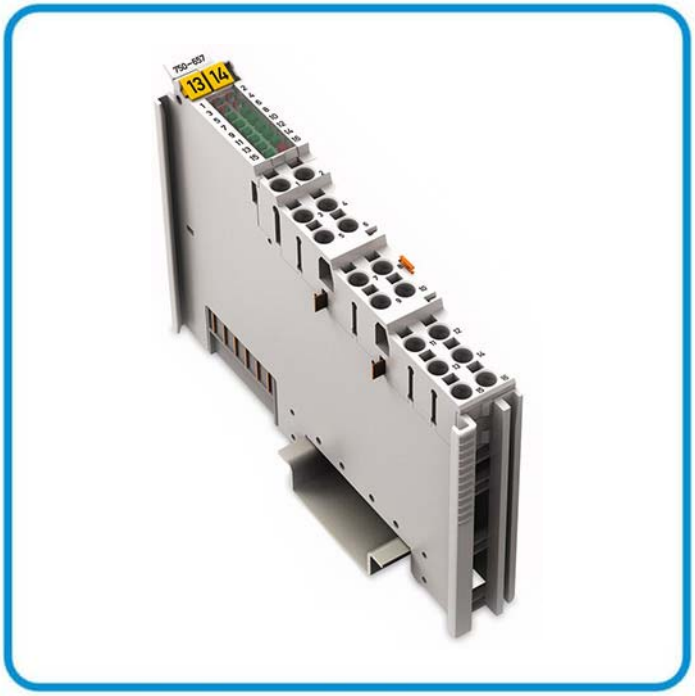
Manual

AUTOMATION



WAGO-I/O-SYSTEM 750

IO-Link Master

750-657

Version 1.0.2, valid from FW/HW-Version 02/01

WAGO®
INNOVATIVE CONNECTIONS

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

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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 protected by trademark or patent.

Table of Contents

1 Notes about this Documentation

Note

Keep this documentation!
The operating instructions are part of the product and shall be kept for the entire lifetime of the device. They shall be transferred to each subsequent owner or user of the device. Care must also be taken to ensure that any supplement to these instructions are included, if applicable.

1.1 Validity of this Documentation

This documentation is only applicable to the I/O module 750-657 (IO-Link Master) of the WAGO-I/O-SYSTEM 750 series from FW/HW-Version 02/01.

The I/O module 750-657 shall only be installed and operated according to the instructions in this manual and in the manual for the used fieldbus coupler/controller.

NOTICE

Consider power layout of the WAGO-I/O-SYSTEM 750!
In addition to these operating instructions, you will also need the manual for the used fieldbus coupler/controller, which can be downloaded at www.wago.com. There, you can obtain important information including information on electrical isolation, system power and supply specifications.

1.2 Copyright

1.3 Symbols

DANGER

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

DANGER

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

WARNING

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

CAUTION

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

NOTICE

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

NOTICE

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

Note

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

Information

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

1.4 Number Notation

Table 1: Number notation

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

1.5 Font Conventions

Table 2: Font conventions

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

2 Important Notes

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

2.1 Legal Bases

2.1.1 Subject to Changes

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

2.1.2 Personnel Qualifications

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

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

2.1.3 Use of the 750 Series in Compliance with Underlying Provisions

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

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

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" in the manual for the used fieldbus coupler/controller.

Appropriate housing (per 94/9/EG) is required when operating the WAGO-I/O-SYSTEM 750 in hazardous environments. Please note that a prototype test certificate must be obtained that confirms the correct installation of the system in a housing or switch cabinet.

2.1.4 Technical Condition of Specified Devices

The components to be supplied Ex Works, are equipped with hardware and software configurations, which meet the individual application requirements. WAGO Kontakttechnik GmbH & Co. KG will be exempted from any liability in case of changes in hardware or software as well as to non-compliant usage of components.

Please send your request for modified and new hardware or software configurations directly to WAGO Kontakttechnik GmbH & Co. KG.

2.2 Safety Advice (Precautions)

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

DANGER

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

DANGER

Installation only in appropriate housings, cabinets or in electrical operation rooms!
The WAGO-I/O-SYSTEM 750 and its components are an open system. As such, install the system and its components exclusively in appropriate housings, cabinets or in electrical operation rooms. Allow access to such equipment and fixtures to authorized, qualified staff only by means of specific keys or tools.

NOTICE

Replace defective or damaged devices!
Replace defective or damaged device/module (e.g., in the event of deformed contacts), since the long-term functionality of device/module involved can no longer be ensured.

NOTICE

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

NOTICE

Cleaning only with permitted materials!
Clean soiled contacts using oil-free compressed air or with ethyl alcohol and leather cloths.

NOTICE

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

NOTICE

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

NOTICE

Avoid electrostatic discharge!
The devices are equipped with electronic components that you may destroy by electrostatic discharge when you touch. Pay attention while handling the devices to good grounding of the environment (persons, job and packing).

3 The IO-Link Technology

IO-Link defines a communication standard (acc. IEC 61131-9) for connecting both current digital inputs/outputs and intelligent IO-Link devices to the control level. IO-Link devices describe sensors and actuators of the field level that have IO-Link functionality.

The IO-Link technology is predominantly used in the industrial sector of manufacturing automation. With IO-Link, configuration, diagnostics and maintenance from the control are possible to the lowest field level in addition to process data communication. For example, sensor failures can be diagnosed and localize in the control directly.

With central parameter data storage in the IO-Link master and the possibility of project development, attached devices can be simply replaced and configurations copied.

Communication occurs via serial point-to-point links in standard 3-wire technology. Both data and diagnostic information as well as power supply are carried over the serial IO-Link interface simultaneously.

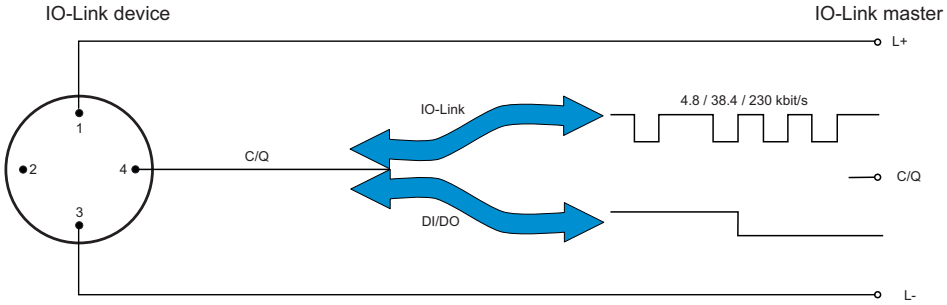


Figure 1: 3-wire connection technology (based on Physics 2 of the IO-Link-specification 1.0.0)

Configuration of IO-Link devices is based on standardized description files "IO Device Description" (IODD), which are provided by the device manufacturers and interpreted in the respective configuration software. Thus, IO-Link devices can be integrated in current automation systems and network structures independent of the bus systems used.

At the time of creating this documentation, the IO-Link specification v1.1_Nov2010 is being assumed into the IEC standard and will be standardized as IEC 61131-9 by "IEC international". The "IO-Link" designation be continued as "Single-drop digital communication interface for small sensors and actuators" (SDCI).

Information

Additional Information

More information about IO-Link is available on the Internet at http://www.io-link.com.

4 Device Description

The IO-Link Master 750-657 module is used to connect intelligent actuators/sensors that the IO-Link communication system uses on the control level. Using 3-wire connection technology, up to four IO-Link devices can be connected to the individual ports of the IO-Link master.

In addition to the two supply lines L+ and L-, there is another connection (C/Q) used to transfer process, configuration, parameterization and diagnostic data. The process data width of an IO-Link device can be between one bit (e.g. simple switches) and 32 bytes (e.g. complex sensors/actuators).

Transfer is based on 24V levels. Transfer is half-duplex, i.e. data is sent and received one after the other.

Standard sensor cables can be used. Shielding is not required.

WAGO-I/O-*CHECK*, function blocks or PROFIBUS-GSD/GSE can be used to configure and parameterize the IO-Link master.

Two-color LEDs together with the status byte provide information about the operating status of the individual IO-Link ports.

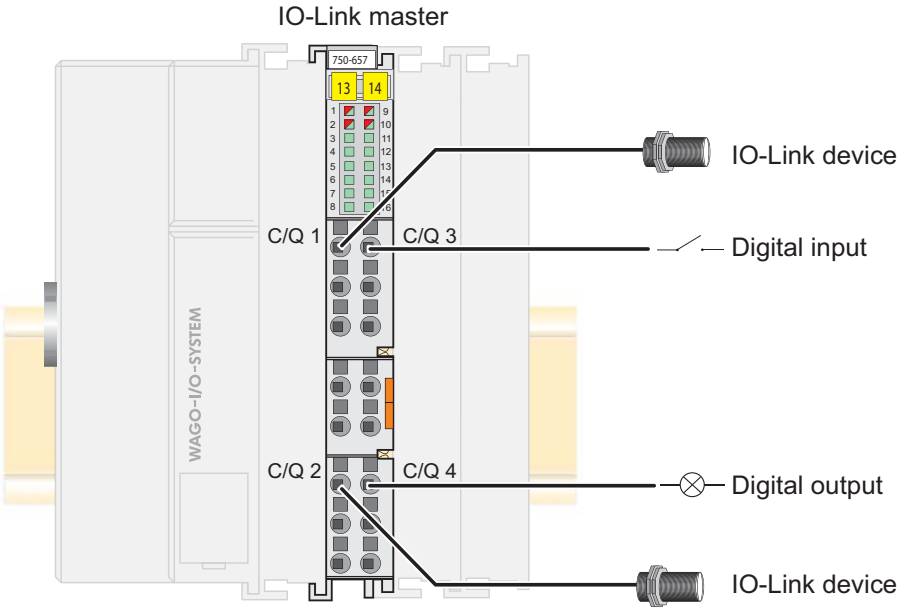


Figure 2: Connection example: IO-Link master with various devices

Note

Do not use IO-Link for safety-related applications!
In general, do not use IO-Link technology for safety-related applications, e.g. emergency stop switch.

The 750-657 module can be used with the fieldbus couplers and controllers of the WAGO-I/O-SYSTEM 750 of the specified version or higher listed in the "Compatibility list" table.

Table 3: Compatibility List 750-657

Fieldbus system	Fieldbus coupler/-controller	Item No.	Hardware Version	Software Version	Firmware Loader Version
PROFIBUS	Fieldbus coupler	750-333	16	20	03
ETHERNET	Fieldbus coupler	750-341	08	09	02
		750-342	17	07	06
		750-352	02	02	03
		750-354	01	01	01
	Programmable fieldbus controller	750-841	19	11	02
		750-842	18	13	06
		750-843	02	10	06
		750-871	07	05	02
		750-872	03	04	02
		750-873	03	04	02
		750-880	02	04	03
		750-880/ 0025-0001	03	04	03
		750-880/ 0025-0002	03	04	03
		750-881	02	02	03
		750-882	02	05	03
		750-884	03	06	03
		750-885	04	06	03
DeviceNet	ECO Fieldbus coupler	750-346	10	05	01
	Fieldbus coupler	750-306	4K	15	02
	Programmable fieldbus controller	750-806	10	07	02
CANopen	Fieldbus coupler	750-337	19	11	02
		750-338	19	02	02
	ECO Fieldbus coupler	750-347	08	04	01
		750-348	08	04	01
	Programmable fieldbus controller	750-837	14	09	04
		750-838	14	05	04
EtherCat	Fieldbus coupler	750-354	01	01	01
KNX	Programmable fieldbus controller	750-849	04	03	02
BACnet	Programmable fieldbus controller	750-830	02	03	02
LONWORKS	Programmable fieldbus controller	750-819	09	13	03
	Fieldbus coupler	750-319	05	07	03

Table 3: Compatibility List 750-657

Fieldbus system	Fieldbus coupler/-controller	Item No.	Hardware Version	Software Version	Firmware Loader Version
WAGO-IPC	IPC	758-0870/ 0000-0010	Firmware revision 2.4.31 / 0111 Internal bus FW revision 01.02.10(12)		
		758-0870/ 0000-0111	Firmware revision 01.01.26(05) Internal bus FW revision 01.02.10(12)		
		758-0875/ 0000-0111	Firmware revision 01.01.26(05) Internal bus FW revision 01.02.10(12)		
		758-0876/ 0000-0112	Firmware revision 01.01.26(05) Internal bus FW revision 01.02.10(12)		

Note

Restriction on CANopen couplers 750-347 and 750-348!
With a process data length of 4 bytes, the byte sequence is turned for CANopen couplers up to software version 08.

