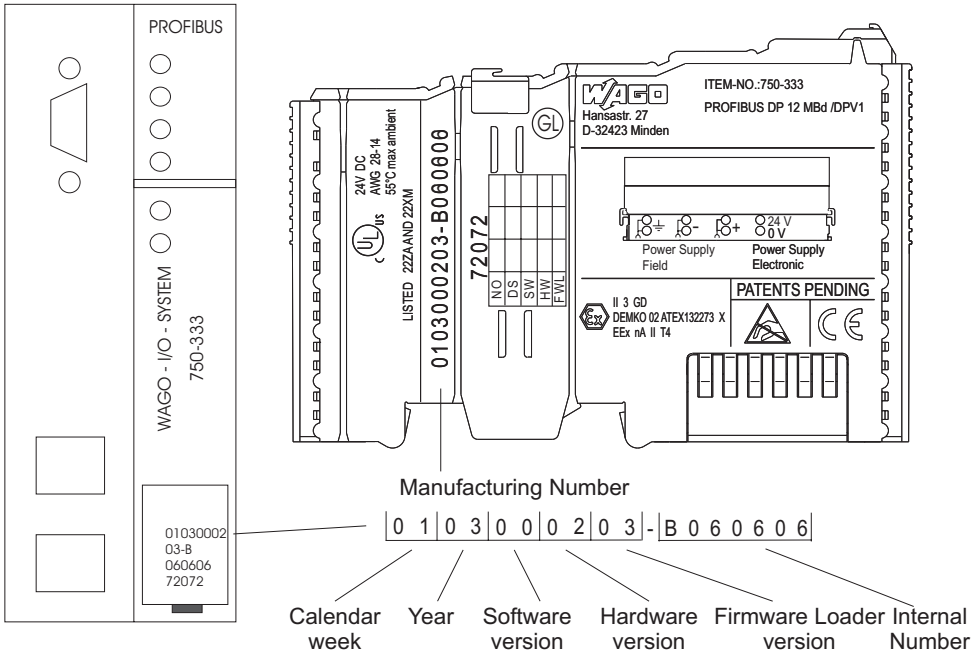


Fig. 2-3: Example: Manufacturing Number of a PROFIBUS fieldbus coupler 750-333

g01xx15e

The manufacturing number consists of the production week and year, the software version (if available), the hardware version of the component, the firmware loader (if available) and further internal information for WAGO Kontakttechnik GmbH.

2.4 Component Update

For the case of an Update of one component, the lateral marking on each component contains a prepared matrix.

This matrix makes columns available for altogether three updates to the entry of the current update data, like production order number (NO; starting from calendar week 13/2004), update date (DS), software version (SW), hardware version (HW) and the firmware loader version (FWL, if available).

Update Matrix

Current Version data for:		1. Update	2. Update	3. Update	
Production Order Number	**NO**				← Only starting from calendar week 13/2004
Datestamp	**DS**				
Software index	**SW**				
Hardware index	**HW**				
Firmware loader index	**FWL**				← Only for coupler/ controller

If the update of a component took place, the current version data are registered into the columns of the matrix.

Additionally with the update of a fieldbus coupler or controller also the cover of the configuration and programming interface of the coupler or controller is printed on with the current manufacturing and production order number.

The original manufacturing data on the housing of the component remain thereby.

2.5 Storage, Assembly and Transport

Wherever 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.

Statically shielded transport bags with metal coatings are to be used for the transport of open components for which soiling with amine, amide and silicone has been ruled out, e.g. 3M 1900E.

2.6 Mechanical Setup

2.6.1 Installation Position

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

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

WAGO item 249-116	End stop for DIN 35 rail, 6 mm wide
WAGO item 249-117	End stop for DIN 35 rail, 10 mm wide

2.6.2 Total Expansion

The length of the module assembly (including one end module of 12mm width) that can be connected to the coupler/controller is 780mm. When assembled, the I/O modules have a maximum length of 768mm.

Examples:

- 64 I/O modules of 12mm width can be connected to one coupler/controller.
- 32 I/O modules of 24mm width can be connected to one coupler/controller.

Exception:

The number of connected I/O modules also depends on which type of coupler/controller is used. For example, the maximum number of I/O modules that can be connected to a Profibus coupler/controller is 63 without end module.The maximum total expansion of a node is calculated as follows:

Warning
The maximum total length of a node without coupler/controller must not exceed 780mm. Furthermore, restrictions made on certain types of couplers/controllers must be observed (e.g. for Profibus).

2.6.3 Assembly onto Carrier Rail

2.6.3.1 Carrier rail properties

All system components can be snapped directly onto a carrier rail in accordance with the European standard EN 50022 (DIN 35).

Warning
WAGO 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 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 bus 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).

2.6.3.2 WAGO DIN Rail

WAGO carrier rails meet the electrical and mechanical requirements.

Item Number	Description
210-113 /-112	35 x 7.5; 1 mm; steel yellow chromated; slotted/unslotted
210-114 /-197	35 x 15; 1.5 mm; steel yellow chromated; slotted/unslotted
210-118	35 x 15; 2.3 mm; steel yellow chromated; unslotted
210-198	35 x 15; 2.3 mm; copper; unslotted
210-196	35 x 7.5; 1 mm; aluminum; unslotted

2.6.4 Spacing

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

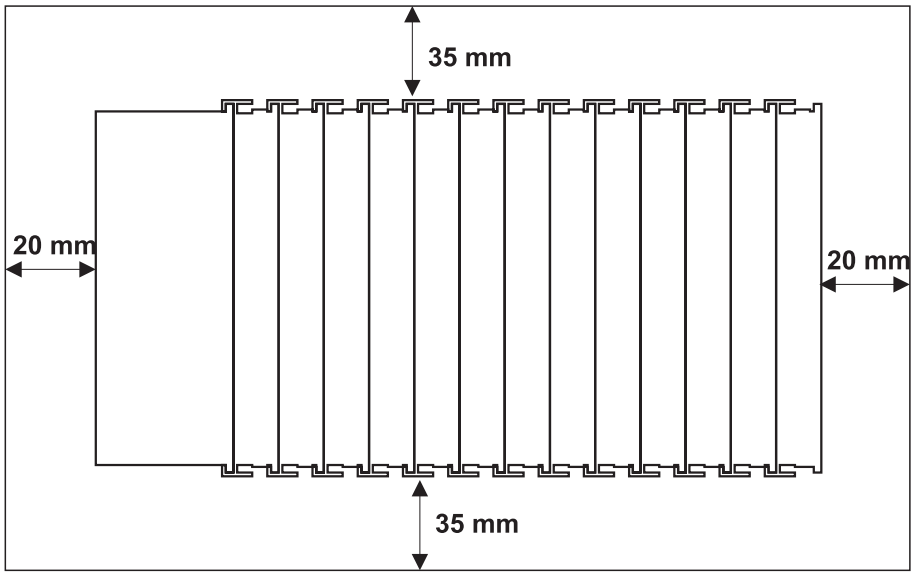


Fig. 2-4: Spacing g01xx13x

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

2.6.5 Plugging and Removal of the Components

Warning
Before work is done on the components, the voltage supply must be turned off.

In order to safeguard the coupler/controller from jamming, it should be fixed onto the carrier rail with the locking disc To do so, push on the upper groove of the locking disc using a screwdriver.

To pull out the fieldbus coupler/controller, release the locking disc by pressing on the bottom groove with a screwdriver and then pulling the orange colored unlocking lug.

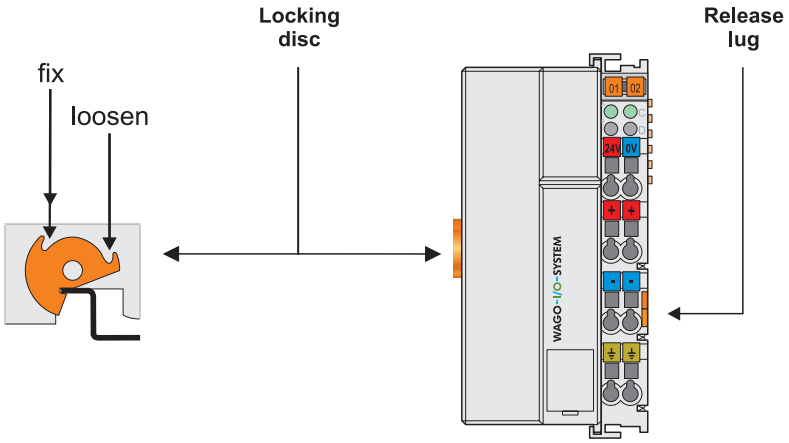


Fig. 2-5: Coupler/Controller and unlocking lug g01xx12e

It is also possible to release an individual I/O module from the unit by pulling an unlocking lug.

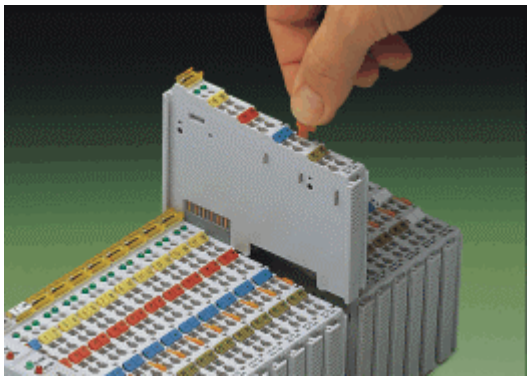


Fig. 2-6: removing bus terminal p0xxx01x

Danger
Ensure that an interruption of the PE will not result in a condition which could endanger a person or equipment!
For planning the ring feeding of the ground wire, please see chapter 2.6.3.

2.6.6 Assembly Sequence

All system components can be snapped directly on a carrier rail in accordance with the European standard EN 50022 (DIN 35).

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

Starting with the coupler/controller, the bus modules are assembled adjacent to each other according to the project planning. Errors in the planning of the node in terms of the potential groups (connection via the power contacts) are recognized, as the bus modules with power contacts (male contacts) cannot be linked to bus modules with fewer power contacts.

Attention
Always link the bus modules with the coupler/controller, and always plug from above.

Warning
Never plug bus modules from the direction of the end terminal. A ground wire power contact, which is inserted into a terminal without contacts, e.g. a 4-channel digital input module, has a decreased air and creepage distance to the neighboring contact in the example DI4.

Always terminate the fieldbus node with an end module (750-600).

2.6.7 Internal Bus/Data Contacts

Communication between the coupler/controller and the bus modules as well as the system supply of the bus modules is carried out via the internal bus. It is comprised of 6 data contacts, which are available as self-cleaning gold spring contacts.

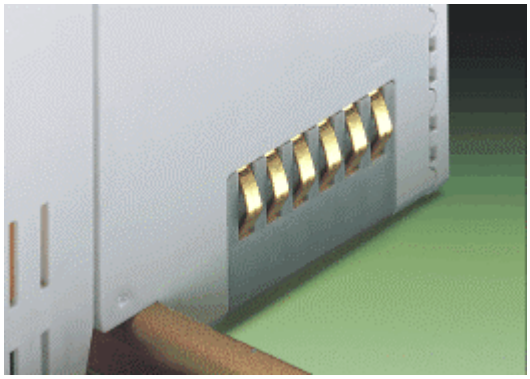


Fig. 2-7: Data contacts p0xxx07x

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

ESD (Electrostatic Discharge)
The modules are equipped with electronic components that may be destroyed by electrostatic discharge. When handling the modules, ensure that the environment (persons, workplace and packing) is well grounded. Avoid touching conductive components, e.g. gold contacts.

2.6.8 Power Contacts

Self-cleaning power contacts , are situated on the side of the components which further conduct the supply voltage for the field side. These contacts come as touchproof spring contacts on the right side of the coupler/controller and the bus module. As fitting counterparts the module has male contacts on the left side.

Danger
The power contacts are sharp-edged. Handle the module carefully to prevent injury.

Attention
Please take into consideration that some bus modules have no or only a few power jumper contacts. The design of some modules does not allow them to be physically assembled in rows, as the grooves for the male contacts are closed at the top.

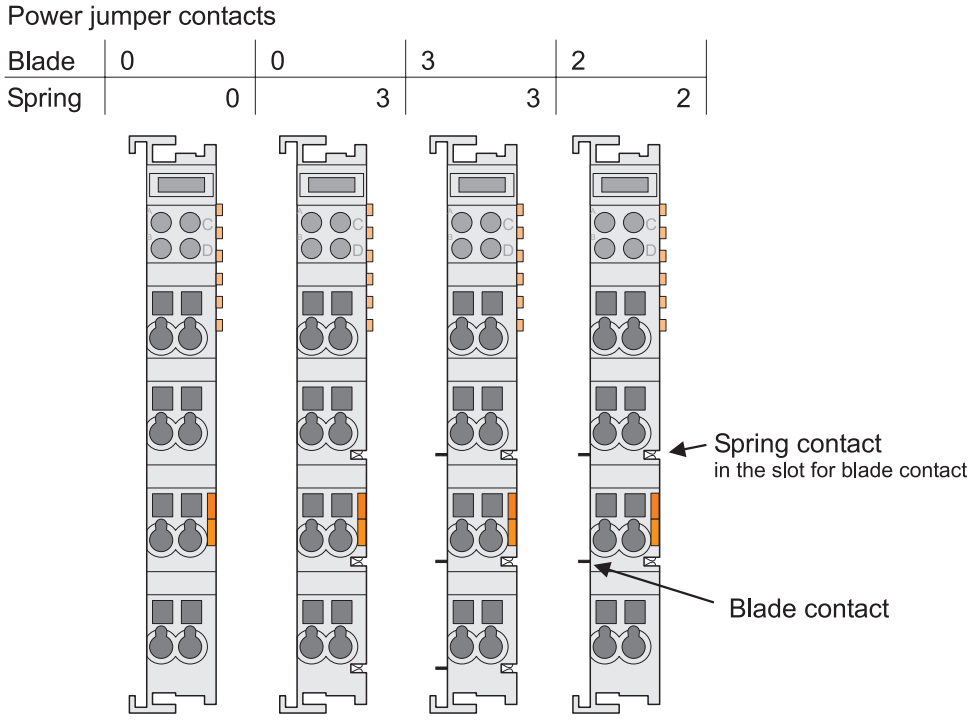


Fig. 2-8: Example for the arrangement of power contacts g0xxx05e

Recommendation
With the WAGO ProServe® Software smartDESIGNER, the assembly of a fieldbus node can be configured. The configuration can be tested via the integrated accuracy check.

2.6.9 Wire connection

All components have CAGE CLAMP® connections.

The WAGO CAGE CLAMP® connection is appropriate for solid, stranded and fine–stranded conductors. Each clamping unit accommodates one conductor.

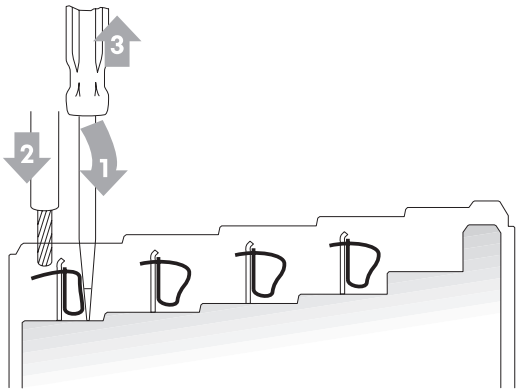


Fig. 2-9: CAGE CLAMP® Connection g0xxx08x

The operating tool is inserted into the opening above the connection. This opens the CAGE CLAMP®. Subsequently the conductor can be inserted into the opening. After removing the operating tool, the conductor is safely clamped.

More than one conductor per connection is not permissible. If several conductors have to be made at one connection point, then they should be made away from the connection point using WAGO Terminal Blocks. The terminal blocks may be jumpered together and a single wire brought back to the I/O module connection point.

Attention
If it is unavoidable to jointly connect 2 conductors, then a ferrule must be used to join the wires together.
Ferrule:

Length	8 mm
Nominal cross section$_{max.}$	1 mm^2 for 2 conductors with 0.5 mm^2 each
WAGO Product	216-103 or products with comparable properties

2.7 Power Supply

2.7.1 Isolation

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

- Operational voltage for the fieldbus interface.
- Electronics of the couplers/controllers and the bus modules (internal bus).
- All bus modules have an electrical isolation between the electronics (internal bus, logic) and the field electronics. Some digital and analog input modules have each channel electrically isolated, please see catalog.

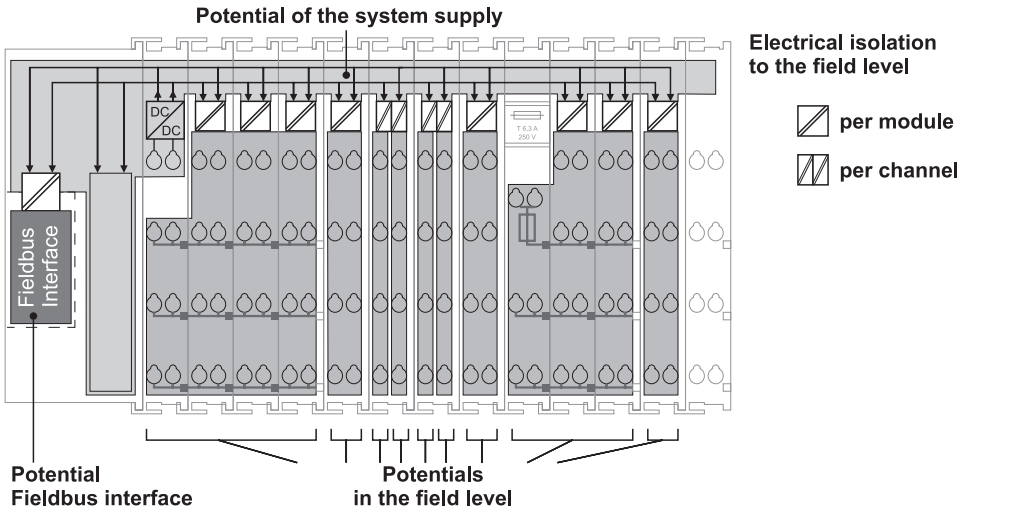


Fig. 2-10: Isolation g0xxx01e

Attention
The ground wire connection must be present in each group. In order that all protective conductor functions are maintained under all circumstances, it is recommended that a ground wire be connected at the beginning and end of a potential group. (ring format, please see chapter "2.8.3"). Thus, if a bus module comes loose from a composite during servicing, then the protective conductor connection is still guaranteed for all connected field devices.

When using a joint power supply unit for the 24 V system supply and the 24 V field supply, the electrical isolation between the internal bus and the field level is eliminated for the potential group.

2.7.2 System Supply

2.7.2.1 Connection

The WAGO-I/O-SYSTEM 750 requires a 24 V direct current system supply (-15% or +20 %). The power supply is provided via the coupler/controller and, if necessary, in addition via the internal system supply modules (750-613). The voltage supply is reverse voltage protected.

Attention
The use of an incorrect supply voltage or frequency can cause severe damage to the component.

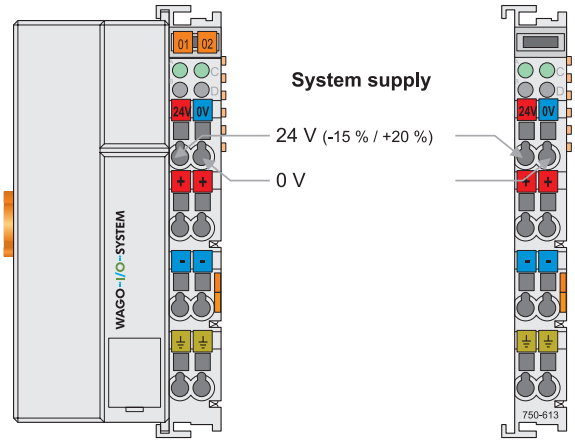


Fig. 2-11: System Supply g0xxx02e

The direct current supplies all internal system components, e.g. coupler/controller electronics, fieldbus interface and bus modules via the internal bus (5 V system voltage). The 5 V system voltage is electrically connected to the 24 V system supply.

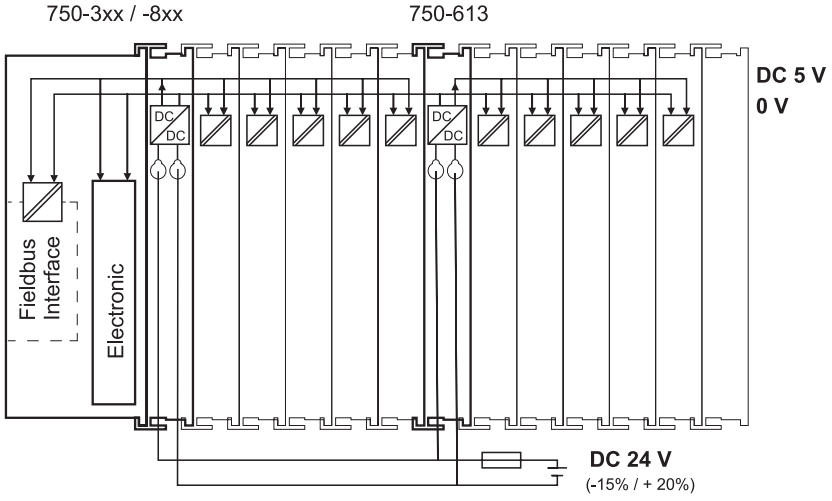


Fig. 2-12: System Voltage g0xxx06e

Attention
Resetting the system by switching on and off the system supply, must take place simultaneously for all supply modules (coupler/controller and 750-613).

2.7.2.2 Alignment

Recommendation
A stable network supply cannot be taken for granted always and everywhere. Therefore, regulated power supply units should be used in order to guarantee the quality of the supply voltage.

The supply capacity of the coupler/controller or the internal system supply module (750-613) can be taken from the technical data of the components.

Internal current consumption*)	Current consumption via system voltage: 5 V for electronics of the bus modules and coupler/controller
Residual current for bus terminals*)	Available current for the bus modules. Provided by the bus power supply unit. See coupler/controller and internal system supply module (750-613)

*) cf. catalogue W4 Volume 3, manuals or Internet

Example

Coupler 750-301:
internal current consumption:350 mA at 5V
residual current for
bus modules: 1650 mA at 5V
sum $I(5V)_{total}$: 2000 mA at 5V

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

Attention
If the sum of the internal current consumption exceeds the residual current for bus modules, then an internal system supply module (750-613) must be placed before the module where the permissible residual current was exceeded.

Example:

A node with a PROFIBUS Coupler 750-333 consists of 20 relay modules (750-517) and 10 digital input modules (750-405).

Current consumption:
20* 90 mA = 1800 mA
10* 2 mA = 20 mA
Sum 1820 mA

The coupler can provide 1650 mA for the bus modules. Consequently, an internal system supply module (750-613), e.g. in the middle of the node, should be added.

Recommendation
With the WAGO ProServe® Software smartDESIGNER, the assembly of a fieldbus node can be configured. The configuration can be tested via the integrated accuracy check.

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

Coupler/Controller

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

750-613

$I(5\ V)_{total}$ =	Sum of all the internal current consumption of the connected bus modules
Input current I(24 V) =	$5\ V / 24\ V * I(5\ V)_{total} / \eta$ $\eta = 0.87$ (at nominal load)

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

During the test, all outputs, in particular those of the relay modules, must be active.

2.7.3 Field Supply

2.7.3.1 Connection

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

The coupler/controller provides field side power (DC 24V). In this case it is a passive power supply without protection equipment.
Power supply modules are available for other potentials, e.g. AC 230 V.
Likewise, with the aid of the power supply modules, various potentials can be set up. The connections are linked in pairs with a power contact.

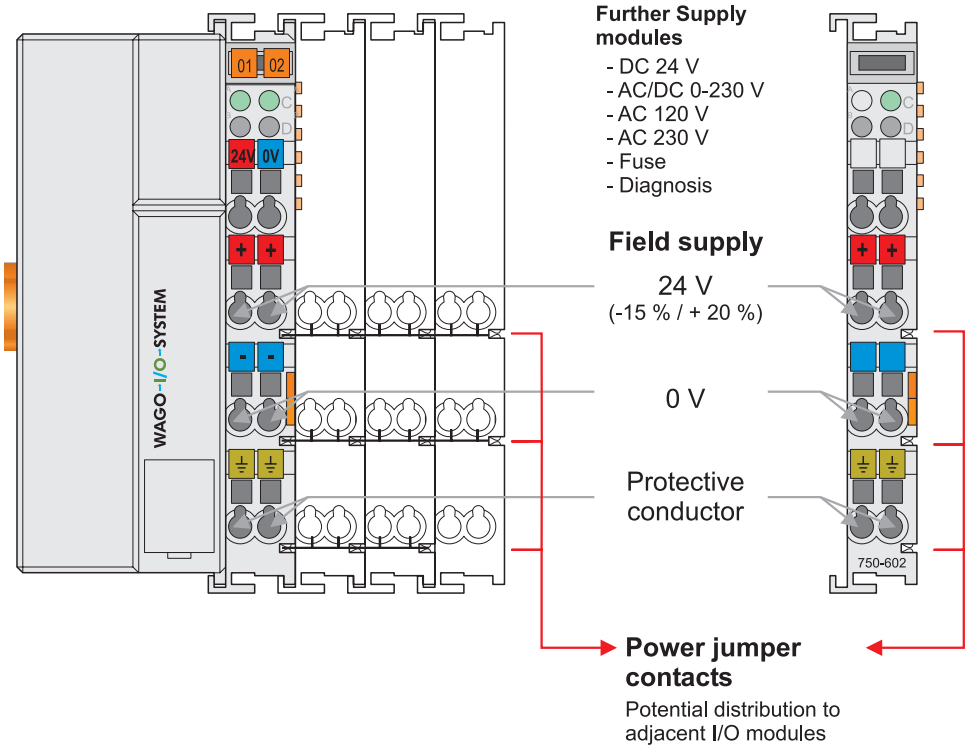


Fig. 2-13: Field Supply (Sensor/Actuator) g0xxx03e

The supply voltage for the field side is automatically passed to the next module via the power jumper contacts when assembling the bus modules .

The current load of the power contacts must not exceed 10 A on a continual basis. The current load capacity between two connection terminals is identical to the load capacity of the connection wires.

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.

Attention
Some bus 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 a field supply is required for subsequent bus modules, then a power supply module must be used.
Note the data sheets of the bus modules.

In the case of a node setup with different potentials, e.g. the alteration from DC 24 V to AC 230V, a spacer module should be used. The optical separation of the potentials acts as a warning to heed caution in the case of wiring and maintenance works. Thus, the results of wiring errors can be prevented.

2.7.3.2 Fusing

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

750-601	24 V DC, Supply/Fuse
750-609	230 V AC, Supply/Fuse
750-615	120 V AC, Supply/Fuse
750-610	24 V DC, Supply/Fuse/Diagnosis
750-611	230 V AC, Supply/Fuse/Diagnosis

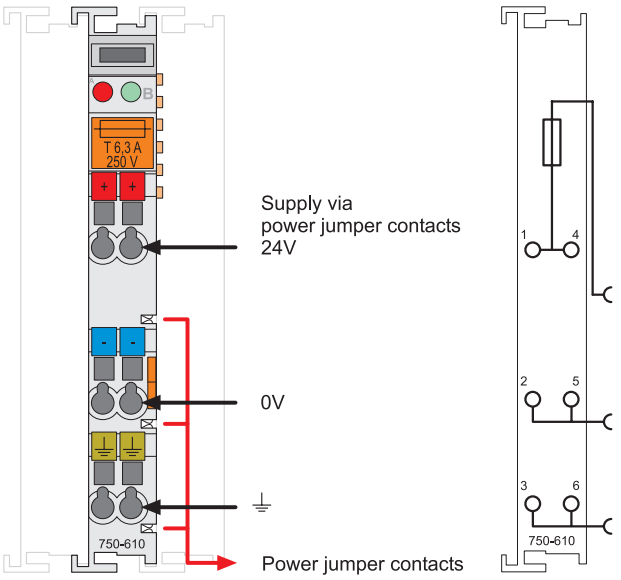


Fig. 2-14: Supply module with fuse carrier (Example 750-610) g0xxx09x

Warning
In the case of power supply modules with fuse holders, only fuses with a maximum dissipation of 1.6 W (IEC 127) must be used.

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 bus 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.

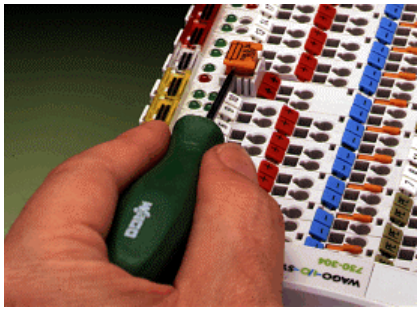


Fig. 2-15: Removing the fuse carrier p0xxx05x

Lifting the cover to the side opens the fuse carrier.

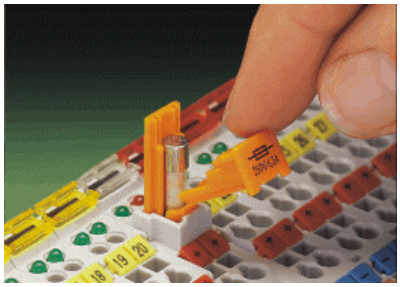


Fig. 2-16: Opening the fuse carrier p0xxx03x

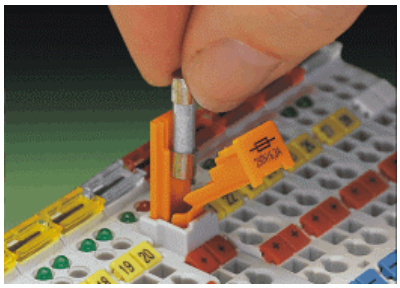


Fig. 2-17: Change fuse p0xxx04x

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

Alternatively, fusing can be done externally. The fuse modules of the WAGO series 281 and 282 are suitable for this purpose.

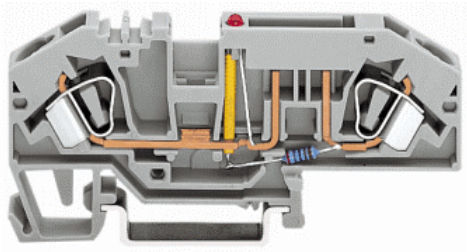


Fig. 2-18: Fuse modules for automotive fuses, Series 282 pf66800x

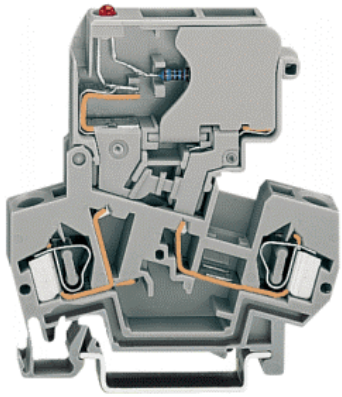


Fig. 2-19: Fuse modules with pivotable fuse carrier, Series 281 pe61100x

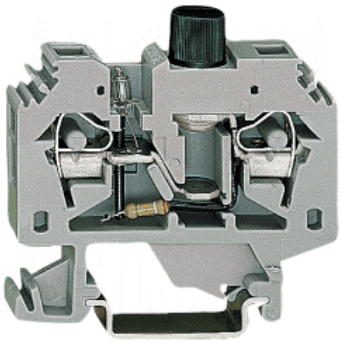


Fig. 2-20: Fuse modules, Series 282 pf12400x

2.7.4 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-volt supply are required for the certified operation of the system.

Item No.	Name	Description
750-626	Supply filter	Filter module for system supply and field supply (24 V, 0 V), i.e. for field bus 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.

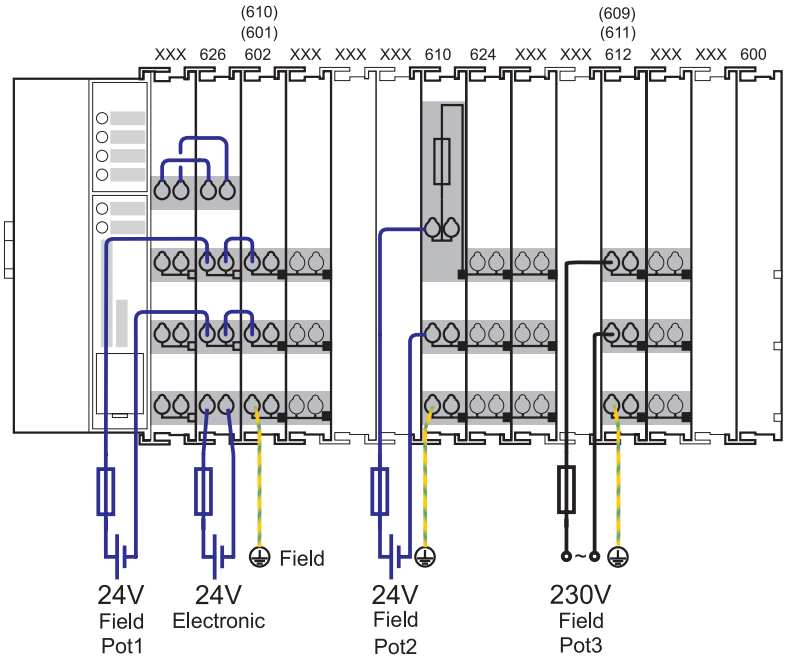


Fig. 2-21: Power supply concept g01xx11e

Note
Another potential power terminal 750-601/602/610 must only be used behind the filter terminal 750-626 if the protective earth conductor is needed on the lower power contact or if a fuse protection is required.

2.7.5 Supply example

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

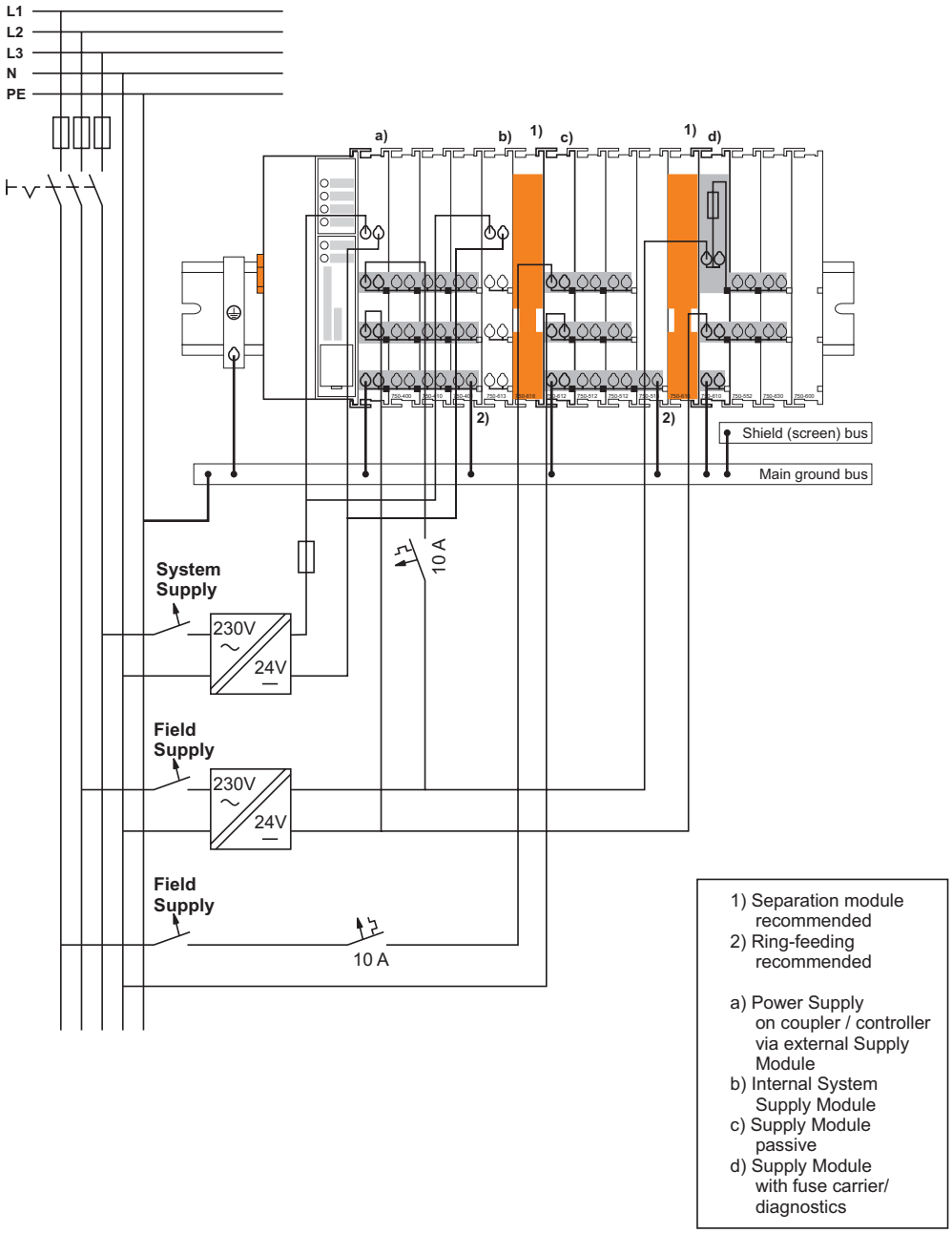


Fig. 2-22: Supply example

g0xxx04e

2.7.6 Power Supply Unit

The WAGO-I/O-SYSTEM 750 requires a 24 V direct current system supply with a maximum deviation of -15% or +20 %.

Recommendation
A stable network supply cannot be taken for granted always and everywhere. Therefore, regulated power supply units should be used in order to guarantee the quality of the supply voltage.

A buffer (200 µF per 1 A current load) should be provided for brief voltage dips. The I/O system buffers for approx 1 ms.

The electrical requirement for the field supply is to be determined individually for each power supply point. Thereby all loads through the field devices and bus modules should be considered. The field supply as well influences the bus modules, as the inputs and outputs of some bus modules require the voltage of the field supply.

Note
The system supply and the field supply should be isolated from the power supplies in order to ensure bus operation in the event of short circuits on the actuator side.

WAGO products Article No.	Description
787-903	Primary switched - mode, DC 24 V, 5 A wide input voltage range AC 85-264 V PFC (Power Factor Correction)
787-904	Primary switched - mode, DC 24 V, 10 A wide input voltage range AC 85-264 V PFC (Power Factor Correction)
787-912	Primary switched - mode, DC 24 V, 2 A wide input voltage range AC 85-264 V PFC (Power Factor Correction)
 288-809 288-810 288-812 288-813	Rail-mounted modules with universal mounting carrier AC 115 V / DC 24 V; 0,5 A AC 230 V / DC 24 V; 0,5 A AC 230 V / DC 24 V; 2 A AC 115 V / DC 24 V; 2 A

2.8 Grounding

2.8.1 Grounding the DIN Rail

2.8.1.1 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 electronic connection is established via the screw. Thus, the carrier rail is grounded.

Attention
Care must be taken to ensure the flawless electrical connection between the carrier rail and the frame or housing in order to guarantee sufficient grounding.

2.8.1.2 Insulated Assembly

Insulated assembly has been achieved when there is constructively no direct conduction connection between the cabinet frame or machine parts and the carrier rail. Here the earth must be set up via an electrical conductor.

The connected grounding conductor should have a cross section of at least 4 mm^2.

Recommendation
The optimal insulated setup is a metallic assembly plate with grounding connection with an electrical conductive link with the carrier rail.

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

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

2.8.2 Grounding Function

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

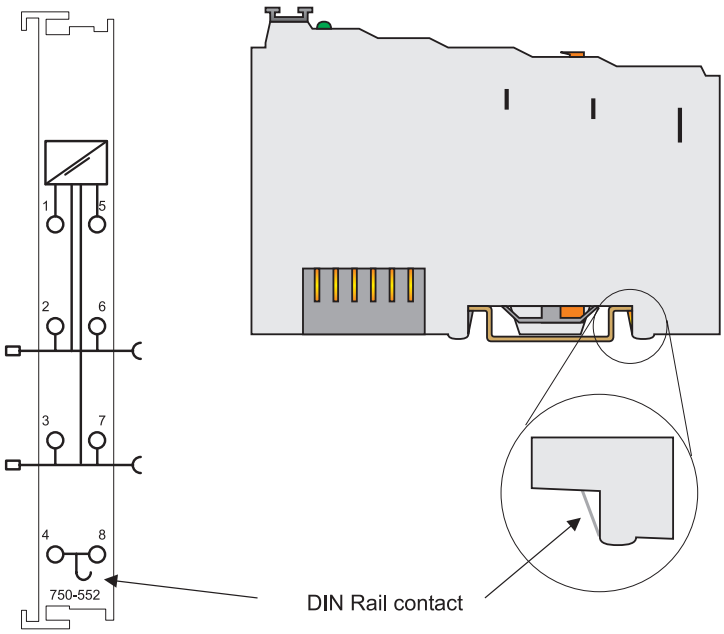


Fig. 2-23: Carrier rail contact g0xxx10e

Attention
Care must be taken 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, please see chapter 2.6.3.2.

2.8.3 Grounding Protection

For the field side, the ground wire is connected to the lowest connection terminals of the power supply module. The ground connection is then connected to the next module via the Power Jumper Contact (PJC). If the bus module has the lower power jumper contact, then the ground wire connection of the field devices can be directly connected to the lower connection terminals of the bus module.

Attention
Should the ground conductor connection of the power jumper contacts within the node become disrupted, e.g. due to a 4-channel bus terminal, the ground connection will need to be re-established.

The ring feeding of the grounding potential will increase the system safety. When one bus module is removed from the group, the grounding connection will remain intact.

The ring feeding method has the grounding conductor connected to the beginning and end of each potential group.

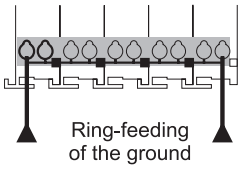


Fig. 2-24: Ring-feeding g0xxx07e

Attention
The regulations relating to the place of assembly as well as the national regulations for maintenance and inspection of the grounding protection must be observed.

2.9 Shielding (Screening)

2.9.1 General

The shielding of the data and signal conductors reduces electromagnetic interferences thereby increasing the signal quality. Measurement errors, data transmission errors and even disturbances caused by overvoltage can be avoided.

Attention
Constant shielding is absolutely required in order to ensure the technical specifications in terms of the measurement accuracy.

The data and signal conductors should be separated from all high-voltage cables.

The cable shield should be potential. With this, incoming disturbances can be easily diverted.

The shielding should be placed over the entrance of the cabinet or housing in order to already repel disturbances at the entrance.

2.9.2 Bus Conductors

The shielding of the bus conductor is described in the relevant assembly guidelines and standards of the bus system.

2.9.3 Signal Conductors

Bus modules for most analog signals along with many of the interface bus modules include a connection for the shield.

Note
For better shield performance, the shield should have previously been placed over a large area. The WAGO shield connection system is suggested for such an application.
This suggestion is especially applicable when the equipment can have even current or high impulse formed currents running through it (for example through atmospheric end loading).

2.9.4 WAGO Shield (Screen) Connecting System

The WAGO Shield Connecting system includes a shield clamping saddle, a collection of rails and a variety of mounting feet. Together these allow many dfferent possibilities. See catalog W4 volume 3 chapter 10.

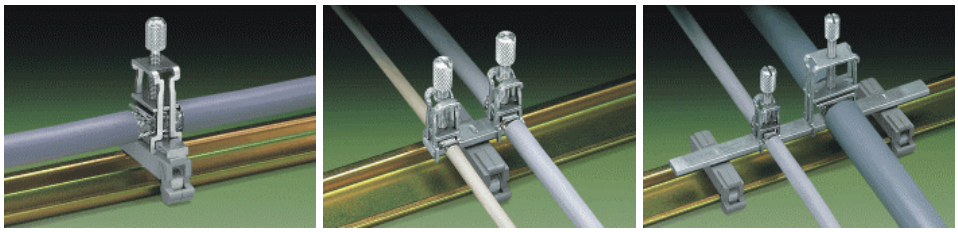


Fig. 2-25: WAGO Shield (Screen) Connecting System p0xxx08x, p0xxx09x, and p0xxx10x

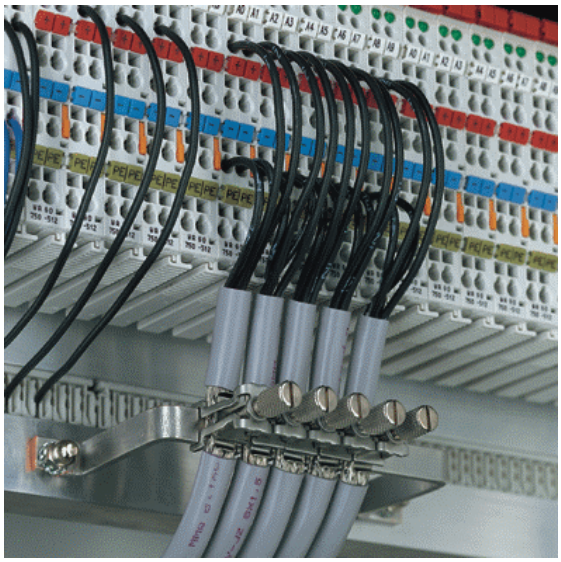


Fig. 2-26: Application of the WAGO Shield (Screen) Connecting System p0xxx11x

2.10 Assembly Guidelines/Standards

DIN 60204,	Electrical equipping of machines
DIN EN 50178	Equipping of high-voltage systems with electronic components (replacement for VDE 0160)
EN 60439	Low voltage – switch box combinations

3 Fieldbus Coupler

3.1 PROFINET IO 750-340

3.1.1 Description

The fieldbus coupler 750-340 maps the peripheral data of almost all I/O modules in the WAGO-I/O-SYSTEM 750/753 on PROFINET IO.

In the initialization phase, the fieldbus coupler determines the physical structure of the node and creates a local process image with all inputs and outputs. I/O modules with a bit width smaller than 8 can be combined to form one byte in order to optimize the address space.

The diagnostics concept is based on channel specific diagnostic messages that are mapped to the respective alarms. Coding is done according to IEC 61158 (PROFINET IO).

The bus coupler has the following features:

- Process data length
  Max. 320 byte input data including all user data qualifiers
  (max. 2 byte process data qualifiers (IOXS) for each input module)
  Max. 320 byte output data including all user data qualifiers
  (max. 2 byte process data qualifiers (IOXS) for each output module)

- Transfer speed of up to 100 Mbit/s full-duplex, also with autonegotiation (factory settings)

- Support of all WAGO-I/O-SYSTEM 750/753 I/O modules excepting RTC module 75x-640, MP-Bus (Multi Point Bus) master module 75x-643, 2-channel vibration velocity/bearing condition monitoring VIB I/O 75x-645, AS-Interface Master module 75x-655, Stepper controllers 75x-670 and 75x-671 as well as PROFIsafe modules 75x-660, 75x-665 and 75x-666.

- Configurable data format for each signal channel of complex I/O modules.

- Configurable substitute value behavior for each output module in the event of failure.

- Configurable substitute values for each output channel in the event of failure

- 1 x RJ45 bus connection

3.1.2 Hardware

3.1.2.1 View

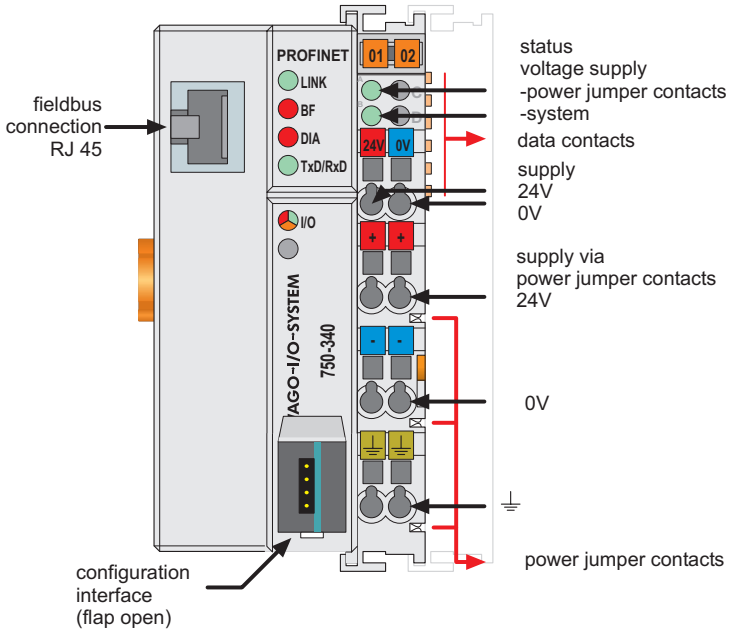


Fig. 3.1.2-1: View g034000e

The fieldbus coupler consists of:

- Power supply for the system supply as well as power jumper contacts for the field side supply via I/O modules.
- Fieldbus connection via RJ45 socket
- Display elements (LEDs) for status display of the operation, the fieldbus communication, the operating voltages as well as for fault messages and diagnostics
- Configuration interface
- Electronics for communication with the I/O modules (internal bus) and the fieldbus interface

3.1.2.2 Power Supply

The power is supplied via terminals with CAGE CLAMP® connection. The power supply provides power to both the system and the field side.

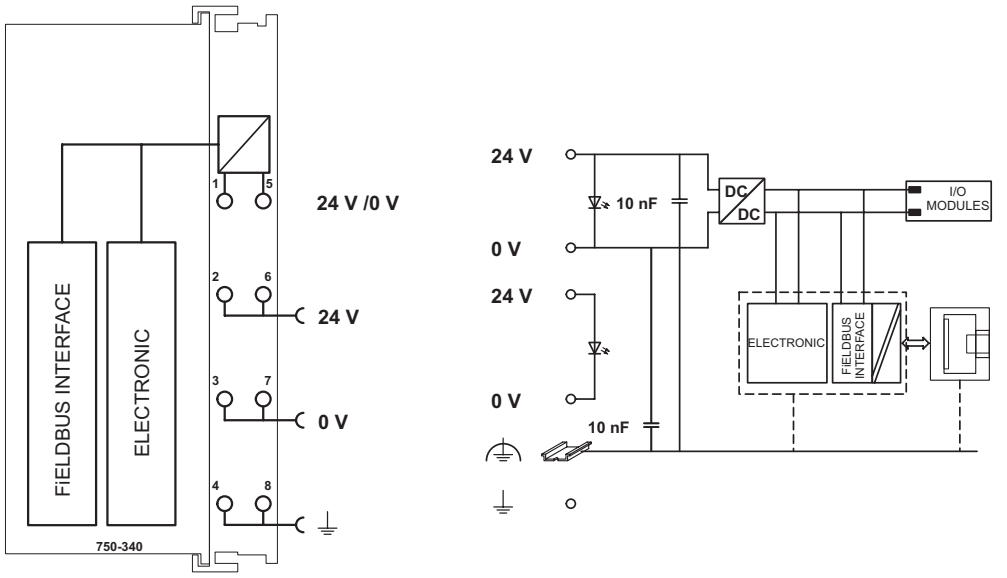


Fig. 3.1.2-2: Power supply g034001e

The integrated power supply unit provides the required power to the electronics and to the I/O modules.

The electrical isolation between the RJ45 Ethernet connector and the electronics is provided by a transformer.

3.1.2.3 Fieldbus Connection

The PROFINET IO interface is designed as a RJ45 connection and complies with 100BaseTX standards.

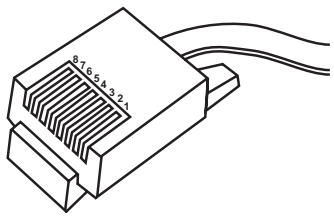


Fig. 3.1.2-3:
Bus connection RJ45, plug g0xxx20x

Pin	Signal	Description
1	TD +	Send data +
2	TD -	Send data -
3	RD +	Receiving data +
4	-	Not assigned
5	-	Not assigned
6	RD -	Receiving data -
7	-	Not assigned
8	-	Not assigned

The electrical isolation between the fieldbus interface and the internal electronics is provided by a transformer.

The connection point of the coupler is lowered to fit in an 80mm high switch box once connected to the PROFINET connector.

3.1.2.4 Display Elements

The operating status of the fieldbus coupler or of the fieldbus node is indicated via light diodes (LEDs).

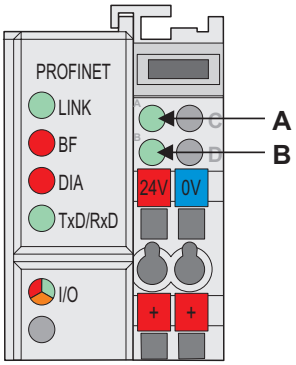


Fig. 3.1.2-4:
Display elements g034002x

LED	Color	Significance
LINK	green	The "LINK" LED indicates that a physical connection to the Ethernet network is established. It flashes with a frequency of 2 Hz for a period of 3 seconds when the fieldbus coupler is requested to the participant flash test by the DCP protocol (Discovery and basic Configuration Protocol).
BF	red	The "BF" LED provides information on the current status of the PROFINET IO data exchange.
DIA	red	The "DIA" LED indicates the upcoming of diagnostics events. The message from the diagnostics is not supported by all I/O modules or must be explicitly released for each channel.
TxD/ RxD	green	The "TxD/RxD" LED indicates the communication that is taking place over the Ethernet.
I/O	red /green / orange	The "I/O" LED indicates both the internal bus communication and occurring errors.
A	green	Status of the operating voltage – system
B	green	Status of the operating voltage – power contacts

3.1.2.5 Configuration Interface

The configuration interface is located behind the cover flap. It is used for communicating with WAGO-I/O-CHECK 2 and optionally for updating the device software (firmware).

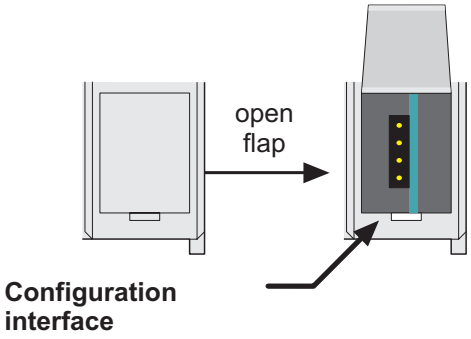


Fig. 3.1.2-5: Configuration interface g01xx06e

Fitting the 4-pole male connector to the RS 232 DSub9 connector is done using the WAGO configuration cable 750-920.

Caution
The communication cable 750-920 must not be connected or removed when energized, i.e. the coupler/controller must be voltage free!

3.1.3 I/O Device Configuration

The fieldbus coupler takes over the task of the I/O device in PROFINET IO. This way, an I/O controller can access the process data of the I/O module periphery after the cyclic exchange of productive data has been successfully established. Selecting the I/O modules for the process data exchange and defining the time grid is done when configuring the I/O controller. The configuration and parameter setting of the fieldbus coupler and I/O modules is based on the device's GSD file.

3.1.3.1 GSD File

Under PROFIBUS IO, the features of the devices are described by the manufacturer in form of a GSD file and made available to the user. The file is provided in XML format.

Structure, content and coding of the device specifications are standardized, so that any I/O devices can be configured using manufacturer-independent tools.

Further Information
The PNO provides information about the GSD files of all listed manufacturers.

GSD and symbol files for configuring the WAGO I/O devices can be obtained on CD under the item number 750-916 or on the WAGO INTERNET site.

http://www.wago.com

GSD file for I/O device 750-340	**gsdml-V2.0-wago-series750_753-20070215.xml**

The GSD file is read by the configuration software and the corresponding settings are transferred. For the necessary entries and handling steps, please refer to the software user manuals.

3.1.3.2 Configuration

The I/O device is configured in accordance with the physical arrangement of the node (slot oriented).

Module slot 0 contains the fieldbus coupler in its function as station substitute. It does not deliver any process data itself, but provides the parameters required to perform overall settings of the I/O device.

Slots 1 to max. 128 reflect the physical arrangement of the I/O modules that deliver a part of the process and/or diagnostics data. Supply modules without diagnostics, internal system supply module, field side connection module as well as separation and end modules are not considered during configuration as they do not provide any process data and/or diagnostics data.

For each I/O module, up to 8 configuration modules are available in the hardware catalog. The modules are designated by their item number followed by the number of signal channels, e.g. 75x-467 2AE. Additional information is included in the module description as different configuration possibilities are available (see below).

3.1.3.2.1 Configuring Digital I/O Modules

Four digital I/O modules with a granularity smaller or equal to 8 bits are listed in the I/O device hardware catalog. Three modules reserve 1, 2 or 4 bytes in the respective area, one of them is used to fill the reserved areas. The 2- and 4-byte modules can be found in the hardware catalog under the sub-category "Word / double word module". With configuration modules that require more process image memory than the level of existing information of the respective I/O modules, the amount of bit information, which is still available in the allocated area, is indicated in brackets with a positive sign.

The item numbers of the modules, that do not provide a process image memory but are used to fill previously excessively reserved bit information, are marked with a star (*). Furthermore, the module names, that are represented with a negative sign in brackets, contain the amount of information that has been previously allocated in the area of the process image by the I/O module.

Module	Description	Name example
DI_32	Configuration module for 32 digital inputs, 4 bytes are reserved in the input process image of the I/O controller. The bit information in the first byte is allocated to the input data of the configured I/O module according to the number of existing signal channels. Remaining bit locations (shown with a positive sign in brackets) can be allocated to the signal states of the following I/O modules having the same type of signal. This is done by configuring the DI_0 modules of the relevant I/O modules.	**750-400 2DE(+30 BIT E)**
DI_16	Configuration module for 16 digital inputs, 2 bytes are reserved in the input process image of the I/O controller. The bit information in the first byte is allocated to the input data of the configured I/O module according to the number of existing signal channels. Remaining bit locations (shown with a positive sign in brackets) can be allocated to the signal states of the following I/O modules having the same type of signal. This is done by configuring the DI_0 modules of the relevant I/O modules.	**750-400 2DE(+14 BIT E)**

Module	Description	Name example
DI_8	Configuration module for 8 digital inputs, 1 byte is reserved in the input process image of the I/O controller. The bit information in the first byte is allocated to the input data of the configured I/O module according to the number of existing signal channels. Remaining bit locations (shown with a positive signal in brackets) can be allocated to the signal states of the following I/O modules having the same type of signal. This is done by configuring the DI_0 modules of the relevant I/O modules.	**750-400 2DE(+6 BIT E)**
DI_0	Configuration module for filling input information previously reserved by modules ***DI_32, DI _1***6 or ***DI _8.*** Care must be taken that the number of previously reserved input bits are sufficient to receive the existing input information of the configured I/O module (shown with a negative sign in brackets).	**750-400* 2DE(-2 BIT E)**
DO_32	Configuration module for 32 digital outputs, 4 bytes are reserved in the output process image of the I/O controller. The bit information in the first byte is allocated to the output data of the configured I/O module according to the number of existing signal channels. Remaining bit locations (carried with a positive signal in brackets) can be allocated to the signal conditions of the following digital I/O module using the same type of signal. This is carried out using the projection of ***DI_0*** modules for the relevant I/O modules.	**750-504 4DA(+28 BIT A)**
DO_16	Configuration module for 16 digital outputs, 2 bytes are reserved in the output process image of the I/O controller. The bit information in the first byte is allocated to the output data of the configured I/O module according to the number of existing signal channels. Remaining bit locations (shown with a positive signal in brackets) can be allocated to the signal states of the following digital output I/O modules having the same type of signal. This is done by configuring the ***DO_0*** modules of the relevant I/O modules.	**750-504 4DA(+12 BIT A)**

Module	Description	Name example
DO_8	Configuration module for 8 digital outputs, 1 byte is reserved in the output process image of the I/O controller. The bit information in the first byte is allocated to the output data of the configured I/O module according to the number of existing signal channels. Remaining bit locations (shown with a positive signal in brackets) can be allocated to the signal states of the following digital output I/O modules having the same type of signal. This is done by configuring the ***DO_0*** modules of the relevant I/O modules.	**750-504 4DA(+4 BIT A)**
DO_0	Configuration module for filling input information previously reserved by modules ***DI_32, DI _1***6 or ***DI _8.*** Care must be taken that the number of previously reserved output bits is sufficient to receive the existing output information of the configured I/O module (represented in brackets with a negative sign).	**750-504* 4DA(-4 BIT A)**

Digital I/O modules can deliver both process data as well as additional diagnostic information. Furthermore, they store the raw diagnostic data in the input process image via 4 additional configuration modules. Three modules of the respective input modules allocate 1, 2 or 4 bytes in the input image, 3 modules of the respective output modules reserve 1, 2 or 4 bytes in the input and output image. Respectively, 1 module of the I/O modules is used to fill previously reserved input and/or output areas. The 2 and 4 byte modules can be found in the hardware catalog under the sub-category "Word / double word module".

Module	Description	Name example
DI_DIA_32	Configuration module for 32 digital inputs, 4 bytes are reserved in the input process image of the I/O controller. The bit information in the first byte is allocated to the input and diagnostics data of the configured I/O module according to the number of existing signal channels. Remaining bit locations (shown in brackets with a positive sign) can be allocated to the signal states of the following I/O modules having the same type of signal. This is done by configuring the ***DI_0- DI_DIA_0*** or ***DO_DIA_0*** modules of the relevant I/O modules.	**75x-425 2DE(+28 BIT E), DIA in E-PA**

Module	Description	Name example
DI_DIA_16	Configuration module for 16 digital inputs, 2 bytes are reserved in the input process image of the I/O controller. The bit information in the first byte is allocated to the input and diagnostics data of the configured I/O module according to the number of existing signal channels. Remaining bit locations (shown in brackets with a positive sign) can be allocated to the signal states of the following I/O modules having the same type of signal. This is done by configuring the ***DI_0- DI_DIA_0*** or ***DO_DIA_0*** modules of the relevant I/O modules.	**75x-425 2DE(+12 BIT E), DIA in E-PA**
DI_DIA_8	Configuration module for 8 digital inputs, 1 byte is reserved in the input process image of the I/O controller. The existing bit information in the first byte is allocated to the input and diagnostics data of the configured I/O module according to the respective number of existing signal channels. Remaining bit locations (shown in brackets with a positive sign) can be allocated to the signal states of the following I/O modules having the same type of signal. This is done by configuring the ***DI_0- DI_DIA_0*** or ***DO_DIA_0*** modules of the relevant I/O modules.	**75x-425 2DE(+4 BIT E), DIA in E-PA**
DI_DIA_0	Configuration module for filling input information previously reserved by modules ***DI_32, DI_DIA_32 DI_16, DI_DIA_16, DI _8*** or ***DI _8.*** Care must be taken that the number of previously reserved input bits is sufficient to receive the existing input and diagnostic information of the configured I/O module (represented in brackets with a negative sign).	**75x-425 2DE(-4 BIT E), DIA in E-PA**

Module	Description	Name example
DO_DIA_32	Configuration module for 32 digital input and outputs, 4 bytes are reserved in the output and output process image of the I/O controller. The bit information in the first byte of the output area is allocated to the output data of the configured I/O module according to the number of existing signal channels. The bit information in the first byte of the input area is allocated to the raw diagnostics data of the individual signal channels. Remaining bit locations of the reserved input and output area (indicated in brackets with a positive sign) can be allocated to the signal conditions of the following digital I/O modules having the same type of signal. This is done by configuring the ***Dx0*** or ***Dx_DIA_0*** modules of the relevant I/O modules.	**750-507 2DA(+30 BIT I/O), DIA in E-PA**
DO_DIA_16	Configuration module for 16 digital input and outputs, 2 bytes are reserved in the output and output process image of the I/O controller. The bit information in the first byte of the output area is allocated to the output data of the configured I/O module according to the number of existing signal channels. The bit information in the first byte of the input area is allocated to the raw diagnostics data of the individual signal channels. Remaining bit locations of the reserved input and output area (indicated in brackets with a positive sign) can be allocated to the signal conditions of the following digital I/O modules having the same type of signal. This is done by configuring the ***Dx0*** or ***Dx_DIA_0*** modules of the relevant I/O modules.	**750-507 2DA(+12 BIT A), DIA in E-PA**
DO_DIA_8	Configuration module for 8 digital input and outputs, 1 byte is reserved in the output and output process image of the I/O controller. The bit information of the output area is allocated to the output data of the configured I/O module according to the number of existing signal channels. The bit information of the input area is allocated to the raw diagnostics data of the individual signal channels. Remaining bit locations of the reserved input and output area (indicated in brackets with a positive sign) can be allocated to the signal conditions of the following digital I/O modules having the same type of signal. This is done by configuring the ***Dx0*** or ***Dx_DIA_0*** modules of the relevant I/O modules.	**750-507 2DA(+4 BIT A), DIA in E-PA**

Module	Description	Name example
DO_DIA_0	Configuration module for filling input and output information previously reserved by modules ***Dx_32, Dx_DIA_32, Dx_16, Dx_DIA_16, Dx_8*** or ***Dx_DIA_8***. Care must be taken that the number of previously reserved input and output bits are sufficient to receive the existing output and diagnostic information of the configured I/O module (represented in brackets with negative sign).	**750-507 2DA(-4 BIT A), DIA in E-PA**

3.1.3.2.2 Configuring Analog I/O Modules

Two configuration modules are available for configuring analog input and output modules. The first module supplies the user data in the respective input or output process image. The second module, that is provided with EM (Extended Mapping) as module description extension, supplies all existing data including control and status information in the input and output areas. These modules make it possible to access the register structure of the I/O module in productive data exchange, so that, e.g., the operating parameters can be modified.

Module	Description	Exemplary Marking
AI	Configuration module for analog input modules. Each channel provides 1 word (2 bytes) of data in the input process image of the I/O controller.	**75x-467 2AE, 0-10 V**
AI_EM	Configuration module for analog input modules. Each signal channel provides a structure of 1 byte status and 1 word (2 bytes) of data in the input process image of the I/O controller. Each signal channel provides a structure of 1 byte control and 1 word (2 bytes) of data in the output process image if the I/O controller. This information does not have any significance in the output area of the I/O module during normal operation.	**75x-467 2AE, 0-10 V, EM**
AO	Configuration module for analog output modules. Each channel provides 1 word (2 bytes) of data in the output process image of the I/O controller.	**750-550 2AA, 0-10 V**

Module	Description	Exemplary Marking
AO_EM	Configuration module for analog output modules. Each signal channel provides a structure of 1 byte control and 1 word (2 bytes) of data in the output process image of the I/O controller. Each signal channel provides a structure of 1 byte status and 1 word (2 bytes) of data in the input process image. During standard operation, the status byte diagnostics fault provides the I/O module with information of the upcoming fault. The data in the input area of the I/O module does not have any significance with this type of operation.	**750-550 2AA, 0-10 V, EM**

3.1.3.2.3 Configuring Specialty Modules

A configuration module is available for configuring all speciality modules such as counter, PWM, encoder and serial interfaces that provides all information of the respective I/O module in the input and output process images. This module makes it possible to access the register structure of the I/O module in the productive data exchange so that, e.g., the operating parameters can be modified. The structure of the process image is specific to the module and can be obtained from the respective I/O module documentation. The I/O modules 750-511 and 750-630 are an exception as they have two configuration modules.

Module	Description	Marking
PWM	Configuration module for pulse width output module. Each channel provides 1 word (2 bytes) of data in the output process image of the I/O controller.	**75x-511 2PWM**
PWM_EM	Configuration module for pulse width output module. Each signal channel provides a structure of 1 byte status and 1 word (2 bytes) of data in the input process image if the I/O controller. Each signal channel provides a structure of 1 byte control and 1 word (2 bytes) of data in the output process image if the I/O controller. Depending on the operating mode selected, process information is also carried by the input data in productive data exchange.	**75x-511 2PWM, EM**
SSI	Configuration module for SSI interface. 1 double word (4 bytes) of data are provided in the input process image of the I/O controller.	**750-630 1SSI**

Module	Description	Marking
SSI_EM	Configuration module the SSI interface. A structure of 1 byte control and 1 double word (4 bytes) of data are provided in the output process image of the I/O controller. A structure of 1 byte status and 1 double word (4 bytes) of data are provided in the input process image of the I/O controller. The status byte supplies the information for the upcoming faults in the productive data exchange. The productive dada exchange does not have any significance in the output area of the I/O module.	**750-630 1SSI, EM**

3.1.3.2.4 Configuring System Modules

Five configuration modules are available for the diagnostic capable field side supply modules. Four of these modules provide the diagnostics information in the input process image.

Module	Description	Exemplary name
PE_DIA_32	Configuration module for 32 digital inputs, 4 bytes are reserved in the input process image of the I/O controller. The bit information in the first byte is allocated to the 2 bit diagnostics data of the configured supply module. Remaining bit locations (indicated in brackets with a positive sign) can be allocated to the signal states of the following I/O module having the appropriate type of signal or the diagnostics information of diagnostic capable I/O modules. This is done by configuring the ***DI_0, - DI_DIA_0 DO_DIA_0*** or ***PE_DIA_0*** modules for the relevant I/O modules.	**750-610 P-Supply, 2DIA(+30 BIT E), DIA in E-PA**
PE_DIA_16	Configuration module for 16 digital inputs, 2 bytes are reserved in the input process image of the I/O controller. The bit information in the first byte is allocated to the 2 bit diagnostics data of the configured supply module. Remaining bit locations (indicated in brackets with a positive sign) can be allocated to the signal states of the following I/O module having the appropriate type of signal or the diagnostics information of diagnostic capable I/O modules. This is done by configuring the ***DI_0, - DI_DIA_0 DO_DIA_0*** or ***PE_DIA_0*** modules for the relevant I/O modules.	**750-610 P-Supply, 2DIA(+14 BIT E), DIA in E-PA**

Module	Description	Exemplary name
PE_DIA_8	Configuration module for 8 digital inputs, 1 byte is reserved in the input process image of the I/O controller. 2 bit are allocated to the diagnostics data of the configured supply module. Remaining bit locations (indicated in brackets with a positive sign) can be allocated to the signal states of the following I/O module having the appropriate type of signal or the diagnostics information of diagnostic capable I/O modules. This is done by configuring the ***DI_0, - DI_DIA_0 DO_DIA_0*** or ***PE_DIA_0*** modules for the relevant I/O modules.	**750-610 P-Supply, 2DIA(+6 BIT E), DIA in E-PA**
PE_DIA_0	Configuration module for filling input information previously reserved by modules ***DI_32, PE_DIA_32, Dx_DIA_32, DI_16, PE_DIA_16, Dx_DIA_16, DI _8, PE_DIA_8*** or ***Dx_DIA_8***. Care must be taken that the number of previously reserved input and output bits are sufficient to receive 2 bit diagnostic information of the configured I/O module (represented in brackets with a negative sign).	**750-610 P-Supply, 2DIA(-2 BIT E), DIA in E-PA**
DIA_0	The 2 bit diagnostics information are not available in the input process image of the I/O controller.	**750-610 P-Supply, DIA**

3.1.3.3 Parameter Setting

3.1.3.3.1 Station Parameters

The parameters of the station substitute are used to set the overall settings of the PROFINET IO node. Some of the settings are used in the modules as default settings and can be optionally overwritten within the module configuration.

Parameter	Setting	Description
Restart the internal bus after a fault		Restart of the internal data bus following a fault, such as, for example, no end module following
	POWER ON RESET*)	after an interruption of the buscoupler supply
	AUTORESET	immediately after overcoming the internal bus fault
Internal Data Bus Extension		Use of the internal data bus extension
	EEPROM setting*)	Based upon the settings made in EEPROM that are made using the "WAGO Extension Settings" tool.
	not used	is excluded
	used	is possible
Message external module / channel fault		The external diagnostics information of all diagnostics capable I/O modules are
	locked	not transferred to the PROFINET I/O Controller
	released*)	transferred to the PROFINET I/O Controller
Process value display		Word or double word orientated process data are transfered to the PROFINET I/O Controller in:
	INTEL (LSB-MSB)	"Little Endian" format
	MOTOROLA (MSB-LSB)*)	"Big Endian" format

Parameter	Setting	Description
Behavior in case of a PROFINET I/O fault		In the case of a malfunction of the PROFINET IO communication, the status of the connected output periphery can be influenced in various ways:
	Stop internal bus transmission	The process data exchange on the internal bus is stopped, all outputs drop out after a module specific monitoring time of 100 ms
	Set output image to zero	All outputs are immediately reset
	Freeze output image	All outputs maintain the last status before the malfunction
	Switch Default value*)	All outputs switch the substitute value configured when designing the module
Reaction to an internal bus fault		In the event of a malfunction of an internal communication between fieldbus controller and I/O modules, such as, for example no end module,
	PROFINET I/O stop data exchange*)	Separates the cyclic connection to the PROFINET IO controller.
	Set input image to zero	The input information of the respective periphery module is set to zero
	Freeze input image	The input information of the periphery module prevailing before the fault is maintained
	*) Default settings	

3.1.3.3.2 Standard Module Parameters

Certain characteristics of some I/O modules can be parameterized during the configuration. At present, this only applies to the output modules whose substitute value behavior can be set independent of the modules used.

Parameter	Setting	Description
Substitute value behavior of the outputs		In case the I/O controller does not supply valid output data for the module or the group of modules then
	`according to the device settings*)`	the set strategy on the side of the station substitute applies (I/O device).
	`according to the referenced module settings*)`[2]	the set strategy on the side of the referenced digital module by which the output data has been reserved. These settings apply to digital output modules without process data. These are characterized using a * behind the item number.
	`Output values are set to 0`	all outputs are immediately reset
	`Outputs maintain the last valid value`	all outputs maintain the last valid value
	`outputs take on their default value`	all outputs switch to their configured substitute value
	`*) Presetting`	
	`2) Digital modules whose process data has been allocated to their previous slots implicitly take over the default value strategy of the module on the slot allocated.`	

3.1.3.3.3 Fault Safe Module Parameters (F-Parameters)

Fault safe I/O modules require the standardized PROFIsafe configuration to ensure a safe exchange of productive data.

Parameter	Setting	Description
F_Check_iPar	`NoCheck`*1)	There are no individual parameters contained in the F-parameters that have to be checked.
F_SIL	`SIL3`*1)	The module complies with the safety catagory 3.
F_CRC_Length	`3-Byte-CRC`*1)	The productive data transfer is safeguarded using a 3 byte CRC in case of PROFINET IO.
F_Par_Version	`1`*1)	all outputs maintain the last valid value
F_Source_Add	1 ... 65534	The F-Source address addresses the F-Host
F_Dest_Add	1 ... 1022	The F-Target address addresses the F-Device
F_WD_Time	`100`*2) 1 ... 10000	The F-Watchdog monitors the data exchange between the F-Host and F-Device. The settings are carried out in milliseconds.
	`*1) Fixed settings`	
	`*2) Presettings`	

3.1.3.3.4 Channel Parameters

Individual settings of the channel characteristics can be performed when designing several I/O modules. The following channel specific settings can be made depending on the I/O module:

Parameter	Setting	Description
Asynch. diagnostic message channel x		With external faults, channel diagnostics and the respective alarms are
	locked*)	not transferred to the I/O controller
	released	transferred to the I/O controller
Process data format channel x		Word or double word orientated process data of the signal channel are transferred to the PROFINET IO Controller in:
	according to the device settings*)	format that is set on the side of the station substitute.
	INTEL (LSB-MSB)	"Little Endian" format
	MOTOROLA (MSB-LSB)	"Big Endian" format
Default data output channel x	**I/O module specific 0x0000*) ... 0xFFFF**	When configuring the substitute value behavior on the side of the I/O module, these values are transmitted to the complex signal channel with invalid output data of the I/O controller.
Default output status channel x	**0*) ... 1**	When configuring the substitute value behavior on the side of the I/O module, these values are transmitted to the binary signal channel with invalid output states of the I/O controller.
	*) Default settings	

3.1.3.4 Station Naming

The fieldbus coupler (I/O Device) can be clearly identified using its device name within a PROFINET IO network. The device name enables the I/O controller to allocate the device with an IP address for establishing the productive data exchange when starting the system. The I/O device receives the device name during configuration (station naming) and saves it permanently. The device name is transferred using **D**iscovery and basic **C**onfiguration-**P**rotocol (DCP). The device is activated using the Ethernet address (MAC address).

3.1.4 Initialization Phase of the Fieldbus Coupler

The communication system can be commissioned after the PROFINET IO system has been configured, the I/O devices have been installed and a name has been given to the station.

After the power supply has been switched on, the fieldbus coupler initializes the internal communication system. In the phase where the I/O LED flashes red with 10 Hz, the arranged I/O modules are determined and are allocated to the PROFINET IO process image according to the standard defaults of the bus coupler. After a trouble free start that is displayed using a green lit "I/O" LED, the coupler changes to the condition "Fieldbus start" where it then waits for the connection build-up of the I/O controller. If the coupler upload procedure was not carried out with success then the red I/O LED signals the cause of failure through a flashing cycle. The cause of failures can be obtained in chapter 3.1.9.1.

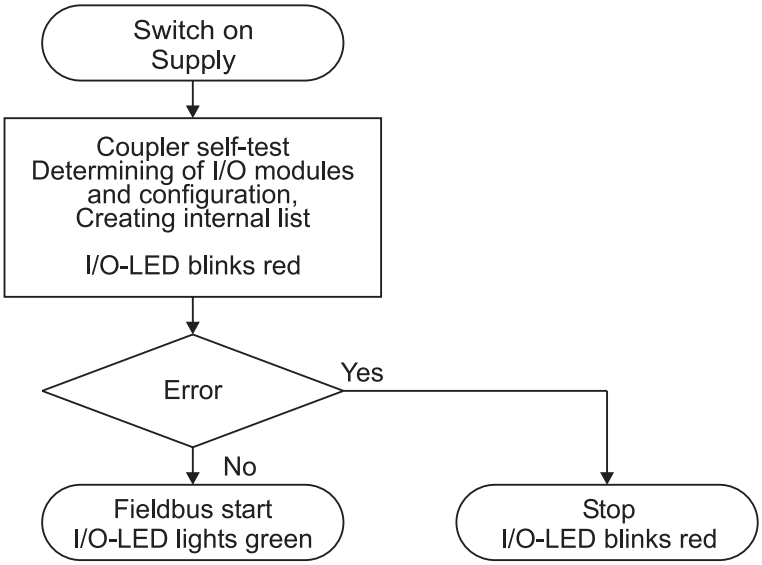


Fig. 3.1.4-6: Initialization phase g012113e

3.1.5 Process Image

3.1.5.1 Local Process Image

After being switched on, the coupler identifies all I/O modules connected that supply or receive process data (data width or bit width > 0).

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

The fieldbus coupler allocates the user data of the connected I/O modules according to specified rules to the local input and output image. The allocation is carried out according to the slots. Digital I/O modules with a data width less than 8 bits are always opened with one bit in the respective process image area.

After a successful configuration test while establishing the connection, if there is any difference between the user configuration and the process image generated during start up, a new process image is created according to the user configuration. One of the reasons for this may be the packing of digital I/O modules or the lack of configuration modules for the connected I/O modules during configuration.

3.1.5.2 Allocation of the Input and Output Data

The process data is exchanged via the PROFINET IO using the higher ranking controls. A maximum of 320 bytes of output data (including all IOPS and IOCS) can be transferred from the I/O controller to the bus coupler. The bus coupler sends a maximum of 320 byte of input data (including all IOPS and IOCS) to the I/O controller.

When configuring a node, the individual modules are configured in accordance with their physical arrangement (slot orientated). These modules can be taken over from a hardware catalog of the configuration tool. All specific information on the relevant modules is contained in the associated GSD file.

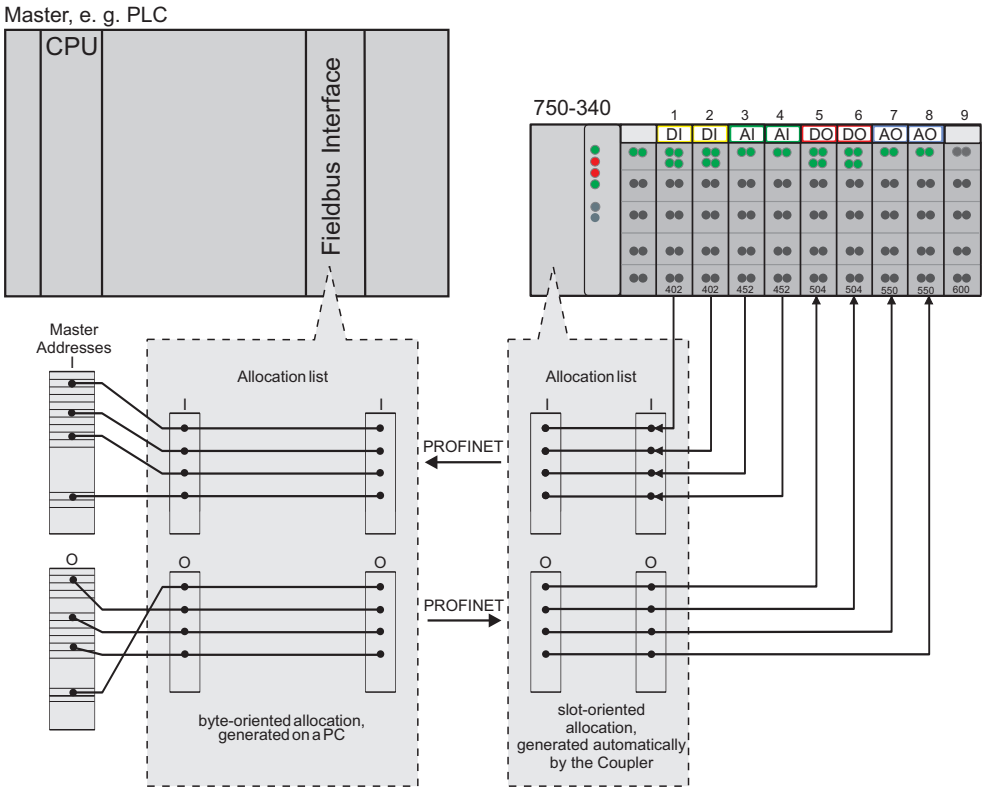


Fig. 3.1.5-7: Allocation of the input and output data g034003e

In productive data exchange, one or two byte IOXS process data qualifiers are available for each configuration module providing information of the validity of the module data. The process data qualifiers are an integral part of the maximum length of the telegram of 320 bytes and must therefore be considered when mounting the modules.

3.1.5.2.1 Digital Input Modules

The group of digital input I/O modules is divided into 8 types of modules:

Type of module	Description	Substitute I/O modules
2DI	2-channel digital input module	75x-400, 75x-401, 75x-405, 75x-406, 75x-407, 75x-410, 75x-411, 75x-412, 75x-413, 75x-416, 75x-427, 75x-435
2DI_2DIA	2-channel digital input module 1 Bit diagnostic per channel	75x-419, 75x-421, 75x-425
2DI_2DIA_PI	2-channel digital input module 1 Bit diagnostic per channel, additional diagnostic in the input image	
2DI_2DIA_2ACK	2-channel digital input module 1 Bit diagnostic and 1 bit diagnostic confirmation per channel	75x-418
2DI_2DIA_2ACK_PI	2-channel digital input module 1 Bit diagnostic and 1 bit diagnostic confirmation per channel, with additional diagnostics in the input image	
4DI	4-channel digital input module	75x-402, 75x-403, 75x-408, 75x-409, 75x-414, 75x-415, 75x-422, 75x-423, 75x-424, 75x-428, 75x-432, 75x-433
8DI	8-channel digital input module	75x-430, 75x-431, 75x-436, 75x-437
16DI	16-channel digital input module	75x-4xx

Digital input modules receive the consumer status (IOCS) from the I/O controller and supply it with the provider status (IOPS) of the existing input and optional existing diagnostic information.
The following table shows a list of the number of bytes for the individual modules that are allocated in the respective process image (PI) and the telegrams (TLG) in the direction of transmission and reception (Tx, Rx).