4.1 View

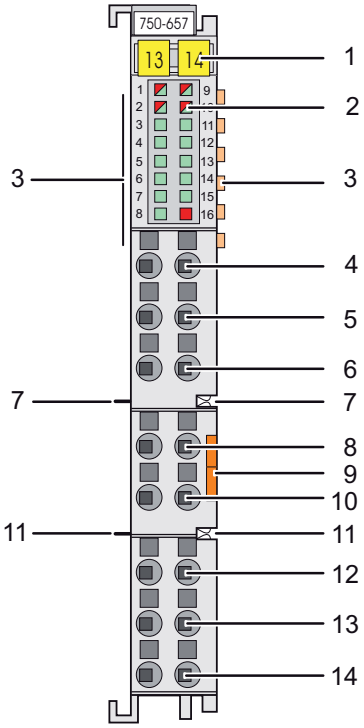


Figure 3: View

Table 4: Caption acc. to figure “View“

No.	Designation	Description	Details see chapter
1	---	Marking possibility with Mini-WSB	---
2	1…16	Status LEDs	“Device Description” > “Display Elements”
3	---	Data contacts	“Device Description” > “Connections”
4	1, 9	CAGE CLAMP® connections, C/Q 1, C/Q 3	“Device Description” > “Connections”
5	2, 10	CAGE CLAMP® connections, L+, 24 V	“Device Description” > “Connections”
6	3, 11	CAGE CLAMP® connections, L-, 0 V	“Device Description” > “Connections”
7	---	Power jumper contact, L+, 24 V	“Device Description” > “Connections”
8	4, 12	CAGE CLAMP® connections, Field supply 24 V	“Device Description” > “Connections”
9	---	Release clip	“Mounting” > “Insert and remove device”
10	5, 13	CAGE CLAMP® connections, Field supply 0 V	“Device Description” > “Connections”
11	---	Power jumper contact, L-, 0 V	“Device Description” > “Connections”
12	6, 14	CAGE CLAMP® connections, C/Q 2, C/Q 4	“Device Description” > “Connections”
13	7, 15	CAGE CLAMP® connections, L+, 24 V	“Device Description” > “Connections”
14	8, 16	CAGE CLAMP® connections, L-, 0 V	“Device Description” > “Connections”

4.2 Connectors

4.2.1 Data Contacts/Internal Bus

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

Figure 4: Data contacts

NOTICE

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

NOTICE

Ensure that the environment is well grounded!
The 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. data contacts.

4.2.2 Power Jumper Contacts/Field Supply

⚠ CAUTION

Risk of injury due to sharp-edged male contacts!
The male contacts are sharp-edged. Handle the module carefully to prevent injury.

The I/O module 750-657 has 2 self-cleaning power jumper contacts that supply and transmit power for the field side. The contacts on the left side of the I/O module are designed as male contacts and the contacts on the right side as spring contacts.

Table 5: Power jumper contacts

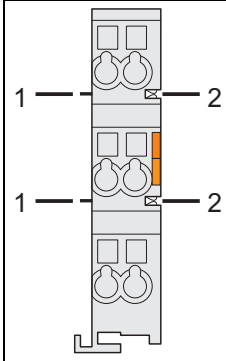


Figure 5: Power jumper contacts

Connection	Type	Number	Function
1	Blade contact	2	Infeed of the field supply voltage (U_V and 0 V)
2	Spring contact	2	Forwarding of the field supply voltage (U_V and 0 V)

NOTICE

Do not exceed maximum current via power contacts!
The maximum current to flow through the power contacts is 10 A.
Greater currents can damage the power contacts.
When configuring the system, ensure that this current is not exceeded. If exceeded, an additional potential feed module must be used.

Note

Use potential feed module for Ground (earth)!
The I/O module has no power contacts for PE intake and transfer. Use a potential feed module when a PE feed is needed for the subsequent I/O modules.

4.2.3 CAGE CLAMP® Connections

Table 6: Connections

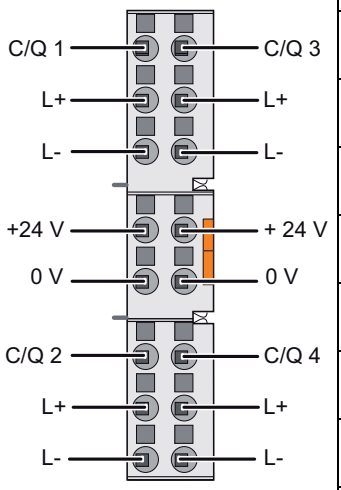


Figure 6: Connections

Termination	Channel	Designation	Function
1	1	C/Q 1	IO-Link Port 1
2	---	L+	Power supply DC 24 V
3	---	L-	Power supply 0 V
4	---	+ 24 V	Field supply 24 V
5	---	0 V	Field supply 0 V
6	2	C/Q 2	IO-Link Port 2
7	---	L+	Power supply DC 24 V
8	---	L-	Power supply 0 V
9	3	C/Q 3	IO-Link Port 3
10	---	L+	Power supply DC 24 V
11	---	L-	Power supply 0 V
12	---	+ 24 V	Field supply 24 V
13	---	0 V	Field supply 0 V
14	4	C/Q 4	IO-Link Port 4
15	---	L+	Power supply DC 24 V
16	---	L-	Power supply 0 V

4.3 Display Elements

Table 7: Display Elements

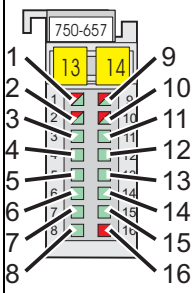


Figure 7: Display Elements

LED	Channel	Designation	Status	Function
1	1	Operating status C/Q 1	Green	IO-Link: Device connected, IO-Link Data OK
				SIO, DI, DO: High state
			Green blinking	Start-up or parameterization, duration ≥ 3 s
			Red blinking	Error*, no valid process data for C/Q 1
			Off	IO-Link: No device connected
				SIO, DI, DO: Low state
2	2	Operating status C/Q 2	Green	IO-Link: Device connected, IO-Link Data OK
				SIO, DI, DO: High state
			Green blinking	Start-up or parameterization, duration ≥ 3 s
			Red blinking	Error*, no valid process data for C/Q 2
			Off	IO-Link: No device connected
				SIO, DI, DO: Low state
3	-	-	Off	reserved
4	-	-	Off	reserved
5	-	-	Off	reserved
6	-	-	Off	reserved
7	-	-	Off	reserved
8	-	Operating status IO-Link master	Green blinking	Parameterization active
			Off	Parameterization inactive
9	3	Operating status C/Q 3	Green	IO-Link: Device connected, IO-Link Data OK
				SIO, DI, DO: High state
			Green blinking	Start-up or parameterization, duration ≥ 3 s
			Red blinking	Error*, no valid process data for C/Q 3
			Off	IO-Link: No device connected
				SIO, DI, DO: Low state
10	4	Operating status C/Q 4	Green	IO-Link: Device connected, IO-Link Data OK
				SIO, DI, DO: High state
			Green blinking	Start-up or parameterization, duration ≥ 3 s
			Red blinking	Error*, no valid process data for C/Q 4
			Off	IO-Link: No device connected
				SIO, DI, DO: Low state
11	-	-	Off	reserved
12	-	-	Off	reserved
13	-	-	Off	reserved
14	-	-	Off	reserved
15	-	-	Off	reserved
16	-	General error	Red	IO-Link error or internal error
			Off	No Error

* (e.g. short circuit unsuitable IO-Link device, other disturbance in the communication)

4.4 Schematic Diagram

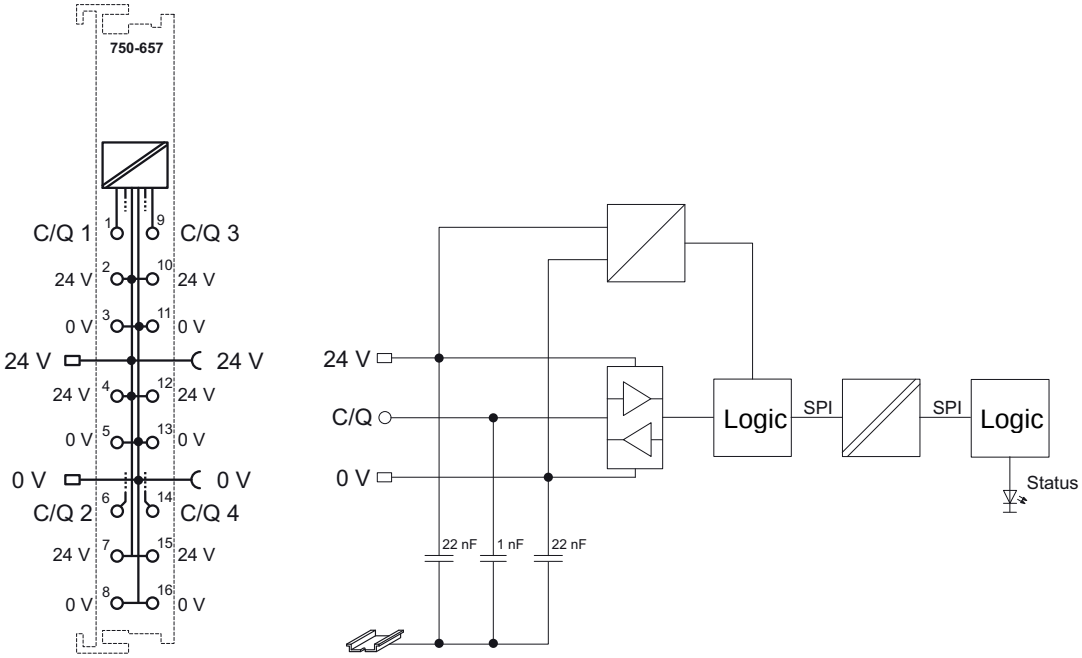


Figure 8: Schematic Diagram

4.5 Technical Data

4.5.1 Device Data

Table 8: Technical Data – Device

Width	12 mm
Height (from upper edge of DIN 35 rail)	64 mm
Length	100 mm
Weight	Approx. 55 g
Operating temperature	0 °C ... +55 °C
Storage temperature	-25 °C ... +85 °C
Relative air humidity (operation/storage)	95 % (without condensation)
Degree of protection	IP 20

4.5.2 Supply

Table 9: Technical Data – Supply

Voltage supply	system voltage 5 V via internal data bus, 24 V via power jumper contacts
Current consumption, system voltage $_{typ.}$ (5 V DC)	40 mA
Current consumption $_{max.}$ (24 V DC)	1250 mA (50 mA internal power supply field side + 4 x 100 mA output current from C/Q + 4 x 200 mA supply voltage L+ of the devices)
Voltage via power jumper contacts	24 V DC (supply e.g. via 750-625)
Current via power jumper contacts $_{max.}$	10 A
Power consumption $P_{max.}$	1,2 W
Isolation (peak value)	500 V DC system/supply

4.5.3 Communication

Table 10: Technical Data – Communication

Data width, internal	4..24 Byte configurable
Transmission modes IO-Link (Master/Devices)	4,8 kbaud (COM1) 38,4 kbaud (COM2) 230,4 kbaud (COM3)
Diagnostic information	Internal bus status via status byte, event codes via acyclic channel

4.5.4 IO-Link Ports

Table 11: Technical Data – IO-Link Ports

Operation mode IO-Link	
IO-Link specification	v1.0, v1.1 acc.to IEC 61131-9
Number of ports	4
Communication mode	COM1 (4,8 kBaud) COM2 (38,4 kBaud) COM3 (230,4 kBaud) Depending on connected sensor/actuator
Operation modes	IO-Link/SIO (Standard Input/Output) DI (Digital Input, Default) DO (Digital Output) Inactive
Frame types	0, 1.1-1.2, 1.V, 2.1-2.6, 2.V
Connection type	Unshielded standard 3-wire cable (Physics 2 acc. IO-Link standard)
Line length $_{max.}$	20 m
Sensor supply U_V	DC 24 V
Nominal current per port (L+)	200 mA
Maximum current per port (C/Q)	100 mA
Short-circuit-protected (C/Q)	yes
Short-circuit current $_{max.}$ (C/Q)	450 mA
Operation mode SIO/DI (Input type 1 acc. to norm EN 61131-2:2007)	
Signal current (0)	6 mA typ.
Signal voltage (0)	≤ 5 V
Signal current (1)	7 mA typ.
Signal voltage (1)	≥ 15 V
Operation mode DO	
Output voltage	DC 24 V
Output current $_{max.}$	100 mA

NOTICE

Note reverse polarity protection and connection!
The supply of 24 V to the power contacts is protected against reverse polarity if the potential on C/Q is not 0 V!
→ Simultaneous reverse polarity and short circuit on C/Q against 0 V can cause destruction!
Incorrectly connecting a device to the L+/L- connection of the IO-Link master can destroy the device.
Ensure that the connection is correct.

NOTICE

Do not create a negative voltage on C/Q!
Do not create a negative voltage between L- and C/Q because this can cause the destruction of the IO-Link master.

Note

Note the minimum cable cross-section!
Maintain the recommended minimum cable cross-section:
For 20 m cable length, select a minimum cross-section of 0.34 mm².
You can use unshielded cable.

Note

Use binary sensors with PNO or push/pull output!
Binary sensors with PNP output or push/pull output can be connected to an IO-Link master in operating modes "DI" and "DO", but not connected to an NPN output.

4.6 Approvals

The following approvals have been granted to 750-657 I/O modules:

IO-Link Conformity according to the IO-Link standard

CE Conformity Marking

cULus cULus UL508

Information

More Information about Approvals
Detailed references to the approvals are listed in the document "Overview Approvals **WAGO-I/O-SYSTEM 750**", which you can find on the DVD "AUTOMATION Tools and Docs" (order no. 0888-0412) or via the internet under: www.wago.com → Documentation → WAGO-I/O-SYSTEM 750 → System Description.