Module / Type	750-4xx ...						750-4xx* ...					
	Data length / [Byte]				Data type		Data length / [Byte]				Data type	
	PA		TLG		E	A	PA		TLG		E	A
	E	A	Tx	Rx			E	A	Tx	Rx		
2DI	1	0	2	1	UINT8	-	0	0	1	1	-	-
	2	0	3	1	UINT16	-						
	4	0	5	1	UINT32	-						
2DI_2DIA	1	0	2	1	UINT8	-	0	0	1	1	-	-
	2	0	3	1	UINT16	-						
	4	0	5	1	UINT32	-						
2DI_2DIA_2ACK	1	1	3	3	UINT8	UINT8	0	0	2	2	-	-
	1	1	2	2	UINT16	UINT16						
	1	1	2	2	UINT32	UINT32						
4DI	1	0	2	1	UINT8	-	0	0	1	1	-	-
	2	0	3	1	UINT16	-						
	4	0	5	1	UINT32	-						
8DI	1	0	2	1	UINT8	-						
	2	0	3	1	UINT8	-	0	0	1	1	-	-
	4	0	5	1	UINT8	-						
16DI	2	0	3	1	UINT16	-						
	4	0	5	1	UINT32	-	0	0	1	1	-	-

3.1.5.2.2 Digital Output Modules

The group of digital output I/O modules is divided into 12 types of module types:

Type of module	Description	Substitute I/O modules
2DO	2-channel digital output modules	75x-501, 75x-502, 75x-405, 75x-406, 75x-407, 75x-410, 75x-411, 75x-412, 75x-413, 75x-416, 75x-427, 75x-435
2DI_2DIA	2-channel digital output modules 1 Bit diagnostics per signal channel	75x-507, 75x-522, 75x-523
2DI_2DIA_PI	2-channel digital output module 1 Bit diagnostic per signal channel, additional diagnostic in the input image	75x-507, 75x-522, 75x-523
2DI_4DIA	2-channel digital output modules 2 Bit diagnostics per signal channel	75x-506
2DI_4DIA_PI	2-channel digital output module 2 Bit diagnostic per signal channel, additional diagnostic in the input image	75x-506
4DO	4-channel digital output modules	75x-504, 75x-403, 75x-408, 75x-409, 75x-414, 75x-415, 75x-422, 75x-423, 75x-424, 75x-428, 75x-432, 75x-433
4DO_4DIA	4-channel digital output modules 1 Bit diagnostics per signal channel	75x-532
4DO_4DIA_PI	4-channel digital output module 1 Bit diagnostic per signal channel, additional diagnostic in the input image	75x-532
8DI	8-channel digital input module	75x-530, 75x-536
8DO_8DIA	8-channel digital output modules 1 Bit diagnostics per signal channel	75x-537
8DO_8DIA_PI	8-channel digital output module 1 Bit diagnostic per signal channel, additional diagnostic in the input image	75x-537
16DO	16-channel digital output module	75x-5xx

Digital output modules without diagnostics information in the input process image receive the provider status (IOPS) from the I/O controller and supplies it with the consumer status (IOCS) of existing output information. The accompanying process data is additionally transmitted in the opposite direction in case the corresponding diagnostics module appears in the input image of the I/O controller.

The following table shows a list of the number of bytes for the individual modules that are allocated in the respective process image (PA) and the telegrams (TLG) in the direction of transmission and reception (Tx, Rx).

Module	750-5xx ...	750-5xx* ...

Type	Data length / [Byte]				Data type		Data length / [Byte]				Data type	
	PA		TLG		E	A	PA		TLG		E	A
	E	A	Tx	Rx			E	A	Tx	Rx		
2DO	0	1	1	2	-	UINT8	0	0	1	1	-	-
	0	2	1	3	-	UINT16						
	0	4	1	5	-	UINT32						
2DO_2DIA	0	1	1	2	-	UINT8	0	0	1	1	-	-
	0	2	1	3	-	UINT16						
	0	4	1	5	-	UINT32						
2DO_2DIA_PI	1	1	3	3	UINT8	UINT8	0	0	1	1	-	-
	2	2	4	4	UINT16	UINT16						
	4	4	6	6	UINT32	UINT32						
2DO_4DIA	0	1	1	2	-	UINT8	0	0	1	1	-	-
	0	2	1	3	-	UINT16						
	0	4	1	5	-	UINT32						
2DO_4DIA_PI	1	1	3	3	UINT8	UINT8	0	0	1	1	-	-
	2	2	4	4	UINT16	UINT16						
	4	4	6	6	UINT32	UINT32						
4DO	0	1	1	2	-	UINT8	0	0	1	1	-	-
	0	2	1	3	-	UINT16						
	0	4	1	5	-	UINT32						
4DO_4DIA	0	1	1	2	-	UINT8	0	0	1	1	-	-
	0	2	1	3	-	UINT16						
	0	4	1	5	-	UINT32						
4DO_4DIA_PI	1	1	3	3	UINT8	UINT8	0	0	1	1	-	-
	2	2	4	4	UINT16	UINT16						
	4	4	6	6	UINT32	UINT32						
8DO	0	1	1	2	-	UINT8						
	0	2	1	3	-	UINT16	0	0	1	1	-	-
	0	4	1	4	-	UINT32						
8DO_8DIA	0	1	1	2	-	UINT8						
	0	2	1	3	-	UINT16	0	0	1	1	-	-
	0	4	1	5	-	UINT32						
8DO_8DIA_PI	1	1	3	3	UINT8	UINT8						
	2	2	4	4	UINT16	UINT16	0	0	1	1	-	-
	4	4	6	6	UINT32	UINT32						
16DO	0	1	1	3	-	UINT16						
	0	2	1	5	-	UINT32	0	0	1	1	-	-

3.1.5.2.3 Analog Input Modules

The group of analog input modules is divided into 5 types of modules:

Type of module	Description	Substitute I/O modules
AI	2-channel analog input module, 16 Bit input data per signal channel	75x-452, 75x-454, 75x-456, 75x-461, 75x-462, 75x-465, 75x-466, 75x-467, 75x-469, 75x-472, 75x-474, 75x-475, 75x-476, 75x-477, 75x-478, 75x-479, 75x-480, 75x-481, 75x-483, 75x-485, 75x-491, 75x-492
2AI_EM	2-channel analog input module, 16 Bit input and output data plus control and status byte per signal channel, access to the register structure using cyclic data exchange	
3AI_EM	3-channel analog input module, 16 Bit input and output data plus control and status byte per signal channel, access to the register structure using cyclic data exchange	75x-493
4AI	4-Channel analog input module, 16-Bit signed process value per signal channel	75x-453, 75x-455, 75x-457, 75x-459, 75x-460, 75x-463, 75x-468
4AI_EM	4-channel analog input module, 16 Bit input and output data plus control and status byte per signal channel, access to the register structure using cyclic data exchange	

Analog input modules receive the consumer status (IOCS) from the I/O controller and supply it with the provider status (IOPS) of the existing input information in case only the actual user data is replaced. If all existing information in the input and output image is made available then the process data qualifier is additionally transmitted in the opposite direction.
The following table shows a list of the number of bytes for the individual modules that are allocated in the respective process image (PA) and the telegrams (TLG) in the direction of transmission and reception (Tx, Rx).

Module / Type	75x-4xx nAE, …							
	Data length / [Byte]				Data object			
	PA		TLG					
	E	A	Tx	Rx	E	INST	A	INST
2AI	4	-	5	1	INT16	2	-	-
4AI	8	-	9	1	INT16	4	-	-

Module / Type	75x-4xx nAE, …, EM							
	Data length / [Byte]				Data object			
	PA		TLG					
	E	A	Tx	Rx	Input	INST	Output	INST
2AI_EM	6	6	7	7	INT16	2	INT16	2
3AI_EM	12	12	13	13	UINT8,UINT8, INT16	3	UINT8,UINT8, INT16	3
4AI_EM	12	12	12	12	UINT8,UINT16	4	UINT8,UINT16	4

3.1.5.2.4 Analog Output Modules

The group of analog output modules is divided into 4 types of modules:

Type of module	Description	Substitute I/O modules
2AO	2-channel analog output module, 16 Bit output data per signal channel	75x-550, 75x-552, 75x-554, 75x-556, 75x-560, 75x-585
2AO_EM	2-channel analog output module, 16 Bit input and output data plus control and status byte per signal channel, access to the register structure using cyclic data exchange	
4AO	4-Channel analog output module, 16-Bit signed process value per signal channel	75x-551, 75x-553, 75x-555, 75x-557, 75x-559
4AO_EM	4-channel analog output module, 16 Bit input and output data plus control and status byte per signal channel, access to the register structure using cyclic data exchange	

Analog output modules receive the consumer status (IOCS) from the I/O controller and supply it with the provider status (IOPS) of the existing output information in case only the actual user data is replaced. If all existing information in the input and output image is made available then the process data qualifier is additionally transmitted in the opposite directions.
The following table shows a list of the number of bytes for the individual modules that are allocated in the respective process image (PA) and the telegrams (TLG) in the direction of transmission and reception (Tx, Rx).

Module / Type	75x-4xx nAE, …							
	Data length / [Byte]				Data object			
	PA		TLG		E	INST	A	INST
	E	A	Tx	Rx				
2AO	4	-	5	1	-	-	I16	2
4AO	8	-	9	1	-	-	I16	4

Module / Type	75x-4xx nAE, …							
	Data length / [Byte]				Data object			
	PA		TLG		E	INST	A	INST
	E	A	Tx	Rx				
2AO_EM	6	6	7	7	U8,I16	2	U8,I16	2
4AO_EM	12	12	12	12	U8,I16	4	U8,I16	4

3.1.5.2.5 Specialty Modules

3.1.5.2.5.1 Meter and Position Transmitter Interfaces

The group of meter and position transmitter interfaces is divided into 5 types of modules:

Type of module	Description	Substitute I/O modules
1CNT	1 (2)-channel meter module, 32 (16) Bit input and output data plus control and status byte per signal channel, access to the register structure using cyclic data exchange	75x-404
2CNT	2-channel analog output module, 16 Bit input and output data plus control and status byte per signal channel, access to the register structure using cyclic data exchange	75x-638
SSI	SSI Interface, 32 Bit input data	75x-630
SSI_EM	SSI Interface, 32 Bit input and output data plus control and status byte per signal channel, access to the register structure using cyclic data exchange	
DII	Digital impulse interface, 24 Bit input and output data plus control and status byte per signal channel, access to the register structure using cyclic data exchange	75x-635
ENC	Encoder Interface, 32 Bit input and output data plus control and status byte per signal channel, access to the register structure using cyclic data exchange	75x-631, 75x-634, 75x-637

The provider and consumer status (IOPS) of the input or output information are exchanged between the I/O controller and I/O device in both directions with meter and position transmitter interfaces. With the SSI Interface 75x-630, there is also an additional possibility for exclusively transmitting the input data of the transmitter. In this case, the I/O device only receives the consumer status (IOCS) from the I/O controller and supplies it with the provider status (IOPS).
The following table shows a list of the number of bytes for the individual modules that are allocated in the respective process image (PA) and the telegrams (TLG) in the direction of transmission and reception (Tx, Rx).

Module / Type	75x-630 1SSI							
	Data length / [Byte]				Data object			
	PA		TLG		E	INST	A	INST
	E	A	Tx	Rx				
SSI	4	0	5	1	U32	1	-	-

Module / Type	75x-404 1CNT / 75x-630 1SSI, EM / 75x-6xx …							
	Data length / [Byte]				Data object			
	PA		TLG		E	INST	A	INST
	E	A	Tx	Rx				
1CNT	6	6	8	8	U8,U8,U32	1	U8,U8,U32	1
2CNT	6	6	8	8	U8,U16	2	U8,I16	2
SSI_EM	6	6	8	8	U8,U8,U32	1	U8,U8,U32	1
DII	4	4	6	6	U8[4]	1	U8[4]	1
ENC	6	6	8	8	U8,U16	2	U8,U16	2

3.1.5.2.5.2 Pulse Width Output Module

Two module types exist for the PWM output module:

Type of module	Description	Substitute I/O modules
PWM	2-Channel PWM output module, 16-Bit signed process value per signal channel	75x-511
PWM_EM	2-channel PWM output module, 16 Bit input and output data plus control and status byte per signal channel, access to the register structure using cyclic data exchange	

PWM output modules receive the consumer status (IOCS) from the I/O controller and supply it with the provider status (IOPS) of the existing output information in case only the actual user data is replaced. If all existing information in the input and output image is made available then the process data qualifier is additionally transmitted in the opposite direction.

The following table shows a list of the number of bytes for the individual modules that are allocated in the respective process image (PA) and the telegrams (TLG) in the direction of transmission and reception (Tx, Rx).

Module / Type	75x-511 2PWM							
	Data length / [Byte]				Data object			
	PA		TLG		E	INST	A	INST
	E	A	Tx	Rx				
PWM	4	-	5	1	-	-	I16	2

Module / Type	75x-511 2PWM, EM							
	Data length / [Byte]				Data object			
	PA		TLG		E	INST	A	INST
	E	A	Tx	Rx				
PWM_EM	6	6	7	7	U8,I16	2	U8,I16	2

3.1.5.2.5.3 Serial Interfaces and Gateways

The group of serial interfaces and their gateways is divided into 4 types of modules:

Type of module	Description	Substitute I/O modules
SER	Serial interface	75x-404
DXCH	Data exchange module	75x-638
DALI	DALI/DSI Master	75x-635
ENOC	ENOCEAN RF-Module	75x-631, 75x-634, 75x-637

The provider and consumer status (IOPS) of the input or output information are exchanged between the I/O controller and I/O device in both directions with serial interfaces and their gateways.
The following table shows a list of the number of bytes for the individual modules that are allocated in the respective process image (PA) and the telegrams (TLG) in the direction of transmission and reception (Tx, Rx).

Module / Type	75x-650 RS 232 C / 75x-651 RS 485 / 75x-653 TTY / 75x-654 DXCH 75x-641 DALI/DSI / 75x-642 RF-RCV EnOcean							
	Data length / [Byte]				Data object			
	PA		TLG		E	INST	A	INST
	E	A	Tx	Rx				
SER	6	6	8	8	U8[6]	1	U8[6]	1
DXCH	6	6	8	8	U8[6]	1	U8[6]	1
DALI	6	6	8	8	U8[6]	1	U8[6]	1
ENOC	4	4	6	6	U8[4]	1	U8[4]	1

3.1.5.2.5.4 PROFIsafe I/O Modules

The consumer status (IOPS) of the input or output information is exchanged between the I/O controller and I/O device in both directions with PROFIsafe I/O modules.
The following table shows a list of the number of bytes for the individual modules that are allocated in the respective process image (PA) and the telegrams (TLG) in the direction of transmission and reception (Tx, Rx).

Module / Type	753-661 4F-DE / 753-662 8F-DE / 75x-667 4F-DE/DA							
	Data length / [Byte]				Data object			
	PA		TLG		E	INST	A	INST
	E	A	Tx	Rx				
PROFIsafe	5	5	7	7	U8[5]	1	U8[5]	1

3.1.5.2.6 System Modules

3.1.5.2.6.1 Potential Supply Modules

The group of potential supply modules is divided into 2 types of modules:

Type of module	Description	Substitute I/O modules
2DIA	Supply module with 2 Bit diagnostics	750-610, 750-611
2DIA_PI	Supply module with 2 Bit diagnostics, and additional diagnostics with input image	750-610, 750-611

In case there is no diagnostics data prepared in the input image, potential supply modules supply a provider status (IOPS) to the I/O controller. If the input data is available in the input process image then the consumer status (IOCS) is received from the I/O controller.

The following table shows a list of the number of bytes for the individual modules that are allocated in the respective process image (PA) and the telegrams (TLG) in the direction of transmission and reception (Tx, Rx).

Module / Type	750-6xx ...						750-6xx* ...					
	Data length / [Byte]				Data type		Data length / [Byte]				Data type	
	PA		TLG		E	A	PA		TLG		E	A
	E	A	Tx	Rx			E	A	Tx	Rx		
2DIA	0	0	1	0	-	-						
2DIA_PI	1	0	2	1	UINT8	-	0	0	1	1	-	-
	2	0	3	1	UINT16	-						
	4	0	5	1	UINT32	-						

3.1.5.3 Example

The allocation should become clear by way of a fieldbus node with a coupler and 17 I/O modules.

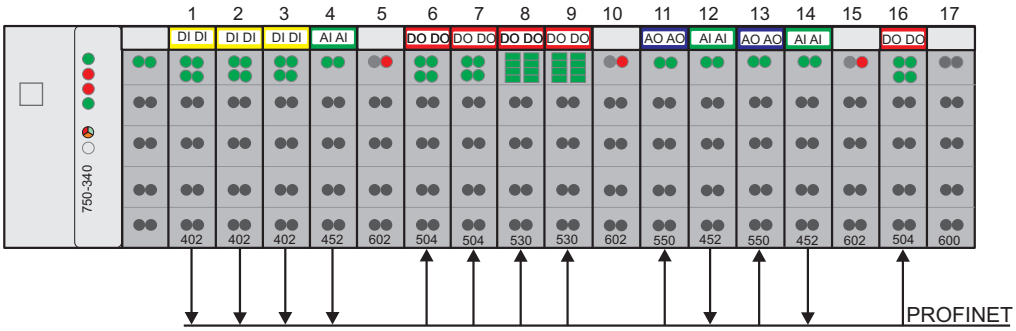


Fig. 3.1.5-8: Application example

g012115x

No.	I/O module	Module	PA I/O Controller *	
		Identifier	Inputs	Outputs
1	Digital input	75x-402 4DE(+4 BIT E) (UINT8 IN)	E 12.0	---
	Digital input		E 12.1	---
	Digital input		E 12.2	---
	Digital input		E 12.3	---
2	Digital input	75x-402* 4DE(-4 BIT E) (-)	E 12.4	---
	Digital input		E 12.5	---
	Digital input		E 12.6	---
	Digital input		E 12.7	---
3	Digital input	75x-402 4DE(+12 BIT E) (UINT16 IN)	E 13.0	---
	Digital input		E 13.1	---
	Digital input		E 13.2	---
	Digital input		E 13.3	---
4	Analog input	750-452 2AE, 0-20 mA (INT16[2] IN)	EW 256	---
	Analog input		EW 258	---
5	Supply	750-610 Supply, DIA (-)	---	---
6	Digital output	75x-504 4DA(+28 BIT A) (UINT32 OUT)	---	A 8.0
	Digital output		---	A 8.1
	Digital output		---	A 8.2
	Digital output		---	A 8.3
7	Digital output	75x-504* 4DA(-4 BIT A) (-)	---	A 8.4
	Digital output		---	A 8.5
	Digital output		---	A 8.6
	Digital output		---	A 8.7

No.	I/O module	Module	PA I/O Controller *	
		Identifier	Inputs	Outputs
8	Digital output	75x-530* 8DA(-8 BIT A) (-)	---	A 9.0
	Digital output		---	A 9.1
	Digital output		---	A 9.2
	Digital output		---	A 9.3
	Digital output		---	A 9.4
	Digital output		---	A 9.5
	Digital output		---	A 9.6
	Digital output		---	A 9.7
9	Digital output	75x-530* 8DA(-8 BIT A) (-)	---	A 10.0
	Digital output		---	A 10.1
	Digital output		---	A 10.2
	Digital output		---	A 10.3
	Digital output		---	A 10.4
	Digital output		---	A 10.5
	Digital output		---	A 10.6
	Digital output		---	A 10.7
10	Power supply	750-610 P-Supply, DIA (-)	---	---
11	Analog output	750-550 2AA, 0-10 V (INT16[2] OUT)	---	AW 256
	Analog output		---	AW 258
12	Analog input	750-452 2AE, 0-20 mA (INT16[2] IN)	EW 260	---
	Analog input		EW 262	---
13	Analog output	750-550 2AA, 0-10 V, EM ({UINT8, INT16}[2] IN/OUT)	EB264, EW265	AB264, AW265
	Analog output		EB267, EW268	AB267, AW268
14	Analog input	750-452 2AE, 0-20 mA, EM {UINT8, INT16}[2] IN/OUT	EB270, EW271	AB270, AW271
	Analog input		EB273, EW274	AB273, AW274
15	Power supply	750-610 P-Supply. 2DIA(+6 BIT E), DIA in E-PA (UINT8)	E 14.0 ... E 14.1	---
16	Digital output	75x-504 4DA(+4 BIT A) (UINT8 OUT)	---	A 11.0
	Digital output		---	A 11.1
	Digital output		---	A 11.2
	Digital output		---	A 11.3
17	End module	End module	---	---

* The addresses stated in the table correspond with the process data allocation given in the hardware configuration.

3.1.5.4 Establishing the Connection

Before starting the productive data exchange between the I/O controller and the I/O device, individual communication instances are created within the PROFINET IO context management and the I/O configuration (target configuration) of the modules is notified. After the connection structure has been checked and once the actual configuration has been adjusted (optional), the I/O device receives all necessary operating settings (parameters) so that the cyclic data exchange via "record data" sets can be established. Both the buscoupler and the connected I/O modules are supplied with parameters. Once all settings have been made, the I/O device signals that it is ready to send and receive cyclic productive data.

3.1.6 Configuration and Parameter Setting of I/O Modules

Setting the parameters of I/O modules is performed via "record data" sets. Modules with diagnostics capability allow the diagnostics message to be locked or released for each channel. Digital outputs provide the possibility of switching a configurable substitute value for each channel in the case of invalid output information.

Possible configuration and parameter values can be found in chapter 5.3, "Configuration and Parameter Setting of the Modules".

Note
For simplification, only the item numbers are shown as module designation in the table. Therefore, the module "75x-400" corresponds to module "750-400 2 DI/24 V DC/3.0 ms" or
"753-400 2 DI/24 V DC/3.0ms"

3.1.7 Diagnostics

3.1.7.1 Diagnostics Data Sets

The diagnostics information of the buscoupler (I/O device) can be read out acyclically using standard diagnostics data sets (records). The structure of the data sets is defined in the PROFINET IO specification (see IODReadReq or IODReadRes). The data set number (index) allows to distinguish between the diagnostics level and the diagnostics structures.

The following diagnostics data sets can be requested in case of an upcoming diagnostics message:

Data set number		Description	Available on slot
0x800A	32778	Standardized channel diagnostics of a sub-module slot (sub-slot specific)	0 ... 128
0x800B	32779		
0x800C	32780		
0xAFF0	45040	Data sets for identification and servicing purposes	0
0xC00A	49162	Channel diagnostics of a slot (slot specific); currently identical with the data set number 800AH, as only one sub-module can exist for each module.	0 ... 128
0xC00B	49163		
0xC00C	49164		
0xE002	57346	Deviations in the set and actual configuration of the sub-modules allocated to the I/O controller (I/O-AR).	0
0xE00A	57354	Channel diagnostics of all signal channels allocated to a connection (AR), contains all channel diagnostics structures of the sub-module slots.	0
0xE00B	57355		
0xE00C	57356		
0xF00A	61450	Channel diagnostics of all signal channels allocated to the application profile 0 (API 0)[*1)], contains all channel diagnostics structures of the individual sub-module slots.[*1)]	0
0xF00B	61451		
0xF00C	61452		

[*1)] Several connections (AR´s) can be established to an API. The buscoupler only enables one connection (AR) of the API 0 to an I/O controller in the firmware versions 01 and 02.

3.1.7.2 Structure of the Standardized Diagnosis Data Sets

The diagnosis data sets comprise of several structure elements. The first element in the data set is the head of the structure. It describes the version and the length of the following data. An identifier `(BlockType)` specifies the structure of the diagnosis data. The following identifiers are currently used by the buscoupler:

Identifier	Description
0x0010	Channel Diagnostics
0x8104	Deviating set / actual configuration

The version enables you to see if the process type (Application Process Identifier – API) follows immediately after the head structure or not.

Version	Description
1.0	Data set does not contain the API
1.1	Data set contains the API

The head of the structure has a length of 6 bytes and is composed of as follows:

Byte offset	Data type			Description	
0 / 1	WORD			**Database contents**	
				0x0010	Channel Diagnostics
				0x8104	Deviating set / actual configuration
2 / 3	WORD			**Length of the data sets in bytes**	
					Length of the version in bytes including
4/5	BYTE	0x01		**Version (major) = 1**	
	BYTE			**Version (minor)**	
				0	Diagnostics data will follow at the end
				1	API will follow at the end
6 / 7	DWORD	0x00	0x00	**API = 0**	
8 / 9		0x00	0x00		Only available in version 1,1

The process type API has a data length of 4 bytes. Depending on the version of the data set, the diagnostics data follow with Byteoffset 6 (Version 1.0) or Byteoffset 10 (Version 1.1). However, the description of the diagnostics data in the sub-chapters - depending on the `BlockType` - begins back with Byteoffset 0.

3.1.7.2.1 Channel Specific Diagnostics

Errors occurring when configuring and setting the parameters of the station (I/O device) and the connected I/O modules as well as external errors from the connected periphery are reported by the coupler via channel specific diagnostics. External errors reported by the subassemblies (e.g. short circuits, line interruptions) are only transmitted to the I/O controller after release when setting the module's parameters.

The `BlockType` in the head structure of the data set corresponds to the value for the channel diagnostics (0x0010). The length defines the following diagnostics data for faulty sub-modules or channels.

The data for the channel diagnostics is triggered using a general structure (see `ChannelDiagnosis` or `ExtChannelDiagnosis`), which is followed by the fault indication of the respective channels. The general structure has a length of 10 bytes and is composed of as follows:

Byte-offset	Data type			Description	
0 / 1	WORD			**Module slot for the alarm source**	
				Range	0 ... 128
2 / 3	WORD	0x00	0x01	**Sub-module slot for the alarm source = 1**	
4 / 5	WORD	0x80	0x00	**ID of the alarm source = sub module (0x8000)**	
6 / 7	BYTE	0x08		**Fault type = upcoming fault (0x08)**	
	BYTE		0x00	**Reserved (0x00)**	
8 / 9	WORD			**Fault type = diagnostics for the sub module**	
				0x8000	Channel Diagnostics
				0x8002	Extended channel diagnostics

As already mentioned, special data sets of faulty sub-modules or channels are following the general structure. This information may be repeated depending on how many different fault messages exist for the channels of a sub-module. The number of existing channel diagnostics data sets can be determined using the length indicated in the head structure.

The following sub-chapters describe the standardized and extended channel diagnostics information that is supported by the coupler.

3.1.7.2.1.1 Channel Diagnostics

The channel diagnostics is set by the coupler when external channel faults occur (e.g. short circuits or overvoltage). These types of faults are defined in the PROFINET IO specification.

The fault type (`SubStructureDefined`) contains the value for channel diagnostics (0x8000).

Each fault of a signal channel or sub-module is described in a data set (see `ChannelDiagnosisData)`. The structure of the data set has 6 bytes and is composed of as follows:

Byte offset	Data type			Description	
0 / 1	WORD			**Alarm source**	
				0x0000 ... 0x0007 0x8000	Channel 0 … 7 Sub-module
2 / 3	BYTE			**Fault- / Channel type**	
				2^2 ... 2^0	reserved
				2^4, 2^3	Fault type = upcoming fault = 1
				2^7 ... 2^5	Channel type
					'000' reserved
					'001' Input channel
					'010' Output channel
					'011' Input / Output channel
					'100' ... '111' reserved
	BYTE			**Data format**	
				0x00	User defined data format
				0x01	Bit
				0x02	2 Bit
				0x03	4 Bit
				0x04	Byte
				0x05	Word
				0x06	Double word
				0x07	2 double words
				0x08 ... 0xFF	reserved
4 / 5	WORD			**Fault type**	
				0x0000	Reserved, not specified
				0x0001	Short circuit
				0x0002	Low voltage
				0x0003	High voltage
				0x0004	Overload
				0x0005	Over temperature
				0x0006	Wire Break
				0x0007	Upper limit value exceeded
				0x0008	Lower limit value exceeded
				0x0009	Fault
				0x000A ... 0x000F	Reserved
				0x0010	Faulty parameter setting
				0x0011	Faulty voltage supply
				0x0012	Fuse fault
				0x0013	Receiver buffer overflow
				0x0014	Ground fault
				0x0015	Reference point is no longer available
				0x0016	Sampling fault
				0x0017	Threshold value undershot / overshot
				0x0018	Output deactivated
				0x0019	Safety relevant fault
				0x001A	External fault
				0x001B	Frame fault
				0x001C	Cycle time fault
				0x001D ... 0x001E	Manufacturer specific
				0x001F	Module fault

Byte offset	Data type			Description	
				0x0020 ... 0x003F	Reserved
				0x0040	Wrong F Address of the PROFIsafe I/O module (F-Slave)
				0x0041	Invalid F Address of the PROFIsafe I/O module (F-Slave)
				0x0042	Wrong F Address of the I/O Controller (F-Host)
				0x0043	Invalid F Address of the I/O Controller (F-Host)
				0x0044	SIL class is not supported
				0x0045	Wrong F-CRC length
				0x0046	Wrong version of the F parameter set.
				0x0047	Invalid CRC of the F parameter set
				0x0048 ... 0x00FF	Reserved
				0x0100 ... 0x7FFF	Manufacturer specific
				0x8000 ... 0xFFFF	Reserved

3.1.7.2.1.2 Fault Types of I/O Modules with Diagnostics Capability

The fault numbers 0x0000 / 0 to 0x000F / 15 contain standard messages. The allocated meaning of fault numbers 0x001B / 27 to 0x001F / 31 are recommended in the specification. Starting with fault number 0x0020 / 32, the associated fault messages are reserved or can be used according to the manufacturer specifications.

Fault number		Significance
STANDARDIZED	0x0000 / 0	Reserved, not specified
	0x0001 / 1	Short circuit
	0x0002 / 2	Low voltage
	0x0003 / 3	High voltage
	0x0004 / 4	Overload
	0x0005 / 5	Over temperature
	0x0006 / 6	Wire Break
	0x0007 / 7	Upper limit value exceeded
	0x0008 / 8	Lower limit value undershot
	0x0009 / 9	Fault
	0x000A / 10 ... 0x000F / 15	reserved
QUASISTA	0x0010 / 16	Configuration fault
	0x0011 / 17	Transmitter or load voltage missing
	0x0012 / 18	Fuse fault
	0x0013 / 19	free
	0x0014 / 20	Ground fault
	0x0015 / 21	Reference channel fault

Fault number		Significance
	0x0016 / 22	Sampling fault
	0x0017 / 23	Threshold value undershot / overshot
	0x0018 / 24	Output deactivated
	0x0019 / 25	Safety relevant fault
	0x001A / 26	External fault
	0x001B / 27	Free
	0x001C / 28	Fault PROFIsafe I/O module
	0x001D / 29 ... 0x001E / 30	free
	0x001F / 31	Missing configuration
RESERVED	0x0020 / 32 ... 0x003F / 64	Reserved
STANDARDIZED	0x0040	Wrong F-device address
	0x0041	Invalid F-device address
	0x0042	Wrong F-Host address
	0x0043	Invalid F-Host address
	0x0044	SIL class not supported
	0x0045	Wrong F CRC length
	0x0046	Wrong version of the F_parameter set.
	0x0047	Invalid CRC of the F-parameter set
RESERVED	0x0048 / 72 ... 0x00FF / 255	Reserved
	0x0100 / 256	Internal bus fault
RESERVED	0x0101 / 257 ... 0x7FFF / 32767	Manufacturer specific
	0x8000 / 32768 ... 0xFFFF / 65535	Reserved

3.1.7.2.2 Fault Cases of I/O Modules with Diagnostics Capability

Article number	Data format	Fault type		Significance
75x-418, 75x-419, 75x-421	BIT	0x1A / 26	External fault	Short circuit of the transmitter power supply
75x-425	BIT	0x1A / 26	External fault	Signal line to transmitter interrupted or short circuited
750-506	BIT	0x01 / 1 0x02 / 2 0x06 / 6	Short circuit Overvoltage Line break fault	Signal output short circuited Field voltage to the signal output inadequate Signal line to the actuator interrupted or not connected
750-507, 750-532, 750-537	BIT	0x1A / 26	External fault	Short circuit of the signal output against +24V or GND, signal line to the actuator is interrupted or not connected or excess temperature through overloading.
750-522, 750-523	BIT	0x1A / 26	External fault	External fault (broken wire, overload or short circuit, manual operation)
750-460, 750-461, 750-469	WORD	0x06 / 6 0x08 / 8 0x09 / 9	Broken wire Lower limit value undershot Fault	Signal line to transmitter interrupted Measurement range shortfall or signal line to the transmitter has a short circuit Internal fault (e.g. hardware)
750-452, 750-465, 750-467, 750-468, 750-472, 750-475, 750-477	WORD	0x07 / 7 0x09 / 9	Upper limit value exceeded Fault	Measurement range overflow Internal fault (e.g. hardware fault)
750-453, 750-454, 750-455, 750-456, 750-457, 750-459, 750-466, 750-474, 750-476, 750-478, 750-479, 750-480, 750-483, 750-485, 750-492	WORD	0x07 / 7 0x08 / 8 0x09 / 9	Upper limit value exceeded Lower limit value undershot Fault	Measurement range overflow of the input signal Measurement range shortfall of the input signal Internal fault (e.g. hardware fault)
750-491	WORD	0x03 / 3 0x07 / 7 0x09 / 9	Overvoltage Upper limit value exceeded Fault	 Measurement range overflow of the input signal Internal fault (e.g. hardware fault)

Article number	Data format	Fault type		Significance
750-553, 750-555, 750-557, 750-559, 750-560	WORD	0x09 / 9	Fault	Output short circuit Internal fault (e.g. hardware fault)
750-610, 750-611	BIT	0x11 / 17 0x12 / 18	Transmitter or load voltage missing Fuse defective	Field voltage too low or not present Fuse defective or not present
750-630	DWORD	0x16 / 22 0x1A / 26	Sampling fault External fault	An incorrect data frame exists, i.e. the data frame is not terminated with zero (possible wire break of clock lines). SSI has no power supply or data line break, or D+ and D- have been inverted.
750-635	OTHER	0x09 / 9	Fault	Wave speed has not been set or inadequate stop impulse or the maximum wave speed has been exceeded or timeout, no measurement values exist, measurement value is invalid or fault when setting the wave speed or zero point has occurred or invalid transmitter selection, the selected transmitter address is invalid because of the missing initialization
750-637	OTHER	0x09 / 9	Fault	
750-641	OTHER	0x09 / 9 0x1A / 26	Fault External fault	General module faults such as POST of the internal flash memory, DALI bus faults (continuous short circuit or open circuit), however, no faulty electronic ballasts.
750-642, 750-650, 750-651, 750-653	OTHER	0x07 / 7	Upper limit value exceeded	The receiver buffer is completely full, there is a danger of loss of data

Article number	Data format	Fault type		Significance
750-661, 750-662, 750-667	BIT	0x1C / 28	Fault PROFIsafe I/O module	There is an external fault on and input or output channel. The detailed cause of fault can be determined using the record data set of the module (see also documentation on PROFIsafe I/O modules).
	OTHER			There is a module fault, e.g. program sequence fault. The detailed cause of a fault can be determined using the record data set of the module (see also documention on PROFIsafe I/O modules).
		0x40 / 64	Wrong F-Host address	The F-device address set by the I/O module differs from the addresses set during configuration.
		0x41 / 65	Invalid F-device address	The F-device address has been configured with 0 or 65535.
		0x42 / 66	Wrong F-Host address	The F-Host address set during projection differs.
		0x43 / 67	Invalid F-Host address	The F-Host address has been configured with 0 or 65535.
		0x44 / 68	SIL class not supported	One SIL class has been configured that is not supported by the F-device.
		0x45 / 69	Wrong F-CRC length	An F-CRC length unequal to 2 bytes has been configured.
		0x46 / 70	Wrong version of the F-parameter set.	An F-parameter set version unequal to PROFIsafe V2 has been configured.
		0x47 / 71	Invalid CRC of the F-parameter set	The F-parameter set is inconsistant.

3.1.7.2.2.1 Extended Channel Diagnostics

The buscoupler uses the extended channel diagnostics to signal internal bus, configuration and parameter setting faults. According to the PROFINET IO standard, extended fault information must be expressed according to the manufacturer specifications.

The fault type (`UserstructureIdentifier`) has the value for the extended channel diagnostics (0x8002).

The structure for the data set (see `ExtChannelDiagnosisData`) has 12 bytes and is composed of as follows:

Byte offset	Data type			Description	
0 / 1	WORD			**Alarm source**	
				0x0000 ... 0x0007 0x8000	Channel 0 … 7 Sub-module
2 / 3	BYTE			**Fault- / Channel type**	
				2^2 ... 2^0	reserved
				2^4, 2^3	Fault type = upcoming fault = 1
				2^7 ... 2^5	Channel type
					'000' Reserved
					'001' Input channel
					'010' Output channel
					'011' Input / Output channel
					'100' ... '111' Reserved
	BYTE			**Data format**	
				0x00	User defined data format
				0x01	Bit
				0x02	2 Bit
				0x03	4 Bit
				0x04	Byte
				0x05	Word
				0x06	Double word
				0x07	2 double words
				0x08 ... 0xFF	Reserved
4 / 5	WORD			**Fault type**	
				0x0000	Reserved, not specified
				0x0010	Faulty parameter setting
				0x001F	Missing configuration
				0x0100	Internal data bus fault
6 / 7	WORD			**Extended fault type**	
				0x0000 ... 0xFFFF	Extended fault description
8 / 9	DWORD			**Additional value**	
10 / 11					Additional fault description

The following tables describe the possible fault messages that are based on the combination of fault type, extended fault type and additional value. The "xx" symbols used for some additional values represent the signal channel (0x0000 ... 0x0007) where the fault has been detected.

The faults described in the following table are faults occurring when configuring both the station substitute (buscoupler) and the modules (I/O modules). Configuration faults are coded using fault type 0x0010 in accordance with the PROFINET IO standard.

Fault type "Configuration fault" (0x0010)“		
Extended fault type	**Additional value**	**Description**
0x0001	0xC0018001	The module type (Identifier) is not recognized.
0x0002	0xC0018002	The module type (Identifier) is invalid.
0x0003	0xC0018003	The status of the module is not allowed during configuration.
0x0004	0xC0018004	The length of the configuration data for the module is smaller than expected.
0x0005	0xC0018005	The length of the configuration data for the module is larger than expected.
0x0006	0xC0018006	The received configuration data for the module is not supported.
0x0007	0xC0018007	The characteristics (Property) for the module are not supported.
0x0008	0xC0018008	The reserved module parameter have an invalid value.
0x0010	0xC0018010	The substitute value behavior for the inputs of the module are not supported
0x0011	0xC0018011	The substitute value behavior for the inputs of the module is not allowed
0x0012	0xC0018012	The bit offset for the inputs of the module is not allowed
0x0013	0xC0018013	The bit offset for the inputs of the module exceed the maximum offset.
0x0014	0xC0018014	The reserved input parameters of the module have an invalid value.
0x0015	0xC0018015	The configured data length for the input module are smaller than expected
0x0016	0xC0018016	The configured data length for the input module are larger than expected
0x0017	0xC0018017	The configured data length for the input module is not allowed
0x0020	0xC0018020	The substitute value behavior for the outputs of the module are not supported
0x0021	0xC0018021	The substitute value behavior for the output of the module is not allowed
0x0022	0xC0018022	The bit offset for the output of the module is not allowed
0x0023	0xC0018023	The bit offset for the output of the module exceed the maximum offset.
0x0024	0xC0018024	The reserved output parameters of the module have an invalid value.
0x0025	0xC0018025	The configured data length for the output module is smaller than expected
0x0026	0xC0018026	The configured data length for the output module is larger than expected
0x0027	0xC0018027	The configured data length for the output module is not allowed

Fault type "Configuration fault" (0x0010)“		
Extended fault type	**Additional value**	**Description**
0x0030	0xC0018030	The combination of input and diagnostics is not supported in the process image.
0x0031	0xC0018031	The combination of input and diagnostics is not allowed in the process image.
0x0032	0xC0018032	The bit offset for the output of the module is not allowed
0x0033	0xC0018033	The bit offset for the diagnostics of the module exceeds the maximum offset.
0x0034	0xC0018034	The reserved diagnostics parameters of the module have an invalid value.
0x0035	0xC0018035	The diagnostics connection of the module is aborted.
0x0051	0xC001xx51	The reserved channel parameter of the module has an invalid value.
0x0060	0xC001xx60	The substitute value for the input channel of the module is not allowed.
0x0061	0xC001xx61	The substitute value for the input channel of the module exceeds its maximum.
0x0062	0xC001xx62	The substitute value for the input channel of the module falls below its minimum.
0x0070	0xC001xx70	The substitute value for the output channel of the module is not allowed.
0x0071	0xC001xx71	The substitute value for the output channel of the module exceeds its maximum.
0x0072	0xC001xx72	The substitute value for the output channel of the module falls below its minimum.
0x0080	0xC001xx80	The substitute value for the output channel of the module is not allowed.
0x0081	0xC001xx81	The connection of the channel diagnostics of the module is not allowed.
0x0090	0xC0018090	The status of the station during the configuration is not allowed.
0x0091	0xC0018091	The length of the configuration data for the station is smaller than expected.
0x0092	0xC0018092	The length of the configuration data for the station is larger than expected.
0x0093	0xC0018093	The reserved station parameters (Table 0, register 0) have invalid values.
0x0094	0xC0018094	The reserved station parameters (Table 0, register 1) have invalid values.
0x0095	0xC0018095	The register access (Table 0, register 1) is not allowed.
0x0096	0xC0018096	The setting of the diagnostics channel (Table 0, register 1) is not allowed.

Fault type "Configuration fault" (0x0010)“		
Extended fault type	**Additional value**	**Description**
0x0097	0xC0018097	The reserved station parameters (Table 0, register 2) have invalid values.
0x0098	0xC0018098	The settings for the internal data bus extension (Table 0, register 2) is not allowed.
0x0099	0xC0018099	The reserved station parameters (Table 0, register 3) have invalid values.
0x009A	0xC001809A	The connection for creating the process image (Table 0, register 3) is deactivated.
0x009B	0xC001809B	The algorithm for creating the process image (Table 0, register 3) is not allowed.
0x009C	0xC001809C	The integration of control and status data of complex modules (Table 0, register 3) is activated.
0x009D	0xC001809D	Formatting of complex module data (Table 0, register 3) is not allowed.
0x009E	0xC001809E	Formatting of digital module data (Table 0, register 3) is not allowed.
0x009F	0xC001809F	The data allocation (Table 0, register 3) is not allowed (neither bytes nor words).
0x00A0	0xC00180A0	The setting for updating the input data (Table 0, register 3) is not allowed (not asynchronous).
0x00A1	0xC00180A1	The setting for updating the output data (Table 0, register 3) is not allowed (not asynchronous).
0x00A2	0xC00180A2	The settings for the behavior of fieldbus faults (Table 0, register 3) is not allowed.
0x00A3	0xC00180A3	The settings for the behavior of internal data bus faults (Table 0, register 3) is not allowed.
0x00A4	0xC00180A4	The settings for activating the diagnostics (Table 0, register 3) is not allowed.
0x00A5	0xC00180A5	The linking of the diagnostics data to the process image (Table 0, register 3) is activated.
0x00A6	0xC00180A6	The reserved station parameters (Table 0, register 4) have invalid values.
...	...	...
0x00B2	0xC00180B2	The reserved station parameters (Table 0, register 4) have invalid values.
0x00B3	0xC00180B3	The reserved station parameter (Table 100, register 75) have invalid values.
0x00B4	0xC00180B4	The module setting (Table 100, register 75) is not allowed.
0x00B5	0xC00180B5	The reserved station parameter (Table 100, register 76) have invalid values.
0x00B6	0xC00180B6	The reserved station parameter (Table 100, register 77) have invalid values.

Missing parameters for both the station substitute (buscoupler) and the modules (I/O modules) are also reported using an extended channel diagnostics. Fault type **0x001F** is classified as missing parameters in accordance with the standard.

Fault type "missing parameters (0x001F)"		
Extended fault type	**Additional value**	**Description**
0x0009	0xC0018009	Module or coupler are not configured.

Faults occurring on the internal data bus system are also indicated by transmitting an extended channel diagnostics. This is a manufacturer specific fault that is displayed using the fault type $\mathbf{100_H}$. Additional fault information is available in the following table.

Fault type "Internal bus fault (0x0100)“		
Extended fault type	**Additional value**	**Description**
0x0001	0x00000106	The module configuration that has been determined on the internal bus after AUTORESET differs from the configuration performed before the internal bus fault occurred.
0x0003	0x01100300	Internal bus protocol fault due to internal bus RESET fault.
0x0003	0x01110300	Internal bus protocol fault due to command fault.
0x0003	0x01120300	Internal bus protocol fault due to faulty input data.
0x0003	0x01140300	Internal bus protocol fault due to faulty output data.
0x0003	0x01180300	Internal bus protocol fault caused by timeout.
0x0004	0x011204xx	Internal bus interruption after module slot xx (xx = 0 ... 250).
0x0005	0x011005xx	Internal bus initializing fault because of an abortive register communication with the module on slot xx (xx = 1 ... 250).

3.1.7.2.3 Difference between Target and Actual Configuration

A diagnostics is performed by the coupler when there is a difference between the module configuration of the I/O controller and the number of connected sub-modules (I/O modules).

The `BlockType` in the head structure of the data set corresponds to the value of the module differences (0x8104). The length gives information on the differences between the configured and connected modules or sub-modules.

A structure head is used for the module differences.

Byte offset	Data type			Description	
0 / 1	DWORD	0x00	0x00	**API** (**A**pplication **P**rocess **I**nstance) = 0	
2 / 3		0x00	0x00		
4 / 5	WORD			**Number of slots with differences between target and actual configuration**	
					dependent on the number of data sets that follow

The number of data sets for each module that has been faulty configured is stored in the head structure.

Byte offset	Data type			Description	
14 / 15	WORD			**Module slot with set / actual deviation**	
				Value range	1 ... 255
16 / 17	DWORD			**Identification of the physically connected modules**	
10 / 11					
12 / 13	WORD			**Module status**	
				0x0000	no module is connected
				0x0001	Physically connected and configured module do not correspond
				0x0002	Physically connected and configured module correspond but at least one sub-module is missing or does not correspond.
				0x0003	Physically connected and configured module do not correspond but are compatible
				0x0004 ... 0xFFFF	reserved
14 / 15	WORD			**Number of sub-module slots where a difference between the target and actual configuration exists, otherwise 0**	

The data sets of faulty configured sub-modules are following the data set of one module.

Byte offset	Data type			Description	
14 / 15	WORD	0x00	0x01	**Sub-module slot with target and actual deviation**	
16 / 17	DWORD	0x00	0x00	**Identification of the physically connected sub-module = 0**	
10 / 11		0x00	0x00		
12 / 13	WORD			**Sub-module status**	
				0x0000	no sub-module is connected
				0x0001	Physically connected and configured sub-module do not correspond
				0x0002	Sub-module is locked by the I/O controller
				0x0003	reserved
				0x0004	one application is accessing the sub-module
				0x0005	reserved
				0x0006	reserved
				0x0007	Physically connected and configured sub-module do not correspond but are compatible
				0x0008 ... 0xFFFF	reserved

The sub-module data sets follow direct one after another. Their number is stored in the head structure. The next module data set follows after the sub-module data sets.

3.1.7.2.4 Data Set for Identification and Servicing Purposes (I&M 0)

This data set allows to read the device information that may be required for the system documentation and for service purposes.

Byte offset	Information		Description
0	0x00	0x20	Block type
2	0x00	0x38	Block length = 56 Byte
4	0x01	0x00	Block version 1.0
6	0x01	0x1D	Manufacturer ID WAGO **285_D**
8	**0x37**	**0x35**	WAGO order number filled out with spaces „**750-340** “
10	**0x30**	**0x2D**	
12	**0x33**	**0x34**	
14	**0x30**	0x20	
16	0x20	0x20	
...	...	...	
26	0x20	0x20	
28	**0x30**	**0x30**	MAC-ID WAGO filled out with spaces “**0030DE*KLMNOP*** ”
30	**0x33**	**0x30**	
32	**0x44**	**0x45**	

Byte offset	Information		Description
34	0xKK	0xLL	
36	0xMM	0xNN	
38	0xOO	0xPP	
40	0x20	0x20	
42	0x20	0x20	
44	0x00	0x05	Hardware version 05
46	0x56	0x01	Firmware version "V" 01.00.03
48	0x00	0x03	
50	0x00	0x01	
52	0x00	0x00	
54	0x00	0x00	
56	0x01	0x01	
58	0x00	0x00	Only I&M0 is supported

3.1.8 Acyclic Communication using Record Data Sets

In addition to cyclic data communication (PROFIBUS IO standard in compliance with IEC 61158), PROFIBUS IO also offers acyclic communication services as an option. These acyclic services run parallel to cyclic data transfer. The data sets are addressed via the module slots, the sub-module slots and the data set number (index) of the module. In doing so, the sub-module slot should always be addressed with 1. The meaning of the indexes can be determined in the area of 0x0000 to 0x7FFF according to the manufacturer specifications. The area of 0x8000 to 0xFFFF is established by the PROFINET IO standard and the following applications.

3.1.8.1 Data Set Detail diagnostics for PROFIsafe I/O Modules

Via channel diagnostics, the PROFIsafe I/O modules indicate if a fault has occurred and if it has been caused by a module or channel failure. In the event of a channel failure, the detail diagnostics is made available at "record data" set 0x0024 (36) for the input channel and at "record data" set 0x002C (44) for the output channel. Detailed module faults can be determined via "record data" set 0x0034 (52). The length of the detail diagnostics that must be requested is 2 bytes. The coding of the detail diagnostics is as follows:

Detail diagnostics "F Input channels PROFIsafe" (Data set 36, 2 Byte long)	
Fault	**Description**
0x0K01	Cross connection between two input channels that are supplied from two different clock signal sources. K contains the number of the input channel that does not receive a clock signal because of the cross connection. If there is a cross connection between two independent clock signal sources, K is written to the input channel that had recognized the fault at first.
0x0K27	Discrepancy fault with 2 channel evaluation. K contains the input channel that has determined the discrepancy fault.

Detail diagnostics "F Output channels PROFIsafe" (Data set 44, 2 Byte long)	
Fault	**Description**
0x0K04	Overload to output channel K.
0x0K06	Wire break on output channel K.
0x0K23	Short circuit after 24V of the output channel K.
0x0K24	Short circuit after 0V of the output channel K.

Detail diagnostics "F Module PROFIsafe" (Data set 52, 2 Byte long)	
Fault	**Description**
0x0002	Undervoltage field supply
0x0005	Excessive temperature within the PROFIsafe I/O module
0x0009	Fault
0x0019	Safety relevant fault, a hardware fault has occurred on safety relevant switching parts or there is a program sequence fault caused by the device software.
0x0020	External fault, there is a fault in the detail diagnostics for the input or output periphery.

3.1.9 LED Indication

For on-site diagnostics, the coupler has several LEDs that indicate the operational status of the coupler or the entire node.

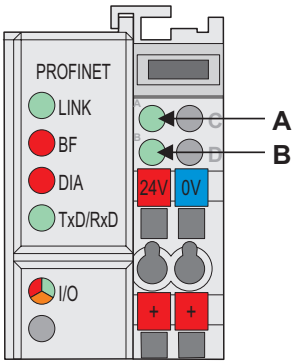


Fig. 3.1.9-9: Indicators 750-340 g034002x

The upper four LEDs (LINK, BF, DIA, TxD/RxD) indicate the state of the PROFINET IO communication.

The lower LED (I/O) displays the internal state of the complete node.

The LEDs A and B display the status of the supply voltage.

3.1.9.1 Blink Code

Detailed error messages are indicated by means of blinking codes. An error is indicated cyclically by up to 3 blinking sequences.

- The error display starts with the first blinking sequence (approx. 10 Hz).
- After a short break, the second blinking sequence starts (approx. 1 Hz). The number of light pulses indicates the **Error Code**.
- After another break, the third blinking sequence starts (approx. 1 Hz). The number of light pulses indicates the **Error Argument**.

3.1.9.2 Fieldbus Status

The upper four LEDs signal the operating status of the PROFIBUS IO communication.

LED	Color	Significance
LINK	green	The LINK LED shows information on the connection to the PROFINET IO network and is used to identify the station by means of the MAC address (2Hz blink frequency when I/O supervisor requests the participant blink test).
BF	red	The BF LED shows information on the condition of the data exchange between the buscoupler and the I/O controller.
DIA	red	The DIA LED shows parameter setting faults and external diagnostics.
TxD/RxD	red	The buscoupler sends and receives PROFINET IO telegrams.

LINK	BF	DIA	TxD/ RxD	Significance	Remedy
Off	Off	Off	Off	The buscoupler is not provided with its required operating voltage or a hardware fault is present.	Check the voltage supply to the bus coupler. Replace the buscoupler if necessary
Off	On	*	Off	The operating voltage for the buscoupler is present. The physical connection to the PROFINET IO is not established.	Make sure that the RJ45 socket is connected to the switch using a CAT 5 Ethernet cable.
On	blinks	*	Off	A physical connection is not established between the buscoupler and I/O controller.	Establish a connection between the buscoupler and I/O controller via the network.
On	blinks	*	pulses	The physical network connection to the I/O controller is established. However, data exchange could not be carried out.	Check the device names that have been allocated to the device. Check the configuration of I/O device.
On	Off	*	On	The buscoupler is performing a productive data exchange with the I/O controller. Configuration and parameter setting has been taken over by the buscoupler.	
*	*	On	*	The buscoupler reports a diagnostics information which is still present.	The data exchange works trouble free. A diagnostic information such as cable break on an analog input module is active.
	* not relevant				

3.1.9.3 Node Status - 'I/O' LED Blinking Code

The communication status via internal bus is indicated via the lower "I/O" LED.

LED	Significance	Remedy
I/O		
Green	Fieldbus coupler operates correctly	
Red	a) At fieldbus coupler start-up: Initialization of internal bus, start-up is indicated by fast blinking for approx. 1-2 seconds	
Red	b) After fieldbus coupler start-up: Internal bus errors are indicated by up to three successive blinking sequences. Between the sequences are short intervals.	Analyze error message (error code and error argument)

After the power is turned on, the coupler starts up. The red ‘I/O‘ LED blinks. After a trouble-free start-up the ‘I/O‘ LED is green.
In the event of a failure the ‘I/O‘ LED keeps blinking.

Detailed error messages are indicated by means of blinking codes. An error is indicated cyclically by up to 3 blinking sequences.

- The error display starts with the first blinking sequence (approx. 10 Hz).
- The second flash sequence appears after an interval (approx. 1 Hz). The number of light pulses indicates the **Error Code.**
- After another break, the third blinking sequence starts (approx. 1 Hz). The number of light pulses indicates the **Error Argument**.

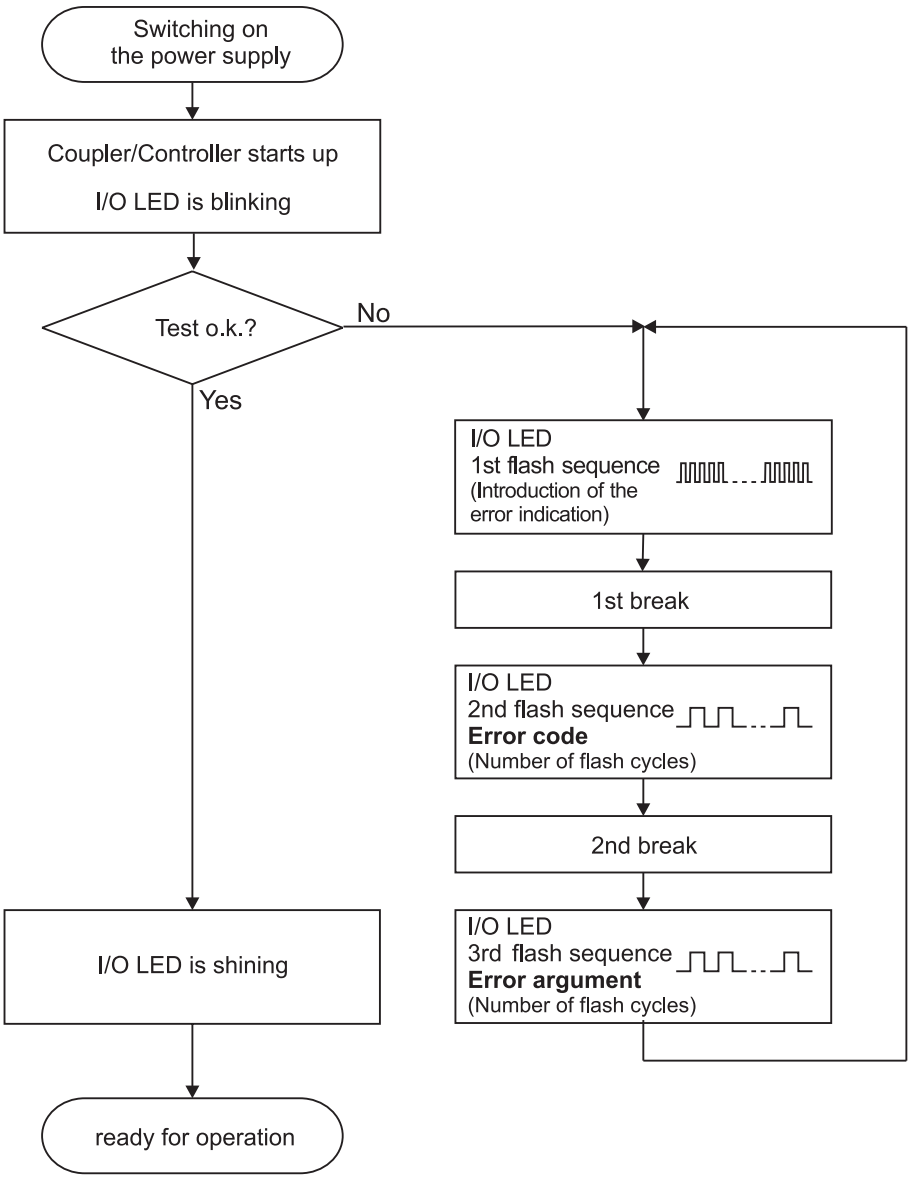


Fig. 3.1.9-10: Signaling the LED node status g012111e

After the error is removed, restart the coupler by turning the power supply off and on again.

3.1.9.4 'I/O' LED Error Messages

First blinking sequence: start of error display
Second blinking sequence: error code
Third blinking sequence: error argument

Error code 1: "Hardware and configuration error"		
Error argument	**Fault Description**	**Remedy**
1	Overflow of the internal buffer memory for the inline code.	Turn off the supply voltage of the node, reduce the number of modules and switch on the supply voltage again. If the error remains, replace the buscoupler.
2	I/O module(s) with unknown data type	Identify the faulty I/O module. Turn off the power supply. Plug the end module in the middle of the node. Turn the power supply on again. - If the LED is keeps blinking, turn off the power supply and plug the end module in the middle of the first half of the node (towards the coupler). - If the LED does not blink, turn off the power supply and plug the end module in the middle of the second half of the node (away from the coupler). Turn the power supply on again. Repeat this procedure (while halving the step size) until the faulty I/O module is detected. Replace the faulty I/O module. Ask for a buscoupler firmware update.
3	Invalid check sum in the parameter area of the buscoupler..	Switch off the supply voltage of the node, replace the buscoupler and switch on again.
4	Fault when writing in the serial EEPROM.	Switch off the supply voltage of the node, replace the buscoupler and switch on again.
5	Fault when reading the serial EEPROM	Switch off the supply voltage of the node, replace the buscoupler and switch on again.
6	Changed I/O module configuration found after AUTORESET.	Restart the coupler by turning the supply voltage off and on again.
7	Invalid hardware-firmware combination.	Switch off the supply voltage of the node, replace the buscoupler and switch on again.
8	Timeout during serial EEPROM access.	Switch off the supply voltage of the node, replace the buscoupler and switch on again.

9	Buscontroller initialization error	Switch off the supply voltage of the node, replace the buscoupler and switch on again.
10	Buffer power failure real time clock (RTC)	Set the clock and hold up the power supply of the buscoupler for at least 15 minutes in order to charge the Goldcap.
11	Fault during read access to the real time clock (RTC)	Set the clock and hold up the power supply of the buscoupler for at least 15 minutes in order to charge the Goldcap.
12	Fault during write access to the real time clock (RTC)	Set the clock and hold up the power supply of the buscoupler for at least 15 minutes in order to charge the Goldcap.
13	Clock interrupt fault	Set the clock and hold up the power supply of the buscoupler for at least 15 minutes in order to charge the Goldcap.
14	Maximum number of gateway modules or mailbox modules exceeded.	Reduce the number of correspondent modules to a valid number.

Error code 2 -not used-		
Fault Argument	**Fault Description**	**Remedy**
-	not used	-
Error code 3 "Protocol error internal bus"		
Fault Argument	**Fault Description**	**Remedy**
-	Internal bus communication is faulty, defective component cannot be identified.	If there are passive power supply modules (750-613) in the node, check first if these modules are supplied correctly with power. To do so, check the status LEDs. If all modules are connected correctly or if there are no 750-613 I/O modules in the node, identify the faulty I/O module as follows: Turn off the supply voltage of the node. Plug the end module in the middle of the node. Turn on the power supply again. - If the LED keeps blinking, turn off the power supply and plug the end module in the middle of the first half of the node (towards the coupler). - If the LED does not blink, turn off the power supply and plug the end module in the middle of the second half of the node (away from the coupler). Turn on the power supply again. Repeat this procedure (while halving the step size) until the faulty I/O module is detected. Replace the faulty I/O module. If there is only one I/O module left and the LED blinks, then either this module or the coupler is defective. Replace the faulty component.

Error code 4 "Physical error internal bus"		
Fault Argument	**Fault Description**	**Remedy**
-	Internal bus data transmission error or interruption of the internal bus at the buscoupler.	Turn off the supply voltage of the node. Plug one I/O module with process data behind the coupler and observe the error argument that is indicated after power on. If no error argument is indicated by the I/O LED, replace the buscoupler. Otherwise identify the faulty I/O module. Turn off the power supply. Plug the end module in the middle of the node. Turn on the power supply again. - If the LED keeps blinking, turn off the power supply and plug the end module in the middle of the first half of the node (towards the coupler). If the LED does not blink, turn off the power supply and plug the end module in the middle of the second half of the node (away from the coupler). Turn the power supply on again. Repeat this procedure (while halving the step size) until the faulty I/O module is detected. Replace the faulty I/O module. If there is only one I/O module left and the LED blinks, then either this module or the coupler is defective. Replace the faulty component.
n*	Interruption of the internal bus behind the nth I/O module with process data.	Turn off the supply voltage of the node, replace the (n+1)th I/O module with process data and turn on the supply voltage again.

Error code 5 "Initialization error internal bus"		
Fault Argument	**Fault Description**	**Remedy**
n*	Error during register communication during internal bus initialization..	Switch off the supply voltage of the node, replace the n-th bus coupler with the process data and switch the power supply back on.
Error code 6 " Fieldbus specific error"		
Fault Argument	**Fault Description**	**Remedy**
1	Invalid MAC-ID	Switch off the supply voltage of the node, replace the buscoupler and switch on again.
2	Initialization error Ethernet hardware	Restart the buscoupler by turning the power supply off and on again. If the error remains, replace the buscoupler.
3	Initialization error TCP/IP stack	Restart the buscoupler by turning the power supply off and on again. If the error remains, replace the buscoupler.
4	Network configuration error (no IP address)	Check the settings of the BootP server.
5	Initialization error of an application protocol	Restart the buscoupler by turning the power supply off and on again.
6	Maximum process image size exceeded	Reduce the number of I/O modules
7	IP address of the buscoupler is repeated several times in the network	Use an IP address that has not been used in the network
8	Error during process image generation	Reduce the number of I/O modules on the node
* 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)		

Example: The 13th I/O module is removed.	
1.	The "I/O" LED starts the error display with the first blinking sequence (approx. 10 Hz).
2.	After the first break, the second blinking sequence starts (approx. 1 Hz). The "I/O" LED blinks four times, thus indicating error code 4 (data error internal bus).
3.	After the second break, the third blinking sequence starts. The I/O LED blinks twelve times. Error argument 12 means that the internal bus is interrupted behind the twelfth I/O module.

3.1.9.5 Status Supply voltage

The power supply unit of the coupler has two green LEDs. The link upper LED (A) displays the status of the system supply. The left lower LED (B) reports the status of the field supply.

LED A	Significance	Remedy
Green	System supply O.K.	
Off	System supply missing	Check supply voltage (24 V and 0 V)

LED B	Significance	Remedy
Green	Field supply O.K.	
Off	Field supply missing	Check supply voltage (24 V and 0 V)

3.1.10 Error Response

3.1.10.1 Fieldbus Failure

A fieldbus failure is indicated if the I/O controller switches off or if the Ethernet cable is interrupted. An error in the I/O controller can also lead to a fieldbus failure

The red BF LED lights up.

When the fieldbus fails, the coupler can release the configurable substitute values of the I/O modules. A substitute value can be determined for each channel when configuring the outputs.

Substitute value strategy	Value (bit orientated) Digital Output Modules	Value (byte orientated) Analog Output Modules
Minimum value	0	0 or. 4 mA, -10 or. 0 V
Maximum value	1	20 mA, 10 V
Substitute value	0 or 1	0/4 ... 20 mA, -10/0 ... +10 V
Stop internal bus	Response determined by the I/O module	

The values are entered into the output process image by the coupler. With I/O modules that have a byte orientated data width (e.g. pulse width module), the substitute value is determined using the value range.

As soon as the fieldbus is reactivated, the process data is transmitted again and the outputs of the node are set accordingly.

3.1.10.2 Internal Bus Failure

An internal bus failure occurs, for example, if an I/O module is removed. If this error occurs during operation, the output modules react like during an internal bus stop. The input process image is set according to the configuration strategy.

The "I/O" LED flashes red. The buscoupler (I/O device) generates a detailed diagnostic message.

When the I/O module fault is repaired, the buscoupler restarts according to the configured restart behavior. The process data is transmitted again and the outputs of the node are set accordingly.

3.1.11 Technical Data

System data	
Number of I/O modules	limited by PROFINET I/O specification
Transmission medium	Twisted Pair S-UTP 100 Ω CAT 5
Buscoupler connection	RJ45
Max. length of fieldbus segment	100 m between switch and 750-340; max. length of network limited by PROFINET I/O specification
Baud rate	100 Mbit/s
Protocols	PROFINET I/O, DCP, DHCP, SNMP
Technical Data	
Number of I/O modules	128
Digital signals Analog signals	max. 2048 (inputs and outputs) max. 128 (inputs and outputs)
Configuration possibilities	via PC
Voltage supply	DC 24 V (-15 % ... + 20 %)
Input current $_{max}$	500 mA at 24 V
Efficiency of the power supply	87 %
Internal current consumption	300 mA at 5 V
Total current for I/O modules	1700 mA bei 5 V
Potential isolation	500 V system / supply
Voltage via power jumper contacts	DC 24 V (-15 % ... + 20 %)
Current via power jumper contacts $_{max}$	DC 10 A
Dimensions W x H* x D (* from upper edge of rail)	51 mm x 65 mm x 100 mm
Weight	approx. 195 g
Accessories	
Miniature WSB Quick marking system	
Standards and regulations (see chapter 2.2)	
EMC Immunity to interference	acc. to EN 50082-2 (96), EN 61000-6-2 (99)
EMC Emission of interference	acc. to EN 50082-2 (94)
Approvals (see chapter 2.2)	
$_{c}UL_{US}$ (UL508)	E175199
Conformity marking	CE

4 Fieldbus Communication

4.1 ETHERNET

4.1.1 General

ETHERNET is a technology, which has been proven and established as an effective means of data transmission in the field of information technology and office communication. Within a short time ETHERNET has also made a successful breakthrough in the area of private PC networks throughout the world.

This technology was developed in 1972 by Dr. Robert M. Metcalfe, David R. Boggs, Charles Thacker, Butler W. Lampson, and Xerox (Stanford, Ct.). Standardization (IEEE 802.3) took place in 1983.

ETHERNET predominantly uses coaxial cables or twisted pair cables as a transmission medium. Connection to ETHERNET, often already existing in networks, (LAN, Internet) is easy and the data exchange at a transmission rate of 10 Mbps or for some couplers/controllers also 100 Mbps is very fast.

ETHERNET has been equipped with higher level communication software in addition to standard IEEE 802.3, such as TCP/IP (Transmission Control Protocol / Internet Protocol) to allow communication between different systems. The TCP/IP protocol stack offers a high degree of reliability for the transmission of information.

In the ETHERNET based (programmable) fieldbus couplers and controllers developed by WAGO, usually various application protocols have been implemented on the basis of the TCP/IP stack.

These protocols allow the user to create applications (master applications) with standardized interfaces and transmit process data via an ETHERNET interface.

In addition to a series of management and diagnostic protocols, fieldbus specific application protocols are implemented for control of the module data, depending upon the coupler or controller, e. g. MODBUS TCP (UDP), EtherNet/IP, BACnet, KNXNET/IP, PROFINET, Powerlink, Sercos III or others.

Information such as the fieldbus node architecture, network statistics and diagnostic information is stored in the ETHERNET (programmable) fieldbus couplers and controllers and can be viewed as HTML pages via a web browser (e.g., Microsoft Internet-Explorer, Netscape Navigator) being served from the HTTP server in the couplers and controllers.

Furthermore, depending on the requirements of the respective industrial application, various settings such as selection of protocols, TCP/IP, internal clock and security configurations can be performed via the web-based management system. However, you can also load web pages you have created yourself into the couplers/controllers, which have an internal file system, using FTP.

The WAGO ETHERNET TCP/IP fieldbus node does not require any additional master components other than a PC with a network card. So, the fieldbus node can be easily connected to local or global networks using the fieldbus connection. Other networking components such as hubs, switches or repeaters can also be used. However, to establish the greatest amount of “determinism” a switch is recommended.

The use of ETHERNET as a fieldbus allows continuous data transmission between the plant floor and the office. Connection of the ETHERNET TCP/IP fieldbus node to the Internet even enables industrial processing data for all types of applications to be called up world-wide. This makes site independent monitoring, visualization, remote maintenance and control of processes possible.

4.1.2 Network Architecture – Principles and Regulations

A simple ETHERNET network is designed on the basis of one PC with a network interface card (NI), one crossover connection cable (if necessary), one ETHERNET fieldbus node and one 24 V DC power supply for the coupler/controller voltage source.

Each fieldbus node consists of a (programmable) fieldbus coupler or controller and a number of needed I/O modules.

Sensors and actuators are connected to the digital or analog I/O modules on the field side. These are used for process signal acquisition or signal output to the process, respectively.

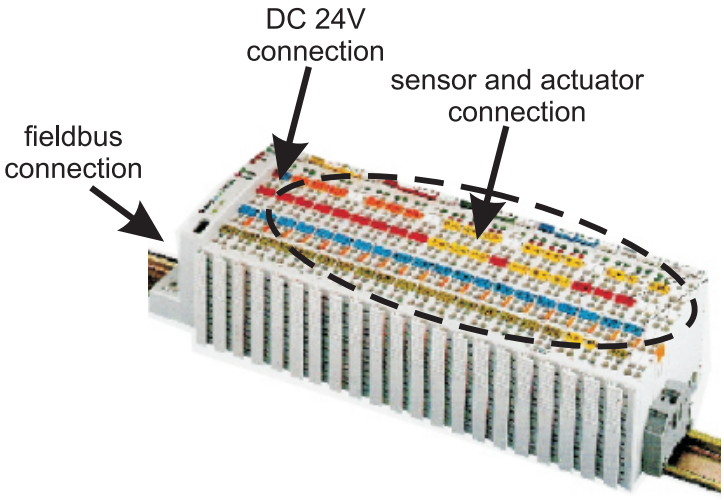


Fig. 4-1. Connection Example and Principle of a Fieldbus Node for a Network Architecture
1Netwerkknotene

Fieldbus communication between master application and (programmable) fieldbus coupler or controller takes place using the implemented fieldbus specific application protocol, e. g. MODBUS TCP (UDP), EtherNet/IP, BACnet, KNXNET/IP, PROFINET, Powerlink, Sercos III or others.

4.1.2.1 Transmission Media

General ETHERNET transmission standards

For transmitting data the ETHERNET standard supports numerous technologies with various parameters (e.g., transmission speed, medium, segment length and type of transmission).

1Base5	Uses a 24 AWG UTP (twisted pair cable) for a 1Mbps baseband signal for distances up to 500 m (250 m per segment) in a physical star topology.
10Base2	Uses a 5 mm 50 Ohm coaxial cable for a 10Mbps baseband signal for distances of up to 185 m in a physical bus topology (often referred to as Thin ETHERNET or ThinNet).
10Base5	Uses a 10 mm 50 Ohm coaxial cable for a 10Mbps baseband signal for distances of up to 500 m in a physical bus topology (often referred to as Thick ETHERNET).
10Base-F	Uses a fiber-optic cable for a 10Mbps baseband signal for distances of up to 4 km in a physical star topology. (There are three sub-specifications: 10Base-FL for fiber-optic link, 10Base-FB for fiber-optic backbone and 10Base-FP for fiber-optic passive).
10Base-T	Uses a 24 AWG UTP or STP/UTP (twisted pair cable) for a 10Mbps baseband signal for distances up to 100 m in a physical star topology.
10Broad36	Uses a 75 Ohm coaxial cable for a 10Mbps baseband signal for distances of up to 1800 m (or 3600 m with double cables) in a physical bus topology.
100BaseTX	Specifies a 100 Mbps transmission with a twisted pair cable of Category 5 and RJ45-connectors. A maximum segment of 100 meters may be used.

Tab. 4-1: ETHERNET Transmission Standards

Beyond that there are still further transmission standards, for example: 100Base-T4 (Fast ETHERNET over twisted conductors), 100Base-FX (Fast ETHERNET over fiber-optic cables) or P802.11 (Wireless LAN) for a wireless transmission.

The media types are shown with their IEEE shorthand identifiers. The IEEE identifiers include three pieces of information.
The first item, for example, “10”, stands for the media.
The third part of the identifier provides a rough indication of segment type or length. For thick coaxial cable, the “5” indicates a 500 meter maximum length allowed for individual thick coaxial segments. For thin coaxial cable, the “2” is rounded up from the 185 meter maximum length for individual thin coaxial segments. The “T” and “F” stand for ‘twisted pair’ and ‘fiber optic’, and simply indicate the cable type.

10Base-T, 100BaseTX

Either the 10BaseT standard or 100BaseTX can be used for the WAGO ETHERNET fieldbus node.
The network architecture is very easy and inexpensive to assemble with S-UTP cable as transmission medium or with cables of STP type.
Both types of cable can be obtained from any computer dealer.

S-UTP cable (screened unshielded twisted pair) is single-shielded cable of Category 5 with overall shield surrounding all twisted unshielded conductor pairs and an impedance of 100 ohm.
STP cable (shielded twisted pair) is cable of Category 5 with stranded and individually shielded conductor pairs; no overall shield is provided.

Wiring of the fieldbus nodes

Maybe, a crossover cable is required for direct connection of a fieldbus node to the network card of the PC.

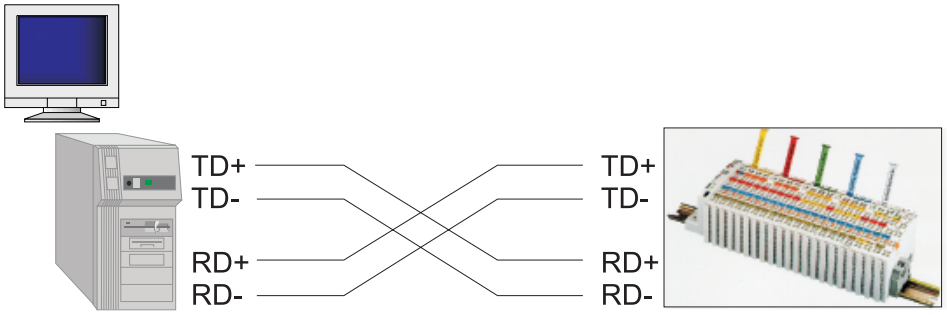


Fig. 4-2: Direct Connection of a Node with Crossover Cable g012906d

If several fieldbus nodes are to be connected to a network card, the fieldbus nodes can be connected via an ETHERNET switch or hub with straight through/parallel cables.

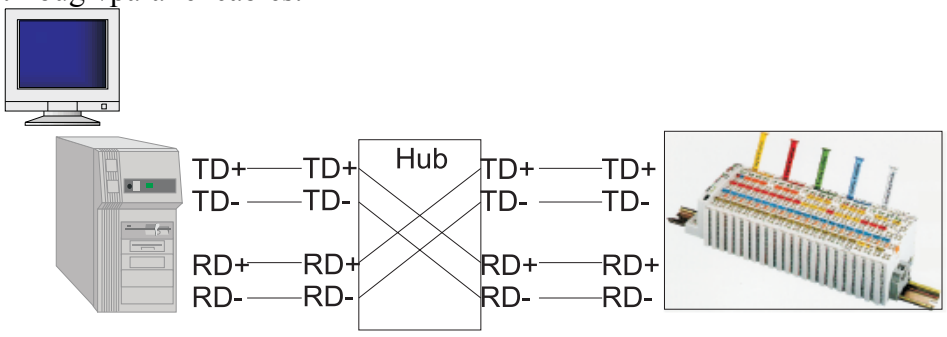


Fig. 4-3: Connection of a Node by means of a Hub with Parallel cables g012908d

An ETHERNET switch is a device that allows all connected devices to transmit and receive data with each other. The switch can also be viewed as a “data traffic cop” where the hub “polices” the data coming in and going out of the individual ports, so the data will only be transmitted to the required node. WAGO recommends using a switch rather then a hub, this will allow for a more deterministic architecture.

Attention
The cable length between the node and the hub cannot be longer than 100 m (328 ft.) without adding signal conditioning systems (i.e., repeaters). Various possibilities are described in the ETHERNET standard for networks covering larger distances.

4.1.2.2 Network Topologies

In the case of 10Base-T, or 100BaseTX several stations (nodes) are connected using a star topology according to the 10Base-T ETHERNET Standard.

Therefore, this manual only deals with the star topology, and the tree topology for larger networks in more detail.

Star Topology

A star topology consists of a network in which all nodes are connected to a central point via individual cables.

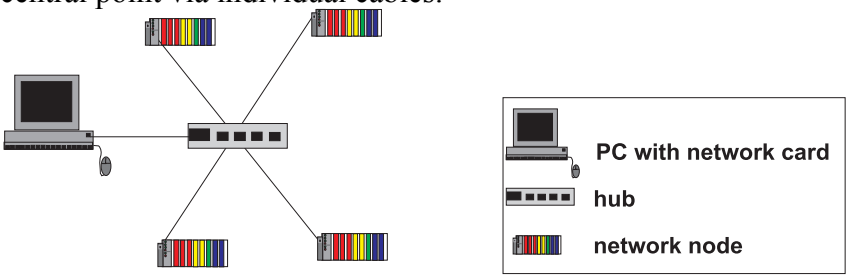


Fig. 4-4: Star Topology G012903e

A star topology offers the advantage of allowing the extension of an existing network. Stations can be added or removed without network interruption. Moreover, in the event of a defective cable, only the network segment and the node connected to this segment is impaired. This considerably increases the fail-safe of the entire network.

Tree Topology

The tree topology combines characteristics of linear bus and star topologies. It consists of groups of star-configured workstations connected to a linear bus backbone cable. Tree topologies allow for the expansion of an existing network, and enables schools, etc. to configure a network to meet their needs.

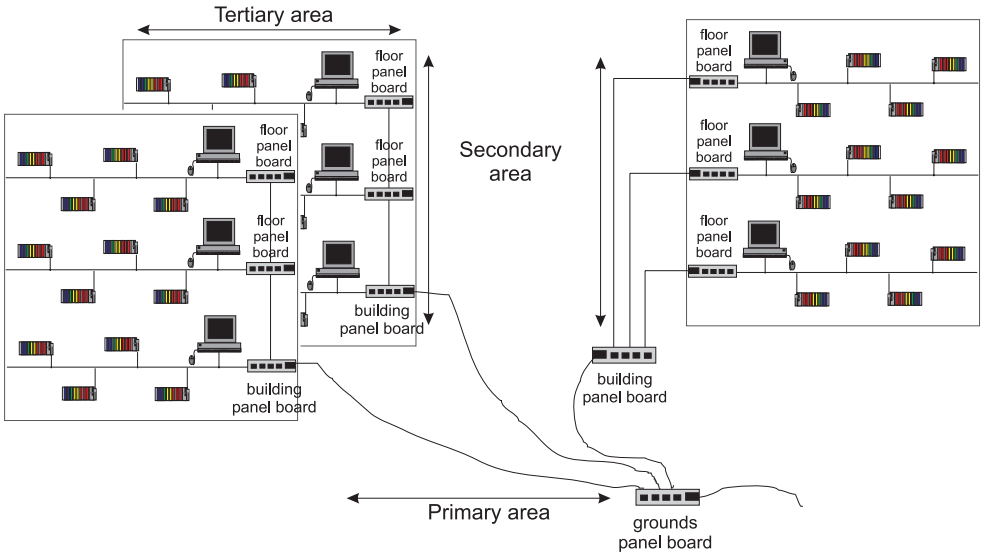


Fig. 4-5: Tree Topology G012904e

5-4-3 Rule

A consideration in setting up a tree topology using ETHERNET protocol is the
5-4-3 rule. One aspect of the ETHERNET protocol requires that a signal sent out on the network cable must reach every part of the network within a specified length of time. Each concentrator or repeater that a signal goes through adds a small amount of time. This leads to the rule that between any two nodes on the network there can only be a maximum of 5 segments connected through 4 repeators/concentrators. In addition, only 3 of the segments may be populated (trunk) segments if they are made of coaxial cable. A populated segment is one that has one or more nodes attached to it. In Figure 5-5, the 5-4-3 rule is adhered to. The furthest two nodes on the network have 4 segments and 3 repeators/concentrators between them.

This rule does not apply to other network protocols or ETHERNET networks where all fiber optic cabling or a combination of a backbone with UTP cabling is used. If there is a combination of fiber optic backbone and UTP cabling, the rule is simply translated to 7-6-5 rule.

Cabling guidelines

"Structured Cabling" specifies general guidelines for network architecture of a LAN, establishing maximum cable lengths for the grounds area, building and floor cabling.

The "Structured Cabling" is standardized in EN 50173, ISO 11801 and TIA 568-A. It forms the basis for a future-orientated, application-independent and cost-effective network infrastructure.

The cabling standards define a domain covering a geographical area of 3 km and for an office area of up to 1 million square meters with 50 to 50,000 terminals. In addition, they describe recommendations for setting up of a cabling system.

Specifications may vary depending on the selected topology, the transmission media and coupler modules used in industrial environments, as well as the use of components from different manufacturers in a network. Therefore, the specifications given here are only intended as recommendations.

4.1.2.3 Coupler Modules

There are a number of hardware modules that allow for flexible arrangement for setting up an ETHERNET network. They also offer important functions, some of which are very similar.

The following table defines and compares these modules and is intended to simplify the correct selection and appropriate application of them.

Module	Characteristics/application	ISO/OSI layer
Repeater	Amplifier for signal regeneration, connection on a physical level.	1
Bridge	Segmentation of networks to increase the length.	2
Switch	Multiport bridge, meaning each port has a separate bridge function. Logically separates network segments, thereby reducing network traffic. Consistent use makes ETHERNET collision-free.	2 (3)
Hub	Used to create star topologies, supports various transmission media, does not prevent any network collisions.	2
Router	Links two or more data networks. Matches topology changes and incompatible packet sizes (e.g. used in industrial and office areas).	3
Gateway	Links two manufacturer-specific networks which use different software and hardware (i.e., ETHERNET and Interbus-Loop).	4-7

Tab. 4-2: Comparison of Coupler Modules for Networks

4.1.2.4 Important Terms

Data security

If an internal network (Intranet) is to be connected to the public network (e.g., the Internet) then data security is an extremely important aspect.

Undesired access can be prevented by a **Firewall**.
Firewalls can be implemented in software or network components. They are interconnected in a similar way to routers as a switching element between Intranets and the public network. Firewalls are able to limit or completely block all access to the other networks, depending on the access direction, the service used and the authenticity of the network user.