4.7 Standards and Guidelines

SDCI acc. to IEC 61131-9/WD V0.5
SDCI = “Single-drop digital communication interface for small sensors and actuators“

750-657 I/O modules meet the following requirements on emission and immunity of interference:

EMC CE-Immunity to interference	acc. to EN 61000-4-2
EMC CE-Immunity to interference	acc. to EN 61000-4-3
EMC CE-Immunity to interference	acc. to EN 61000-4-4
EMC CE-Immunity to interference	acc. to EN 61000-4-5
EMC CE-Immunity to interference	acc. to EN 61000-4-6
EMC CE-Immunity to interference	acc. to EN 61000-4-8
EMC CE-Emission of interference	acc. to EN 55016-2-3

5 Function Description

The IO-Link master is operated on a fieldbus coupler/controller of the WAGO-I/O-SYSTEM 750. Up to four IO-Link devices according to IEC 61131-9 or four digital inputs/outputs can be connected to the IO-Link master.

Device description files are used to configure and parameterize the IO-Link master and IO-Link devices via the WAGO-I/O-*CHECK* software (see section "Configuration and Parameterization").

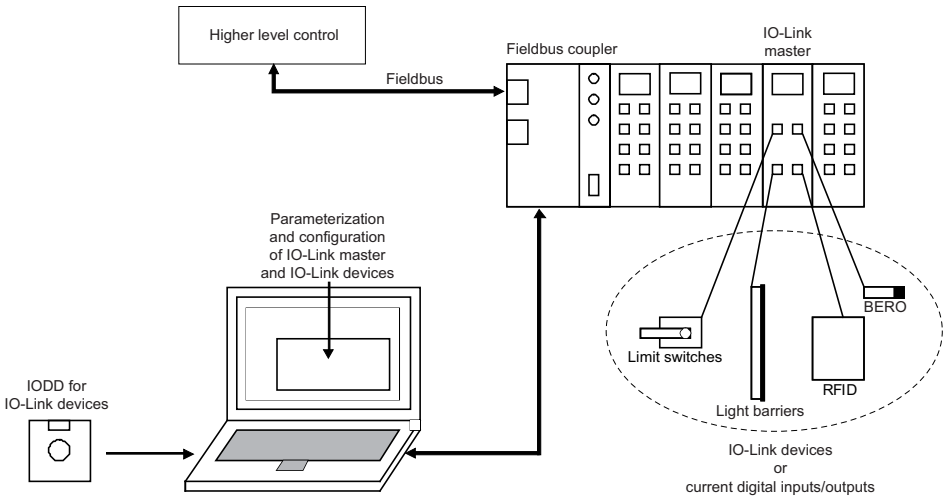


Figure 9: Complete system

The IO-Link master supports 4 operating modes: **IO-Link** or **SIO** ("Standard Input/Output"), **DI** ("Digital Input", default setting), **DO** ("Digital Output") and **Inactive**. The respective operating mode can be set separately for each port of the IO-Link master.

The data between the IO-Link master and attached devices is exchanged cyclically via the **IO-Link** interface and depending on the source, processed accordingly and transferred via the **internal bus**. Process input data is transferred via the fieldbus to the control or process output data via the **fieldbus** and internal bus to the I/O module. Details on the use of certain fieldbuses is available in the appendix, section "Fieldbus-Specific Additions".

The process image of the IO-Link master can be set to up to 24 bytes depending on the device attached. The process image is divided into control/state byte, Mailbox bytes, SIO byte and an area divided into 4 segments used for the 4 IO-Link ports. If the set segment size of a port is insufficient to transfer the data in one cycle, the data of the individual IO-Link devices can also be transferred fragmented via the respective port.

Parameters and data from the IO-Link master and attached IO-Link devices can be accessed from the PLC via the process image. In this way, any parameterization processes and backup procedures can be carried out from the PLC at run-time.

5.1 Parameter Model of the IO-Link Master

The parameters of the master are mapped to an IO-Link-specific data model. A distinction is made between the following records:

- Information and configuration data of the IO-Link master **(IOL-M Basic Configuration)**
- Configurations of IO-Link ports 1 to 4 **(IOL-M_Port Configuration 1..4)**
- Device identification of the IO-Link master **(I&M)** and attached devices **(I&M 0..4)**
- Information about the IO-Link master itself **(IOL-M Directory)** This information is read only.
- Records of the attached IO-Link devices **(ISDU)** according to the IO-Link specification.

The IO-Link-specific records are described in detail in the appendix, section "IO-Link Master tables". More information about the "Indexed Service Data Unit" (ISDU) is available in the section "Parameter Access via ISDU".

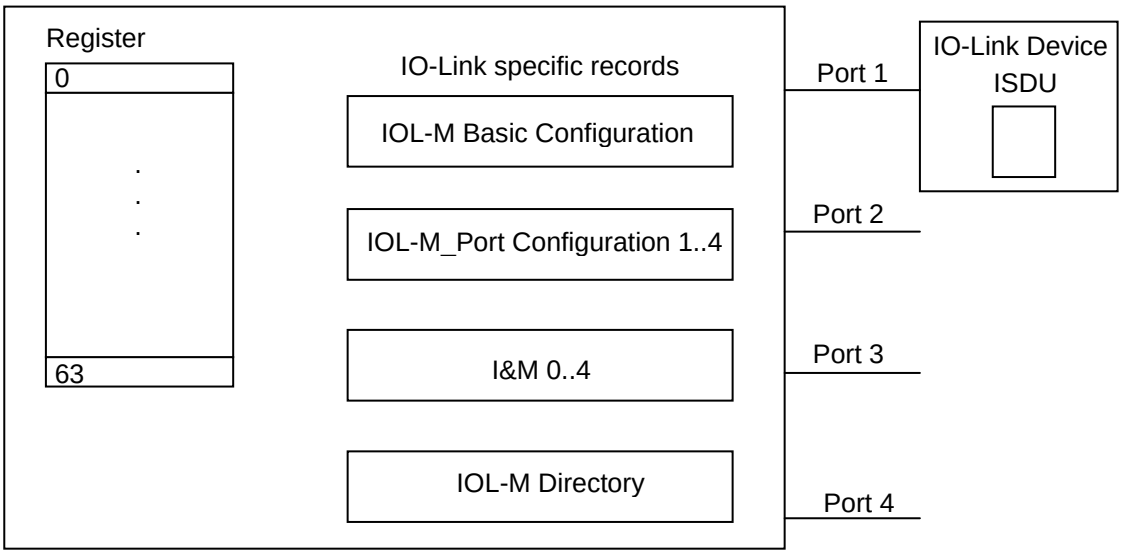


Figure 10: Parameter Model of the IO-Link Master

6 Process Image

The process image size of the IO-Link master can be adjusted to the devices (switches, IO-Link compatible devices, etc.) attached to the IO-Link ports. Process image sizes of 4, 6, 8, 10, 12, 16, 20 or 24 bytes can be set. As process data is exchanged, the process image has a fixed structure of a control/status byte, Mailbox bytes and SIO byte regardless of the current configuration.
After the SIO byte, another data storage area is available in which cyclical process data can be transferred from IO-Link devices.

Table 12: Process image (for example, Mailbox size 2 bytes)

Process image						
Pi size	**Input data**			**Output data**		
4 Byte	S0	Status byte		C0	Control byte	
	FC0	Acyclic channel	Register byte 0	FC0	Acyclic channel	Register byte 0
	MB0	Mailbox-Byte	Register byte 1	MB0	Mailbox byte	Register byte 1
	SIO	SIO byte		SIO	SIO byte	
6 Byte	D0	Data byte 0		D0	Data byte 0	
	D1	Data byte 1		D1	Data byte 1	
8 Byte	D2	Data byte 2		D2	Data byte 2	
	D3	Data byte 3		D3	Data byte 3	
10 Byte	D4	Data byte 4		D4	Data byte 4	
	D5	Data byte 5		D5	Data byte 5	
12 Byte	D6	Data byte 6		D6	Data byte 6	
	D7	Data byte 7		D7	Data byte 7	
16 Byte	D8	Data byte 8		D8	Data byte 8	
	D9	Data byte 9		D9	Data byte 9	
	D10	Data byte 10		D10	Data byte 10	
	D11	Data byte 11		D11	Data byte 11	
20 Byte	D12	Data byte 12		D12	Data byte 12	
	D13	Data byte 13		D13	Data byte 13	
	D14	Data byte 14		D14	Data byte 14	
	D15	Data byte 15		D15	Data byte 15	
24 Byte	D16	Data byte 16		D16	Data byte 16	
	D17	Data byte 17		D17	Data byte 17	
	D18	Data byte 18		D18	Data byte 18	
	D19	Data byte 19		D19	Data byte 19	

6.1 Control/status byte

The first byte of the internal bus process image is reserved for the control byte (data direction fieldbus coupler/controller → IO-Link master) or status byte (data direction IO-Link master → fieldbus coupler/controller).

The control byte is used to switch between register communication (see appendix, section "Register Communication" and mailbox communication (see section "Mailbox").

During register communication, the register query response is contained in the status byte followed by 2 bytes of register data.

If the mailbox is active, status information of the I/O module and IO-Link ports is displayed cyclically via the status byte.

Control byte

Table 13: Control byte

Control byte							
Bit 7	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
0	res.*	res.*	res.*	res.*	res.*	res.*	res.*
1	0 = Read register 1 = Write register	Register number					

* reserved

Status byte

Table 14: Status byte

Status byte							
Bit 7	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
0	GEN_ ERR	PORT4_ ERR	PORT3_ ERR	PORT2_ ERR	PORT1_ ERR	IOLM_ ERR	INT_ ERR
1	Res.	Register number					

(Bit 7)	0	Mailbox active
	1	Register communication active
GEN_ERR	0	No error
	1	Error is pending. Set when one of the bits 0…5 = 1.
PORT4_ERR	0	The device attached to port 4 is not in the fault condition.
	1	The device attached to port 4 is in the fault condition.
PORT3_ERR	0	The device attached to port 3 is not in the fault condition.
	1	The device attached to port 3 is in the fault condition.
PORT2_ERR	0	The device attached to port 2 is not in the fault condition.
	1	The device attached to port 2 is in the fault condition.
PORT1_ERR	0	The device attached to port 1 is not in the fault condition.
	1	The device attached to port 1 is in the fault condition.
IOLM_ERR	0	The IO-Link master is not in the fault condition.
	1	The IO-Link master is in the fault condition.
INT_ERR	0	No internal errors
	1	Internal error. Possible causes: • 24V field supply missing • Communication via mailbox and process data faulty.

6.2 Mailbox

Modules with mailbox functionality have an acyclic communication channel (mailbox) in the process image. The "Mailbox 2.0" transmission method is hereinafter abbreviated as "Mailbox".

If the Mailbox is active (control byte, bit 7 = 0), it is used to transfer configuration, parameterization and diagnostic data. Byte 1 and byte 2 of the internal bus process image are used by default. A Mailbox size of 2 bytes is permitted for FW/HW version 02/01.

More information about the "Mailbox 2.0 Transmission Method" is available in the respective section in the appendix.

6.3 SIO Byte

"SIO" is an abbreviation for "Standard Input/Output". The SIO byte is used in the IO-Link operating mode in SIO mode (input only), as well as in the "DI" and "DO" operating modes to transfer data to and from digital inputs or outputs to and from the control.

The following table provides an overview of the SIO byte.

Table 15: SIO Byte

SIO byte							
Bit 7	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
0	0	0	0	SIO3	SIO2	SIO1	SIO0

SIO3	0	Process data of digital port 4: logical '0'
	1	Process data of digital port 4: logical '1'
SIO2	0	Process data of digital port 3: logical '0'
	1	Process data of digital port 3: logical '1'
SIO1	0	Process data of digital port 2: logical '0'
	1	Process data of digital port 2: logical '1'
SIO0	0	Process data of digital port 1: logical '0'
	1	Process data of digital port 1: logical '1'

Input data:
In the IO-Link operating mode in SIO mode and in the "DI" operating mode, the status of the associated channel always appears in the SIO byte.
In the "IO-Link" operating mode, the LSB of the process data of the associated channel appears independent of the IO-Link device type. The display is redundant to the data in the associated process data segment.

Note

Corresponding SIO bits always zero during fragmentation!
If you have switched on fragmentation of the process data, the corresponding bit is always zero on the SIO byte.

Output data:
The SIO byte is only applied when the associated process data segment has a length of 0. Otherwise, the value is ignored in the SIO byte.
Process data that exceeds 1 bit per port is in the range of the cyclic data (see the following section).

6.4 Cyclic Process Data

The following is an example of a Mailbox size of 2 bytes during configuration:

The first bytes of the process image are already allocated with the control/status byte, the Mailbox bytes and the SIO byte.

If the selected internal bus data width is more than the set Mailbox size + control/status and SIO byte, another data storage area is available in addition to using the SIO byte in which process data is transferred cyclically from attached IO-Link devices (see the following figure).

Four segments can be configured in this area – one segment for each pot available. The segment size is set based on the requirements of the application or attached devices.

The figure shows the following application with a Mailbox set to 2 bytes:

- Internal bus data width: 24 bytes
- Segment size for port 1: 3 bytes
- Segment size for port 2: 2 bytes
- Segment size for port 3: 5 bytes
- Segment size for port 4: 7 bytes

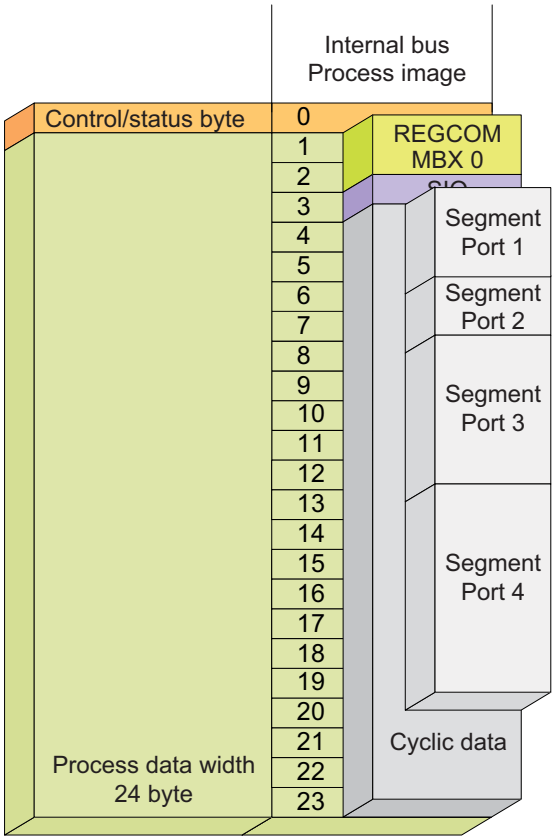


Figure 11: Internal bus data width and segment size

Note

Process data width of the internal bus affects the size of the cyclic data!
If the internal bus process data width is set to 12 or 8 bytes and the Mailbox size is 2 bytes, for example, the data storage area available is reduced for the cyclical data accordingly. With a setting of 4 bytes, only the SIO byte is available for cyclic data.

Note

Segment size ≠ process data width of the IO-Link device!
The segment size of a port segment does not have to match the process data width of the attached IO-Link device.

Note

Asymmetric segment positions possible!
Port segments do not have to be arranged symmetrically in terms of the positions on the internal bus process input and internal bus process output image.
Whether the process data is transferred fragmented or unfragmented is insignificant (see the following segment).

6.4.1 Unfragmented Process Data

If the size of a port segment is equal to or larger than the process data width of the attached IO-Link device and fragmentation for this segment is switched off, the process data of the IO-Link device is transferred via internal bus. The following example shows the process data for an attached IO-Link device with a Mailbox size of 2 bytes, process data width of 3 bytes (segment width: 5 bytes) on port 3.

Table 16: Distribution of the process data in the IO-Link master, example

Byte	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Content	Control byte / Status byte	Mailbox / Register comm..	Mailbox / Register comm.	SIO byte	Segment Port 1	Segment Port 1	Segment Port 1	Segment Port 2	Segment Port 2	**Segment Port 3 = 0x12**	**Segment Port 3 = 0x34**	**Segment Port 3 = 0x56**	Segment Port 3 = 0x00	Segment Port 3 = 0x00	Segment Port 4	Segment Port 4	Segment Port 4	Segment Port 4	Segment Port 4	Segment Port 4	Segment Port 4	Unused, 0x00	Unused, 0x00	Unused, 0x00
Port					1			2		3					4									

Note

Segment size > process data width of the IO-Link device!
If the segment size is equal to or greater than the process data width of the IO-Link device, the excess bytes of the input data are populated with "0x00". The excess bytes are ignored in the output direction.

Note

Segment size < process data width of the IO-Link device!
If the segment size is smaller than the process data width of the IO-Link device and fragmentation is set to "inactive", the input process data is cut upwards. In the output direction, the missing bytes are populated with zeros.
Notice: Avoid this configuration because the PLC output data does not correspond to the output value!

6.4.2 Fragmented Process Data

An IO-Link device can process up to 32 bytes of process data per port and per direction. With 4 ports, up to 128-byte process data and 128-byte process output data is possible.
Because the data width of the internal bus may not be sufficient, the IO-Link master provides the option of fragmented transfer of process data. When fragmentation is switched on, the data is transferred fragmented per port independent of each other and in the respective port segment.

More information about fragmentation is available in the appendix, section "Mailbox 2.0 Transmission Mechanism".

7 Mounting

7.1 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 installation.

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

⚠ CAUTION

Risk of injury due to sharp-edged male contacts!
The male contacts are sharp-edged. Handle the module carefully to prevent injury.

NOTICE

Connect the I/O modules in the required order!
Never plug I/O 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.

NOTICE

Assemble the I/O modules in rows only if the grooves are open!
Please take into consideration that some I/O 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.

Note

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

7.2 Inserting and Removing Devices

DANGER

Use caution when interrupting the PE!
Make sure that people or equipment are not placed at risk when removing an I/O module and the associated PE interruption. To prevent interruptions, provide ring feeding of the ground conductor, see section "Grounding/Ground Conductor" in manual "System Description WAGO-I/O-SYSTEM 750".

NOTICE

Perform work on devices only if the system is de-energized!
Working on devices when the system is energized can damage the devices. Therefore, turn off the power supply before working on the devices.

7.2.1 Inserting I/O Module

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

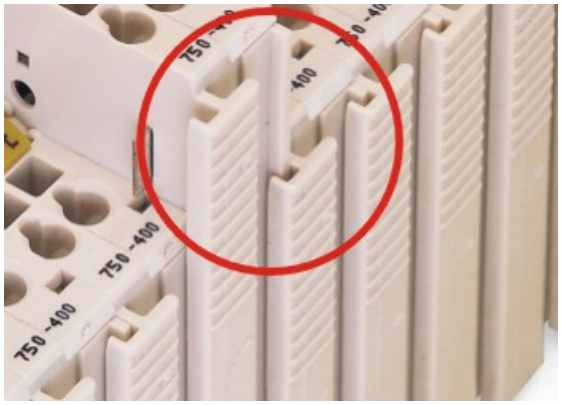


Figure 12: Insert I/O module

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

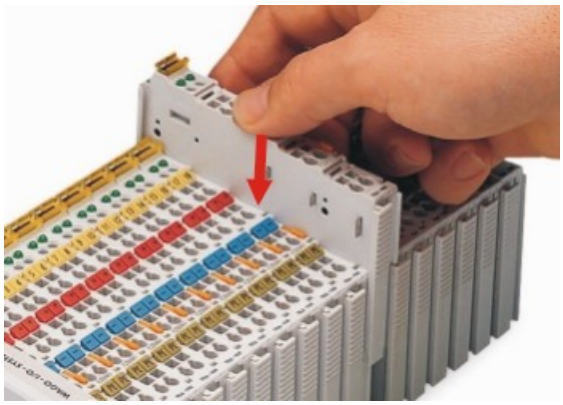


Figure 13: Snap the I/O module into place

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

7.2.2 Removing the I/O Module

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

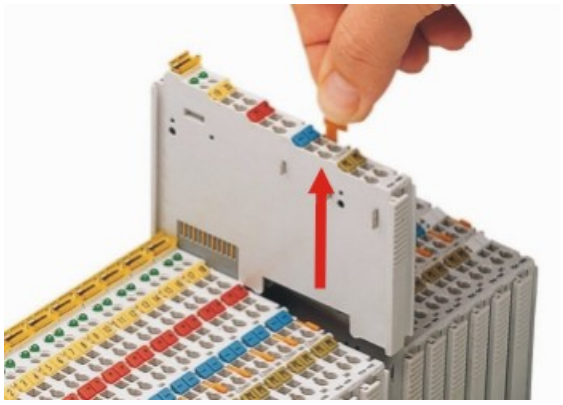


Figure 14: Removing the I/O module

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

8 Connect Devices

8.1 Connecting a Conductor to the CAGE CLAMP®

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

Note

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

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

Exception:
If it is unavoidable to jointly connect 2 conductors, then you must use a ferrule to join the wires together. The following ferrules can be used:

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.

1. To open the CAGE CLAMP® insert the actuating tool into the opening above the connection.
2. Insert the conductor into the corresponding connection opening.
3. To close the CAGE CLAMP® simply remove the tool - the conductor is then clamped firmly in place.

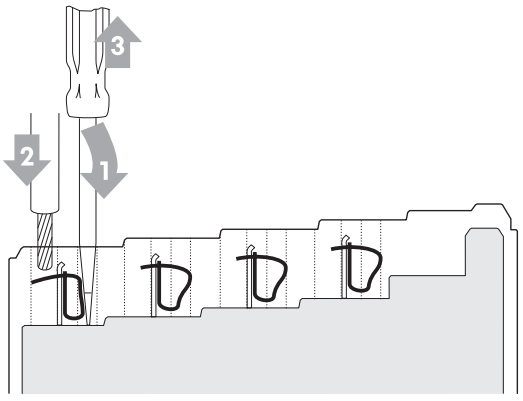


Figure 15: Connecting a conductor to a CAGE CLAMP®

9 Configuration and Parameterization

You can commission, configure or parameterize in a variety of ways:

- Software WAGO-I/O-*CHECK* using IODD device description files
- Software WAGO-I/O-*PRO* with corresponding function block "WagoLib_IO_Link.lib" of the WAGO-I/O-*PRO* library
- Configuration software using device description files (e.g. PROFIBUS-GSD/GSE), see appendix, section "Configuration Using PROFIBUS GSD/GSE"

Configuration and parameterization via WAGO-I/O-*CHECK* and WAGO-I/O-*PRO* make use of acyclic communication via the Mailbox and register communication. For access via the Mailbox, a parameter access service is provided by the I/O module. Register communication and the parameter access service are explained in the appendix, section "Register Communication" or "Mailbox 2.0 Transmission Method".

9.1 Configuration and Parameterization with WAGO-I/O-*CHECK*

The WAGO-I/O-*CHECK* software from WAGO Kontakttechnik GmbH & Co. KG can be used to conveniently and completely configure and parameterize the IO-Link master:

- Configuration of node-internal transmission bus
- Parameterization of the operating modes of the IO-Link master
- Diagnosis of the IO-Link master
- Importing of the IO-Link-specific device description fields (IODDs)
  - Display,
  - Configure and
  - Parameterize IO-Link devices
- Diagnosis of IO-Link devices

Information

Additional Information

You receive the WAGO-I/O-*CHECK* on a CD-ROM under order ID 759-302. The CD-ROM includes all program files for the application.
The documentation for the WAGO-I/O-*CHECK* software is available on the Internet at http://www.wago.com under Documentation → WAGO-Software 759 → WAGO-I/O-*CHECK*.

To open the specific parameterization dialog for the IO-Link master, right-click on the IO-Link master and select the **Settings** menu item (see the following figure).

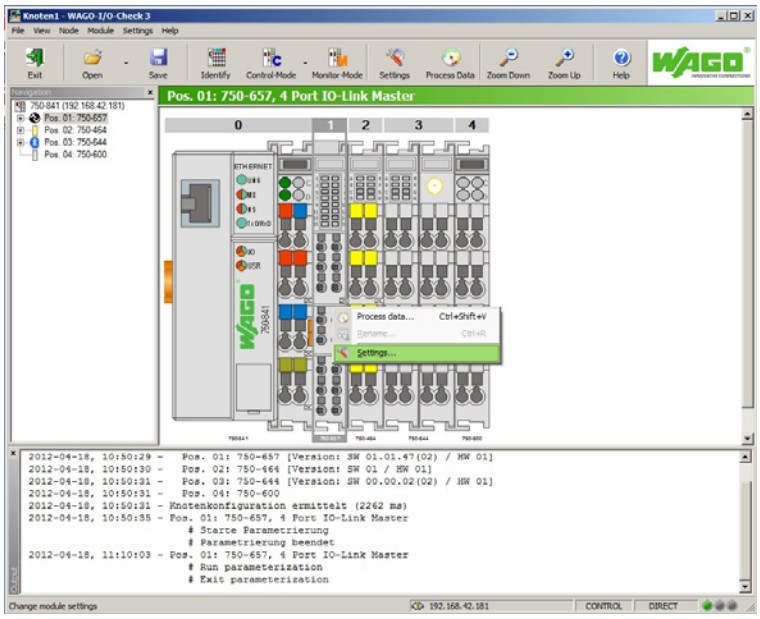


Figure 16: WAGO-I/O-*CHECK* user interface

The parameterization dialog appears, which forms the basis for the following description.