Real-time ability

Transmission above the fieldbus system level generally involves relatively large data quantities. The permissible delay times may also be relatively long (0.1...10 seconds).
However, real-time behavior within the fieldbus system level is required for ETHERNET in industry.
In ETHERNET it is possible to meet the real-time requirements by restricting the bus traffic (< 10 %), by using a master-slave principle, or also by implementing a switch instead of a hub.
MODBUS/TCP is a master/slave protocol in which the slaves only respond to commands from the master. When only one master is used, data traffic over the network can be controlled and collisions avoided.

Shared ETHERNET

Several nodes linked via a hub share a common medium. When a message is sent from a station, it is broadcast throughout the entire network and is sent to each connected node. Only the node with the correct target address processes the message. Collisions may occur and messages have to be repeatedly transmitted as a result of the large amount of data traffic. The delay time in a Shared ETHERNET cannot be easily calculated or predicted.

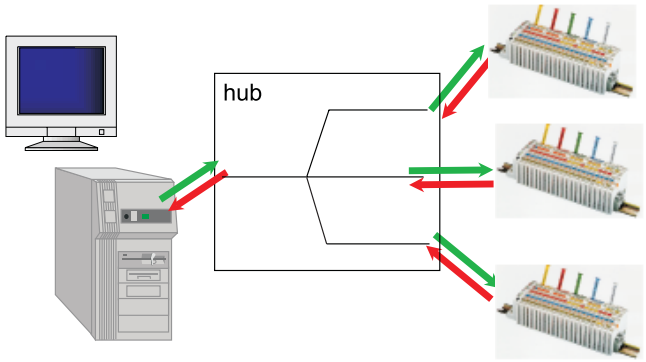


Fig. 4-6: Principle of Shared ETHERNET G012910e

Deterministic ETHERNET

The TCP/IP software or the user program in each subscriber can limit transmittable messages to make it possible to determine real-time requirements. At the same time the maximum medium message rate (datagrams per second), the maximum medium duration of a message, and the minimum time interval between the messages (waiting time of the subscriber) is limited.

Therefore, the delay time of a message is predictable.

Switched ETHERNET

In the case of Switched Ethernet, several fieldbus nodes are connected by a switch. When data from a network segment reaches the switch, it saves the data and checks for the segment and the node to which this data is to be sent. The message is then only sent to the node with the correct target address. This reduces the data traffic over the network, extends the bandwidth and prevents collisions. The runtimes can be defined and calculated, making the Switched Ethernet deterministic.

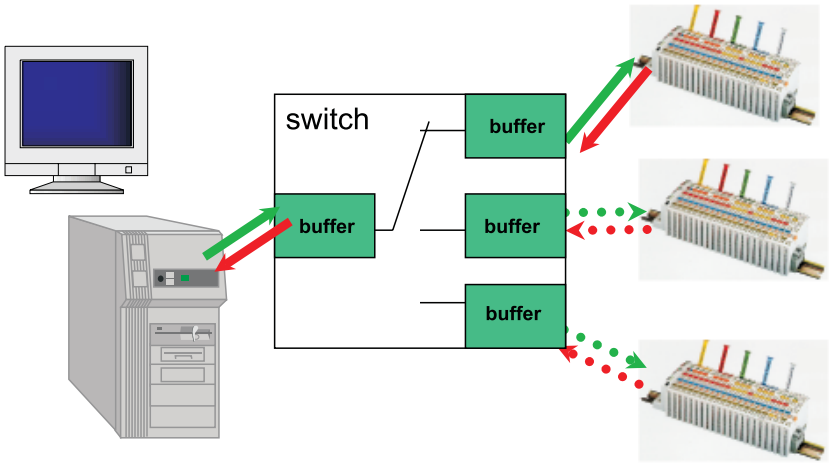


Fig. 4-7: Principle of Switched ETHERNET G012909e

4.1.3 Network Communication

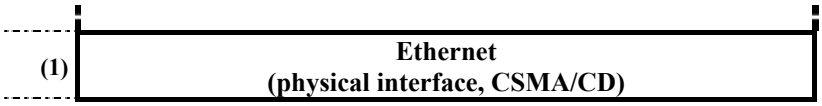
Fieldbus communication between master application and (programmable) fieldbus coupler or controller usually takes place using an implemented fieldbus specific application protocol, e. g. MODBUS TCP (UDP), EtherNet/IP, BACnet, KNXNET/IP, PROFINET, Powerlink, Sercos III or others.

The protocol layer model helps with an example (MODBUS and EtherNet/IP) to explain the classification and interrelationships between the communication and application protocols.
In this example, the fieldbus communication can take place using either the MODBUS protocol or EtherNet/IP.

4.1.3.1 Protocol layer model

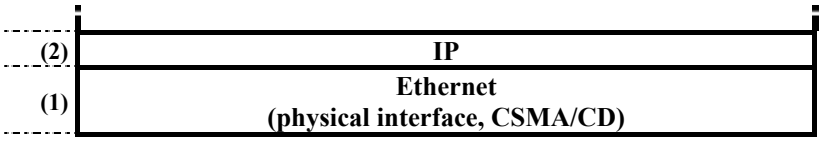
(1) Ethernet:

The Ethernet hardware forms the basis for the physical exchange of data. The exchanged data signals and the bus access procedure CSMA/CD are defined in a standard.



(2) IP:

For the communication the Internet Protocol (IP) is positioned above the Ethernet hardware. This bundles the data to be transmitted in packets along with sender and receiver address and passes these packets down to the Ethernet layer for physical transmission. At the receiver end, IP accepts the packets from the Ethernet layer and unpacks them.

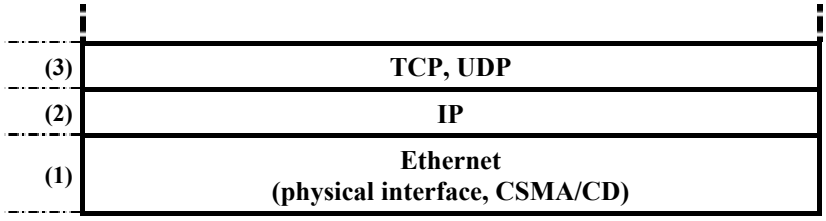


(3) TCP, UDP:

a) TCP: (Transmission Control Protocol)
The TCP protocol, which is positioned above the IP layer, monitors the transport of the data packets, sorts their sequence and sends repeat requests for missing packets. TCP is a connection-oriented transport protocol.
The TCP and IP protocol layers are also jointly described as the TCP/IP protocol stack or TCP/IP stack.

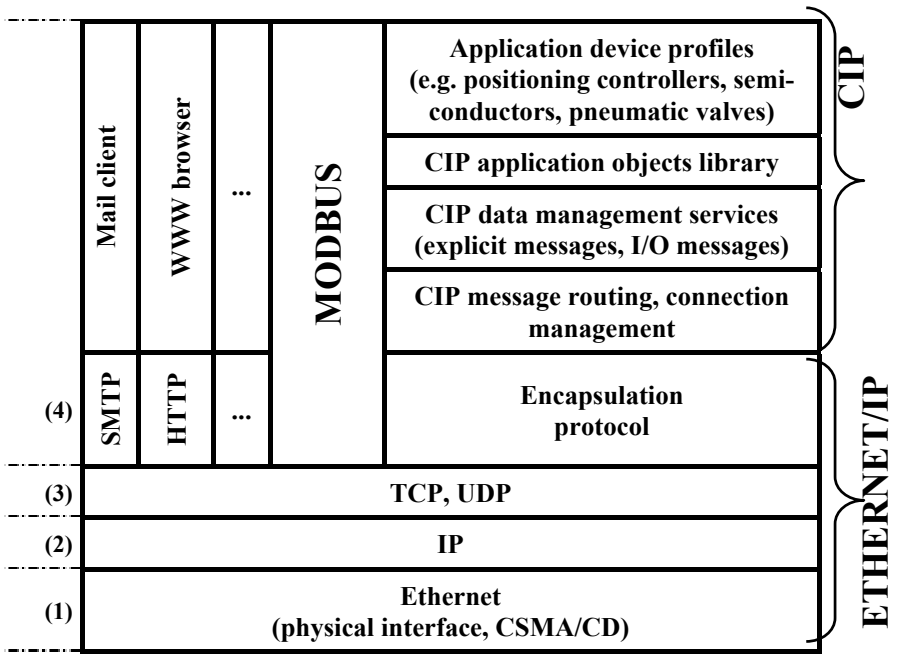
b) UDP: (User Datagram Protocol)
The UDP layer is also a transport protocol like TCP, and is arranged above the IP layer. In contrast to the TCP protocol, UDP is not connection oriented. That means there are no monitoring mechanisms for data exchange between sender and receiver.

The advantage of this protocol is in the efficiency of the transmitted data and the resultant increase in processing speed.
Many programs use both protocols. Important status information is sent via the reliable TCP connection, while the main stream of data is sent via UDP.



(4) Management, Diagnostic and Application Protocols:

Positioned above the TCP/IP stack or UDP/IP layer are correspondingly implemented management, diagnostic and application protocols that provide services that are appropriate for the application. For the management and diagnostic, these are, for example, SMTP (Simple Mail Transport Protocol) for e-mails, HTTP (Hypertext Transport Protocol) for www browsers and some others.
In this example, the protocols MODBUS/TCP (UDP) and EtherNet/IP are implemented for use in industrial data communication.
Here the MODBUS protocol is also positioned directly above TCP (UDP)/IP; EtherNet/IP, on the other hand, basically consists of the protocol layers Ethernet, TCP and IP with an encapsulation protocol positioned above it. This serves as interface to CIP (Control and Information Protocol).
DeviceNet uses CIP in the same way as EtherNet/IP. Applications with DeviceNet device profiles can therefore be very simply transferred to EtherNet/IP.



4.1.3.2 Communication Protocols

In addition to the ETHERNET standard, the following important communication protocols are implemented in the WAGO ETHERNET based (programmable) fieldbus couplers and controllers:

- IP Version 4 (Raw-IP and IP-Multicast)
- TCP
- UDP
- ARP

The following diagram is intended to explain the data structure of these protocols and how the data packets of the communication protocols Ethernet, TCP and IP with the adapted application protocol MODBUS nested in each other for transmission. A detailed description of the tasks and addressing schemes of these protocols is contained in the following.

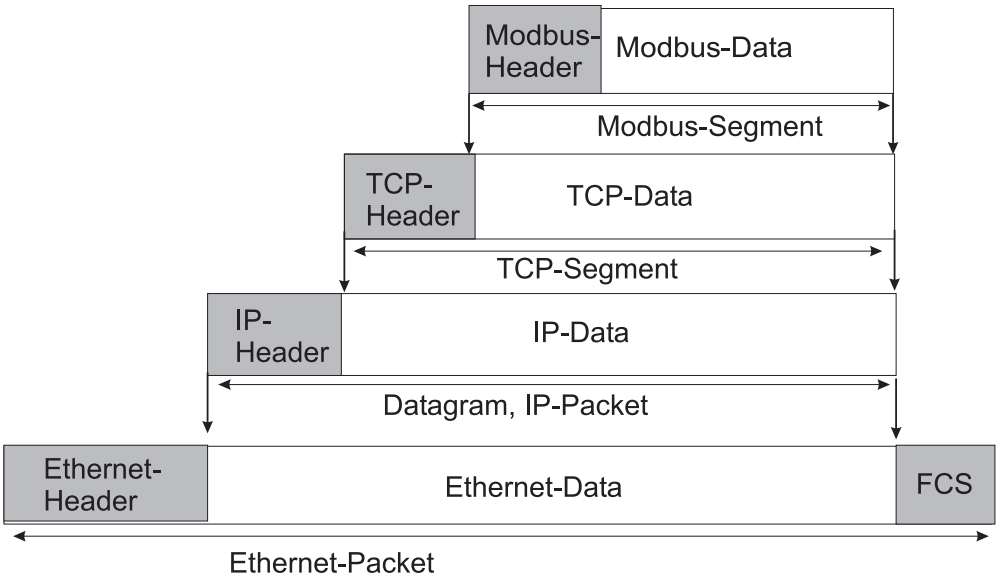


Fig. 4-8: Communication Protocols G012907e

4.1.3.2.1 ETHERNET

ETHERNET address (MAC-ID)

Each WAGO ETHERNET (programmable) fieldbus coupler or controller is provided from the factory with a unique and internationally unambiguous physical ETHERNET address, also referred to as MAC-ID (Media Access Control Identity). This can be used by the network operating system for addressing on a hardware level.
The address has a fixed length of 6 Bytes (48 Bit) and contains the address type, the manufacturer's ID, and the serial number.
Examples for the MAC-ID of a WAGO ETHERNET fieldbus coupler (hexadecimal): 00_H-30_H-DE_H-00_H-00_H-01_H.
ETHERNET does not allow addressing of different networks.
If an ETHERNET network is to be connected to other networks, higher-ranking protocols have to be used.

Note
If you wish to connect one or more data networks, routers have to be used.

ETHERNET Packet

The datagrams exchanged on the transmission medium are called "ETHERNET packets" or just "packets". Transmission is connectionless; i.e. the sender does not receive any feedback from the receiver. The data used is packed in an address information frame. The following figure shows the structure of such a packet.

Preamble	ETHERNET-Header	ETHERNET_Data	Check sum
8 Byte	14 Byte	46-1500 Byte	4 Byte

Fig. 4-9: ETHERNET-Packet

The preamble serves as a synchronization between the transmitting station and the receiving station. The ETHERNET header contains the MAC addresses of the transmitter and the receiver, and a type field.
The type field is used to identify the following protocol by way of unambiguous coding (e.g., 0800_{hex} = Internet Protocol).

4.1.3.3 Channel access method

In the ETHERNET Standard, the fieldbus node accesses the bus using CSMA/CD (Carrier Sense Multiple Access/ Collision Detection).

- Carrier Sense: The transmitter senses the bus.
- Multiple Access: Several transmitters can access the bus.
- Collision Detection: A collision is detected.

Each station can send a message once it has established that the transmission medium is free. If collisions of data packets occur due to several stations transmitting simultaneously, CSMA/CD ensures that these are detected and the data transmission is repeated.

However, this does not make data transmission reliable enough for industrial requirements. To ensure that communication and data transmission via ETHERNET is reliable, various communication protocols are required.

4.1.3.3.1 IP-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 addresses

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

Attention
Internet addresses have to be unique throughout the entire interconnected networks.

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: Byte1, Host-ID: Byte2 - Byte4)

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’.
Meaning 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: Byte1 - Byte2, Host-ID: Byte3 - Byte4)**

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’.
Meaning 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: Byte1 - Byte3, Host-ID: Byte4)

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’.
Meaning 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

	Address range of the subnetwork	Possible number of networks	Possible number of Subscribers per network
Class A	1.XXX.XXX.XXX - 126.XXX.XXX.XXX	127 (2^7)	Ca. 16 Million (2^{24})
Class B	128.000.XXX.XXX - 191.255.XXX.XXX	Ca. 16 thousand (2^{14})	Ca 65 thousand (2^{16})
Class C	192.000.000.XXX - 223.255.255.XXX	Ca. 2 million (2^{21})	254 (2^8)

Each WAGO ETHERNET (programmable) 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.

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

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

Attention
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.

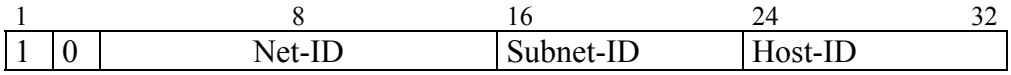


Fig. 4-10: Class B address with Field for Subnet ID

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:**

255	**.**0	**.**0	**.**0

- **Class B Subnet mask:**

255	.255	.0	.0

- **Class C Subnet mask:**

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 the subnet mask.
Only then does it check the node number and delivers the entire packet frame, if it corresponds.

Example of 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:	172.16.00	10101100 00010000 00000000 00000000
Subnet-ID:	0.0.233.128	00000000 00000000 11101001 10000000
Host-ID:	0.0.0.72	00000000 00000000 00000000 01001000

Attention
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.

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.

IP-Header	IP-Data

Fig. 4-11: IP Packet

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

4.1.3.3.1.1 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.

4.1.3.3.1.2 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 Internet level is realised with the help of the *Internet Group Message Protocol* IGMP; neighbouring 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.

4.1.3.3.2 TCP 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 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.

TCP segment

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.

4.1.3.3.3 UDP

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.

4.1.3.3.4 ARP

ARP (Address Resolution Protocol).
This protocol combines the IP address with the physical MAC address of the respective Ethernet card. It is always used when data transfer to an IP address takes place in the same logical network in which the sender is located.

4.1.3.4 Administration and Diagnosis Protocols

In addition to the communication protocols described above, various fieldbus specific application protocols and a view protocols for system admimnistration and diagnosis can be implemented.

- BootP
- HTTP
- DHCP
- DNS
- SNTP
- FTP
- SMTP.

More information

You can find a list of the exact available implemented protocols in the chapter "Technical Data" to the fieldbus coupler and/or controller.

4.1.3.4.1 BootP (Bootstrap Protocol)

The BootP protocol defines a request/response mechanism with which the MAC-ID of a fieldbus node can be assigned a fix IP address.
For this a network node is enabled to send requests into the network and call up the required network information, such as the IP address of a BootP server. The BootP server waits for BootP requests and generates the response from a configuration database.

The dynamic configuration of the IP address via a BootP server offers the user a flexible and simple design of his network. The WAGO BootP server allows any IP address to be easily assigned for the WAGO (programmable) fieldbus coupler or controller. You can download a free copy of the WAGO BootP server over the Internet at: http://www.wago.com.

More information

The procedure for address allocation with the WAGO BootP Server is described in detail in the Chapter “Starting up a Fieldbus Node”.

The BOOTP Client allows for dynamic configuring of the network parameters:

Parameter	Meaning
IP address of the client	Network address of the (programmable) fieldbus coupler or controller
IP address of the router	If communication is to take place outside of the local network, the IP address of the routers (gateway) is indicated in this parameter.
Subnet mask	The Subnet mask makes the (programmable) fieldbus coupler or controller able to differentiate, which parts of

	the IP address determine the network and which the network station.
IP addresses of the DNS servers	Here the IP addresses can be entered by maximally 2 DNS servers.
Host name	Name of the host

When using the bootstrap protocol for configuring the node, the network parameters (IP address, etc...) are stored in the EEPROM.

Note
The network configuration is only stored in the EEPROM when the BootP protocol is used, although not if configuration is done via DHCP.

The BootP protocol is activated in the (programmable) fieldbus coupler or controller by default.

When the BootP protocol is activated, the (programmable) fieldbus coupler or controller expects a BootP server to be permanently present.
If, however, there is no BootP server available after a power-on reset, the network remains inactive.
To operate the (programmable) fieldbus coupler or controller with the IP configuration stored in the EEPROM, you must first deactivate the BootP protocol.
This is done via the web-based management system on the appropriate HTML page saved in the (programmable) fieldbus coupler or controller, which is accessed via the “Port” link.
If the BootP protocol is deactivated, the (programmable) fieldbus coupler or controller uses the parameters stored in the EEPROM at the next boot cycle.

If there is an error in the stored parameters, a blink code is output via the IO LED and configuration via BootP is automatically switched on.

4.1.3.4.2 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**.

4.1.3.4.3 DHCP (Dynamic Host Configuration Protocol)

The coupler's/controller's built-in HTML pages provide an option for IP configuration from a DHCP server, a BootP server, or the data stored in its EEPROM by default.

Note
The network configuration via DHCP is not stored in the EEPROM, this only occurs when using the BootP protocol.

The DHCP client allows dynamic network configuration of the coupler/controller by setting the following parameters:

Parameter	Meaning
IP address of the client	Network address of the coupler/controller
IP address of the router	If communication is to take place outside of the local network, the IP address of the routers (gateway) is indicated in this parameter.
Subnet mask	The Subnet mask makes the coupler/controller able to differentiate, which parts of the IP address determine the network and which the network station.
IP addresses of the DNS servers	Here the IP addresses can be entered by maximally 2 DNS servers.
Lease time	Here the maximum duration can be defined, how long the coupler/controller keeps the assigned IP address. The maximum lease time is 24.8 days. This results from the internal resolution of timer.
Renewing time	The Renewing time indicates, starting from when the coupler/controller must worry about the renewal of the leasing time.
Rebinding time	The Rebinding time indicates, after which time the coupler/controller must have gotten its new address.

In the case of configuration of network parameters via the DHCP protocol, the coupler/controller automatically sends a request to a DHCP server after initialisation. If there is no response, the request is sent again after 4 seconds, a further one after 8 seconds and again after 16 seconds. If all requests remain unanswered, a blink code is output via the "IO" LED. Transfer of the parameters from the EEPROM is not possible.

Where a lease time is used, the values for the renewing and rebinding time must also be specified. After the renewing time expires, the coupler/controller attempts to automatically renew the lease time for its IP address . If this continually fails up to the rebinding time, the coupler/controller attempts to obtain a new IP address. The time for the renewing should be about one half of the lease time. The rebinding time should be about $^{7}/_{8}$ of the lease time.

4.1.3.4.4 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 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.

4.1.3.4.5 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 clock module integrated 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 under the “Clock” link. The following parameters must be set:

Parameter	Meaning
Address of the Time server	The address assignment can be made either over a IP address or a host name.
Time zone	The time zone relative to GMT (Greenwich Mean time). A range of -12 to +12 hours is acceptable.
Update Time	The update time indicates the interval in seconds, in which the synchronization with the time server is to take place.
Enable Time Client	It indicates whether the SNTP Client is to be activated or deactivated.

4.1.3.4.6 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 1.5 MB is available for the file system. The file system is mapped to RAM disk. To permanently store the data of the RAM disk, the information is additionally copied into the flash memory. The data is stored in the flash after the file has been closed. Due to the storage process, access times during write cycles are long.

Note
Up to 1 million write cycles are possible for writing to the flash memory for the file system.

The following table shows the supported FTP commands for accesses to the file system:

Command	Function
USER	Identification of the user
PASS	User password
ACCT	Account for access to certain files
REIN	Server reset
QUIT	Terminates the connection
PORT	Addressing of the data link
PASV	Changes server in the listen mode
TYPE	Determines the kind of the representation for the transferred file
STRU	Determines the structure for the transferred file
MODE	Determines the kind of file transmission
RETR	Reads file from server
STOR	Saves file on server
APPE	Saves file on server (Append mode)
ALLO	Reservation of the necessary storage location for the file
RNFR	Renames file from (with RNTO)
RNTO	Renames file in (with RNFR)
ABOR	Stops current function
DELE	Deletes file
CWD	Changes directory
LIST	Gives the directory list
NLST	Gives the directory list
RMD	Deletes directory
PWD	Gives the actually path
MKD	Puts on a dirctory

The TFTP (Trival File Transfer Protocol) is not supported by some of the couplers/controllers.

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

4.1.3.4.7 SMTP (Simple Mail Transfer Protocol)

The Simple Mail Transfer Protocol (SMTP) enables sending of ASCII text messages to mail boxes on TCP/IP hosts in a network. It is therefore used for sending and receiving e-mails.

The e-mail to be sent is created with a suitable editor and placed in a mail outbasket.

A send SMTP process polls the out-basket at regular intervals and therefore finds mail waiting to be sent. It then establishes a TCP/IP connection with the target host, to which the message is transmitted. The receive SMTP process on the target host accepts the TCP connection. The message is then transmitted and finally placed in an in-basket on the target system. SMTP expects the target system to be online, otherwise no TCP connection can be established. Since many desktop computers are switched off at the end of the day, it is impractical to send SMTP mail there. For that reason, in many networks special SMTP hosts are installed in many networks, which are permanently switched on to enable distribution of received mail to the desktop computers.

4.1.3.5 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. There are based on ETHERNET couplers/controllers available developed by WAGO, with the following possible application protocols:

- MODBUS TCP (UDP)
- EtherNet/IP
- BACnet
- KNXnet/IP
- PROFINET
- Powerlink
- Sercos III

More information
You can find a list of the exact available implemented protocols in the chapter "Technical Data" to the fieldbus coupler and/or controller.
If fieldbus specific application protocols are implemented, then these protocols are individual described in the following chapters.

4.2 PROFINET

4.2.1 Description

PROFINET is the innovative and open standard for industrial Ethernet (IEC 61158).

PROFINET enables a universal use from production automation to process automation. Devices can be integrated from the field levels to management levels.

PROFINET applies IT standards, supports safety applications and covers the complete range of drive engineering through its real-time feature.

PROFINET uses standard TCP/IP protocols for parameter setting, configuring and for diagnostics. This provides the main foundation for connecting to higher level systems (MES, ERP).

Real-Time (RT) is used for transmitting time-critical process data, which enables high performance data transfer as known with PROFIBUS.

Isochronous Real Time (IRT) is used to implement especially demanding tasks such as difficult motion control applications.

The investment protection of existing systems plays an important role for PROFINET and therefore the integration into existing field bus systems such as PROFIBUS, INTERBUS, etc. are supported right from the start.

PROFINET IO enables decentralized field devices to be connected to a central control system (I/O controller). The familiar I/O view of PROFIBUS is maintained in doing so. The characteristics of the field devices are described by so-called GSDML files that are provided by the respective manufacturers.

PROFINET CBA (Component Based Automation) is used in distributed automation systems. It allows stand-alone operating part units of machines to be arranged to new individual units in a simple way that increases the reusability of these part units.

Standard network topologies such as star, tree, line and ring can be implemented using PROFINET. That way, the specific demands of Ethernet networks can be met in industrial environments.

A high standard of quality is ensured through inspections conforming to standards carried out within the PROFINET network and the certification of PROFINET devices.

Further information
The PROFIBUS / PROFINET user organization provides documents that deal with themes concerning PROFIBUS on their INTERNET page:
– Technical descriptions

– Guidelines

www.profibus.com

4.2.2 Cabling

The guidelines for Ethernet cabling apply to the cabling of the PROFINET network.

5 I/O Modules

5.1 Overview

All listed bus modules, in the overview below, are available for modular applications with the WAGO-I/O-SYSTEM 750.
For detailed information on the I/O modules and the module variations, please refer to the manuals for the I/O modules.
You will find these manuals on CD ROM „ELECTRONICC Tools and Docs“ (Item-no.: 0888-0412) or on the web pages:
www.wago.com → Service → Download → Documentation.

More Information
Current information on the modular WAGO-I/O-SYSTEM is available in the Internet under:
www.wago.com

5.1.1 Digital Input Modules

DI DC 5 V	
750-414	4 Channel, DC 5 V, 0.2 ms, 2- to 3-conductor connection, high-side switching
DI DC 5(12) V	
753-434	8 Channel, DC 5(12) V, 0.2 ms, 1-conductor connection, high-side switching
DI DC 24 V	
750-400, 753-400	2 Channel, DC 24 V, 3.0 ms, 2- to 4-conductor connection; high-side switching
750-401, 753-401	2 Channel, DC 24 V, 0.2 ms, 2- to 4-conductor connection; high-side switching
750-410, 753-410	2 Channel, DC 24 V, 3.0 ms, 2- to 4-conductor connection; high-side switching
750-411, 753-411	2 Channel, DC 24 V, 0.2 ms, 2- to 4-conductor connection; high-side switching
750-418, 753-418	2 Channel, DC 24 V, 3.0 ms, 2- to 3-conductor connection; high-side switching; diagnostic
750-419	2 Channel, DC 24 V, 3.0 ms, 2- to 3-conductor connection; high-side switching; diagnostic
750-421, 753-421	2 Channel, DC 24 V, 3.0 ms, 2- to 3-conductor connection; high-side switching; diagnostic
750-402, 753-402	4 Channel, DC 24 V, 3.0 ms, 2- to 3-conductor connection; high-side switching
750-432, 753-432	4 Channel, DC 24 V, 3.0 ms, 2-conductor connection; high-side switching
750-403, 753-403	4 Channel, DC 24 V, 0.2 ms, 2- to 3-conductor connection; high-side switching

750-433, 753-433	4 Channel, DC 24 V, 0.2 ms, 2-conductor connection; high-side switching
750-422, 753-422	4 Channel, DC 24 V, 2- to 3-conductor connection; high-side switching; 10 ms pulse extension
750-408, 753-408	4 Channel, DC 24 V, 3.0 ms, 2- to 3-conductor connection; low-side switching
750-409, 753-409	4 Channel, DC 24 V, 0.2 ms, 2- to 3-conductor connection; low-side switching
750-430, 753-430	8 Channel, DC 24 V, 3.0 ms, 1-conductor connection; high-side switching
750-431, 753-431	8 Channel, DC 24 V, 0.2 ms, 1-conductor connection; high-side switching
750-436	8 Channel, DC 24 V, 3.0 ms, 1-conductor connection; lowside switching
750-437	8 Channel, DC 24 V, 0.2 ms, 1-conductor connection; low-side switching
DI AC/DC 24 V	
750-415, 753-415	4 Channel, AC/DC 24 V, 2-conductor connection
750-423, 753-423	4 Channel, AC/DC 24 V, 2- to 3-conductor connection; with power jumper contacts
DI AC/DC 42 V	
750-428, 753-428	4 Channel, AC/DC 42 V, 2-conductor connection
DI DC 48 V	
750-412, 753-412	2 Channel, DC 48 V, 3.0ms, 2- to 4-conductor connection; high-side switching
DI DC 110 V	
750-427, 753-427	2 Channel, DC 110 V, Configurable high-side or low-side switching
DI AC 120 V	
750-406, 753-406	2 Channel, AC 120 V, 2- to 4-conductor connection; high-side switching
DI AC 120(230) V	
753-440	4 Channel, AC 120(230) V, 2-conductor connection; high-side switching
DI AC 230 V	
750-405, 753-405	2 Channel, AC 230 V, 2- to 4-conductor connection; high-side switching
DI NAMUR	
750-435	1 Channel, NAMUR EEx i, Proximity switch acc. to DIN EN 50227
750-425, 753-425	2 Channel, NAMUR, Proximity switch acc. to DIN EN 50227
750-438	2 Channel, NAMUR EEx i, Proximity switch acc. to DIN EN 50227
DI Intruder Detection	
750-424, 753-424	2 Channel, DC 24 V, Intruder Detection

5.1.2 Digital Output Modules

DO DC 5 V	
750-519	4 Channel, DC 5 V, 20mA, short-circuit-protected; high-side switching
DO DC 12(14) V	
753-534	8 Channel, DC 12(14) V, 1A, short-circuit-protected; high-side switching
DO DC 24 V	
750-501, 753-501	2 Channel, DC 24 V, 0.5 A, short-circuit-protected; high-side switching
750-502, 753-502	2 Channel, DC 24 V, 2.0 A, short-circuit-protected; high-side switching
750-506, 753-506	2 Channel, DC 24 V, 0.5 A, short-circuit-protected; high-side switching; with diagnostics
750-507, 753-507	2 Channel, DC 24 V, 2.0 A, short-circuit-protected; high-side switching; with diagnostics; No longer available, replaced by 750-508
750-508	2 Channel, DC 24 V, 2.0 A, short-circuit-protected; high-side switching; with diagnostics; Replacement for 750-508
750-535	2 Channel, DC 24 V, EEx i, short-circuit-protected; PNP-positive switching
750-504, 753-504	4 Channel, DC 24 V, 0.5 A, short-circuit-protected; high-side switching
750-531, 753-531	4 Channel, DC 24 V, 0.5 A, short-circuit-protected; high-side switching
750-516, 753-516	4 Channel, DC 24 V, 0.5 A, short-circuit-protected; low-side switching
750-530, 753-530	8 Channel, DC 24 V, 0.5 A, short-circuit-protected; high-side switching
750-537	8 Channel, DC 24 V, 0.5 A, short-circuit-protected; high-side switching; with diagnostics
750-536	8 Channel, DC 24 V, 0.5 A, short-circuit-protected; low-side switching
DO AC 120(230) V	
753-540	4 Channel, AC 120(230) V, 0.25 A, short-circuit-protected; high-side switching
DO AC/DC 230 V	
750-509, 753-509	2 Channel Solid State Relay, AC/DC 230 V, 300 mA
750-522	2 Channel Solid State Relay, AC/DC 230 V, 500 mA, 3 A (< 30 s)
DO Relay	
750-523	1 Channel, AC 230 V, AC 16 A, isolated output, 1 make contact, bistable, manual operation
750-514, 753-514	2 Channel, AC 125 V , AC 0.5 A , DC 30 V, DC 1 A, isolated outputs, 2 changeover contacts
750-517, 753-517	2 Channel, AC 230 V, 1 A, isolated outputs, 2 changeover contacts
750-512, 753-512	2 Channel, AC 230 V, DC 30 V, AC/DC 2 A, non-floating, 2 make contacts
750-513, 753-513	2 Channel, AC 230 V, DC 30 V, AC/DC 2 A, isolated outputs, 2 make contacts

5.1.3 Analog Intput Modules

AI 0 - 20 mA	
750-452, 753-452	2 Channel, 0 - 20 mA, Differential Inputs
750-465, 753-465	2 Channel, 0 - 20 mA, single-ended (S.E.)
750-472, 753-472	2-channel, 0 - 20 mA, 16 Bit, single-ended (S.E.)
750-480	2-channel, 0 - 20 mA ,Differential Inputs
750-453, 753-453	4 Channel, 0 - 20 mA, single-ended (S.E.)
AI 4 - 20 mA	
750-454, 753-454	2 Channel, 4 - 20 mA,Differential Inputs
750-474, 753-474	2 Channel, 4 - 20 mA, 16 Bit, single-ended (S.E.)
750-466, 753-466	2 Channel, 4 - 20 mA, single ended (S.E.)
750-485	2 Channel, 4 - 20 mA, EEx i, single ended (S.E.)
750-492, 753-492	2 Channel, 4 - 20 mA, Isolated Differential Inputs
750-455, 753-455	4 Channel, 4 - 20 mA, single ended (S.E.)
AI 0 - 1 A	
750-475, 753-475	2-channel, 0 - 1 A AC/DC ,Differential Inputs
AI 0 - 5 A	
750-475/020-000, 753-475/020-000	2-channel, 0 - 5 A AC/DC ,Differential Inputs
AI 0 - 10 V	
750-467, 753-467	2 Channel, DC 0 - 10 V, single-ended (S.E.)
750-477, 753-477	2 Channel, AC/DC 0 - 10 V,Differential Inputs
750-478, 753-478	2 Channel, DC 0 - 10 V, single-ended (S.E.)
750-459, 753-459	4 Channel, DC 0 - 10 V, single-ended (S.E.)
750-468	4 Channel, DC 0 - 10 V, single-ended (S.E.)
AI DC ± 10 V	
750-456, 753-456	2 Channel, DC ± 10 V,Differential Inputs
750-479, 753-479	2 Channel, DC ± 10 V,Differential Measurement Input
750-476, 753-476	2 Channel, DC ± 10 V, single-ended (S.E.)
750-457, 753-457	4 Channel, DC ± 10 V, single-ended (S.E.)
AI DC 0 - 30 V	
750-483, 753-483	2 Channel, DC 0 -30 V,Differential Measurement Input
AI Resistance Sensors	
750-461, 753-461	2 Channel, Resistance Sensors, PT100 / RTD
750-481/003-000	2 Channel, Resistance Sensors, PT100 / RTD, EEx i
750-460	4 Channel, Resistance Sensors, PT100 / RTD
AI Thermocouples	

750-462	2 Channel, thermocouples with diagnostics Sensor types: J, K, B, E, N, R, S, T, U
750-469, 753-469	2 Channel, thermocouples with diagnostics Sensor types: J, K, B, E, N, R, S, T, U, L
AI Others	
750-491	1 Channel for Resistor Bridges (Strain Gauge)

5.1.4 Analog Output Modules

AO 0 - 20 mA	
750-552, 753-552	2 Channel, 0 - 20 mA
750-585	2 Channel, 0 - 20 mA, EEx i
750-553, 753-553	4 Channel, 0 - 20 mA
AO 4 - 20 mA	
750-554, 753-554	2-channel, 4 - 20 mA
750-554, 753-554	4-channel, 4 - 20 mA
AO DC 0 - 10 V	
750-550, 753-550	2 Channel, DC 0 - 10 V
750-560	2 Channel, DC 0 - 10 V, 10 Bit, 100 mW, 24 V
750-559, 753-559	4 Channel, DC 0 - 10 V
AO DC ± 10 V	
750-556, 753-556	2 Channel, DC ± 10 V
750-557, 753-557	4 Channel, DC ± 10 V

5.1.5 Special Modules

Counter Modules	
750-404, 753-404	Up / Down Counter, DC 24 V, 100 kHz
750-638, 753-638	2 Channel, Up / Down Counter, DC 24 V/ 16Bit / 500 Hz
Frequency Measuring	
750-404/000-003, 753-404/000-003	Frequency Measuring
Pulse Width Module	
750-511	2-channel Pulse Width Module, DC 24 V, short-circuit-protected, high-side switching
Distance and Angle Measurement Modules	
750-630	SSI Transmitter Interface
750-631	Incremental Encor Interface, TTL level squarewave
750-634	Incremental Encor Interface, DC 24 V
750-637	Incremental Encor Interface RS 422, cam outputs
750-635, 753-635	Digital Pulse Interface
Serial Interfaces	
750-650, 753	Serial Interface RS 232 C
750-653, 753	Serial Interface RS 485
750-651	TTY-Serial Interface, 20 mA Current Loop
750-654	Data Exchange Module
DALI / DSI Master Module	
750-641	DALI / DSI Master Module
AS interface Master Module	
750-655	AS interface Master Module
Radio Receiver Module	
750-642	Radio Receiver EnOcean
MP Bus Master Module	
750-643	MP Bus (Multi Point Bus) Master Module
Vibration Monitoring	
750-645	2-Channel Vibration Velocity / Bearing Condition Monitoring VIB I/O
PROFIsafe Modules	
750-660/000-001	8FDI 24V DC PROFIsafe
750-665/000-001	4FDO 0.5A / 4FDI 24V DC PROFIsafe
750-666/000-001	1FDO 10A / 2FDO 0.5A / 2FDI 24V PROFIsafe
RTC Module	
750-640	RTC Module

5.1.6 System Modules

Module Bus Extension	
750-627	Module Bus Extension, End Module
750-628	Module Bus Extension, Coupler Module
DC 24 V Power Supply Modules	
750-602	DC 24 V, passiv
750-601	DC 24 V, max. 6.3 A,without diagnostics, with fuse-holder
750-610	DC 24 V, max. 6.3 A, with diagnostics, with fuse-holder
750-625	DC 24 V, EEx i, with fuse-holder
DC 24 V Power Supply Modules with bus power supply	
750-613	Bus power supply, 24 V DC
AC 120 V Power Supply Modules	
750-615	AC 120 V, max. 6.3 A without diagnostics, with fuse-holder
AC 230 V Power Supply Modules	
750-612	AC/DC 230 V without diagnostics, passiv
750-609	AC 230 V, max. 6.3 A without diagnostics, with fuse-holder
750-611	AC 230 V, max. 6.3 A with diagnostics, with fuse-holder
Filter Modules	
750-624	Filter Module for field side power supply
750-626	Filter Module for system and field side power supply
Field Side Connection Module	
750-603, 753-603	Field Side Connection Module, DC 24 V
750-604, 753-604	Field Side Connection Module, DC 0 V
750-614, 753-614	Field Side Connection Module, AC/DC 0 ... 230 V
Separation Modules	
750-616	Separation Module
750-621	Separation Module with Power Contacts
Binary Spacer Module	
750-622	Binary Spacer Module
End Module	
750-600	End Module, to loop the internal bus

5.2 Structure of the PROFINET IO Process Data

Depending on the data type, the data bytes (D0 ... Dn) of the byte or word orientated I/O module are transferred via PROFINET IO in Motorola or Intel format according to the parameter settings of the device and individual signal channels.

Note
For the significance of input and output bits or bytes of the individual I/O modules please refer to the corresponding description of the I/O modules.