9.1.1 User Interface

The user interface is divided into the following areas:

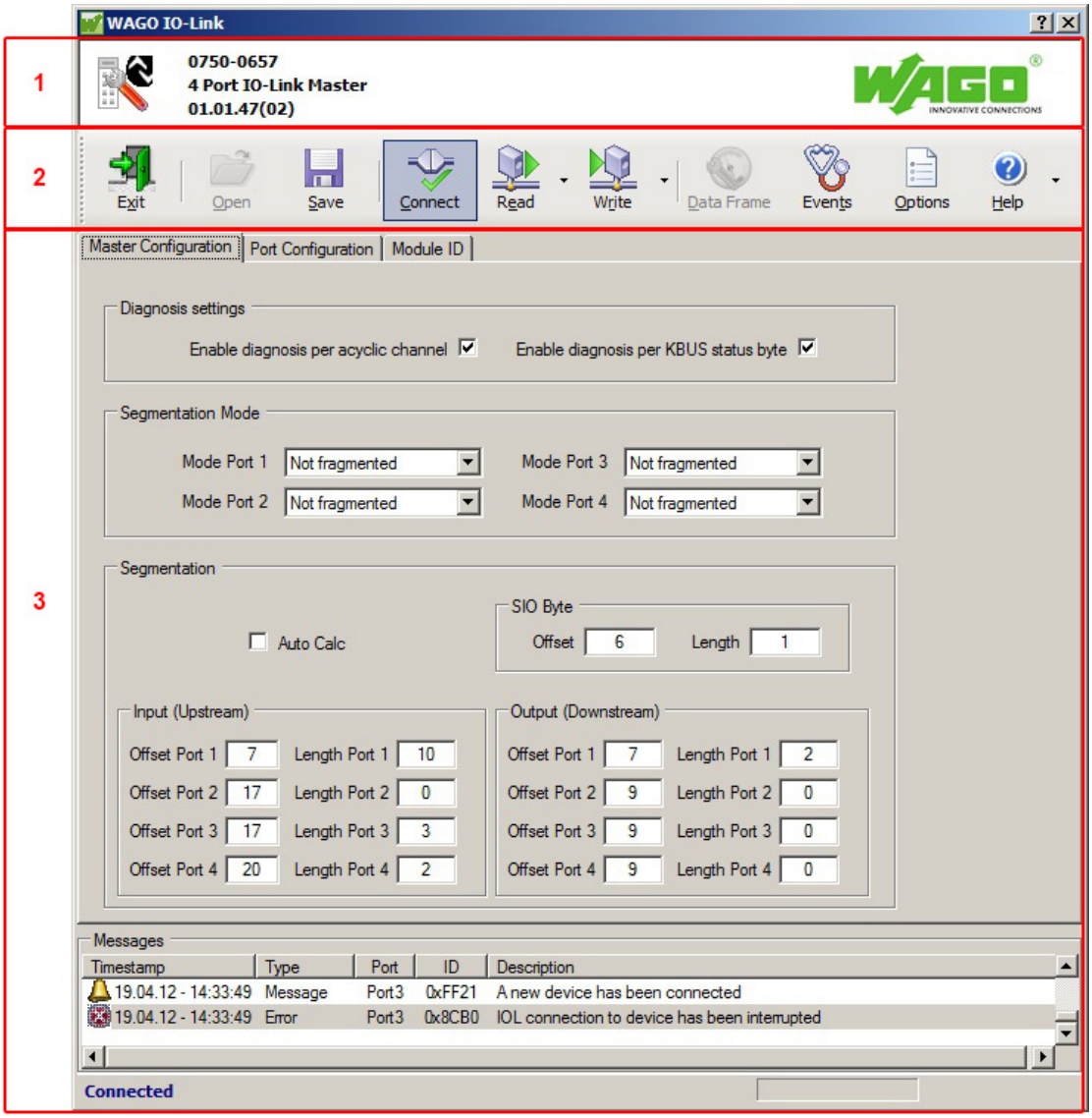


Figure 17: IO-Link master user interface

1 Title bar

2 Toolbar

3 Master Configuration, Port Configuration und Module ID tabs (diagnostic and event message at the bottom)

These areas will be explained in more detail in the following sections.

9.1.1.1 Title Bar

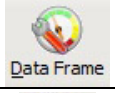
Article number, name and version number of the IO-Link master appear in the title bar of the parameterization dialog.

9.1.1.2 Toolbar

The toolbar in the parameterization dialog contains the following buttons:

Figure 18: Buttons in the toolbar

Table 17: Buttons in the toolbar

Button	Function	Description
	**[Exit]**	Closes the parameterization dialog
	**[Open]**	Opens an existing parameterization file. WAGO-I/O-*CHECK* displays the default dialog for opening files.
	**[Save]**	Saves the current parameter in a parameter file. WAGO-I/O-*CHECK* displays the default dialog for saving files.
	**[Connect]**	Establish communication with the IO-Link master.
	**[Read]**	Reads the current parameters of the page displayed from the IO-Link master and displays them in the window. Another menu item is available in the context menu: **Read parameters on current page** Read parameters on current page **Read all Parameters** Read all parameters
	**[Write]**	Writes the current parameters of the page displayed to the I/O module. Additional menu items are available in the context menu: **Write parameters on current page** Write parameters on the current page in IO-Link master **Write All Parameters** Write all parameters in IO-Link master **Load User Settings** Load user settings **Save As User Settings** Save user settings
	**[Data Frame]**	Set process image size. The Mailbox size cannot be changed (see the following section).
	**[Events]**	Opens diagnostic and event messages (see section "Events").
	**[Options]**	Opens a dialog to set actions at application startup and exit (see section "Options")
	**[Help]**	Opens the WAGO-I/O-*CHECK* online help.

9.1.1.2.1 Data Frame

To set the data width of the internal bus, press the **[Data Frame]** button. By default, the data width is 4 bytes.

Which internal bus data width makes sense depends on the respective application. It should be noted that minimum 4 bytes of the maximum 24 available are already allocated. If you connect IO-Link devices that process more than 1 bit of process data, then set the data width of the internal bus to a value greater than 4 bytes.

The Mailbox begins with an offset of 1 (after the control/status byte) in the process image and occupies at least 2 bytes. The Mailbox size can be set to max. x bytes (see the following formula) for configuring the IO-Link master.

x = Process image total size - 1 SIO byte - 1 control/status byte

The Mailbox size is 2 bytes by default. To increase the Mailbox size during the configuration, enter the new required value manually in the respective "Length" input field or use the arrow keys to select the value.

By entering a higher value in the "Length" field (e.g. 6 bytes), the data throughput is increased and the configuration operations are executed faster.

The bigger the Mailbox, the more the process data moves back in the process image of the IO-Link master.

Note

Make sure the offsets are correct in the process image!
When increasing the size of the Mailbox, make sure you adjust the position of the SIO byte and the offsets of the process data slots as required. Use the "AutoCalc" function in WAGO-I/O-*CHECK* to determine and write the new values to the IOL master.

Note

Reset the Mailbox size after configuration!
Reset the Mailbox size after the configuration to the original value.
If the Mailbox size is not reset, Mailbox data may overlay important process data.

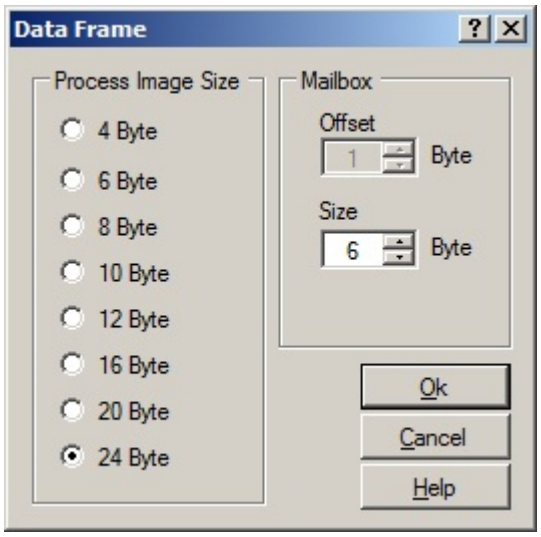


Figure 19: Setting the process image size

Table 18: Setting the process image size

Option	Description
Process Image Size	
4, 6, 8, 10, 12, 16, 20 or 24 Byte	Setting the process image size
Mailbox	
Offset [Byte]	Offset for the Mailbox start (can be changed)
Size [Byte]	Mailbox size (can be changed)
[Ok]	Save the process image size set
[Cancel]	Close window without saving
[Help]	Opens the WAGO-I/O-*CHECK* online help

9.1.1.2.2 Options

Click the **[Options]** button to set actions at application startup, exit and timeout.

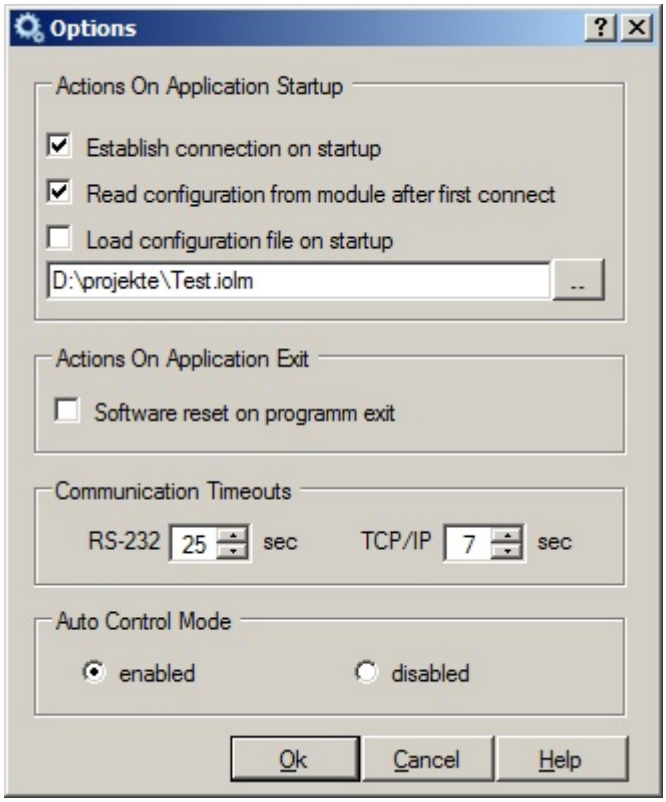


Figure 20: Set options

Table 19: Set options

Option	Description	
Actions On Application Startup		
Establish connection on startup	☑	A connection is established automatically on startup of the configuration dialog.
	☐	The connection is established only after clicking **[Connect]**.
Read configuration from module after first connect	☑	Configurations are automatically read and displayed after the first connection. When a new connection is established, the configuration is only read by clicking the **[Read]** button.
	☐	Configurations are only read by clicking the **[Read]** button.
Load configuration file on startup	☑	Load an existing configuration file created previously by clicking the **[Save]** button.
	☐	Do not load a configuration file.
Actions On Application Exit		
Software reset on program exit	☑	Restart the fieldbus coupler/controller after closing the configuration dialog.
	☐	Do not restart after closing the configuration dialog.
Communication Timeouts		
RS-232 ___ sec	Time during which a response is expected after sending the command via RS-232 interface or TCP/IP before the next command is sent.	
TCP/IP ___ sec		
Auto Control Mode		
The "Auto Control Mode" is used to switch write access to the process image on or off. **Recommended:** Depending on the fieldbus coupler/controller used and corresponding firmware, performance can be increased by switching the "Auto Control Mode" off when not needed.		
switched on	◉	Write access to process image ON
switched off	○	Write access to process image OFF
[Ok]	Save the settings made.	
[Cancel]	Close window without saving	
[Help]	Opens the WAGO-I/O-*CHECK* online help	

9.1.1.2.3 Events

To display Mailbox events, diagnostic and error messages of the IO-Link master, click **[Events]**. Two tabs are available to switch between "Mailbox Events" and "Diagnoses/Errors".

The toolbar in the "Events" dialog includes the following buttons:

Figure 21: Toolbar buttons

Table 20: Toolbar buttons

Button	Function	Description
	[Close]	Closes the message window.
	[Refresh]	Refreshes the list of messages.
	[Show/hide data column]	Shows/hides the "Data" column.
	[Save]	Saves all messages previously logged to a file.
	[First Entry]	Go to the first entry.
	[Last Entry]	Go to the last entry.
	[Clear List]	Clears the current list of messages. (Click **[Refresh]** to display the data again.)
	[Help]	Opens the WAGO-I/O-*CHECK* online help.

9.1.1.2.3.1 Mailbox Events

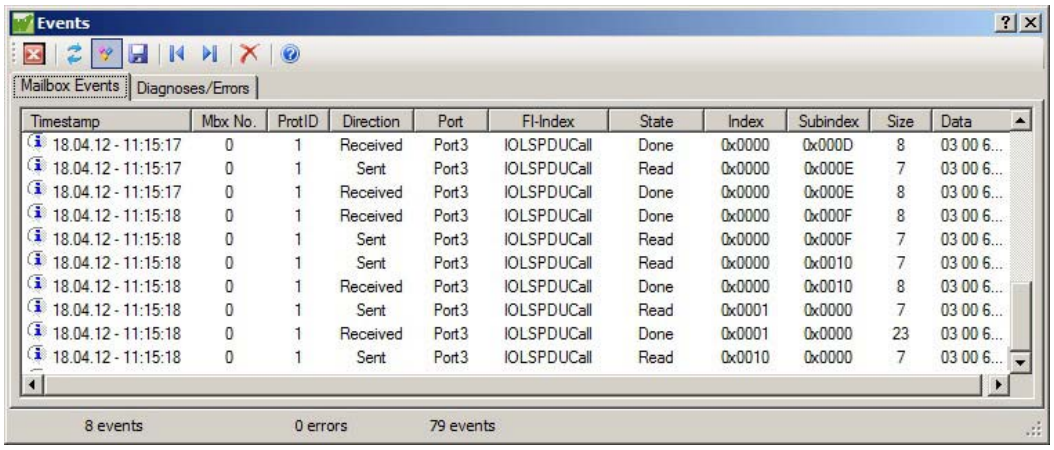


Figure 22: Display of Mailbox events

Table 21: Display of Mailbox events

Option	Description
Timestamp	Timestamp of the Mailbox events
Mbx No.	0 Acyclic channel 1,2,3,4 Fragmentation service
ProtID	Protocol ID 0 IOL_PD 1 IOL_CALL 2 IOL_DIAG
Direction	Data direction: “Received“, “Sent“
Port	Master or device
FI-Index	Specification of the record to be accessed (see section "FI_Index")
State	Status: “Init“, “Sync“, “Ready“, “Done“
Index	Index (see table "Access to Data Areas") 0x100 IOL-M Basic configuration 0x200 IOL-M Port 1 0x300 IOL-M Port 2 0x400 IOL-M Port 3 0x500 IOL-M Port 4 0x1000 Command register
Subindex	IOL subindex (if device event)
Size	Size of the telegram
Data	Display of the telegram data

9.1.1.2.3.2 Diagnoses/Errors

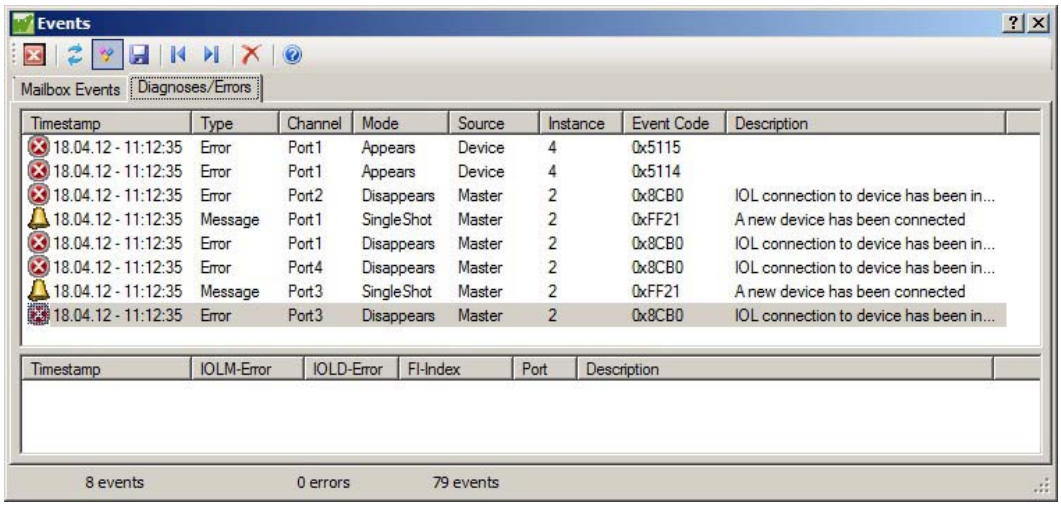


Figure 23: Display of diagnostic and error messages

Table 22: Display of diagnostic and error messages

Option	Description
Timestamp	Message timestamp
Type	Message type: “Error”, “Warning” or “Message”
Channel	Master, Port 1, Port 2, Port 3, Port 4
Mode	Unconfirmed message “Single shot“, “Appear“, “Disappear“
Source	Master/Appl. or Device
Instance	Event instance: 0: Unknown 1: Physical layer 2: Data link layer 3: Application layer 4: Application
Event Code	Event code hexadecimal (see table "Event Codes of the IO-Link Masters")
Description	Description of the diagnostic message or event
IOLM-Error	IOL master error code (see section "Error Messages")
IOLD-Error	IOL device error code (see section "Error Messages")
FI-Index	Specification of the record to be accessed (see section "FI_Index")
Port	Master, Port 1, Port 2, Port 3, Port 4

Diagnostic and error messages are also displayed at the bottom of the window on the configuration pages.

9.1.1.3 Register “Master Configuration“

The base configuration of the IO-Link master appears in the "Master Configuration" tab. In addition, you can set the fragmentation for the ports.

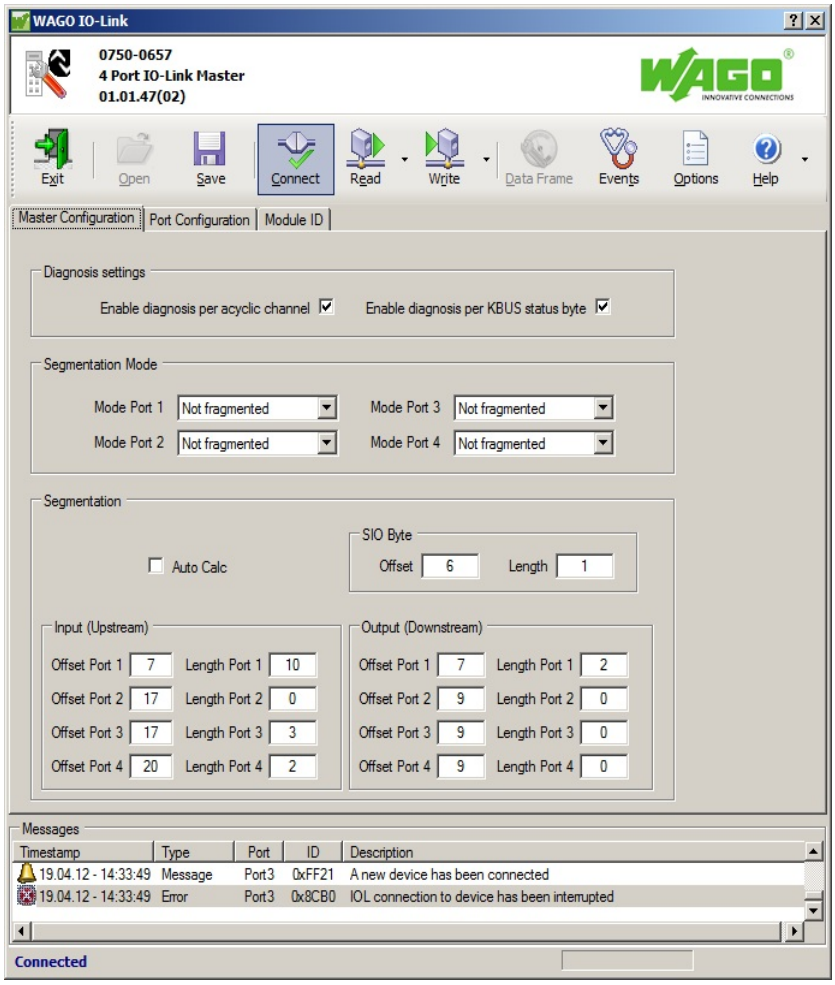


Figure 24: Register “Master Configuration“

Table 23: Register “Master Configuration“

Option	Description
Diagnosis settings	
Enable diagnosis per acyclic channel	☑ Switch on acyclic diagnosis via the Mailbox
	☐ Switch off acyclic diagnosis via the Mailbox No diagnosis events of the IO-Link master (Notice: Not those of the attached devices!) are sent via the acyclic channel to the control. The diagnosis of the IO-Link master and the individual ports are to be viewed separately.
	Note **Do not use acyclic diagnosis in connection with a PROFIBUS coupler!** Do not enable acyclic diagnosis via WAGO-I/O-*CHECK* if using a PROFIBUS coupler. The GSD/GSE file is used for this purpose.
Enable diagnosis per KBUS status byte	☑ Switch on cyclic diagnosis via the status byte
	☐ Switch off cyclic diagnosis via the status byte Error states of the I/O module and attached devices are no longer displayed in the status byte.
	Note **No display in the status byte when diagnosis is off!** If diagnosis is disabled, important diagnostic messages from attached devices may not longer appear in the status byte.
Segmentation Mode	
Modus Port x	**fragmented** Enable fragmentation of the respective port.
	not fragmented Disable fragmentation of the respective port.
Segmentation	
Auto Calc	☑ Offset in the Input/Output area is automatically calculated (in bytes) from the port lengths entered. That the total process image size is not exceeded is checked. The total process image size is compared to the process image size from the respective IODD (if the port configuration has already been read once).
	☐ Offset in the Input/Output area must be manually entered (in bytes).
SIO Byte	
Offset	Position of the SIO byte in relation to the control/status byte (SIO-Byte = 1st byte after Mailbox bytes) (parameters readable only)
Length	Position of a port segment in relation to the control/status byte (length of the SIO-Byte = 1 byte) If "Auto Calc" is enabled, tooltips are displayed when there are entries that do not fit. • "Length differs from value of selected device (xx Byte)"→ If the length differs from the value of a selected IODD. • "Length has to be 1 byte minimum for fragmentation" → If a length of "0" is entered, but the port is set to Fragmentation. • "Input/Output configuration (xx byte) exceeds available process data length of yy byte" → If the lengths entered exceed the total process image size set.
	Note **SIO byte is after the Mailbox byte!** Note when calculating the offset that the SIO byte is after the last Mailbox byte.

Data Direction Control → I/O Module

Table 24: Register “Master Configuration”

Option	Description
Output (Downstream)	
Offset Port x	Position of a port segment in relation to the control/status byte
Length Port x	Set the length of a port segment in bytes.

Table 25: Internal bus process data, Example of a segment distribution with a 2-byte Mailbox size

Byte / Offset	**0**	**1**	**2**	**3**	**Offset = 4**	**Offset = 7**	**Offset = 9**	**Offset = 14**	**21**	**22**	**23**
Content	Control byte / status byte	Mailbox / Reg.ister comm.	Mailbox / Register comm.	SIO byte	Segment Port 1 Segment Port 1 Segment Port 1	Segment Port 2 Segment Port 2	Segment Port 3 Segment Port 3 Segment Port 3 Segment Port 3 Segment Port 3	Segment Port 4 Segment Port 4 Segment Port 4 Segment Port 4 Segment Port 4 Segment Port 4 Segment Port 4	Unused, 0x00	Unused, 0x00	Unused, 0x00
Segment length					Size = 3	Size = 2	Size = 5	Size = 7			

A few rules must be followed during segmentation:

- **The smallest value for Offset is 4.**
  The first 4 bytes of the internal bus process image are already occupied by the status/control byte, at least two Mailbox bytes and the SIO byte.

- **Segments may not overlap**
  Segments can only lie next to each other.

- **Offset + port segment length must lie within the internal bus**
  The width of the internal bus process image must be configurable within 4, 6, 8, 10, 12, 16, 20 and 24 bytes.

Data Direction I/O Module → Control

Table 26: Register “PI Segmentation”

Option	Description
Input (Upstream)	
Offset Port x	Position of a port segment in relation to the control/status byte
Length Port x	Set the length of a port segment in bytes.

9.1.1.4 Register “Port Configuration“

The setting options in the "Port Configuration" tab are identical for all ports. The tabs at the top of the window are used to switch between ports 1 to 4.

One IODD (description files standardized by the manufacturer), which contains the available parameters of the IO-Link, can be assigned to each of the 4 ports and each attached IO-Link device.

Note

Save IODD files in a specific directory!
So that IODD files are displayed under "Port Configuration", save them in the following path:

For Windows XP:
C:\Documents and Settings\All Users\Common Files\WAGO Software

For Windows 7:
C:\Users\Public\Documents\WAGO Software

Note

Only assign the IODD when the IO-Link master is not connected!
If the IO-Link master is connected, i.e. the **[Connect]** button is active in the toolbar, the IODD cannot be selected.
Disconnecting the IO-Link master enables the drop-down field to select the IODD.

Click the **[Read]** button in the toolbar to read the respective port configuration.

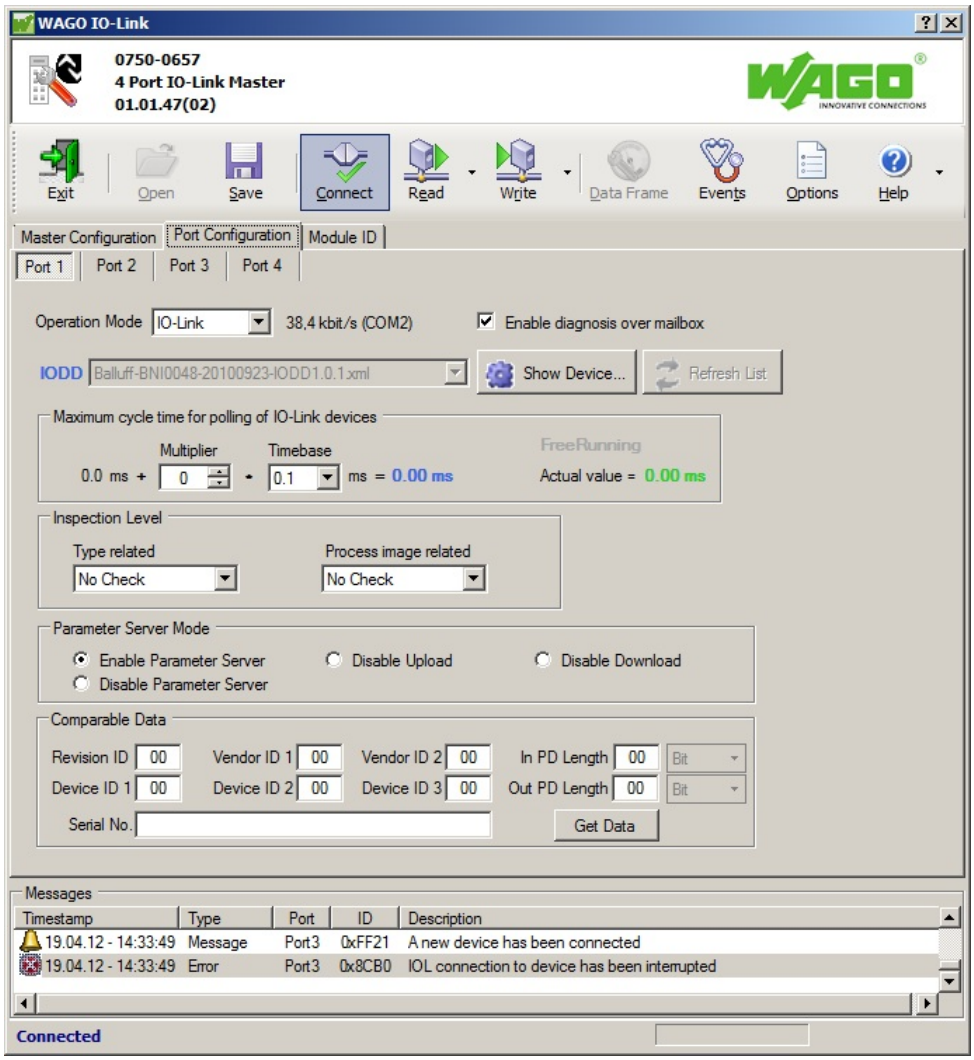


Figure 25: Register “Port Configuration“

Table 27: Register “Port Configuration”