5.2.1 Digital Input Modules

5.2.1.1 2 DI Modules

750-400, 753-400, 750-401, 753-401, 750-405, 753-405, 750-406, 753-406, 750-407, 753-407, 750-410, 753-410, 750-411, 753-411, 750-412, 753-412, 750-413, 753-413, 750-416, 753-416, 750-427, 753-427, 750-435, 753-435, 750-438, 753-438

Process Image Length in [Bit]		
Diagnostics information in the PROFIBUS IO process image	Input	Output
Yes (not possible)	-	-
No	2	0

5.2.1.2 2 DI Modules with Diagnostics

750-419, 753-419, 750-421, 753-421, 750-425, 753-425
(1 Bit diagnostics / channel)

Process Image Length in [Bit]		
Diagnostics information in the PROFIBUS IO process image	Input	Output
Yes	4	0
No	2	0

750-418, 753-418
(1 bit diagnostics / channel, 1 bit confirmation / channel)

Process Image Length in [Bit]		
Diagnostics information in the PROFIBUS IO process image	Input	Output
Yes	4	2
No	2	2

5.2.1.3 4 DI Modules

750-402, 753-402, 750-403, 753-403, 750-408, 753-408,
750-409, 753-409, 750-414, 753-414, 750-415, 753-415,
750-422, 753-422, 750-423, 753-423, 750-424, 753-424,
750-428, 753-428, 750-432, 753-432, 750-433, 753-433

Process Image Length in [Bit]		
Diagnostics information in the PROFIBUS IO process image	Input	Output
Yes (not possible)	-	-
No	4	0

5.2.1.4 8 DI Modules

750-430, 753-430, 750-431, 753-431, 750-436, 753-436,
750-437, 753-437

Process Image Length in [Bit]		
Diagnostics information in the PROFIBUS IO process image	Input	Output
Yes (not possible)	-	-
No	8	0

5.2.1.5 16 DI Modules

750-4xx, 753-4xx

Process Image Length in [Bit]		
Diagnostics information in the PROFIBUS IO process image	Input	Output
Yes (not possible)	-	-
No	16	0

5.2.2 Digital Output Modules

5.2.2.1 2 DO Modules

750-501, 753-501, 750-502, 753-502, 750-509, 753-509,
750-512, 753-512, 750-513, 753-513, 750-514, 753-514,
750-517, 753-517, 750-535, 753-535

Process Image Length in [Bit]		
Diagnostics information in the PROFIBUS IO process image	Input	Output
Yes (not possible)	-	-
No	0	2

5.2.2.2 2 DO Modules with Diagnostics

750-507, 753-507, 750-522, 753-522, 750-523
(1 Bit diagnostics / channel)

Process Image Length in [Bit]		
Diagnostics information in the PROFIBUS IO process image	Input	Output
Yes	2	2
No	0	2

750-506, 753-506
(2 bit diagnostics / channel)

Process Image Length in [Bit]		
Diagnostics information in the PROFIBUS IO process image	Input	Output
Yes	4	2
No	0	2

5.2.2.3 4 DO Modules

750-504, 753-504, 750-516, 753-516, 750-519, 753-519,
750-531, 753-531

Process Image Length in [Bit]		
Diagnostics information in the PROFIBUS IO process image	Input	Output
Yes (not possible)	-	-
No	0	4

5.2.2.4 4 DO Modules with Diagnostics

750-532, 753-532
(1 bit diagnostics / channel)

Process Image Length in [Bit]		
Diagnostics information in the PROFIBUS IO process image	Input	Output
Yes	4	4
No	0	4

5.2.2.5 8 DO Modules

750-530, 753-530, 750-536, 753-536

Process Image Length in [Bit]		
Diagnostics information in the PROFIBUS IO process image	Input	Output
Yes (not possible)	-	-
No	0	8

5.2.2.6 8 DO Modules with Diagnostics

750-537, 753-537 (1 bit diagnostics / channel)

Process Image Length in [Bit]		
Diagnostics information in the PROFIBUS IO process image	Input	Output
Yes	8	8
No	0	8

5.2.2.7 16 DO Modules

750-5xx, 753-5xx

Process Image Length in [Bit]		
Diagnostics information in the PROFIBUS IO process image	Input	Output
Yes (not possible)	-	-
No	0	16

5.2.3 Analog Input Modules

5.2.3.1 2 AI Modules

750-452, 753-452, 750-454, 753-454, 750-456, 753-456,
750-461, 753-461, 750-462, 753-462, 750-465, 753-465,
750-466, 753-466, 750-467, 753-467, 750-469, 753-469,
750-472, 753-472, 750-474, 753-474, 750-475, 753-475,
750-476, 753-476, 750-477, 753-477, 750-478, 753-478,
750-479, 753-479, 750-480, 753-480, 750-483, 753-483,
750-485, 753-485, 750-491, 753-491, 750-492, 753-492

Process Image Length in [Byte]				
Register communication using the PROFINET IO process image?	Input		Output	
Yes	6		6	
No	4		0	
Mapping with access to the register structure				
Data format	MOTOROLA		INTEL	
I/O range	Input	Output	Input	Output
Channel 0	S0	C0	S0	C0
	D1	D1	D0	D0
	D0	D0	D1	D1
Channel 1	S1	C1	S1	C1
	D3	D3	D2	D2
	D2	D2	D3	D3
Mapping without access to the register structure				
	MOTOROLA		INTEL	
	Input	Output	Input	Output
Channel 0	D1	-	D0	-
	D0	-	D1	-
Channel 1	D3	-	D2	-
	D2	-	D3	-

5.2.3.2 3 AI Modules

750-493, 753-493

Process Image Length in [Byte]				
Register communication using the PROFINET IO process image?	Input		Output	
Yes	12		12	
No (not possible)	-		-	
Mapping with access to the register structure				
Data format	MOTOROLA		INTEL	
I/O range	Input	Output	Input	Output
Channel 0	S0	C0	S0	C0
	-	-	-	-
	D1	D1	D0	D0
	D0	D0	D1	D1
Channel 1	S1	C1	S1	C1
	-	-	-	-
	D3	D3	D2	D2
	D2	D2	D3	D3
Channel 2	S2	C2	S2	C2
	-	-	-	-
	D5	D5	D4	D4
	D4	D4	D5	D5

5.2.3.3 4 AI Modules

750-453, 753-453, 750-455, 753-455, 750-457, 753-457,
750-459, 753-459, 750-460, 753-460, 750-463, 753-463,
750-468, 753-468

Process Image Length in [Byte]				
Register communication using the PROFINET IO process image?	Input		Output	
Yes	12		12	
No	8		0	
Mapping with access to the register structure				
Data format	MOTOROLA		INTEL	
I/O range	Input	Output	Input	Output
Channel 0	S0	C0	S0	C0
	D1	D1	D0	D0
	D0	D0	D1	D1
Channel 1	S1	C1	S1	C1
	D3	D3	D2	D2
	D2	D2	D3	D3
Channel 2	S2	C2	S2	C2
	D5	D5	D4	D4
	D4	D4	D5	D5
Channel 3	S3	C3	S3	C3
	D7	D7	D6	D6
	D6	D6	D7	D7
Mapping without access to the register structure				
Data format	MOTOROLA		INTEL	
I/O range	Input	Output	Input	Output
Channel 0	D1	-	D0	-
	D0	-	D1	-
Channel 1	D3	-	D2	-
	D2	-	D3	-
Channel 2	D5	-	D4	-
	D4	-	D5	-
Channel 3	D7	-	D6	-
	D6	-	D7	-

5.2.4 Analog Output Modules

5.2.4.1 2 AO Modules

750-550, 753-550, 750-552, 753-552, 750-554, 753-554,
750-556, 753-556, 750-560, 753-560, 750-585, 753-585

Process Image Length in [Byte]				
Register communication using the PROFINET IO process image?	Input		Output	
Yes	6		6	
No	0		4	
Mapping with access to the register structure				
Data format	MOTOROLA		INTEL	
I/O range	Input	Output	Input	Output
Channel 1	S0	C0	S0	C0
	D1	D1	D0	D0
	D0	D0	D1	D1
Channel 2	S1	C1	S1	C1
	D3	D3	D2	D2
	D2	D2	D3	D3
Mapping without access to the register structure				
Data format	MOTOROLA		INTEL	
I/O range	Input	Output	Input	Output
Channel 1	-	D1	-	D0
	-	D0	-	D1
Channel 2	-	D3	-	D2
	-	D2	-	D3

5.2.4.2 4 AO Modules

750-551, 750-553, 750-555, 750-557, 750-559

Process Image Length in [Byte]				
Register communication using the PROFINET IO process image?	Input		Output	
Yes	12		12	
No	0		8	
Mapping with access to the register structure				
Data format	MOTOROLA		INTEL	
I/O range	Input	Output	Input	Output
Channel 1	S0	C0	S0	C0
	D1	D1	D0	D0
	D0	D0	D1	D1
Channel 2	S1	C1	S1	C1
	D3	D3	D2	D2
	D2	D2	D3	D3
Channel 3	S2	C2	S2	C2
	D5	D5	D4	D4
	D4	D4	D5	D5
Channel 4	S3	C3	S3	C3
	D7	D7	D6	D6
	D6	D6	D7	D7
Mapping without access to the register structure				
Data format	MOTOROLA		INTEL	
I/O range	Input	Output	Input	Output
Channel 1	-	D1	-	D0
	-	D0	-	D1
Channel 2	-	D3	-	D2
	-	D2	-	D3
Channel 3	-	D5	-	D4
	-	D4	-	D5
Channel 4	-	D7	-	D6
	-	D6	-	D7

5.2.5 Specialty Modules

5.2.5.1 Counter Modules

750-404, 753-404
(1 or 2 counter inputs)

Process Image Length in [Byte]				
Register communication using the PROFINET IO process image?	Input		Output	
Yes	6		6	
No (not possible)	-		-	
Mapping with access to the register structure				
Data format	MOTOROLA		INTEL	
I/O range	Input	Output	Input	Output
Channel 0	S	C	S	C
	-	-	-	-
	D3	D3	D0	D0
	D2	D2	D1	D1
	D1	D1	D2	D2
	D0	D0	D3	D3

750-638, 753-638
(2 counter inputs)

Process Image Length in [Byte]				
Register communication using the PROFINET IO process image?	Input		Output	
Yes	6		6	
No (not possible)	-		-	
Mapping with access to the register structure				
Data format	MOTOROLA		INTEL	
I/O range	Input	Output	Input	Output
Channel 0	S0	C0	S0	C0
	D1	D1	D0	D0
	D0	D0	D1	D1
Channel 1	S1	C1	S1	C1
	D3	D3	D2	D2
	D2	D2	D3	D3

5.2.5.2 PWM Modules

750-511, 753-511

Process Image Length in [Byte]				
Register communication using the PROFINET IO process image?	Input		Output	
Yes	6		6	
No	0		4	
Mapping with access to the register structure				
Data format	MOTOROLA		INTEL	
I/O range	Input	Output	Input	Output
Channel 0	S0	C0	S0	C0
	D1	D1	D0	D0
	D0	D0	D1	D1
Channel 1	S1	C1	S1	C1
	D3	D3	D2	D2
	D2	D2	D3	D3
Mapping without access to the register structure				
Data format	MOTOROLA		INTEL	
I/O range	Input	Output	Input	Output
Channel 0	-	D1	-	D0
	-	D0	-	D1
Channel 1	-	D3	-	D2
	-	D2	-	D3

5.2.5.3 Stepper Motor Control

750-639, 753-639

Process Image Length in [Byte]				
Register communication using the PROFINET IO process image?	Input		Output	
Yes	4		4	
No (not possible)	-		-	
Mapping with access to the register structure				
Data format	MOTOROLA		INTEL	
I/O range	Input	Output	Input	Output
Channel 0	S0	C0	S0	C0
	-	-	-	-
	D1	D1	D0	D0
	D0	D0	D1	D1

5.2.5.4 SSI Transmitter Interface

750-630, 753-630

Process Image Length in [Byte]				
Register communication using the PROFINET IO process image?	Input		Output	
Yes	6		6	
No	4		0	
Mapping with access to the register structure				
Data format	MOTOROLA		INTEL	
I/O range	Input	Output	Input	Output
Channel 0	S0	C0	S0	C0
	-	-	-	-
	D3	D3	D0	D0
	D2	D2	D1	D1
	D1	D1	D2	D2
	D0	D0	D3	D3
Mapping without access to the register structure				
Data format	MOTOROLA		INTEL	
I/O range	Input	Output	Input	Output
Channel 0	D3	-	D0	-
	D2	-	D1	-
	D1	-	D2	-
	D0	-	D3	-

5.2.5.5 Incremental Encoder Interface

750-631, 753-631, 750-634, 753-634, 750-637, 753-637

Process Image in [Byte]				
Register communication using the PROFINET IO process image?	Input		Output	
Yes	6		6	
No (not possible)	-		-	
Mapping with access to the register structure				
Data format	MOTOROLA		INTEL	
I/O range	Input	Output	Input	Output
Channel 0	S0	C0	S0	C0
	D1	D1	D0	D0
	D0	D0	D1	D1
	S1*	C1*	S1*	C1*
	D3	D3	D2	D2
	D2	D2	D3	D3

* The 2 CONTROL or STATUS bytes only exists with 750-637 or 753-637. The byte is reserved in all other I/O modules and has no content.

5.2.5.6 Digital Impulse Interface

750-635, 753-635

Process Image in [Byte]				
Register communication using the PROFINET IO process image?	Input		Output	
Yes	4		4	
No (not possible)	-		-	
Mapping with access to the register structure				
Data format	MOTOROLA		INTEL	
I/O range	Input	Output	Input	Output
Channel 0	S0	C0	S0	C0
	D0	D0	D0	D0
	D1	D1	D1	D1
	D2	D2	D2	D2

5.2.5.7 Serial Interfaces

750-650, 753-650, 750-651, 753-651, 750-653, 753-653

Process Image in [Byte]				
Register communication using the PROFINET IO process image?	Input		Output	
Yes (not possible)	-		-	
No	6		6	
Mapping with access to the register structure				
Data format	MOTOROLA		INTEL	
I/O range	Input	Output	Input	Output
Channel 0	S	C	S	C
	D0	D0	D0	D0
	D1	D1	D1	D1
	D2	D2	D2	D2
	D3*[1)]	D3*[1)]	D3*[1)]	D3*[1)]
	D4*[2)]	D4*[2)]	D4*[2)]	D4*[2)]

If bytes D3 and D4 contain data depends on the data width:
*[1)] D3 contains data with cases 4 and 5 byte mode
*[2)] D4 contains data in case 5 byte mode.
Bytes D3 and D4 are reserved in 3 byte mode (factory setting) and contain no reference data.

5.2.5.8 Data Exchange Module

750-654, 753-654

Process Image Length in [Byte]				
Register communication using the PROFINET IO process image?	Input		Output	
Yes	6		6	
No (not possible)	-		-	
Mapping with access to the register structure				
Data format	MOTOROLA		INTEL	
I/O range	Input	Output	Input	Output
Channel 0	S0	C0	S0	C0
	D0	D0	D1	D1
	D1	D1	D0	D0
	D2	D2	D2	D2
	D3	D3	D4	D4
	D4	D4	D3	D3

5.2.5.9 DALI/DSI Master

750-641, 753-641

Process Image in [Byte]				
Register communication using the PROFINET IO process image?	Input		Output	
Yes	6		6	
No (not possible)	-		-	
Mapping with access to the register structure				
Data format	MOTOROLA / INTEL			
I/O range	Input	Output	Input	Output
Channel 0	S0	C0	S0	C0
	D0	D0	D0	D0
	D1	D1	D1	D1
	D2	D2	D2	D2
	D3	D3	D3	D3
	D4	D4	D4	D4

5.2.5.10 ENOCEAN Receiver Module

750-642

Process Image in [Byte]				
Register communication using the PROFINET IO process image?	Input		Output	
Yes	4		4	
No (not possible)	-		-	
Mapping with access to the register structure				
Data format	MOTOROLA / INTEL			
I/O range	Input	Output	Input	Output
Channel 0	S0	C0	S0	C0
	D0	D0	D0	D0
	D1	D1	D1	D1
	D2	D2	D2	D2

5.2.6 System Modules

5.2.6.1 Supply Modules

750-610, 750-611 (2 bit diagnostics)

Process Image Length in [Bit]		
Diagnostics information in the PROFIBUS IO process image	Input	Output
Yes	2	0
No	0	0

5.3 Configuration and Parameter Setting of the Modules

5.3.1 Digital I/O Modules

5.3.1.1 2-Channel Digital Input Modules

PNIO Module Type	IO Type	Module Type Substitute	PNIO Data Type	Instances	
				Input	Output
2DE(+ 6 BIT I)	**DI_8**	75x-400, 75x-401, 75x-405, 75x-406, 75x-410, 75x-411, 75x-412, 75x-413, 75x-416, 75x-427, 75x-435, 75x-438	Unsigned 8-Bit field	1	-
2DE(+ 14 BIT I)	**DI_16**		Unsigned 16-Bit field		
2DE(+ 30 BIT I)	**DI_32**		Unsigned 32-Bit field		
*** 2DE(- 2 BIT I)**	**DI_0**	75x-400*, 75x-401*, 75x-405*, 75x-406*,75x-410*, 75x-411*, 75x-412*, 75x-413*,75x-416*, 75x-427*,75x-435*, 75x-438*	-	-	-

PNIO Module Type	Inputs								
	Length [Bit]	Bit allocation							Note
		2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	
2DE(+ 6 BIT I) **2DE(+ 14 BIT I)** **2DE(+ 30 BIT I)**	2							E1	E0	8, 16 or 32 bits are applied in the input process image of the station proxy (fieldbus coupler) by fitting a slot with these modules. The bits 2^0 and 2^1 are assigned with the signal condition of the physically connected I/O module. The bits 2^2 to 2^7, 2^{15} or 2^{31} marked green are made available for the input and / or diagnostics information of the following modules. One byte process data qualifier (IOPS) is managed in the direction of the I/O controller in the cyclic PROFINET IO telegram for these modules.
*** 2DE(- 2 BIT I)**	2					E1	E0			The fitting of slots with this module enables the remaining bit locations to be previously filled with input modules without bytes opened with star (bit fields) in the input process image of the station proxy (fieldbus coupler). One byte process data qualifier (IOPS) is managed in the direction of the I/O controller in the cyclic PROFINET IO telegram for these modules.

Parameter	Value	Significance

5.3.1.2 2-Channel Digital Input Modules with 1 Bit Diagnostics Status per Channel

PNIO Module type	EA Type	Module type member	PNIO Data Type	Instances	
				Input	Output
2DE(+6 BIT I)	**DI_8**	75x-419, 75x-421, 75x-425	Unsigned 8-Bit field	1	-
2DE(+4 BIT I), DIA in E-PA	**DI_DIA_8**				
2DE(+14 BIT I)	**DI_16**		Unsigned 16-Bit field		
2DE(+12 BIT I), DIA in E-PA	**DI_DIA_16**				
2DE(+30 BIT I)	**DI_32**		Unsigned 32-Bit field		
2DE(+28 BIT I), DIA in E-PA	**DI_DIA_32**				
*** 2DE(-2 BIT I)**	**DI_0**	75x-419*, 75x-421*, 75x-425*	-	-	-
*** 2DE(-4 BIT I), DIA in E-PA**	**DI_DIA_0**				

PNIO Module type	Inputs								
	Length [Bit]	Bit allocation								Note
		2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	
2DE(+6 BIT I) **2DE(+14 BIT I)** **2DE(+30 BIT I)**	2							E1	E0	8, 16 or 32 bits are applied in the input process image of the station proxy (fieldbus coupler) by fitting a slot with these modules. The bits 2^0 and 2^1 are allocated with input conditions of the physically connected I/O module in the case of 2DE, furthermore the diagnostics station of both signal channels are filed in the process image in case of 2DE, DIA in E-PA. The bits marked green are made available for the input and / or diagnostics information of the following module slots. One byte process data qualifier (IOPS) is managed in the direction of the I/O controller in the cyclic PROFINET IO telegram for these modules.
2DE(+4 BIT I), DIA im E-PA **2DE(+12 BIT I), DIA im E-PA** **2DE(+28 BIT I), DIA im E-PA**	4					D1	D0	E1	E0	
*** 2DE(-2 BIT I)**	2					E1	E0			The fitting of slots with these modules enables the remaining bit locations to be previously filled with input modules without bytes opened with star (bit fields) in the input process image of the station proxy (fieldbus coupler). The bit locations marked in a light red color are respectively occupied by previous slot allocations. One byte process data qualifier (IOPS) is managed in the direction of the I/O controller in the cyclic PROFINET IO telegram for this module.
				E1	E0					
		...								
		E1	E0							

PNIO Module type	Inputs								
	Length [Bit]	Bit allocation								Note
		2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	
*** 2DE(-4 BIT I), DIA in E-PA**	4			D1	D0	E1	E0			The fitting of slots with this module enables the remaining bit location to be previously filled with input modules without bytes opened with star (bit fields) in the input process image of the station proxy (fieldbus coupler). The bit locations marked in a light red color are respectively occupied by previous slot allocations. One byte process data qualifier (IOPS) is managed in the direction of the I/O controller in the cyclic PROFINET IO telegram for these modules.
		D1	D0	E1	E0					
		...								
		D1	D0	E1	E0					

Parameter	Value	Significance
Asynchronous diagnostics message Channel x (x = 0.1)		With external faults, channel diagnostics and the respective alarms are
	locked*)	• not transferred to the I/O controller
	released	• transferred to the I/O controller
	*) Default settings	

5.3.1.3 4-Channel Digital Input Modules

PNIO Module type	EA Type	Module type member	PNIOdata type	Instances	
				Input	Output
4DE(+4 BIT I)	DI_8	75x-402, 75x-403, 75x-408, 75x-409, 75x-414, 75x-415, 75x-422, 75x-423, 75x-424, 75x-428, 75x-432, 75x-433	Unsigned 8-Bit field	1	-
4DE(+12 BIT I)	DI_16		Unsigned 16-Bit field		
4DE(+28 BIT I)	DI_32		Unsigned 32-Bit field		
* 4DE(-4 BIT I)	DI_0	75x-402*, 75x-403*, 75x-408*, 75x-409*, 75x-414*, 75x-415*, 75x-422*, 75x-423*, 75x-424*, 75x-428*, 75x-432*, 75x-433*	-	-	-

PNIO Module type	Inputs								
	Length [Bit]	Bit allocation								Note
		2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	
4DE(+4 BIT I) 4DE(+12 BIT I) 4DE(+28 BIT I)	4					E3	E2	E1	E0	8, 16 or 32 bits are applied in the input process image of the station proxy (fieldbus coupler) by fitting a slot with these modules. The bits 2^0 to 2^3 are assigned with the signal condition of the physically connected I/O module. The bits marked green are made available for the input and / or diagnostics information of the following module slots. One byte accompanying process data (IOPS) is managed in the direction of the IO controller in the cyclic PROFINET IO telegram for this module.
* 4DE(-4 BIT I)	4			E3	E2	E1	E0			The fitting of slots with this module enables the remaining bit locations to be previously filled with input modules without bytes opened with star (bit fields) in the input process image of the station aproxy (fieldbus coupler). The bit locations marked in a light red color are respectively occupied by previous slot allocations. One byte process data qualifier (IOPS) is managed in the direction of the I/O controller in the cyclic PROFINET IO telegram for this module.
		E3	E2	E1	E0					
		...								
		E3	E2	E1	E0					

Parameter	Value	Significance

5.3.1.4 8-Channel Digital Input Modules

PNIO Module type	EA Type	Module type member	PNIOdata type	Instances	
				Input	Output
8DE	**DI_8**	75x-430, 75x-431, 75x-436, 75x-437	Unsigned 8-Bit field	1	-
8DE(+8 BIT I)	**DI_16**		Unsigned 16-Bit field		
8DE(+24 BIT I)	**DI_32**		Unsigned 32-Bit field		
*** 8DE(-8 BIT I)**	**DI_0**	75x-430*, 75x-431*, 75x-436*, 75x-437*	-	-	-

PNIO Module type	Inputs								
	Length [Bit]	Bit allocation								Note
		2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	
8DE **8DE(+8 BIT I)** **8DE(+24 BIT I)**	8	E7	E6	E5	E4	E3	E2	E1	E0	8, 16 or 32 bits are applied in the input process image of the station proxy (fieldbus coupler) by fitting a slot with these modules. The bits 2^0 to 2^7 are assigned with the signal condition of the physically connected I/O module. The bits marked green are made available for the input and / or diagnostics information of the following module slots. One byte process data qualifier (IOPS) is managed in the direction of the I/O controller in the cyclic PROFINET IO telegram for these modules.
*** 8DE(-8 BIT I)**	8	E5	E4	E3	E2	E1	E0			The fitting of slots with this module enables the remaining bit locations to be previously filled with input modules without bytes opened with star (bit fields) in the input process image of the station proxy (fieldbus coupler). The bit locations marked in a light red color are respectively occupied by previous slot allocations. One byte process data qualifier (IOPS) is managed in the direction of the I/O controller in the cyclic PROFINET IO telegram for this module.
								E7	E6	
		E3	E2	E1	E0					
						E7	E6	E5	E4	
		...								
		E7	E6	E5	E4	E3	E2	E1	E0	

Parameter	Value	Significance

5.3.1.5 16-Channel Digital Input Modules

PNIO Module type	EA Type	Module type member	PNIOdata type	Instances	
				Input	Output
16DE	**DI_16**	-	Unsigned 16-Bit field	1	-
16DE(+16 BIT I)	**DI_32**		Unsigned 32-Bit field		
*** 16DE(-16 BIT I)**	**DI_0**	-	-	-	-

PNIO Module type	Inputs								
	Length [Bit]	Bit allocation								Note
		2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	
16DE **16DE(+16 BIT I)**	16	E7	E6	E5	E4	E3	E2	E1	E0	16 or 32 bits are applied in the input process image of the station proxy (fieldbus coupler) by fitting a slot with these modules. The bits 2^0 to 2^{15} are assigned with the signal condition of the physically connected I/O module. The bits marked green are made available for the input and / or diagnostics information of the following module slots. One byte process data qualifier (IOPS) is managed in the direction of the I/O controller in the cyclic PROFINET IO telegram for these modules.
		E15	E14	E13	E12	E11	E10	E9	E8	
***16DE(-16 BIT I)**	16	E5	E4	E3	E2	E1	E0			The fitting of slots with this module enables the remaining bit locations to be previously filled with input modules without bytes opened with star (bit fields) in the input process image of the station proxy(fieldbus coupler). The bit locations marked in a light red color are respectively occupied by previous slot allocations. One byte process data qualifier (IOPS) is managed in the direction of the I/O controller in the cyclic PROFINET IO telegram for this module.
		E13	E12	E11	E10	E9	E8	E7	E6	
								E15	E14	
		E3	E2	E1	E0					
		E11	E10	E9	E8	E7	E6	E5	E4	
						E15	E14	E13	E12	
		...								
		E7	E6	E5	E4	E3	E2	E1	E0	
		E15	E14	E13	E12	E11	E10	E9	E8	

Parameter	Value	Significance

5.3.2 Digital Output Modules

5.3.2.1 2-Channel Digital Output Modules

PNIO Module type	EA Type	Module type member	PNIOdata type	Instances	
				Input	Output
2DA(+6 BIT O)	**DO_8**	75x-501, 75x-502, 75x-509, 75x-512, 75x-513, 75x-514, 75x-517, 75x-535	Unsigned 8-Bit field	-	1
2DA(+14 BIT O)	**DO_16**		Unsigned 16-Bit field		
2DA(+30 BIT O)	**DO_32**		Unsigned 32-Bit field		
*** 2DA(-2 BIT O)**	**DO_0**	75x-501*, 75x-502*, 75x-509*, 75x-512*, 75x-513*, 75x-514*, 75x-517*, 75x-535*	-	-	-

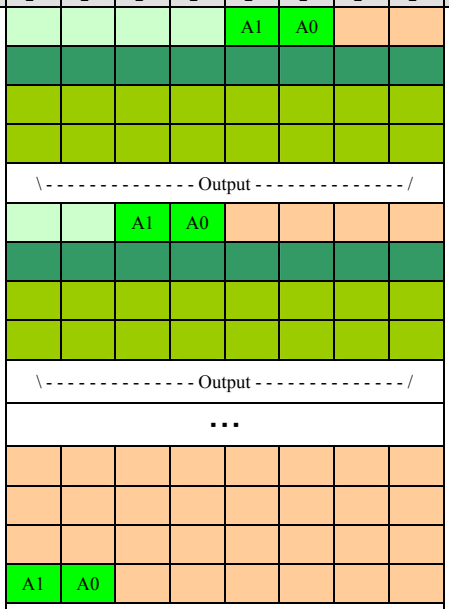
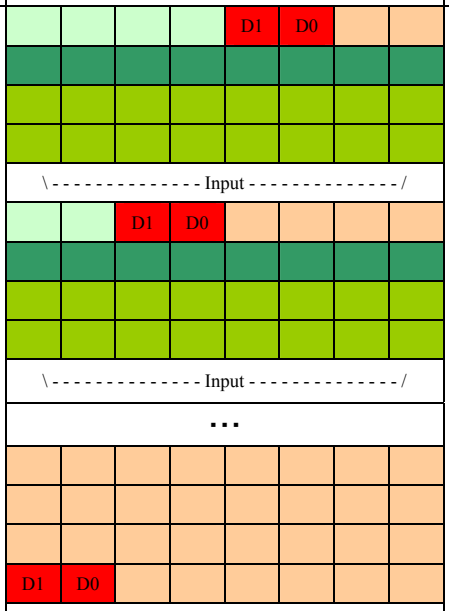
PNIO Module type	Inputs								
	Length [Bit]	Bit allocation								Note
		2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	
2DA(+6 BIT O) **2DA(+14 BIT O)** **2DA(+30 BIT O)**	2							A1	A0	8, 16 or 32 bits are applied in the output process image of the station proxy (fieldbus coupler) by fitting a slot with these modules. The bits 2^0 and 2^1 are assigned with the signal condition of the physically connected I/O module. The bits marked green are made available for the output and / or confirmation diagnostics information of the following module slots. One byte process data qualifier (IOPS) is managed in the direction of the I/O controller in the cyclic PROFINET IO telegram for these modules.
***2DA(-2 BIT O)**	2					A1	A0			The fitting of slots with this module enables the remaining bit location to be previously filled with output modules without bytes opened with stars (Bit field) in the output process image of the station allocator (fieldbus coupler). The bit locations marked in a light red color are respectively occupied by previous slot allocations. One byte process data qualifier (IOCS) is managed in the direction of the I/O controller in the cyclic PROFINET IO telegram for these modules.
				A1	A0					
		...								
		A1	A0							

Parameter	Value	Significance
Substitute value behavior of the outputs		Applies when the I/O controller does not supply valid output data for the module or the group of modules
	according to the device settings*)	• the set strategy on the side of the station substitute applies (I/O device).
	Outputs are set to 0	• all outputs are immediately reset
	Outputs maintain the last valid value	• all outputs maintain the last valid value
	Outputs take on their substitute value	• all outputs switch to their configured substitute value
Substitute output status channel x		When configuring the substitute value behavior on the side of the I/O module, these values are transmitted to the binary signal channel with invalid output states of the I/O controller.
(x = 0.1)	0*)	
	1	
	*) Default settings	

5.3.2.2 2 (1)-Channel Digital Output Modules with 1 Bit Diagnostics Status per Channel

PNIO Module type	EA Type	Module type member	PNIOdata type	Instances	
				Input	Output
2DA(+6 BIT O)	**DO_8**	75x-507, 75x-522, 75x-523 (1 DO)	Unsigned 8-Bit field	-	1
2DA(+6 BIT I/O), DIA in E-PA	**DO_DIA_8**			1	1
2DA(+14 BIT O)	**DO_16**		Unsigned 16-Bit field	-	1
2DA(+12 BIT I/O), DIA in E-PA	**DO_DIA_16**			1	1
2DA(+30 BIT O)	**DO_32**		Unsigned 32-Bit field	-	1
2DA(+28 BIT I/O), DIA in E-PA	**DO_DIA_32**			1	1
*** 2DA(-2 BIT O)**	**DO_0**	75x-507*, 75x-522*, 75x-523* (1 DO)	-	-	-
*** 2DA(-2 BIT I/O), DIA in E-PA**	**DO_DIA_0**				

PNIO Module type	Inputs									
	Length [Bit]	Bit allocation								Note
		2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	
2DA(+6 BIT O) **2DA(+14 BIT O)** **2DA(+30 BIT O)**	2							A1	A0	8, 16 or 32 bits are applied in the output process image of the station proxy (fieldbus coupler) by fitting a slot with these modules. The bits 2^0 and 2^1 are assigned with the signal condition of the physically connected I/O module. The bits 2^2 to 2^7, 2^{15} or 2^{31} marked green are made available for the output and / or confirmation information of the following modules. One byte process data qualifier (IOCS) is managed in the direction of the I/O controller in the cyclic PROFINET IO telegram for these modules.
		\ - - - - - - - - - - - - - - Output - - - - - - - - - - - - - - /								
2DA(+6 BIT I/O), DIA inE-PA **2DA(+14 BIT I/O), DIA in E-PA** **2DA(+30 BIT I/O), DIA in E-PA**	2							A1	A0	8, 16 or 32 bits are applied in the input and output process image of the station proxy (fieldbus coupler) by fitting a slot with these modules. The bits 2^0 and 2^1 in the output area are assigned with the signal condition of the physically connected I/O module. The bits 2^2 to 2^7, 2^{15} or 2^{31} marked green are made available for the output and / or confirmation information of the following modules. The bits 2^0 and 2^1 in the input area are assigned with the diagnostics condition of the physically connected I/O module. The bits marked green are made available for the input and / or diagnostics information of the following module slots. Two byte process data qualifiers (IOCS, IOPS) are managed in the transmission direction of the I/O controller in the cyclic PROFINET IO telegram for this module.
		\ - - - - - - - - - - - - - - Output - - - - - - - - - - - - - - /								
	2							D1	D0	
		\ - - - - - - - - - - - - - - Input - - - - - - - - - - - - - - /								

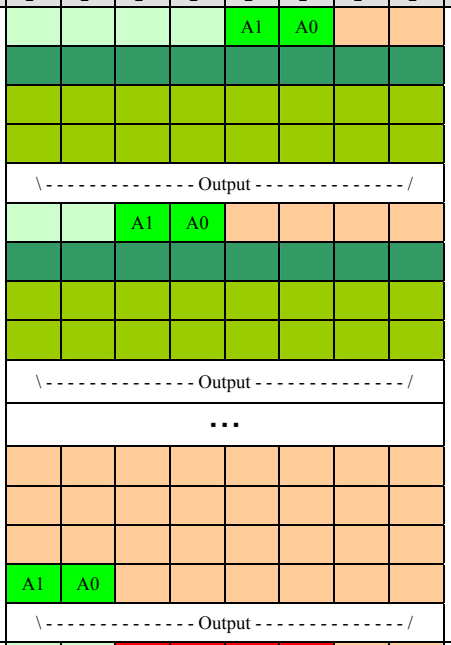
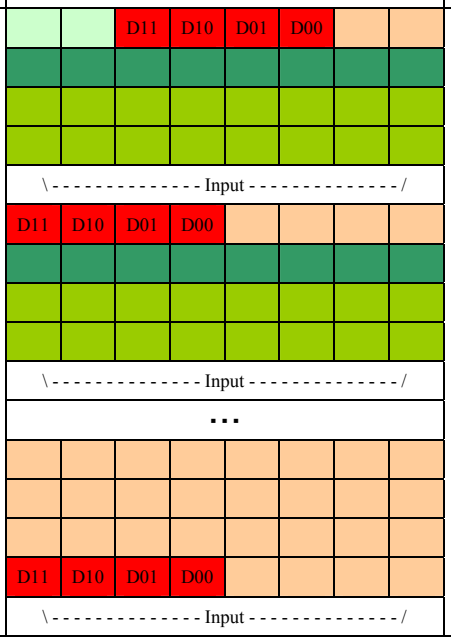
PNIO Module type	Inputs		
	Length [Bit]	Bit allocation 2^7 2^6 2^5 2^4 2^3 2^2 2^1 2^0	Note
*** 2DA(-2 BIT O)**	2		The fitting of slots with this module enables the remaining bit location to be previously filled with output modules without bytes opened with stars (Bit field) in the output process image of the station allocator (fieldbus coupler). The bit locations marked in a light red color are respectively occupied by previous slot allocations. One byte process data qualifier (IOCS) is managed in the direction of the I/O controller in the cyclic PROFINET IO telegram for these modules.
*** 2DA(-2 BIT I/O), DIA in E-PA** **Output see * 2DA(-2 BIT O)**	2		The fitting of slots with this module enables the remaining bit locations to be previously filled with input and / or output modules without bytes opened with star (bit fields) in the input and output process image of the station proxy (fieldbus coupler). The bit locations marked in a light red color are respectively occupied by previous slot allocations. One byte process data qualifier (IOCS) is managed in the direction of the I/O controller in the cyclic PROFINET IO telegram for these modules.

Parameter	Value	Significance
Asynchronous diagnostics message Channel x (x = 0.1)		With external faults, channel diagnostics and the respective alarms are
	locked*)	• not transferred to the I/O Controller
	released	• transferred to the I/O controller
Substitute value behavior of the outputs		In case the I/O controller does not supply valid output data for the module or the group of modules then
	according to the device settings*)	• the set strategy on the side of the station distributor applies (I/O device).
	Outputs are set to 0	• all outputs are immediately reset
	Outputs maintain the last valid value	• all outputs maintain the last valid value
	Outputs take on their substitute value	• all outputs switch to their configured substitute value
Substitute output status channel x		When configuring the substitute value behavior on the side of the I/O module, these values are transmitted to the binary signal channel with invalid output states of the I/O controller.
(x = 0.1)	0*)	
	1	
	*) Default settings	

5.3.2.3 2 (1)-Channel Digital Output Modules with 2 Bit Diagnostics Status per Channel

PNIO Module type	EA Type	Module type member	PNIOdata type	Instances	
				Input	Output
2DA(+6 BIT O)	**DO_8**	75x-506	Unsigned 8-Bit field	-	1
2DA(+6 BIT O, +4 BIT I), DIA in E-PA	**DO_DIA_8**			1	1
2DA(+14 BIT O)	**DO_16**		Unsigned 16-bit field	-	1
2DA(+14 BIT O, +12 BIT I), DIA in E-PA	**DO_DIA_16**			1	1
2DA(+30 BIT O)	**DO_32**		Unsigned 32-bit field	-	1
2DA(+30 BIT O, +28 BIT I), DIA in E-PA	**DO_DIA_32**			1	1
*** 2DA(-2 BIT O)**	**DO_0**	75x-506*	-	-	-
*** 2DA(-2 BIT O, -4 BIT I), DIA in E-PA**	**DO_DIA_0**				

PNIO Module type	Inputs								
	Length [Bit]	Bit allocation								Note
		2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	
2DA(+6 BIT O) **2DA(+14 BIT O)** **2DA(+30 BIT O)**	2							A1	A0	8, 16 or 32 bits are applied in the output process image of the station proxy (fieldbus coupler) by fitting a slot with these modules. The bits 2^0 and 2^1 are assigned with the signal condition of the physically connected I/O module. The bits 2^2 to 2^7, 2^{15} or 2^{31} marked green are made available for the output and / or confirmation information of the following modules. One byte process data qualifier (IOCS) is managed in the transmission direction of the I/O controller in the cyclic PROFINET IO telegram for these modules.
		\ - - - - - - - - - - - - - - Output - - - - - - - - - - - - - - /								
2DA(+6 BIT O, +4 BIT I), DIA in E-PA **2DA(+14 BIT O, +12 BIT I), DIA in E-PA**	2							A1	A0	8, 16 or 32 bits are applied in the input and output process image of the station proxy (fieldbus coupler) by fitting a slot with these modules. The bits 2^0 and 2^1 in the output area are assigned with the signal condition of the physically connected I/O module. The bits 2^2 to 2^7, 2^{15} or 2^{31} marked green are made available for the output and / or confirmation information of the following modules. The bits 2^0 and 2^1 in the input area are assigned with the diagnostics condition of the physically connected I/O module. The bits marked green are made available for the input and / or diagnostics information of the following module slots. Two byte process data qualifiers (IOCS, IOPS) are managed in the transmission direction of the I/O controller in the cyclic PROFINET IO telegram for these modules.
		\ - - - - - - - - - - - - - - Output - - - - - - - - - - - - - - /								
2DA(+30 BIT O, +28 BIT I), DIA in E-PA	4					D11	D10	D01	D00	
		\ - - - - - - - - - - - - - - Input - - - - - - - - - - - - - - /								

PNIO Module type	Inputs		
	Length [Bit]	Bit allocation 2^7 2^6 2^5 2^4 2^3 2^2 2^1 2^0	Note
*** 2DA(-2 BIT O)**	2		The fitting of slots with this module enables the remaining bit locations to be previously filled with output modules without bytes opened with star (bit fields) in the output process image of the station proxy(fieldbus coupler). The bit locations marked in a light red color are respectively occupied by previous slot allocations. One byte process data qualifier (IOCS) is managed in the direction of the I/O controller in the cyclic PROFINET IO telegram for these modules.
*** 2DA(-2 BIT O, -4 BIT I), DIA in E-PA** **Output see * 2DA(-2 BIT O)**	4		The fitting of slots with this module enables the remaining bit locations to be previously filled with input and / or output modules without bytes opened with star (bit fields) in the input and output process image of the station proxy (fieldbus coupler). The bit locations marked in a light red color are respectively occupied by previous slot allocations. One byte process data qualifier (IOCS) is managed in the direction of the I/O controller in the cyclic PROFINET IO telegram for these modules.

Parameter	Value	Significance
Asynchronous diagnostics message Channel x (x = 0.1)		With external faults, channel diagnostics and the respective alarms are
	locked*)	• not transferred to the I/O controller
	released	• transferred to the I/O controller
Substitute value behavior of the outputs		In case the I/O controller does not supply valid output data for the module or the group of modules then
	according to the device settings*)	• the set strategy on the side of the station substitute applies (I/O device).
	Outputs are set to 0	• all outputs are immediately reset
	Outputs maintain the last valid value	• all outputs maintain the last valid value
	Outputs take on their substitute value	• all outputs switch to their configured substitute value
Substitute output status channel x		When configuring the substitute value behavior on the side of the I/O module, these values are transmitted to the binary signal channel with invalid output states of the I/O controller.
(x = 0.1)	0*)	
	1	
	*) Default settings	

5.3.2.4 4-Channel Digital Output Modules

PNIO Module type	EA Type	Module type member	PNIOdata type	Instances	
				Input	Output
4DA(+4 BIT O)	**DO_8**	75x-504, 75x-516, 75x-519	Unsigned 8-Bit field	-	1
4DA(+12 BIT O)	**DO_16**		Unsigned 16-Bit field	-	1
4DA(+28 BIT O)	**DO_32**		Unsigned 32-Bit field	-	1
*** 4DA(-4 BIT O)**	**DO_0**	75x-504*, 75x-516*, 75x-519*	-	-	-

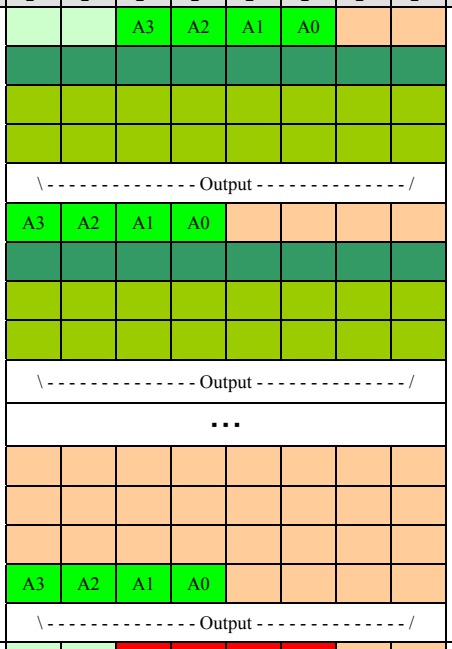
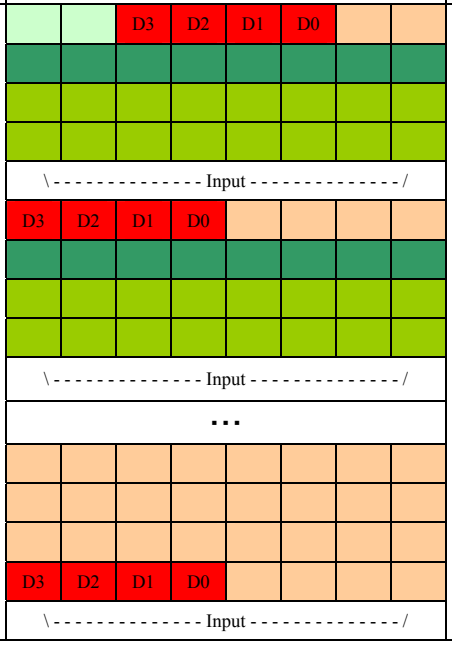
PNIO Module type	Inputs		
	Length [Bit]	Bit allocation	Note
4DA(+4 BIT O) **4DA(+12 BIT O)** **4DA(+28 BIT O)**	4	2^7 2^6 2^5 2^4 2^3 2^2 2^1 2^0 A3 A2 A1 A0	8, 16 or 32 bits are applied in the output process image of the station proxy (fieldbus coupler) by fitting a slot with these modules. The bits 2^0 and 2^3 are assigned with the signal condition of the physically connected I/O module. The bits 2^4 to 2^7, 2^{15} or 2^{31} marked green are made available for the output and / or confirmation information of the following modules. One byte process data qualifier (IOCS) is managed in the transmission direction of the I/O controller in the cyclic PROFINET IO telegram for these modules.
*** 4DA(-4 BIT O)**	4	A3 A2 A1 A0 A3 A2 A1 A0 ... A3 A2 A1 A0	The fitting of slots with this module enables the remaining bit locations to be previously filled with output modules without bytes opened with star (bit fields) in the output process image of the station proxy(fieldbus coupler). The bit locations marked in a light red color are respectively occupied by previous slot allocations. One byte process data qualifier (IOPS) is managed in the direction of the I/O controller in the cyclic PROFINET IO telegram for this module.