Option	Description
Operation Mode	Select operating mode:
	IO-Link Operating mode for connecting an IO-Link-enabled device to a port
	DI Port functions at a type 1 input according to IEC 61131-2. The input is cyclically queried by the IO-Link master. The data is transferred via the internal bus to the higher level control. **NOTICE** **Ensure that the sensor is connected properly!** The I/O module can be destroyed if the sensor is not connected properly in "DI" mode.
	DO The port behaves like a standard digital output. The maximum output current is 100 mA. **NOTICE** **Ensure that the actuator is connected properly!** The I/O module can be destroyed if the actuator is not connected properly in "DO" mode. **Note** **I/O module can be destroyed!** A short circuit or over-current (> 250 mA) causes the output to switch off. The I/O module automatically attempts to activate the output again. If unsuccessful, the output remains off.
	Inactive The port is disabled and ignored by the internal device software.
Transfer rate	Display of the transfer rate and COM port, e.g. 38.4 kbit/s (COM2)
Enable diagnosis over mailbox	☑ Enable port diagnosis via the Mailbox
	☐ Disable port diagnosis via the Mailbox
IODD	Select the device description file IODD (the **[Connect]** button may not be active)
[Show Device…]	Display IODD of the attached device in the new window (can only be selected with IO-Link-enabled devices), see the following section.
[Refresh List]	Refresh the list if new IODD has been added to the folder.
Maximum cycle time for polling of IO-Link devices	
The master cycle time describes the minimum cycle time, in which the IO-Link master queries the attached IO-Link devices. Set for multiplier and timebase values. The resulting cycle time appears as the result of the term directly.	
Multiplier	Set multiplier for the master cycle time (“0” = FreeRunning)
Timebase	Set timebase Depending on the "Timebase" value set, calculation of the master cycle time changes: 0,1 ms → 0,0 ms + MULTIPLIER * TIMEBASE 0,4 ms → 6,4 ms + MULTIPLIER * TIMEBASE 1,6 ms → 32,0 ms + MULTIPLIER * TIMEBASE
Actual value	Displays the current value in milliseconds.

Table 27: Register “Port Configuration”

Option	Description	
Inspector Level		
The "Inspector Level" indicates which parameters of an attached IO-Link device have to match those of the current port configuration to be recognized as valid.		
Type Related	**No Check**	Whether the parameters match is not checked. A device is always recognized as valid (for this part).
	Compatible	The following fields of the attached IO-Link device have to match those of the port configuration: Device ID, Vendor ID.
	Identical	The following fields of the attached IO-Link device have to match those of the port configuration: Device ID, Vendor ID and Serial Number. A unique device serial number is required for valid device recognition.
Process Image related	**No Check**	Whether the parameters match is not checked. A device is always recognized as valid (for this part).
	PD Length Strict	The lengths for the process input and output data of an IO-Link device have to match those saved in the I/O module. Otherwise, the device is classified as invalid.
	PD Length Loose	The process data lengths of the IO-Link master must be equal to or smaller than the buffer size, which provides the I/O module for the IO-Link device.
Parameter Server Mode	**Enable Parameter Server**	Parameter server enabled (factory setting)
	Disable Parameter Server	Parameter server disabled
	Disable Upload	Prevents parameter upload: The upload request of the IO-Link device is suppressed by the I/O module.
	Disable Download	Prevents parameter download: The download request of the control is not sent to the IO-Link device by the I/O module.
Comparable Data		
"Comparable Data" describes data of the devices attached to the ports. This data is only needed for validation when starting a device.		
Revision ID	Version number of the SDCI protocol, which is supported by the IO-Link device.	
Vendor ID 1	Manufacturer ID of the attached device (top byte)	
Vendor ID 2	Manufacturer ID of the attached device (bottom byte)	
Device ID 1	Device ID of the attached device (top byte)	
Device ID 2	Device ID of the attached device (middle byte)	
Device ID 3	Device ID of the attached device (bottom byte)	
In PD Length	Size and structure of the process input data of the IO-Link device	
Out PD Length	Size and structure of the process output data of the IO-Link device	
Serial No.	Unique serial number of the attached device	
[Get Data]	Reads the current data of the device attached to the port	

Application parameter upload:
The IOL-D parameters are uploaded to the parameter server of the IO-Link master if the device parameters have been changed.
This occurs either "remotely" via the bus or "locally" on the device.

Application parameter download:
When uploading to the IO-Link device, the master checks the identity of the device. (DeviceID, VendorID, SerialNumber).
When successful, the parameter server synchronizes the parameters:

- For devices without ISDU support, parameters are always downloaded.
- For devices with ISDU support, parameters are only downloaded if the checksums do not equal the parameter sets.

9.1.1.4.1 IODD View of Ports 1 to 4

The IODDs of the attached devices are displayed in a separate window, which is opened by clicking **[Show Device…]** button.
Information from the respective IODD of the attached devices appears in this window.

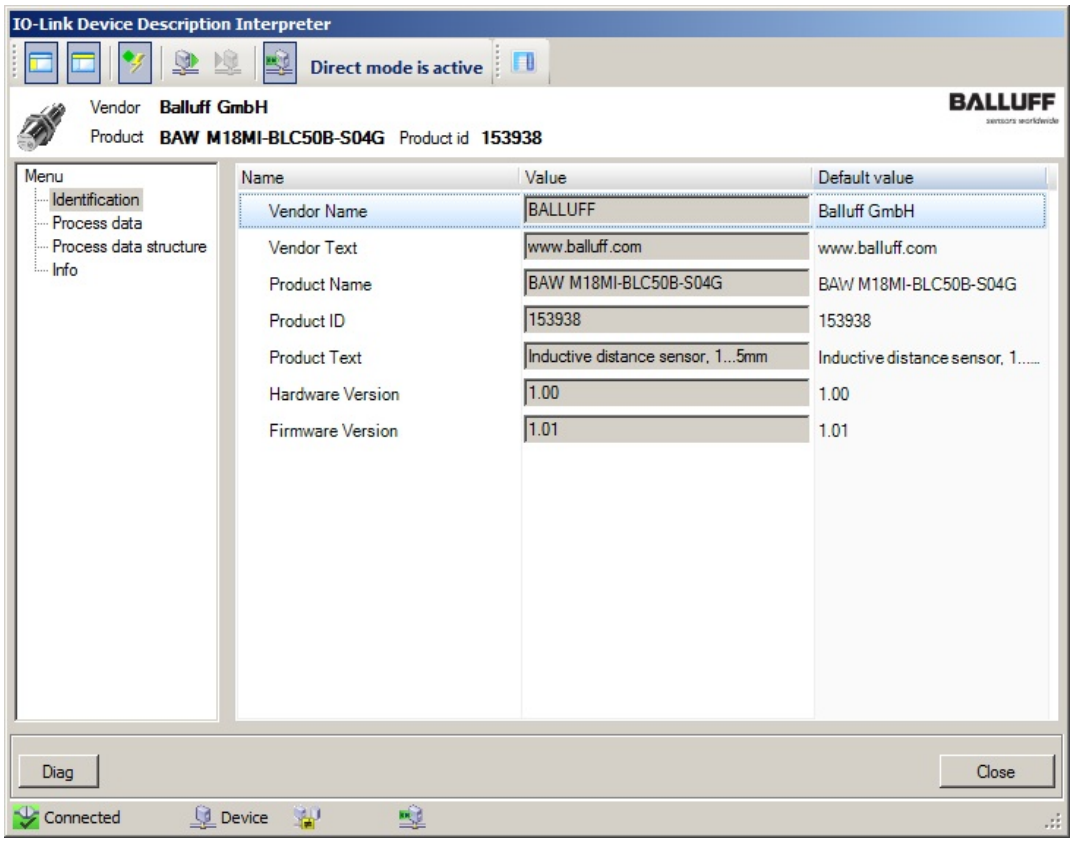


Figure 26: IODD data of the respective ports

The entries of the displayed menus on the left side and the displayed content are IODD-specific and vary by each device.

The buttons above the product image are part of the IODD interpreter, which is integrated in WAGO-I/O-*CHECK*. These buttons are identical for each IODD displayed:

Table 28: IODD interpreter buttons

Button		Description
1		Toggle visibility of the navigation area, display menu
2		Toggle visibility of the identification area
3		Switch between display of the instance record (online, shown in green) and the device record (offline, shown in gray)
4		Load instance record
5		Save instance record
6		Upload device record from the device to the instance record
7		Download instance record to the device record
8		Enable/disable direct mode: All values are saved directly when enabling. When disabling direct mode, the values must be individually saved by clicking button 5 or 7 (only available when switch 3 was used to bring the device online).
9		Show minimum/maximum value

9.1.1.5 Register “Module ID“

Information about the IO-Link master appears in the "Module ID" tab. In addition to reading the I&M0 record, there is read/write access to records I&M1 to I&M4.

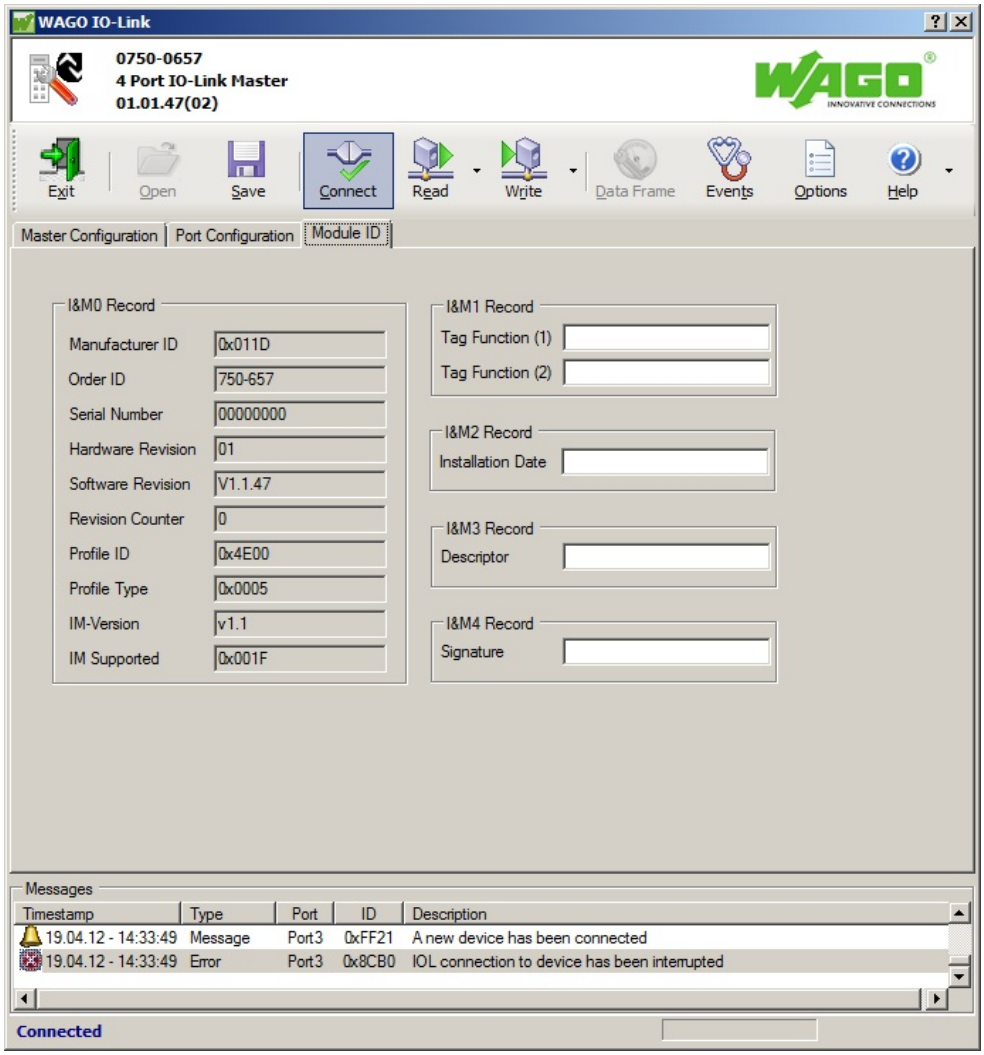


Figure 27: Register “Module ID”

Table 29: Register “Module ID“

Option	Description
I&M0 Record	
Manufacturer ID	Unique manufacturer ID
Order ID	Order ID
Serial Number	Serial number of the I/O module
Hardware Revision	Hardware version number
Software Revision	Software version number
Revision Counter	Revision counter of the IO-Link master (not currently supported, read request returns 0x0000)
Profile ID	IO-Link
Profile Type	Interface module
IM-Version	I&M version
IM-Supported	I&M supported
I&M1 Record	
Tag Function (1)	Data storage area (ASCII format) for free use (Can be used for e.g. saving the installation date.)
Tag Function (2)	Data storage area (ASCII format) for free use (Can be used for e.g. device names or location information.)
I&M2 Record	
Installation Date	Data storage area (ASCII format) for free use (Can be used for e.g. saving the installation date.)
I&M3 Record	
Descriptor	Data storage area (ASCII format) for free use (Can be used for e.g. saving the installation date.)
I&M4 Record	
Signature	Data storage area (ASCII format) for free use (Can be used for e.g. saving the installation date.)