Parameter	Value	Significance
Substitute value behavior of the outputs		In case the I/O controller does not supply valid output data for the module or the group of modules then
	according to the device settings*)	• the set strategy on the side of the station substitute applies (I/O device).
	Outputs are set to 0	• all outputs are immediately reset
	Outputs maintain the last valid value	• all outputs maintain the last valid value
	Outputs take on their substitute value	• all outputs switch to their configured substitute value
Substitute output status channel x		When configuring the substitute value behavior on the side of the I/O module, these values are transmitted to the binary signal channel with invalid output states of the I/O controller.
(x = 0 ... 3)	0*)	
	1	
	*) Default settings	

5.3.2.5 4-Channel Digital Output Modules with 1 Bit Diagnostics Status per Channel

PNIO Module type	EA Type	Module type member	PNIOdata type	Instances	
				Input	Output
4DA(+4 BIT O)	**DO_8**	75x-532	Unsigned 8-Bit field	-	1
4DA(+4 BIT I/O), DIA in E-PA	**DO_DIA_8**			1	1
4DA(+12 BIT O)	**DO_16**		Unsigned 16-Bit field	-	1
4DA(+12 BIT I/O), DIA in E-PA	**DO_DIA_16**			1	1
4DA(+28 BIT O)	**DO_32**		Unsigned 32-Bit field	-	1
4DA(+28 BIT I/O), DIA in E-PA	**DO_DIA_32**			1	1
*** 4DA(-4 BIT O)**	**DO_0**	75x-532*	-	-	-
*** 4DA(-4 BIT I/O), DIA in E-PA**	**DO_DIA_0**				

PNIO Module type	Inputs									
	Length [Bit]	Bit allocation								Note
		2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	
4DA(+4 BIT O) **4DA(+12 BIT O)** **4DA(+28 BIT O)**	4					A3	A2	A1	A0	8, 16 or 32 bits are applied in the output process image of the station proxy (fieldbus coupler) by fitting a slot with these modules. The bits 2^0 and 2^3 are assigned with the signal condition of the physically connected I/O module. The bits 2^4 to 2^7, 2^{15} or 2^{31} marked green are made available for the output and / or confirmation information of the following modules. One byte process data qualifier (IOCS) is managed in the transmission direction of the I/O controller in the cyclic PROFINET IO telegram for these modules.
		\ - - - - - - - - - - - - - - Output - - - - - - - - - - - - - - /								
4DA(+4 BIT I/O), DIA in E-PA **4DA(+12 BIT I/O), DIA in E-PA** **4DA(+28 BIT I/O), DIA in E-PA**	4					A3	A2	A1	A0	8, 16 or 32 bits are applied in the input and output process image of the station proxy (fieldbus coupler) by fitting a slot with these modules. The bits 2^0 and 2^3 in the output area are assigned with the signal condition of the physically connected I/O module. The bits 2^2 to 2^7, 2^{15} or 2^{31} marked green are made available for the output and / or confirmation information of the following modules. The bits 2^0 and 2^3 in the input area are assigned with the diagnostics condition of the physically connected I/O module. The bits marked green are made available for the input and / or diagnostics information of the following module slots. Two byte process data qualifiers (IOCS, IOPS) are managed in the transmission direction of the I/O controller in the cyclic PROFINET IO telegram for these modules.
		\ - - - - - - - - - - - - - - Output - - - - - - - - - - - - - - /								
	4					D3	D2	D1	D0	
		\ - - - - - - - - - - - - - - Input - - - - - - - - - - - - - - /								

PNIO Module type	Inputs		
	Length [Bit]	Bit allocation 2^7 2^6 2^5 2^4 2^3 2^2 2^1 2^0	Note
*** 4DA(-4 BIT O)**	4		The fitting of slots with this module enables the remaining bit locations to be previously filled with output modules without bytes opened with star (bit fields) in the output process image of the station proxy(fieldbus coupler). The bit locations marked in a light red color are respectively occupied by previous slot allocations. One byte process data qualifier (IOPS) is managed in the direction of the I/O controller in the cyclic PROFINET IO telegram for this module.
*** 4DA(-4 BIT I/O), DIA in E-PA** **Output see * 4DA(-4 BIT O)**	4		The fitting of slots with this module enables the remaining bit locations to be previously filled with input and / or output modules without bytes opened with star (bit fields) in the input and output process image of the station proxy (fieldbus coupler). The bit locations marked in a light red color are respectively occupied by previous slot allocations. One byte process data qualifier (IOCS) is managed in the direction of the I/O controller in the cyclic PROFINET IO telegram for these modules.

Parameter	Value	Significance
Asynchronous diagnostics message Channel x (x = 0 ... 3)		With external faults, channel diagnostics and the respective alarms are
	locked*)	• not transferred to the I/O controller
	released	• transferred to the I/O controller
Substitute value behavior of the outputs		In case the I/O controller does not supply valid output data for the module or the group of modules then
	according to the device settings*)	• the set strategy on the side of the station substitute applies (I/O device).
	Outputs are set to 0	• all outputs are immediately reset
	Outputs maintain the last valid value	• all outputs maintain the last valid value
	Outputs take on their substitute value	• all outputs switch to their configured substitute value
Substitute output status channel x		When configuring the substitute value behavior on the side of the I/O module, these values are transmitted to the binary signal channel with invalid output states of the I/O controller.
(x = 0 ... 3)	0*)	
	1	
	*) Default settings	

5.3.2.6 8-Channel Digital Output Modules

PNIO Module type	EA Type	Module type member	PNIO-Data type	Instances	
				Input	Output
8DA	**DO_8**	75x-530, 75x-536	Unsigned 8-Bit field	-	1
8DA(+8 BIT O)	**DO_16**		Unsigned 16-Bit field	-	1
8DA(+24 BIT O)	**DO_32**		Unsigned 32-Bit field	-	1
*** 8DA(-8 BIT A)**	**DO_0**	75x-530*, 75x-536*	-	-	-

PNIO Module type	Inputs									
	Length [Bit]	Bit allocation								Note
		2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	
8DA **8DA(+8 BIT O)** **8DA(+24 BIT O)**	8	A7	A6	A5	A4	A3	A2	A1	A0	8, 16 or 32 bits are applied in the output process image of the station proxy (fieldbus coupler) by fitting a slot with these modules. The bits 2^0 and 2^7 are assigned with the signal condition of the physically connected I/O module. The bits 2^8 to 2^{15} or 2^{31} marked green are made available for the output and / or confirmation information of the following modules. One byte process data qualifier (IOCS) is managed in the transmission direction of the I/O controller in the cyclic PROFINET IO telegram for these modules.
*** 8DA(-8 BIT O)**	8	A5	A4	A3	A2	A1	A0			The fitting of slots with this module enables the remaining bit locations to be previously filled with output modules without bytes opened with star (bit fields) in the output process image of the station proxy(fieldbus coupler). The bit locations marked in a light red color are respectively occupied by previous slot allocations. One byte process data qualifier (IOPS) is managed in the transmission direction of the I/O controller in the cyclic PROFINET IO telegram for these modules.
								A7	A6	
		A3	A2	A1	A0					
						A7	A6	A5	A4	
		...								
		A7	A6	A5	A4	A3	A2	A1	A0	

Parameter	Value	Significance
Substitute value behavior of the outputs		In case the I/O controller does not supply valid output data for the module or the group of modules then
	according to the device settings*)	• the set strategy on the side of the station substitute applies (I/O device).
	Outputs are set to 0	• all outputs are immediately reset
	Outputs maintain the last valid value	• all outputs maintain the last valid value
	Outputs take on their substitute value	• all outputs switch to their configured substitute value
Substitute output status channel x		When configuring the substitute value behavior on the side of the I/O module, these values are transmitted to the binary signal channel with invalid output states of the I/O controller.
(x = 0 ... 7)	0*)	
	1	
	*) Default settings	

5.3.2.7 8-Channel Digital Output Modules with 1 Bit Diagnostics Status per Channel

PNIO Module type	EA Type	Module type member	PNIO-Data type	Instances	
				Input	Output
8DA	**DO_8**	75x-537	Unsigned 8-Bit field	-	1
8DA, DIA in E-PA	**DO_DIA_8**			1	1
8DA(+8 BIT O)	**DO_16**		Unsigned 16-Bit field	-	1
8DA(+8 BIT I/O), DIA in E-PA	**DO_DIA_16**			1	1
8DA(+24 BIT O)	**DO_32**		Unsigned 32-bit field	-	1
8DA(+24 BIT I/O), DIA in E-PA	**DO_DIA_32**			1	1
*** 8DA(-8 BIT A)**	**DO_0**	75x-537*	-	-	-
*** 8DA(-8 BIT I/O), DIA in E-PA**	**DO_DIA_0**				

PNIO Module type	Inputs									
	Length [Bit]	Bit allocation								Note
		2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	
8DA **8DA(+8 BIT O)** **8DA(+24 BIT O)**	8	A7	A6	A5	A4	A3	A2	A1	A0	8, 16 or 32 bits are applied in the output process image of the station proxy (fieldbus coupler) by fitting a slot with these modules.. The bits 2^0 and 2^7 are assigned with the signal condition of the physically connected I/O module. The bits 2^8 to 2^{15} or 2^{31} marked green are made available for the output and / or confirmation information of the following modules. One byte process data qualifier (IOCS) is managed in the transmission direction of the I/O controller in the cyclic PROFINET IO telegram for these modules.
		\ - - - - - - - - - - - - - - Output - - - - - - - - - - - - - - /								
8DA(+8 BIT I/O), DIA in E-PA **8DA(+8 BIT I/O), DIA in E-PA** **8DA(+24 BIT I/O), DIA in E-PA**	8	A7	A6	A5	A4	A3	A2	A1	A0	8, 16 or 32 bits are applied in the input and output process image of the station proxy (fieldbus coupler) by fitting a slot with these modules. The bits 2^0 and 2^7 in the output area are assigned with the signal condition of the physically connected I/O module. The bits 2^8 to 2^{15} or 2^{31} marked green are made available for the output and / or confirmation information of the following modules. The bits 2^0 and 2^7 in the input area are assigned with the diagnostics condition of the physically connected I/O module. The bits marked green are made available for the input and / or diagnostics information of the following module slots. Two byte process data qualifiers (IOCS, IOPS) are managed in the transmission direction of the I/O controller in the cyclic PROFINET IO telegram for these modules.
		\ - - - - - - - - - - - - - - Output - - - - - - - - - - - - - - /								
	8	D7	D6	D5	D4	D3	D2	D1	D0	
		\ - - - - - - - - - - - - - - Input - - - - - - - - - - - - - - /								

PNIO Module type	Inputs		
	Length [Bit]	Bit allocation 2^7 2^6 2^5 2^4 2^3 2^2 2^1 2^0	Note
*** 8DA(-8 BIT A)**	8	A5 A4 A3 A2 A1 A0 A7 A6 \ - - - - - - - - - - - - - - Output - - - - - - - - - - - - - - / A3 A2 A1 A0 A7 A6 A5 A4 \ - - - - - - - - - - - - - - Output - - - - - - - - - - - - - - / ... A7 A6 A5 A4 A3 A2 A1 A0 \ - - - - - - - - - - - - - - Output - - - - - - - - - - - - - - /	The fitting of slots with this module enables the remaining bit locations to be previously filled with output modules without bytes opened with star (bit fields) in the output process image of the station proxy(fieldbus coupler). The bit locations marked in a light red color are respectively occupied by previous slot allocations. One byte process data qualifier (IOPS) is managed in the transmission direction of the I/O controller in the cyclic PROFINET IO telegram for these modules.
*** 8DA(-8 BIT I/O), DIA in E-PA** **Output see * 8DA(-8 BIT A)**	8	D5 D4 D3 D2 D1 D0 D7 D6 \ - - - - - - - - - - - - - - Input - - - - - - - - - - - - - - / D3 D2 D1 D0 D7 D6 D5 D4 \ - - - - - - - - - - - - - - Input - - - - - - - - - - - - - - / ... D7 D6 D5 D4 D3 D2 D1 D0 \ - - - - - - - - - - - - - - Input - - - - - - - - - - - - - - /	The fitting of slots with this module enables the remaining bit location to be previously filled with input and / or output modules without bytes opened with star (bit fields) in the input and output process image of the station proxy (fieldbus coupler). The bit locations marked in a light red color are respectively occupied by previous slot allocations. One byte process data qualifier (IOCS) is managed in the direction of the I/O controller in the cyclic PROFINET IO telegram for these modules.

Parameter	Value	Significance
Asynchronous diagnostics message Channel x (x = 0 ... 7)		With external faults, channel diagnostics and the respective alarms are
	locked*)	• not transferred to the I/O controller
	released	• transferred to the I/O controller
Substitute value behavior of the outputs		Applies when the I/O controller does not supply valid output data for the module or the group of modules
	according to the device settings*)	• the set strategy on the side of the station distributor applies (I/O device).
	Outputs are set to 0	• so that all outputs are immediately reset
	Outputs maintain the last valid value	• that all outputs maintain the last valid value
	outputs take on their default value	• so that all outputs switch to their configured default value
Default output status channel x		With the respective configuration of the default value behavior on the side of the I/O module, these values are released to binary signal channels with invalid output station of the I/O controller.
(x = 0 ... 7)	0*)	
	1	
	*) Default settings	

5.3.2.8 16-Channel Digital Output Modules

PNIO Module type	EA Type	Module type member	PNIO-Data type	Instances	
				Input	Output
16DA	**DO_16**	-	Unsigned 16-Bit field	-	1
16DA(+16 BIT O)	**DO_32**		Unsigned 32-Bit field	-	1
*** 16DA(-16 BIT O)**	**DO_0**	-	-	-	-

PNIO Module type	Inputs									
	Length [Bit]	Bit allocation								Note
		2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	
16DA **16DA(+16 BIT O)**	16	A7	A6	A5	A4	A3	A2	A1	A0	16 or 32 bits are applied in the output process image of the station proxy (fieldbus coupler) by fitting a slot with these modules. The bits 2^0 and 2^{15} are assigned with the signal condition of the physically connected I/O module. The bits 2^{16} to 2^{31} marked green are made available for the output and / or confirmation information of the following modules. One byte process data qualifier (IOCS) is managed in the transmission direction of the I/O controller in the cyclic PROFINET IO telegram for these modules.
		A15	A14	A13	A12	A11	A10	A9	A8	
*** 16DA(-16 BIT O)**	16	A5	A4	A3	A2	A1	A0			The fitting of slots with this module enables the remaining bit locations to be previously filled with output modules without bytes opened with star (bit fields) in the output process image of the station proxy(fieldbus coupler). The bit locations marked in a light red color are respectively occupied by previous slot allocations. One byte process data qualifier (IOPS) is managed in the transmission direction of the I/O controller in the cyclic PROFINET IO telegram for these modules.
		A13	A12	A11	A10	A9	A8	A7	A6	
								A15	A14	
		A3	A2	A1	A0					
		A11	A10	A9	A8	A7	A6	A5	A4	
						A15	A14	A13	A12	
		...								
		A7	A6	A5	A4	A3	A2	A1	A0	
		A15	A14	A13	A12	A11	A10	A9	A8	

Parameter	Value	Significance
Default value behavior of the outputs		Applies when the I/O controller does not supply valid output data for the module or the group of modules
	according to the device settings*)	• the set strategy on the side of the station distributor applies (I/O device).
	Outputs are set to 0	• so that all outputs are immediately reset
	Outputs maintain the last valid value	• that all outputs maintain the last valid value
	outputs take on their default value	• so that all outputs switch to their configured default value
Default output status channel x		With the respective configuration of the default value behavior on the side of the I/O module, these values are released to binary signal channels with invalid output station of the I/O controller.
(x = 0 ... 15)	0*)	
	1	
	*) Default settings	

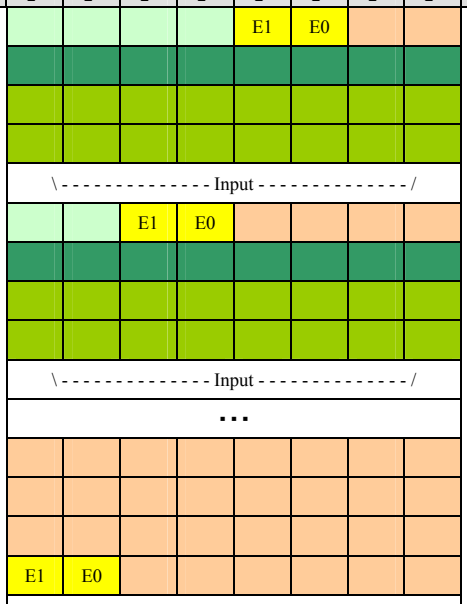
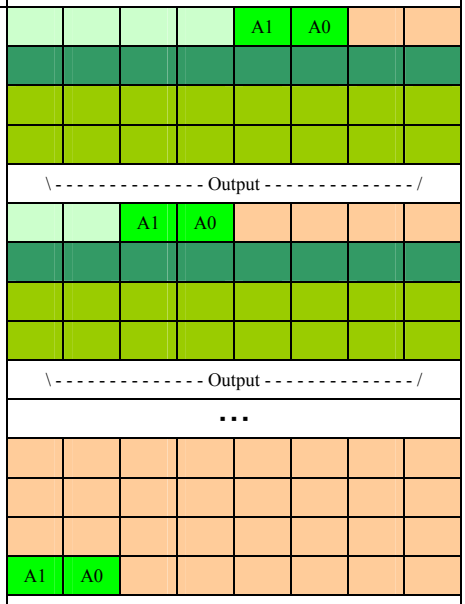
5.3.2.9 2-Channel Digital Input Modules with 1 Bit Diagnostics Status and Confirmation per Channel

PNIO Module type	EA Type	Module type member	PNIO-Data type	Instances	
				Input	Output
2DE(+6 BIT I), 2ACK(+6 BIT O)	**DIO_8**	75x-418	Unsigned 8-Bit field	1	1
2DE(+4 BIT I), 2ACK(+6 BIT O), DIA in E-PA	**DIO_DIA_8**			1	1
2DE(+14 BIT I), 2ACK(+14 BIT O)	**DIO_16**		Unsigned 16-Bit field	1	1
2DE(+12 BIT I), 2ACK(+14 BIT O), DIA in E-PA	**DIO_DIA_16**			1	1
2DE(+30 BIT I), 2ACK(+30 BIT O)	**DIO_32**		Unsigned 32-Bit field	1	1
2DE(+28 BIT I), 2ACK(+30 BIT O), DIA in E-PA	**DIO_DIA_32**			1	1
*** 2DE(-2 BIT I), 2ACK(-2 BIT O)**	**DIO_0**	75x-418*	-	-	-
*** 2DE(-4 BIT I), 2ACK(-2 BIT O), DIA in E-PA**	**DIO_DIA_0**				

PNIO Module type	Inputs									
	Length [Bit]	Bit allocation								Note
		2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	
2DE(+6 BIT I), 2ACK(+6 BIT O) **2DE(+14 BIT I), 2ACK(+14 BIT O)** **2DE(+30 BIT I), 2ACK(+30 BIT O)**	2							Q1	Q0	8, 16 or 32 bits are fitted in the input and output process image of the station proxy (fieldbus coupler) by fitting a slot with these modules. The bits 2^0 and 2^1 in the input area are assigned with the signal condition of the physically connected I/O module. The bits marked green are made available for the input and / or diagnostics information of the following module slots. The bits 2^0 and 2^1 are used to confirm diagnostics results in the output area. The bits 2^2 to 2^7, 2^{15} or 2^{31} marked green are made available for the output and / or confirmation information of the following modules. Two byte process data qualifiers (IOPS, IOCS) are managed in the transmission direction of the I/O controller in the cyclic PROFINET IO telegram for these modules.
		\ - - - - - - - - - - - - - - Output - - - - - - - - - - - - - - /								
	2							E1	E0	
		\ - - - - - - - - - - - - - - Input - - - - - - - - - - - - - - /								

<table>
<tr><th rowspan="2">PNIO
Module type</th><th colspan="10">Inputs</th></tr>
<tr><th>Length
[Bit]</th><th colspan="8">Bit allocation
2^7 2^6 2^5 2^4 2^3 2^2 2^1 2^0</th><th>Note</th></tr>
<tr><td>2DE(+4 BIT I),
2ACK(+6 BIT O),
DIA in E-PA

2DE(+12 BIT I),
2ACK(+14 BIT O),
DIA in E-PA</td><td>2</td><td colspan="8">Q1 Q0
\ - - - - - - - - - - - - - - Output - - - - - - - - - - - - - - /</td><td rowspan="3">8, 16 or 32 bits are appllied in the input and output process image of the station proxy (fieldbus coupler) by fitting a slot with these modules. The bits 2^0 and 2^1 in the input area are assigned with the signal condition of the physically connected I/O module, the bits 2^2 and 2^3 carry the diagnostics information of the signal channels. The bits marked green are made available for the input and / or diagnostics information of the following module slots. The bits 2^0 and 2^1 are used to confirm diagnostics results in the output area. The bits 2^2 to 2^7, 2^{15} or 2^{31} marked green are made available for the output and / or confirmation information of the following modules. Two byte process data qualifiers (IOPS, IOCS) are managed in the transmission direction of the I/O controller in the cyclic PROFINET IO telegram for these modules.</td></tr>
<tr><td>2DE(+28 BIT I),
2ACK(+30 BIT O),
DIA in E-PA</td><td>4</td><td colspan="8">D1 D0 E1 E0
\ - - - - - - - - - - - - - - Input - - - - - - - - - - - - - - /</td></tr>
<tr><td colspan="10"></td></tr>
</table>

PNIO Module type	Inputs		
	Length [Bit]	Bit allocation	Note
		2^7 2^6 2^5 2^4 2^3 2^2 2^1 2^0	
*** 2DE(-2 BIT I), 2ACK(-2 BIT O)**	2		The fitting of slots with this module enables the remaining bit location to be previously filled with input and / or output modules without bytes opened with star (bit fields) in the input and output process image of the station proxy (fieldbus coupler). The bit locations marked in a light red color are respectively occupied by previous slot allocations. One byte process data qualifier (IOPS) is managed in the transmission direction of the I/O controller in the cyclic PROFINET IO telegram for these modules.
	2		

PNIO Module type	Inputs								
	Length [Bit]	Bit allocation								Note
		2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	
*** 2DE(-4 BIT I), 2ACK(-2 BIT O), DIA in E-PA**	4			D1	D0	E1	E0			The fitting of slots with this module enables the remaining bit location to be previously filled with input and / or output modules without bytes opened with star (bit fields) in the input and output process image of the station proxy (fieldbus coupler). The bit locations marked in a light red color are respectively occupied by previous slot allocations.
		\ - - - - - - - - - - - - - - Input - - - - - - - - - - - - - - /								
		D1	D0	E1	E0					One byte process data qualifier (IOPS) is managed in the transmission direction of the I/O controller in the cyclic PROFINET IO telegram for these modules.
		\ - - - - - - - - - - - - - - Input - - - - - - - - - - - - - - /								
		...								
		D1	D0	E1	E0					
		\ - - - - - - - - - - - - - - Input - - - - - - - - - - - - - - /								

Parameter	Value	Significance
Asynchronous diagnostics message Channel x (x = 0.1)		With external faults, channel diagnostics and the respective alarms shall be
	locked*)	• not transferred to the I/O Controller
	released	• transferred to the I/O Controller
	*) Default settings	

5.3.3 Analog Input Modules

5.3.3.1 2-Channel Analog Input Modules

PNIO Module type	EA Type	Module type member	PNIOData Type	Instances	
				Input	Output
2AE	**AI**	75x-452, 75x-454, 75x-456, 75x-461, 75x-462, 75x-465, 75x-466, 75x-467, 75x-469, 75x-472, 75x-474, 75x-475, 75x-476, 75x-477, 75x-478, 75x-479, 75x-480, 75x-483, 75x-485, 75x-491, 75x-492	Integer 16	2	-
2AE, EM	**AI_EM**		Unsigned 8 Integer 16	2	2

PNIO Module type	Inputs			
	Length [Bit]	Bit allocation		Note
		2^7 2^6 2^5 2^4 2^3 2^2 2^1 2^0		
2AE	4	Input date channel 0, HB (LB)	2 words (4 byte) are applied in the input process image of the station proxy (fieldbus coupler) by fitting the slot with this module and are assigned to the input signal channel of the module using 1 word (2 byte) each. The quality rating of the bytes are a result of the selected data format. One byte process data qualifier (IOPS) is managed in the direction of the I/O controller in the cyclic PROFINET IO telegram for this module.	
		Input date channel 0, LB (HB)		
		Input date channel 1, HB (LB)		
		Input date channel 0, HB (LB)		
		\ - - - - - - - - - - - - - - Input - - - - - - - - - - - - - - /		
2AE, EM	6	PD RA | F | Status / Register RES Channel 0 / Table 0	3 words (6 byte) are applied in the output process image of the station proxy (fieldbus coupler) by fitting the slot with this module. This module enables access to the register structure of the I/O module for configuration purposes. Two byte process data qualifiers (IOPS, IOCS) are managed in the direction of the I/O controller in the cyclic PROFINET IO telegram for these modules.	
		Input date / Register date RD Channel 0 / Table 0, HB (LB)		
		Input date / Register date RD Channel 0 / Table 0, LB (HB)		
		PD RA | F | Status / Register RES Channel 1 / Table 1		
		Input date / Register date RD Channel 1 / Table 1, HB (LB)		
		Input date / Register date RD Channel 1 / Table 1, LB (HB)		
		\ - - - - - - - - - - - - - - Input - - - - - - - - - - - - - - /		
	6	PD RA | RW | Register REQ Table 0		
		Register date WR Table 0, HB (LB)		
		Register date WR Table 0, LB (HB)		
		PD RA | RW | Register REQ Table 1		
		Register date WR Table 1, HB (LB)		
		Register date WR Table 0, HB (LB)		
		\ - - - - - - - - - - - - - - Output - - - - - - - - - - - - - - /		

Parameter	Value	Significance
Asynchronous diagnostics message Channel x (x = 0.1)		The following occurs per diagnostics data sets and diagnostics alarm with external faults
	locked*)	• not transferred to the I/O Controller
	released	• transferred to the I/O Controller
Process data format channel x		The process data will be transferred
(x = 0.1)	according to the device settings*)	• using the format settings of the I/O device.
	INTEL (LSB-MSB)	• Little Endian format
	MOTOROLA (MSB-LSB)	• Big Endian format
	*) Default settings	

5.3.3.2 4-Channel Analog Input Modules

PNIO Module type	EA Type	Module type member	PNIO-Data type	Instances	
				Input	Output
4AE	**AI**	75x-453, 75x-455, 75x-457, 75x-459, 75x-460, 75x-463, 75x-468	Integer 16	4	-
4AE, EM	**AI_EM**		Unsigned 8 Integer 16	4	4

PNIO Module type	Inputs									
	Length [Bit]	Bit allocation								Note
		2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	
4AI	8	Input date channel 0, HB (LB)								4 words (8 byte) are applied in the input process image of the station proxy (fieldbus coupler) by fitting the slot with this module and are assigned to the input signal channel of the module using 1 word (2 byte) each. The quality rating of the bytes are a result of the selected data format. One byte process data qualifier (IOPS) is managed in the direction of the I/O controller in the cyclic PROFINET IO telegram for this module.
		Input date channel 0, LB (HB)								
		Input date channel 1, HB (LB)								
		Input date channel 1, LB (HB)								
		Input date channel 2, HB (LB)								
		Input date channel 0, HB (LB)								
		Input date channel 3, HB (LB)								
		Input date channel 0, HB (LB)								
		\ - - - - - - - - - - - - - - Input - - - - - - - - - - - - - - /								

PNIO Module type	Inputs									
	Length [Bit]	Bit allocation								Note
		2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	
4AI_RA	12	PD RA	F	Status / Register RES Channel 0 / Table 0						6 words (12 byte) are applied in the output process image of the station proxy (fieldbus coupler) by fitting the slot with this module. This module enables access to the register structure of the I/O module for configuration purposes. Two byte process data qualifiers (IOPS, IOCS) are managed in the direction of the I/O controller in the cyclic PROFINET IO telegram for these modules.
		Input date / Register date RD Channel 0 / Table 0, HB (LB)								
		Input date / Register date RD Channel 0 / Table 0, LB (HB)								
		PD RA	F	Status / Register RES Channel 1 / Table 1						
		Input date / Register date RD Channel 1 / Table 1, HB (LB)								
		Input date / Register date RD Channel 1 / Table 1, LB (HB)								
		PD RA	F	Status / Register RES Channel 2 / Table 2						
		Input date / Register date RD Channel 2 / Table 2, HB (LB)								
		Input date / Register date RD Channel 2 / Table 2, LB (HB)								
		PD RA	F	Status / Register RES Channel 3 / Table 1						
		Input date / Register date RD Channel 3 / Table 3, HB (LB)								
		Input date / Register date RD Channel 3 / Table 3, LB (HB)								
		\ - - - - - - - - - - - - - - Input - - - - - - - - - - - - - - /								
	12	PD RA	RW	Register REQ Table 0						
		Register date WR Table 0, HB (LB)								
		Register date WR Table 0, LB (HB)								
		PD RA	RW	Register REQ Table 1						
		Register date WR Table 1, HB (LB)								
		Register date WR Table 1, LB (HB)								
		PD RA	RW	Register REQ Table 2						
		Register date WR Table 2, HB (LB)								
		Register date WR Table 2, LB (HB)								
		PD RA	RW	Register REQ Table 3						
		Register date WR Table 3, HB (LB)								
		Register date WR Table 3, LB (HB)								
		\ - - - - - - - - - - - - - - Output - - - - - - - - - - - - - - /								

Parameter	Value	Significance
Asynchronous diagnostics message Channel x (x = 0 ... 3)		The following occurs per diagnostics data sets and diagnostics alarm with external faults
	locked*)	• not transferred to the I/O Controller
	released	• transferred to the I/O Controller
Process data format channel x		The process data will be transferred
(x = 0 ... 3)	according to the device settings*)	• using the format settings of the I/O device.
	INTEL (LSB-MSB)	• Little Endian format
	MOTOROLA (MSB-LSB)	• Big Endian format
	*) Default settings	

5.3.4 Analog Output Modules

5.3.4.1 2-Channel Analog Output Modules

PNIO Module type	EA Type	Module type member	PNIO-Data type	Instances	
				Input	Output
2AA	**AO**	75x-550, 75x-552, 75x-554, 75x-556, 75x-560, 75x-585	Integer 16	-	2-
2AA, EM	**AO_EM**		Unsigned 8 Integer 16	2	2

PNIO Module type	Inputs			
	Length [Bit]	Bit allocation 2^7 2^6 2^5 2^4 2^3 2^2 2^1 2^0	Note
2AA	4	Output date channel 0, HB4) (LB5)) Output date channel 0, LB4) (HB5)) Output date channel 1, HB4) (LB5)) Output date channel 1, LB4) (HB5)) \ - - - - - - - - - - - - - - Output - - - - - - - - - - - - - - /	2 words (4 byte) are applied in the output process image of the station proxy (fieldbus coupler) by fitting the slot with this module and are assigned to the two output signal channels of the module using 1 word (2 byte) each. The quality rating of the bytes are a result of the selected data format that can be set channel for channel. One byte process data qualifier (IOCS) is managed in the direction of the I/O controller in the cyclic PROFINET IO telegram for these modules.
2AA_EM	6	PD RA | F | Status / Register RES Channel 0 / Table 0 Register date RD Table 0, HB4) (LB5)) Register date RD Table 0, LB4) (HB5)) PD RA | F | Status / Register RES Channel 1 / Table 1 Register date RD Table 1, HB4) (LB5)) Register date RD Table 1, LB4) (HB5)) \ - - - - - - - - - - - - - - Input - - - - - - - - - - - - - - /	3 words (6 byte) are applied in the output process image of the station proxy (fieldbus coupler) by fitting the slot with this module. This module enables access to the register structure of the I/O module for configuration purposes. Two byte process data qualifiers (IOPS, IOCS) are managed in the direction of the I/O controller in the cyclic PROFINET IO telegram for these modules.
	6	PD RA | RW | Register REQ Table 0 Output date / Register date WR Channel 0 / Table 0, HB4) (LB5)) Output date / Register date WR Channel 0 / Table 0, LB4) (HB5)) PD RA | RW | Register REQ Table 1 Output date / Register date WR Channel 1 / Table 1, HB4) (LB5)) Output date / Register date WR Channel 1 / Table 1, LB4) (HB5)) \ - - - - - - - - - - - - - - Output - - - - - - - - - - - - - - /	

Parameter	Value	Significance
Default value behavior of the outputs		Applies when the I/O controller does not supply valid output data for the module or the group of modules
	according to the device settings*)	• the set strategy on the side of the station distributor applies (I/O device).
	Outputs are set to 0	• so that all outputs are immediately reset
	Outputs maintain the last valid value	• that all outputs maintain the last valid value
	outputs take on their default value	• so that all outputs switch to their configured default value
Asynchronous diagnostics message Channel x (x = 0, 1)2)		The following occurs per diagnostics data sets and diagnostics alarm with external faults
	locked*)	• not transferred to the I/O Controller
	released	• transferred to the I/O Controller
Process data format channel x		The process data will be transferred
(x = 0.1)	according to the device settings*)	• using the format settings of the I/O device.
	INTEL (LSB-MSB)	• Little Endian Format
	MOTOROLA (MSB-LSB)	• Big Endian Format
Substitute output data channel x		If the switching of substitute values has been selected as a fault strategy, the substitute output data of the individual output channels can be determined here.
(x = 0.1)	0x0000*) – 0x7FFF	
	or	
	0x0000*) – 0xFFFF	
	*) Default settings	
	2) Existence module dependant	

5.3.4.2 4-Channel Analog Output Modules

PNIO Module type	EA Type	Module type member	PNIO-Data type	Instances	
				Input	Output
4AA	**AO**	75x-551, 75x-553, 75x-557, 75x-559	Integer 16	-	2-
4AA, EM	**AO_EM**		Unsigned 8 Integer 16	2	2

PNIO Module type	Inputs									
	Length [Bit]	Bit allocation								Note
		2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	
4AA	8	Output date channel 0, HB4) (LB5))								4 words (8 byte) are applied in the output process image of the station proxy (fieldbus coupler) by fitting the slot with this module and are assigned to the four output signal channels of the module using 1 word (2 byte) each. The quality rating of the bytes are a result of the selected data format that can be set channel for channel. One byte process data qualifier (IOCS) is managed in the direction of the I/O controller in the cyclic PROFINET IO telegram for these modules.
		Output date channel 0, LB4 (HB5))								
		Output date channel 1, HB4 (LB5))								
		Output date channel 1, LB4 (HB5))								
		Output date channel 2, HB4 (LB5))								
		Output date channel 2, LB4 (HB5))								
		Output date channel 3, HB4 (LB5))								
		Output date channel 3, LB4 (HB5))								
		\ - - - - - - - - - - - - - - Output - - - - - - - - - - - - - - /								

PNIO Module type	Inputs									
	Length [Bit]	Bit allocation								Note
		2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	
4AA, EM	12	PD RA	F	Status / Register RES Channel 0 / Table 0						6 words (12 byte) are applied in the output process image of the station proxy (fieldbus coupler) by fitting the slot with this module. This module enables access to the register structure of the I/O module for configuration purposes. Two byte process data qualifiers (IOPS, IOCS) are managed in the direction of the I/O controller in the cyclic PROFINET IO telegram for these modules.
		Register date RD Table 0, HB*4 (LB5)								
		Register date RD Table 0, LB*4 (HB5)								
		PD RA	F	Status / Register RES Channel 1 / Table 1						
		Register date RD Table 1, HB*4 (LB5)								
		Register date RD Table 1, LB*4 (HB5)								
		PD RA	F	Status / Register RES Channel 2 / Chart 2						
		Register date RD Table 2, HB4) (LB5))								
		Register date RD Table 2, LB4) (HB5))								
		PD RA	F	Status / Register RES Channel 3 / Chart 3						
		Register date RD Table 3, HB4) (LB5))								
		Register date RD Table 3, LB4) (HB5))								
		\ - - - - - - - - - - - - - - Input - - - - - - - - - - - - - - /								
	12	PD RA	RW	Register REQ Table 0						
		Output date / Register date WR Channel 0 / Table 0, HB4) (LB5))								
		Output date / Register date WR Channel 0 / Table 0, LB4) (HB5))								
		PD RA	RW	Register REQ Table 1						
		Output date / Register date WR Channel 1 / Table 1, HB4) (LB5))								
		Output date / Register date WR Channel 1 / Table 1, LB4) (HB5))								
		PD RA	RW	Register REQ Table 2						
		Output date / Register date WR Channel 2 / Table 2, HB4) (LB5))								
		Output date / Register date WR Channel 2 / Table 2, LB4) (HB5))								
		PD RA	RW	Register REQ Table 3						
		Output date / Register date WR Channel 3 / Table 3, HB4) (LB5))								
		Output date / Register date WR Channel 3 / Table 3, LB4) (HB5))								
		\ - - - - - - - - - - - - - - Output - - - - - - - - - - - - - - /								

Parameter	Value	Significance
Default value behavior of the outputs		Applies when the I/O controller does not supply valid output data for the module or the group of modules
	according to the device settings*)	• the set strategy on the side of the station distributor applies (I/O device).
	Outputs are set to 0	• so that all outputs are immediately reset
	Outputs maintain the last valid value	• that all outputs maintain the last valid value
	outputs take on their default value	• so that all outputs switch to their configured default value
Asynchronous diagnostics message Channel x (x = 0 ... 3)		The following occurs per diagnostics data sets and diagnostics alarm with external faults
	locked*)	• not transferred to the I/O Controller
	released	• transferred to the I/O Controller
Process data format channel x		The process data will be transferred
(x = 0 ... 3)	according to the device settings*)	• using the format settings of the I/O device.
	INTEL (LSB-MSB)	• Little Endian Format
	MOTOROLA (MSB-LSB)	• Big Endian Format
Substitute output data channel x		If the switching of substitute values has been selected as a fault strategy, the substitute output data of the individual output channels can be determined here.
(x = 0 ... 3)	0x0000*) – 0x7FFF	
	or	
	0x0000*) – 0xFFFF	
	*) Default settings	

5.3.5 Specialty Modules

5.3.5.1 Counter Modules

PNIO Module type	Module type member	PNIO-Data type	Instances	
			Input	Output
1CNT	75x-404	Unsigned 8 [2] Integer 32	1	1
2CNT	75x-638	Unsigned 8 Integer 16	2	2

PNIO Module type	Inputs									
	Length [Bit]	Bit allocation								Note
		2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	
1CNT	6	PD RA	-	Status / Register RES Channel 0 / Table 0						3 words (6 byte) are applied in the output process image of the station proxy (fieldbus coupler) and 2 byte and 1 double word (4 byte) are assigned to the signal channel of the module by fitting the slot with this module. The quality rating of the bytes within the double word are a result of the selected data format that can be set channel for channel. Two byte process data qualifiers (IOPS, IOCS) are managed in the direction of the I/O controller in the cyclic PROFINET IO telegram for these modules.
		Counter reading K. 0 Byte 34) (Byte 05))					Register date RD Table 0, LB5)			
		Counter reading K. 0 Byte 24) (Byte 15))					Register date RD Table 0, HB5)			
		Counter reading K. 0 Byte 14) (Byte 25))					Register date RD Table 0, HB4)			
		Counter reading K. 0 Byte 04) (Byte 35))					Register date RD Table 0, LB4)			
		\ - - - - - - - - - - - - - - Input - - - - - - - - - - - - - - /								
	6	PD RA	RW	Control / Register REQ Channel 0 / Table 0						
		Set counter reading. K. 0 Byte 34) (Byte 05))					Register date RD Table 0, LB5)			
		Set counter reading K. 0 Byte 24) (Byte 15))					Register date RD Table 0, HB5)			
		Set counter reading K. 0 Byte 14) (Byte 25))					Register date RD Table 0, HB4)			
		Set counter reading K. 0 Byte 04) (Byte 35))					Register date RD Table 0, LB4)			
		\ - - - - - - - - - - - - - - Output - - - - - - - - - - - - - - /								

PNIO Module type	Inputs									
	Length [Bit]	Bit allocation								Note
		2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	
2CNT	6	PD RA	-	Status / Register RES Channel 0 / Table 0						3 words (6 byte) are applied in the output process image of the station proxy (fieldbus coupler) and 1 byte and 1 word (2 byte) are assigned to both signal channels of the module by fitting the slot with this module. The quality rating of the bytes within the word are a result of the selected data format that can be set channel for channel. Two byte process data qualifiers (IOPS, IOCS) are managed in the direction of the I/O controller in the cyclic PROFINET IO telegram for these modules.
		Counter reading K. 0 HB4) (LB5))				Register date RD Tab. 0, HB4) (LB5))				
		Counter reading K. 0 LB4) (HB5))				Register date RD Tab. 0, LB4) (HB5))				
		PD RA	-	Status / Register RES Channel 1 / Table 1						
		Counter reading K. 1 HB4) (LB5))				Register date RD Tab. 1, HB4) (LB5))				
		Counter reading K. 1 HB4) (LB5))				Register date RD Tab. 1, LB4) (HB5))				
		\ - - - - - - - - - - - - - - Input - - - - - - - - - - - - - - /								
	6	PD RA	RW	Control / Register REQ Channel 0 / Table 0						
		Set counter reading K. 0 HB4) (LB5))				Register date WR Tab. 0, HB4) (LB5))				
		Set counter reading K. 0 LB4) (HB5))				Register date WR Tab. 0, LB4) (HB5))				
		PD RA	RW	Control / Register REQ Channel 1 / Table 1						
		Set counter reading K. 1 HB4) (LB5))				Register date WR Tab. 1, HB4) (LB5))				
		Set counter reading K. 1 LB4) (HB5))				Register date WR Tab. 1, LB4) (HB5))				
		\ - - - - - - - - - - - - - - Output - - - - - - - - - - - - - - /								

Parameter	Value	Significance
Process data format channel x		The process data will be transferred
(x = 0.1)	according to the device settings*)	• using the format settings of the I/O device.
	INTEL (LSB-MSB)	• Little Endian Format
	MOTOROLA (MSB-LSB)	• Big Endian Format
	*) Default settings	

5.3.5.2 PWM Module

PNIO Module type	EA Type	Module type member	PNIO-Data type	Instances	
				Input	Output
2PWM	**PWM**	75x-511	Integer 16	-	2
2PWM, EM	**PWM_EM**		Unsigned 8 Integer 16	2	2

PNIO Module type	Inputs			
	Length [Bit]	Bit allocation		Note
		2^7 2^6 2^5 2^4 2^3 2^2 2^1 2^0		
PWM	4	Output data channel 0 HB4) (LB5))		2 words (4 byte) are applied in the output process image of the station proxy (fieldbus coupler) by fitting the slot with this module and are assigned to the two output signal channels of the module using 1 word (2 byte) each. The quality rating of the bytes are a result of the selected data format that can be set channel for channel. This module should only be used in standard operation (without article number extension) as no input information can be provided. Two byte process data qualifiers (IOPS, IOCS) are managed in the direction of the I/O controller in the cyclic PROFINET IO telegram for these modules.
		Output data channel 0 LB4) (HB5))		
		Output data channel 1 HB4) (LB5))		
		Output data channel 1 LB4) (HB5))		
		\ - - - - - - - - - - - - - - Output - - - - - - - - - - - - - - /		
PWM_RA	6	PD RA	- Status / Register RES Channel 0 / Table 0	3 words (6 byte) are applied in the output process image of the station proxy (fieldbus coupler) and 1 byte and 1 word (2 byte) are assigned to both signal channels of the module by fitting the slot with this module. The quality rating of the bytes within the word are a result of the selected data format that can be set channel for channel. Two byte process data qualifiers (IOPS, IOCS) are managed in the direction of the I/O controller in the cyclic PROFINET IO telegram for these modules.
		Input date. K. 0 HB4) (LB5))	Register date RD Tab. 0, HB4) (LB5))	
		Input date K. 0 LB4) (HB5))	Register date RD Tab. 0, LB4) (HB5))	
		PD RA	- Status / Register RES Channel 1 / Table 1	
		Input date K. 1 HB4) (LB5))	Register date RD Tab. 1, HB4) (LB5))	
		Input date K. 1 LB4) (HB5))	Register date RD Tab. 1, LB4) (HB5))	
		\ - - - - - - - - - - - - - - Input - - - - - - - - - - - - - - /		
	6	PD RA	RW Control / Register REQ Channel 0 / Table 0	
		Output date K. 0 HB4) (LB5))	Register date WR Tab. 0, HB4) (LB5))	
		Output date K. 0 LB4) (HB5))	Register date WR Tab. 0, LB4) (HB5))	
		PD RA	RW Control / Register REQ Channel 1 / Table 1	
		Set counter reading K. 1 HB4) (LB5))	Register date WR Tab. 1, HB4) (LB5))	
		Set counter reading K. 1 LB4) (HB5))	Register date WR Tab. 1, LB4) (HB5))	
		\ - - - - - - - - - - - - - - Output - - - - - - - - - - - - - - /		

Parameter	Value	Significance
Default value behavior of the outputs		In case the I/O controller does not supply valid output data for the module or the group of modules then
	according to the device settings*)	• the set strategy on the side of the station distributor applies (I/O device).
	Outputs are set to 0	• all outputs are immediately reset
	Outputs maintain the last valid value	• all outputs maintain the last valid value
	Outputs take on their default value	• all outputs switch to their configured substitute value
Process data format channel x		The process data will be transferred
(x = 0.1)	according to the device settings*)	• transfer the settings of the I/O device.
	INTEL (LSB-MSB)	• Little Endian Format
	MOTOROLA (MSB-LSB)	• Big Endian Format
Substitute output data channel x		If the switching of substitute values has been selected as a fault strategy, the substitute output data of the individual output channels can be determined here.
(x = 0.1)	0x0000*) – 0x7FFF	
	or	
	0x0000*) – 0xFFFF	
	*) Default settings	

5.3.5.3 SSI Transmitter Interface

PNIO Module type	EA Type	Module type member	PNIO-Data type	Instances	
				Input	Output
1SSI	SSI	75x-630	Unsigned 32	1	-
1SSI, EM	SSI_EM		Unsigned 8 [2] Unsigned 32	1	1

PNIO Module type	Inputs			
	Length [Bit]	Bit allocation		Note
		2^7 2^6 2^5 2^4 2^3 2^2 2^1 2^0		
1SSI	4	Input data channel 0 Byte 34) (Byte 05))		1 double word (4 byte) is applied in the input process image of the station proxy (fieldbus coupler) by fitting the slot with this module and is assigned to this module. The quality rating of the bytes are a result of the selected data format. Two byte process data qualifiers (IOPS, IOCS) are managed in the direction of the I/O controller in the cyclic PROFINET IO telegram for these modules.
		Input data channel 0 Byte 24) (Byte 15))		
		Input data channel 0 Byte 14) (Byte 25))		
		Input data channel 0 Byte 04) (Byte 35))		
		\ - - - - - - - - - - - - - - Input - - - - - - - - - - - - - - /		
1SSI, EM	6	PD RA	F	Status / Register RES Channel 0 / Table 0
		Input data K. 0 Byte 34) (Byte 05))		Register date RD Table 0, LB5)
		Input data K. 0 Byte 24) (Byte 15))		Register date RD Table 0, HB5)
		Input data K. 0 Byte 14) (Byte 25))		Register date RD Table 0, HB4)
		Input data K. 0 Byte 04) (Byte 35))		Register date RD Table 0, LB4)
		\ - - - - - - - - - - - - - - Input - - - - - - - - - - - - - - /		
	6	PD RA	RW	Control / Register REQ Channel 0 / Table 0
		Output data K. 0 Byte 34) (Byte 05))		Register date RD Table 0, LB5)
		Output data K. 0 Byte 24) (Byte 15))		Register date RD Table 0, HB5)
		Output data K. 0 Byte 14) (Byte 25))		Register date RD Table 0, HB4)
		Output data K. 0 Byte 04) (Byte 35))		Register date RD Table 0, LB4)
		\ - - - - - - - - - - - - - - Output - - - - - - - - - - - - - - /		

Parameter	Value	Significance
Asynchronous diagnostic message channel x		The following occurs per diagnostics data sets and diagnostics alarm with external faults
	locked*)	• not transferred to the I/O Controller
	released	• transferred to the I/O Controller
Process data format channel 0		The process data will be transferred
	according to the device settings*)	• using the format settings of the I/O device.
	INTEL (LSB-MSB)	• Little Endian Format
	MOTOROLA (MSB-LSB)	• Big Endian Format
	*) Default settings	

5.3.5.4 Incremental Encoder Interface

PNIO Module type	Module type member	PNIO-Data type	Instances	
			Input	Output
1ENC	75x-631, 75x-634, 75x-637	Unsigned 8 Unsigned 16	2	2

PNIO Module type	Inputs									
	Length [Bit]	Bit allocation								Note
		2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	
1INC	6	PD RA	-	Status 0 / Register RES Channel 0 / Table 0						3 words (6 byte) are applied in the output process image of the station proxy (field bus coupler) by fitting the slot with this module and are allocated to the physical module. The quality rating of the bytes within the word is a result of the selected data format. This module enables access to the register structure of the I/O module for configuration purposes. Two byte process data qualifiers (IOPS, IOCS) are managed in the direction of the I/O controller in the cyclic PROFINET IO telegram for these modules.
		Input data K. 0 Byte 14) (Byte 05))				Register date RD Tab. 0, HB4) (LB5))				
		Input data K. 0 Byte 04) (Byte 15))				Register date RD Tab. 0, LB4) (HB5))				
		Status 1								
		Input data channel 0 Byte 34) (Byte 25))								
		Input data Byte 24) (Byte 35))								
		\ - - - - - - - - - - - - - - Input - - - - - - - - - - - - - - /								
	6	PD RA	RW	Control 0 / Register REQ Channel 0 / Table 0						
		Output data K. 0 Byte 14) (Byte 05))				Register date WR Tab. 0, HB4) (LB5))				
		Output data K. 0 Byte 04) (Byte 15))				Register date WR Tab. 0, LB4) (HB5))				
		Control 1								
		Output data channel 0 Byte 34) (Byte 25))								
		Output data channel 0 Byte 24) (Byte 35))								
		\ - - - - - - - - - - - - - - Output - - - - - - - - - - - - - - /								

Parameter	Value	Significance
Asynchronous diagnostic message channel 0[2)]		The following occurs per diagnostics data sets and diagnostics alarm with external faults
	locked*)	• not transferred to the I/O Controller
	released	• transferred to the I/O Controller
Process data format channel 0		The process data will be transferred
	according to the device settings	• transfer the settings of the I/O device.
	INTEL (LSB-MSB)	• Little Endian Format
	MOTOROLA (MSB-LSB)	• Big Endian Format
	*) Default settings	
	[2)] only with 75x-637	

5.3.5.5 Digital Impulse Interface

PNIO Module type	Module type member	PNIO-Data type	Instances	
			Input	Output
1DII	75x-635	Unsigned 8 Unsigned 8[3]	1	1

PNIO Module type	Inputs									
	Length [Bit]	Bit allocation								Note
		2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	
1DII	4	PD RA	F	Status 0 / Register RES Channel 0 / Table 0						2 byte and 1 word (4 byte) are applied in the output process image of the station proxy (fieldbus coupler) are assigned to the physical module by fitting the slot with this module. The quality rating of the bytes within the word is a result of the selected data format. This module enables access to the register structure of the I/O module for configuration purposes. Two byte process data qualifiers (IOPS, IOCS) are managed in the direction of the I/O controller in the cyclic PROFINET IO telegram for this module.
		Input data channel 0 Byte 0				Register date RD Table 0, LB				
		Input data channel 0 Byte 1				Register date RD Table 0, HB				
		Input data channel 0 Byte 2								
		\ - - - - - - - - - - - - - - Input - - - - - - - - - - - - - - /								
	4	PD RA	RW	Control 0 / Register REQ Channel 0 / Table 0						
		Output data channel 0 Byte 0				Register date WR Table 0, LB				
		Output data channel 0 Byte 1				Register date WR Table 0, HB				
		Output data channel 0 Byte 2								
		\ - - - - - - - - - - - - - - Output - - - - - - - - - - - - - - /								

Parameter	Value	Significance
Asynchronous diagnostic message channel x		The following occurs per diagnostics data sets and diagnostics alarm with external faults
	locked*)	• not transferred to the I/O Controller
	released	• transferred to the I/O Controller
	*) Default settings	

5.3.5.6 Serial Interfaces and Data Exchange Module

PNIO Module type	Module type member	PNIO-Data type	Instances	
			Input	Output
1SER	75x-650, 75x-651, 75x-653, 75x-654	Unsigned 8 OctetString [5]	1	1

PNIO Module type	Inputs									
	Length [Bit]	Bit allocation								Note
		2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	
1SER	6	PD RA	-	Status 0 / Register RES Channel 0 / Table 0						6 byte are applied in the input and output process image of the station proxy (field bus coupler) by fitting the slot with this module and are allocated to the physical module. Data bytes 3 and / or 4 can be reserved independent of the set type of operation. The possible access to the register structure for configurating purposes also depends on the set type of operation. Two byte process data qualifiers (IOPS, IOCS) are managed in the direction of the I/O controller in the cyclic PROFINET IO telegram for this module.
		Input data channel 0 Byte 0					Register data RD Table 0, LB			
		Input data channel 0 Byte 1					Register data RD Table 1, HB			
		Input data channel 0 Byte 2								
		Input data channel 0 Byte 32)								
		Input data channel 0 Byte 42)								
		\ - - - - - - - - - - - - - - Input - - - - - - - - - - - - - - /								
	6	PD RA	RW	Control 0 / Register REQ Channel 0 / Table 0						
		Output data channel 0 Byte 0					Register data WR Tab. 0, HB4) (LB5))			
		Output data channel 0 Byte 1					Register data WR Tab. 0, LB4) (HB5))			
		Output data channel 0 Byte 26)								
		Output data channel 0 Byte 32)								
		Output data channel 0 Byte 42)								
		\ - - - - - - - - - - - - - - Output - - - - - - - - - - - - - - /								
	[2] only available in 5-Byte-Mode, reserved in 3-Byte Mode									

Parameter	Value	Significance
Asynchronous diagnostic message channel x		The following occurs per diagnostics data sets and diagnostics alarm when the receiver buffer overfills
	locked*)	• not transferred to the I/O Controller
	released	• transferred to the I/O Controller
	*) Default settings	

5.3.5.7 ENOCEAN Receiver Module

PNIO Module type	Module type member	PNIO-Data type	Instances	
			Input	Output
EnOcean	75x-642	Unsigned 8 (Bit field) OctetString [3]	1	1

PNIO Module type	Inputs									
	Length [Bit]	Bit allocation								Note
		2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	
EnOcean	4	PD RA	F	Status 0 / Register RES Channel 0 / Table 0						4 byte are applied in the input and output process image of the station proxy (fieldbus coupler) by fitting the slot with this module and are allocated to the physical module. This module enables access to the register structure of the I/O module for configuration purposes. Two byte process data qualifiers (IOPS, IOCS) are managed in the direction of the I/O controller in the cyclic PROFINET IO telegram for this module.
		Input data channel 0 Byte 0				Register date RD Table 0, LB				
		Input data channel 0 Byte 1				Register date RD Table 1, HB				
		Input data channel 0 Byte 2								
		\ - - - - - - - - - - - - - - - Input - - - - - - - - - - - - - - - /								
	4	PD RA	RW	Control 0 / Register REQ Channel 0 / Table 0						
		Output data channel 0 Byte 0				Register date WR Table 0, LB				
		Output data channel 0 Byte 1				Register date WR Table 1, HB				
		Output data channel 0 Byte 2								
		\ - - - - - - - - - - - - - - - Output - - - - - - - - - - - - - - - /								

Parameter	Value	Significance
Asynchronous diagnostic message channel x		The following occurs per diagnostics data sets and diagnostics alarm when the receiver buffer overfills
	locked*)	• not transferred to the I/O Controller
	released	• transferred to the I/O Controller
	*) Default settings	

5.3.5.8 DALI/DSI Master

PNIO Module type	Module type member	PNIO-Data type	Instances	
			Input	Output
DALI/DSI	75x-641	Unsigned 8 OctetString [5]	1	1

PNIO Module type	Inputs									
	Length [Bit]	Bit allocation								Note
		2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	
DALI/DSI	6	PD RA	-	Status 0 / Register RES Channel 0 / Table 0						6 bytes are applied in the input and output process image of the station proxy (fieldbus coupler) by fitting the slot with this module and are allocated to the physical module. This module enables access to the register structure of the I/O module for configuration purposes. Two byte process data qualifiers (IOPS, IOCS) are managed in the direction of the I/O controller in the cyclic PROFINET IO telegram for this module.
		Input data channel 0 Byte 0								Register date RD Table 0, LB
		Input data channel 0 Byte 1								Register date RD Table 1, HB
		Input data channel 0 Byte 2								
		Input data channel 0 Byte 3								
		Input data channel 0 Byte 4								
		\ - - - - - - - - - - - - - - Input - - - - - - - - - - - - - - /								
	6	PD RA	RW	Control 0 / Register REQ Channel 0 / Table 0						
		Output data channel 0 Byte 0								Register date WR Table 0, LB
		Output data channel 0 Byte 1								Register date WR Table 1, HB
		Output data channel 0 Byte 2								
		Output data channel 0 Byte 3								
		Output data channel 0 Byte 4								
		\ - - - - - - - - - - - - - - Output - - - - - - - - - - - - - - /								

Parameter	Value	Significance
Asynchronous diagnostic message channel x		The following occurs per diagnostics data sets and diagnostics alarm when the receiver buffer overfills
	locked*)	• not transferred to the I/O Controller
	released	• transferred to the I/O Controller
	*) Default settings	

5.3.6 PROFIsafe Safety Modules

PNIO Module type	Module type member	PNIO-Data type	Instances	
			Input	Output
PROFISAFE	753-661, 753-662, 753-667	OctetString [5]	1	1

PNIO Module type	Inputs								
	Length [Bit]	Bit allocation								Note
		2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	
PROFISAFE	5	E7[2)]	E6[2)]	E5[2)]	E4[2)]	E3	E2E 2	E1	E0	5 bytes are applied in the output process image of the station proxy (fieldbus coupler) and are assigned to the physical module by fitting the slot with this module. Two byte process data qualifiers (IOPS, IOCS) are managed in the direction of the I/O controller in the cyclic PROFINET IO telegram for this module..
		F-Status								
		F-Device-CRC Byte 0								
		F- Device -CRC Byte 1								
		F- Device -CRC Byte 2								
		\ - - - - - - - - - - - - - - Input - - - - - - - - - - - - - - /								
	5	-	-	-	-	A3	A2	A1	A0	
		F-Control								
		F-Host-CRC Byte 0								
		F-Host-CRC Byte 1								
		F-Host-CRC Byte 2								
		\ - - - - - - - - - - - - - - Output - - - - - - - - - - - - - - /								
	[2)] only available with 8-Channel F-Input modules									

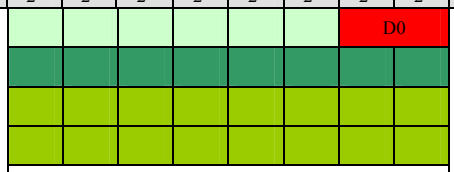
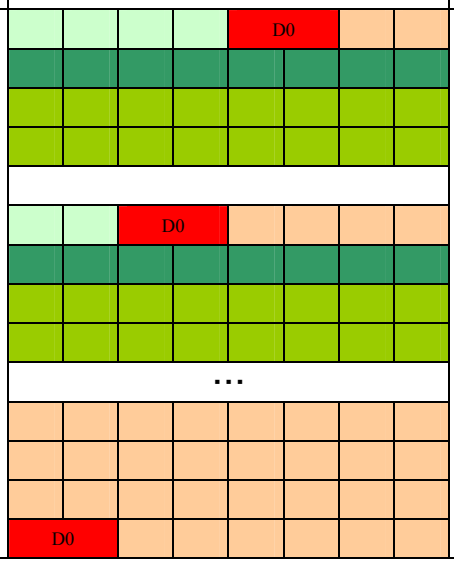
Standard Parameter	Value	Significance
Asynchronous diagnostic message channel x		The following occurs per diagnostics data sets and diagnostics alarm when the receiver buffer overfills
	locked*)	• not transferred to the I/O Controller
	released	• transferred to the I/O Controller
	*) Default settings	

F-Parameter	Value	Significance
F_Check_iPar		Manufacturer specific i-parameters can be found within the F-parameters that
	NoCheck[1)]	• not requested for inspection
	Check	• requested for inspection
F_SIL		The safety catagory reached is
	SIL3[1)]	SIL 3
F_CRC_Length		The length of the CRC for backing up the process data is
	3-Byte-CRC[1)]	3 Byte
F_Par_Version		The version of the F Parameter set is
	1[1)]	1 = V2-Mode
F_Source_Add		PROFIsafe address of the F-Host
	1 …65534	
F_Dest_Add		PROFIsafe address of the I/O module (F-Slave)
	1 …1022	
F_WD_Time		Monitoring time of the F Data set in ms
	50 ... 100[*)] ... 10000	
	*) Default settings	
	[1)] settings that cannot be modified	

5.3.7 Sytem Modules

5.3.7.1 Supply Modules with 2 Bit Diagnostics Status

PNIO Module type		Module type member	PNIO-Data type	Instances	
				Input	Output
2DIA	**DIA_0**	75x-610, 75x-611	-	-	-
2 DIA(+6 BIT I), DIA in E-PA	**PE_DIA_8**		Unsigned 8-bit field	1	-
2DIA(+14 BIT I), DIA in E-PA	**PE_DIA_16**		Unsigned 16-bit field	1	-
2DIA(+30 BIT I), DIA in E-PA	**PE_DIA_32**		Unsigned 32-bit field	1	-
*** 2DIA(-2 BIT I), DIA in E-PA**	**PE_DIA_0**	75x-610*, 75x-611*	-	-	-

PNIO Module type	Inputs		
	Length [Bit]	Bit allocation	Note
		2^7 2^6 2^5 2^4 2^3 2^2 2^1 2^0	
2DIA(+6 BIT I), DIA im E-PA **2DIA(+14 BIT I), DIA im E-PA** **2DIA(+30 BIT I), DIA im E-PA**	2		8, 16 or 32 bits are applied in the input process image of the station proxy (fieldbus coupler) by fitting a slot with these modules. The bits 2^0 and 2^1 in the input area are assigned with the diagnostics condition of the physically connected supply module. The bits 2^2 to 2^7, 2^{15} or 2^{31} marked green are made available for the input and / or diagnostics information of the following modules. One byte process data qualifier (IOPS) is managed in the direction of the I/O control in the cyclic POFINET IO telegram for these modules.
*** 2DIA(-2 BIT I), DIA in E-PA**	2		The fitting of slots with this module enables the remaining bit locations to be previously filled with input modules without bytes opened with star (bit fields) in the input process image of the station proxy(fieldbus coupler). One byte process data qualifier (IOPS) is managed in the direction of the I/O controller in the cyclic PROFINET IO telegram for these modules.

Parameter	Value	Significance
Asynchronous diagnostic message channel x		The following occurs per diagnostics data sets and diagnostics alarm with external faults
	locked*)	• not transferred to the I/O Controller
	released	• transferred to the I/O Controller
	*) Default settings	

6 Use in Hazardous Environments

6.1 Foreword

Today's development shows that many chemical and petrochemical companies have production plants, production, and process automation machines in operation which use gas-air, vapor-air and dust-air mixtures which can be explosive. For this reason, the electrical components used in such plants and systems must not pose a risk of explosion resulting in injury to persons or damage to property. This is backed by law, directives or regulations on a national and international scale. WAGO-I/O-SYSTEM 750 (electrical components) is designed for use in zone 2 explosive environments. The following basic explosion protection related terms have been defined.

6.2 Protective measures

Primarily, explosion protection describes how to prevent the formation of an explosive atmosphere. For instance by avoiding the use of combustible liquids, reducing the concentration levels, ventilation measures, to name but a few. But there are a large number of applications, which do not allow the implementation of primary protection measures. In such cases, the secondary explosion protection comes into play. Following is a detailed description of such secondary measures.

6.3 Classification meeting CENELEC and IEC

The specifications outlined here are valid for use in Europe and are based on the following standards: EN50... of CENELEC (European Committee for Electrotechnical Standardization). On an international scale, these are reflected by the IEC 60079-... standards of the IEC (International Electrotechnical Commission).

6.3.1 Divisions

Explosive environments are areas in which the atmosphere can potentially become explosive. The term explosive means a special mixture of ignitable substances existing in the form of air-borne gases, fumes, mist or dust under atmospheric conditions which, when heated beyond a tolerable temperature or subjected to an electric arc or sparks, can produce explosions. Explosive zones have been created to describe the concentrations level of an explosive atmosphere. This division, based on the probability of an explosion occurring, is of great importance both for technical safety and feasibility reasons. Knowing that the demands placed on electrical components permanently employed in an explosive environment have to be much more stringent than those placed on electrical components that are only rarely and, if at all, for short periods, subject to a dangerous explosive environment.

Explosive areas resulting from gases, fumes or mist:

Zone 0 areas are subject to an explosive atmosphere (> 1000 h /year) continuously or for extended periods.

Zone 1 areas can expect the occasional occurrence of an explosive atmosphere (> 10 h ≤ 1000 h /year).

Zone 2 areas can expect the rare or short-term occurrence of an explosive atmosphere (> 0 h ≤ 10 h /year).

Explosive areas subject to air-borne dust:

Zone 20 areas are subject to an explosive atmosphere (> 1000 h /year) continuously or for extended periods.

Zone 21 areas can expect the occasional occurrence of an explosive atmosphere (> 10 h ≤ 1000 h /year).

Zone 22 areas can expect the rare or short-term occurrence of an explosive atmosphere (> 0 h ≤ 10 h /year).

6.3.2 Explosion protection group

In addition, the electrical components for explosive areas are subdivided into two groups:

Group I: Group I includes electrical components for use in fire-damp endangered mine structures.

Group II: Group II includes electrical components for use in all other explosive environments. This group is further subdivided by pertinent combustible gases in the environment. Subdivision IIA, IIB and IIC takes into account that different materials/substances/gases have various ignition energy characteristic values. For this reason the three sub-groups are assigned representative types of gases:

IIA – Propane
IIB – Ethylene
IIC – Hydrogen

Minimal ignition energy of representative types of gases				
Explosion group	I	IIA	IIB	IIC
Gases	Methane	Propane	Ethylene	Hydrogen
Ignition energy (µJ)	280	250	82	16

Hydrogen being commonly encountered in chemical plants, frequently the explosion group IIC is requested for maximum safety.

6.3.3 Unit categories

Moreover, the areas of use (zones) and the conditions of use (explosion groups) are subdivided into categories for the electrical operating means:

Unit categories	Explosion group	Area of use
M1	I	Fire-damp protection
M2	I	Fire-damp protection
1G	II	Zone 0 Explosive environment by gas, fumes or mist
2G	II	Zone 1 Explosive environment by gas, fumes or mist
3G	II	Zone 2 Explosive environment by gas, fumes or mist
1D	II	Zone 20 Explosive environment by dust
2D	II	Zone 21 Explosive environment by dust
3D	II	Zone 22 Explosive environment by dust

6.3.4 Temperature classes

The maximum surface temperature for electrical components of explosion protection group I is 150 °C (danger due to coal dust deposits) or 450 °C (if there is no danger of coal dust deposit).

In line with the maximum surface temperature for all ignition protection types, the electrical components are subdivided into temperature classes, as far as electrical components of explosion protection group II are concerned. Here the temperatures refer to a surrounding temperature of 40 °C for operation and testing of the electrical components. The lowest ignition temperature of the existing explosive atmosphere must be higher than the maximum surface temperature.

Temperature classes	Maximum surface temperature	Ignition temperature of the combustible materials
T1	450 °C	> 450 °C
T2	300 °C	> 300 °C to 450 °C
T3	200 °C	> 200 °C to 300 °C
T4	135 °C	> 135 °C to 200 °C
T5	100 °C	>100 °C to 135 °C
T6	85°C	> 85 °C to 100 °C

The following table represents the division and attributes of the materials to the temperature classes and material groups in percent:

Temperature classes						
T1	T2	T3	T4	T5	T6	Total*
26.6 %	42.8 %	25.5 %				
94.9 %			4.9 %	0 %	0.2 %	432
Explosion group						
IIA	IIB	IIC				Total*
85.2 %	13.8 %	1.0 %				501

* Number of classified materials

6.3.5 Types of ignition protection

Ignition protection defines the special measures to be taken for electrical components in order to prevent the ignition of surrounding explosive atmospheres. For this reason a differentiation is made between the following types of ignition protection:

Identifi-cation	**CENELEC standard**	**IEC standard**	**Explanation**	**Application**
EEx o	EN 50 015	IEC 79-6	Oil encapsulation	Zone 1 + 2
EEx p	EN 50 016	IEC 79-2	Overpressure encapsulation	Zone 1 + 2
EEx q	EN 50 017	IEC 79-5	Sand encapsulation	Zone 1 + 2
EEx d	EN 50 018	IEC 79-1	Pressure resistant encapsulation	Zone 1 + 2
EEx e	EN 50 019	IEC 79-7	Increased safety	Zone 1 + 2
EEx m	EN 50 028	IEC 79-18	Cast encapsulation	Zone 1 + 2
EEx i	EN 50 020 (unit) EN 50 039 (system)	IEC 79-11	Intrinsic safety	Zone 0 + 1 + 2
EEx n	EN 50 021	IEC 79-15	Electrical components for zone 2 (see below)	Zone 2

Ignition protection “n" describes exclusively the use of explosion protected electrical components in zone 2. This zone encompasses areas where explosive atmospheres can only be expected to occur rarely or short-term. It represents the transition between the area of zone 1, which requires an explosion protection and safe area in which for instance welding is allowed at any time.

Regulations covering these electrical components are being prepared on a world-wide scale. The standard EN 50 021 allows electrical component manufacturers to obtain certificates from the corresponding authorities for instance KEMA in the Netherlands or the PTB in Germany, certifying that the tested components meet the above mentioned standards draft.

Type “n” ignition protection additionally requires electrical components to be marked with the following extended identification:

A – non spark generating (function modules without relay /without switches)

AC – spark generating, contacts protected by seals (function modules with relays / without switches)

L – limited energy (function modules with switch)

Further information
For more detailed information please refer to the national and/or international standards, directives and regulations!

6.4 Classifications meeting the NEC 500

The following classifications according to NEC 500 (National Electric Code) are valid for North America.

6.4.1 Divisions

The "Divisions" describe the degree of probability of whatever type of dangerous situation occurring. Here the following assignments apply:

Explosion endangered areas due to combustible gases, fumes, mist and dust:	
Division 1	Encompasses areas in which explosive atmospheres are to be expected occasionally (> 10 h ≤ 1000 h /year) as well as continuously and long-term (> 1000 h /year).
Division 2	Encompasses areas in which explosive atmospheres can be expected rarely and short-term (>0 h ≤ 10 h /year).

6.4.2 Explosion protection groups

Electrical components for explosion endangered areas are subdivided in three danger categories:

Class I (gases and fumes):	Group A (Acetylene) Group B (Hydrogen) Group C (Ethylene) Group D (Methane)
Class II (dust):	Group E (Metal dust) Group F (Coal dust) Group G (Flour, starch and cereal dust)
Class III (fibers):	No sub-groups

6.4.3 Temperature classes

Electrical components for explosive areas are differentiated by temperature classes:

Temperature classes	Maximum surface temperature	Ignition temperature of the combustible materials
T1	450 °C	> 450 °C
T2	300 °C	> 300 °C to 450 °C
T2A	280 °C	> 280 °C to 300 °C
T2B	260 °C	> 260 °C to 280 °C
T2C	230 °C	>230 °C to 260 °C
T2D	215 °C	>215 °C to 230 °C
T3	200 °C	>200 °C to 215 °C
T3A	180 °C	>180 °C to 200 °C
T3B	165 °C	>165 °C to 180 °C
T3C	160 °C	>160 °C to 165 °C
T4	135 °C	>135 °C to 160 °C
T4A	120 °C	>120 °C to 135 °C
T5	100 °C	>100 °C to 120 °C
T6	85 °C	> 85 °C to 100 °C

6.5 Identification

6.5.1 For Europe

According to CENELEC and IEC

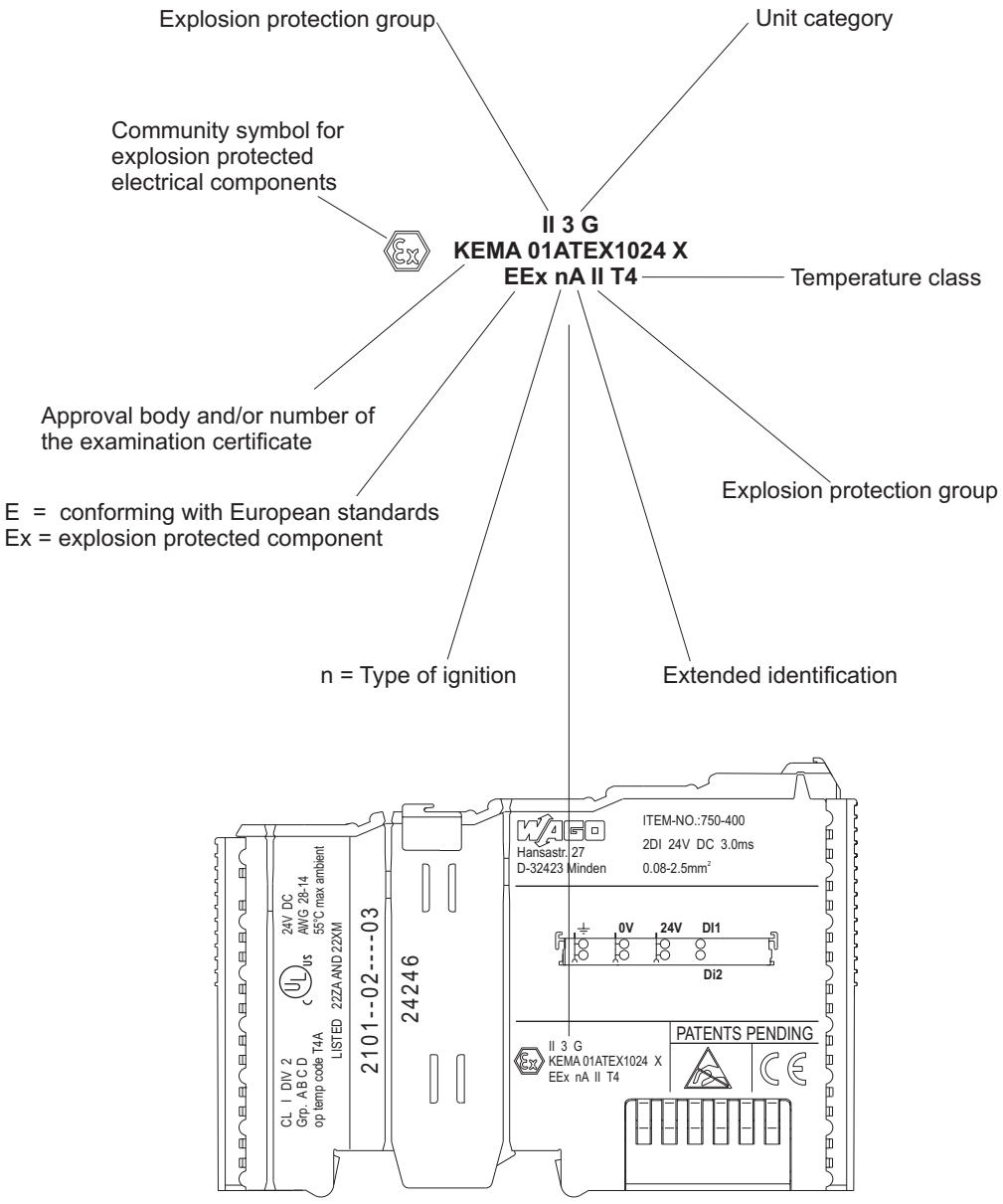


Fig. 6.5.1-1: Example for lateral labeling of bus modules (750-400, 2 channel digital input module 24 V DC) g01xx03e

6.5.2 For America

According to NEC 500

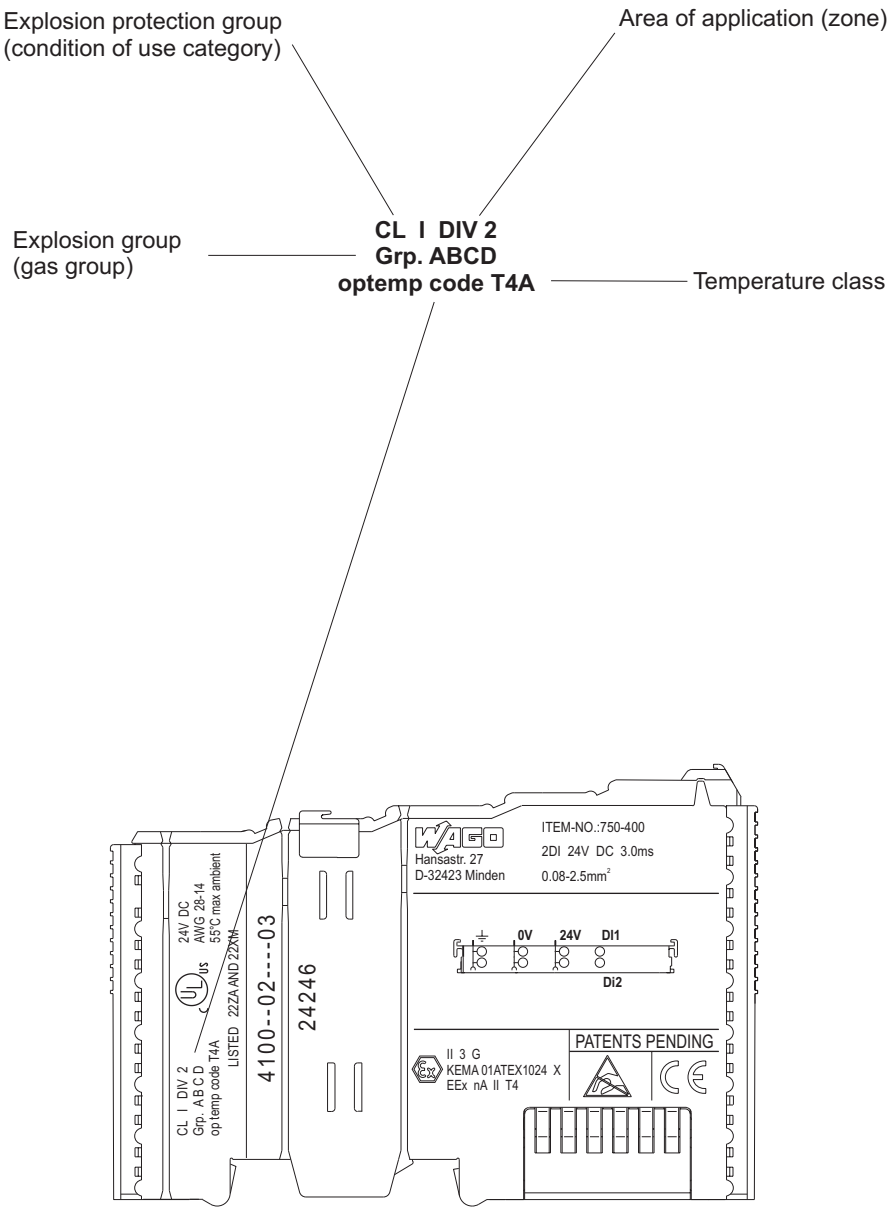


Fig. 6.5.2-1: Example for lateral labeling of bus modules
(750-400, 2 channel digital input module 24 V DC)

g01xx04e

6.6 Installation regulations

In the **Federal Republic of Germany,** various national regulations for the installation in explosive areas must be taken into consideration. The basis being the ElexV complemented by the installation regulation DIN VDE 0165/2.91. The following are excerpts from additional VDE regulations:

DIN VDE 0100	Installation in power plants with rated voltages up to 1000 V
DIN VDE 0101	Installation in power plants with rated voltages above 1 kV
DIN VDE 0800	Installation and operation in telecommunication plants including information processing equipment
DIN VDE 0185	lightning protection systems

The **USA** and **Canada** have their own regulations. The following are excerpts from these regulations:

NFPA 70	National Electrical Code Art. 500 Hazardous Locations
ANSI/ISA-RP 12.6-1987	Recommended Practice
C22.1	Canadian Electrical Code

Danger
When using the WAGO-I/O SYSTEM 750 (electrical operation) with Ex approval, the following points are mandatory:

The fieldbus independent I/O System Modules Type 750-xxx are to be installed in enclosures that provide for the degree of ingress protection of at least IP54.
For use in the presence of combustible dust, the above mentioned modules are to be installed in enclosures that provide for the degree of ingress protection of at least IP64.

The fieldbus independent I/O system may only be installed in hazardous areas (Europe: Group II, Zone 2 or America: Class I, Division 2, Group A, B, C, D) or in non-hazardous areas!

Installation, connection, addition, removal or replacement of modules, fieldbus connectors or fuses may only take place when the system supply and the field supply are switched off, or when the area is known to be non-hazardous.

Ensure that only approved modules of the electrical operating type will be used. The Substitution or Replacement of modules can jeopardize the suitability of the system in hazardous environments!

Operation of intrinsically safe EEx i modules with direct connection to sensors/actuators in hazardous areas of Zone 0 + 1 and Division 1 type requires the use of a 24 V DC Power Supply EEx i module!

DIP switches and potentiometers are only to be adjusted when the area is know to be non-hazardous.

Further Information
Proof of certification is available on request. Also take note of the information given on the module technical information sheet.

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