The parameters listed here are described in detail in the appendix, section "IO-Link Master Tables".

9.2 Startup with WAGO-I/O-*PRO*

The WAGO-I/O-*PRO* library "WagoLib_IO_Link.lib" provides the option to start up the IO-Link master using the corresponding function blocks. In addition to configuring the IO-Link master, communication is also possible via parameter access service "IOL_CALL" (see appendix, section "Mailbox 2.0 Transmission Method") with attached IO-Link devices, with which the IO-Link devices can be configured and parameterized.

IO-Link-specific diagnostic messages can also be displayed. If process data of an IO-Link device is fragmented, the data can be defragmented using function blocks.

Note

Library cannot be used to set the process image size!
The WAGO-I/O-*PRO* library "WagoLib_IO_Link.lib" is not used to set the process image size.

Information

Additional Information
The WAGO-I/O-*PRO* library "WagoLib_IO_Link.lib" and a detailed description are available on the Internet at http://www.wago.de → Service → Downloads → AUTOMATION → Libraries.

10 Diagnostics

The IO-Link master provides two options for diagnosis and event handling – via the status byte and the Mailbox.

Diagnosis via PROFIBUS coupler is found in the appendix in section "Fieldbus-Specific Additions" > "PROFIBUS" > "Diagnosis When Using a PROFIBUS Coupler".

10.1 Diagnosis via the Status Byte

If register communication is disabled (bit 7 in the control byte = 0), status information of the I/O module and IO-Link ports is displayed via the status byte.

Table 30: Status byte

Status byte							
Bit 7	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
0	GEN_ ERR	PORT4_ ERR	PORT3_ ERR	PORT2_ ERR	PORT1_ ERR	IOLM_ ERR	INT_ ERR
1	Res.	Register number of the request (mirrored)					

(Bit 7)	0	Mailbox active
	1	Register communication active
GEN_ERR	0	No error
	1	Error is pending. Set when one of the bits 0…5 = 1.
PORT4_ERR	0	The device attached to port 4 is not in the fault condition.
	1	The device attached to port 4 is in the fault condition.
PORT3_ERR	0	The device attached to port 3 is not in the fault condition.
	1	The device attached to port 3 is in the fault condition.
PORT2_ERR	0	The device attached to port 2 is not in the fault condition.
	1	The device attached to port 2 is in the fault condition.
PORT1_ERR	0	The device attached to port 1 is not in the fault condition.
	1	The device attached to port 1 is in the fault condition.
IOLM_ERR	0	The IO-Link master is not in the fault condition.
	1	The IO-Link master is in the fault condition.
INT_ERR	0	No internal errors
	1	Internal error. Possible causes: • 24V field supply missing • Communication via mailbox and process data faulty.

10.2 Diagnosis via the Mailbox

In addition to configuration and parameterization, the Mailbox is also used for the diagnosis.

If not disabled, diagnoses of the attached IO-Link devices and those of the I/O modules are transferred via the "IOL_DIAG" diagnostic service (see the following section) of the Mailbox to the control. The WAGO-I/O-*PRO* library "WagoLib_IO_Link.lib" provides the required function blocks to process the diagnostic messages.

10.2.1 Diagnostic Telegram

The basic structure of the diagnostic telegram is determined by the function profile for IO-Link, which is defined for PROFIBUS in "IO-Link Integration Part1-2812". A diagnosis is transferred via the Mailbox using the "IOL_DIAG" diagnostic service.

For diagnostic purposes, the IO-Link master provides FIFO memory for 40 diagnostic messages. An FIFO is a buffer, in which the first element in the queue (First In) is also processed first (First Out). If the memory is filled with one or more diagnostic telegrams, diagnostic telegrams are sent as until the FIFO is empty. Confirmation from the control is not required. Upon overflow, the I/O module discards incoming diagnostic telegrams.

The diagnostic telegram from the IO-Link master to the control is structured as follows:

Table 31: Diagnostic telegram

Byte	**0**	**1**	**2**	**3**	**4**	**5**
Content	Service ID	Sequence ID	Event Code		Channel Number	Event Qualifier

Service ID	0x00	Cancel_DiagMsg_Request
	0x01	Idle_Request
	0x02	Send_DiagMsg_Request
	0x03 …0xFF	Reserved
Sequence ID	0x00…0xFF	Used to distinguish successive requests and to assign to the response
Event Code	0x0000…0xFFFF	Event code of the diagnostic message (see the following section)
Channel Number	0x00	IO-Link master
	0x01	Port 1
	0x02	Port 2
	0x03	Port 3
	0x04	Port 4
	0x05…0xFF	Reserved
Event Qualifier	Bit 7…Bit 6	Event mode: 0x0: Reserved 0x1: Single Shot 0x2: Event disappears 0x3: Event appears
	Bit 5…Bit 4	Event type: 0x0: Reserved 0x1: Information 0x2: Warning 0x3: Error
	Bit 3	SOURCE 0 Device application (remote) 1 Master application (local)
	Bit 2…Bit 0	Event instance: 0x0: Unknown 0x1: Physical Layer 0x2: Data Link Layer 0x3: Application Layer 0x4: Application 0x5 – 0x7: Reserved

10.3 Event Codes

In IO-Link, errors and events are displayed in the form of a value of type "UNSIGNED16". In addition to default values, device manufacturers are also allowed to use device or manufacturer-specific codes according to the IO-Link standard. Therefore, a distinction is made in this section between event codes generated by the IO-Link master itself and event codes generated by attached devices if necessary.

10.3.1 Event Codes of the IO-Link Masters

Table 32: Event codes of the IO-Link master

Code (hex)	Type	Mode	PB Error Code	Description	Particular behavior of the I/O module
				Possible cause(s)	**Possible response(s)**
6320	E	Single	-	Event code (PARAMETER_ERROR) from an attached IO-Link device for which there is no detailed information	
8CA2	E	Come / Go	9	PDU checksum error	I/O module attempts to reconnect.
8CB0	E	Come / Go	6	IO-Link connection interrupted	
				Connection error or removal of an IO-Link device	1. Check IO-Link connection 2. Check IO-Link device
8CB2	E	Come / Go	9	Port configuration does not match the attached device.	
					1. Check if a port inspection level is activated. Check for correctness. 2. Check master/slave cycle times. 3. Process data check is enabled and delivers incorrect values. Check for correctness.
8CB3	W	Single	-	Attached device does not respond.	I/O module attempts to reconnect.
				Connection problem or an error in the attached device	1. Check IO-Link connection. 2. Check IO-Link device.
8CB4	E	Come / Go	1	1. Short circuit detected on the port. 2. Low voltage For 1: Defective line, device defective. For 2: Field supply too low	
					1. Check line, check attached device. 2. Check field supply.

Table 32: Event codes of the IO-Link master

Code (hex)	Type	Mode	PB Error Code	Description Possible cause(s)	Particular behavior of the I/O module Possible response(s)
8CB8	N	Single	-	Port was disabled.	Check if disabling the port was intended. Check port configuration.
8CB9	N	Single	-	A fallback command was sent to the device. Possible port switch from IO-Link to DI	
8CBA	N	Single	-	State transition to PRE-OPERATE	
8CBB	N	Single	-	Connection to device established. Parameter server ready.	
8CBC	W	Single	-	Vendor ID of the request does not match the ID in the record.	Check vendor ID.
8CBD	W	Single	-	Data volume larger than available memory resources of the EEPROM	Contact WAGO Support.
8CBE	W	Single	-	Error uploading to the parameter server Checksum error during the ISDU transfer, error in the ISDU telegram	Check ISDU telegram.
8CBF	W	Single	-	Error downloading from the parameter server Checksum error during the ISDU transfer, error in the ISDU telegram	Check ISDU telegram.
8CC3	E	Single	-	1. New port mode corresponds to the new one and new master cycle time corresponds to the old one. 2. Problems with the fallback behavior of a device 3. Problems with the master cycle time	Check new port configuration.
8CC6	E	Come / Go	9	Frequency of event generation is too high. Data loss possible.	Reduce the frequency of event generation.

Table 32: Event codes of the IO-Link master

Code (hex)	Type	Mode	PB Error Code	Description	Particular behavior of the I/O module
				Possible cause(s)	**Possible response(s)**
8CC7	W	Single	-	1. Process data width of the attached device is greater than the associated segment in the internal bus process data. 2. SIO byte and port segment have a size of 0 and port is in DI, DO or SIO operating mode.	
					1. Change segment size to process data width. 2. Change SIO byte to length 1.
8CC8	N	Single	-	If a port-specific diagnosis is disabled, this event appears.	
FF21	N	Single	-	New IO-Link device connected.	
FF22	N	Single	-	IO-Link connection interrupted.	
				Device removed or connection error	Check connection if disconnection unintended.
FF80	N	Single	-	No detailed information available about device.	

Type N	Notification
Type W	Warning
Type E	Error

10.3.2 Event Codes of Attached Devices

The following list provides an overview of event codes according to the IO-Link specification. Which of these event codes are supported by the attached IO-Link device is defined in the respective device documentation or device-specific IODD.

Table 33: Error codes acc. IO-Link specification

Code hex.	Description	Device State	Type
0000	No malfunction	0	N
1000	General malfunction – unknown error	4	E
1001 – 17FF	Reserved		
1800 – 18FF	Manufacturer / vendor specific		
1900 – 3FFF	Reserved		
4000	Temperature fault – Overload	4	E
4001 – 420F	Reserved		
4210	Device temperature over-run – Clear source of heat	2	W
4211 – 421F	Reserved		
4220	Device temperature under-run – Insulate Device	2	W
4221 – 4FFF	Reserved		
5000	Device hardware fault – Device exchange	4	E
5001 – 500F	Reserved		
5010	Component malfunction – Repair or exchange	4	E
5011	Non volatile memory loss – Check batteries	4	E
5012	Batteries low – exchange batteries	2	W
5013 – 50FF	Reserved		
5100	General power supply fault – Check availability	4	E
5101	Fuse blown/open – Exchange fuse		
5102 – 510F	Reserved		
5110	Primary supply voltage over-run – Check tolerance	2	W
5111	Primary supply voltage under-run – Check tolerance	2	W
5112	Secondary supply voltage fault (Port Class B) – Check tolerance	2	W
5113 – 5FFF	Reserved		
6000	Device software fault – Check firmware revision	4	E
6001 – 631F	Reserved		
6320	Parameter error – Check data sheet and values	4	E
6321	Parameter missing – Check data sheet	4	E
6322 – 634F	Reserved		
6350	Parameter changed – Check configuration	4	E
6351 – 76FF	Reserved		
7700	Wire break of a subordinate device – Check installation	4	E
7701 – 770F	Wire break of subordinate device 1 … device 15 – Check installation	4	E
7710	Short Circuit – Check installation	4	E
7711	Ground fault – Check installation	4	E
7712 – 8BFF	Reserved		
8C00	Technology specific application fault – Reset Device	4	E
8C01	Simulation active – Check operational mode	3	W
8C02 – 8C0F	Reserved		
8C10	Process variable range over-run – Process Data uncertain	2	W
8C11 – 8C1F	Reserved		

Table 33: Error codes acc. IO-Link specification

Code hex.	Description	Device State	Type
8C20	Measurement range over-run – Check application	4	E
8C21 – 8C2F	Reserved		
8C30	Process Variable Range under-run – Process Data uncertain	2	W
8C31 – 8C3F	Reserved		
8C40	Maintenance required – Cleaning	1	N
8C41	Maintenance required – Refill	1	N
8C42	Maintenance required – Exchange wear and tear parts	1	N
8C43 – 8C9F	Reserved		
8CA0 – 8DFF	Manufacturer / vendor specific		
8E00 – AFFF	Reserved		
B000 – BFFF	Reserved for profiles		
C000 – FEFF	Reserved		
FF00 – FFFF	SDCI specific Event codes		

N	Notification
W	Warning
E	Error
Device State 0	Device is OK
Device State 1	Maintenance-Required
Device State 2	Out-of-Specification
Device State 3	Functional-Check
Device State 4	Failure

11 Appendix

11.1 Communication Services of the IO-Link Master

There are basically two different procedures:

1. Acyclic services (see section "Mailbox 2.0 Transmission Method")

2. Cyclic transmission of the process image with or without fragmentation (see section "IOL_PD Fragmentation Service")

While the acyclic service is primarily required for demand or event-based data and commands with no or little real-time requirement, cyclic transmission is intended for transmission of device data as close to real-time as possible. To also transfer larger data volumes with smaller data widths of a port segment, a cyclic fragmentation service is available.

11.1.1 Mailbox 2.0 Transmission Method

Mailbox 2.0 defines a service for full duplex transport via a defined channel.

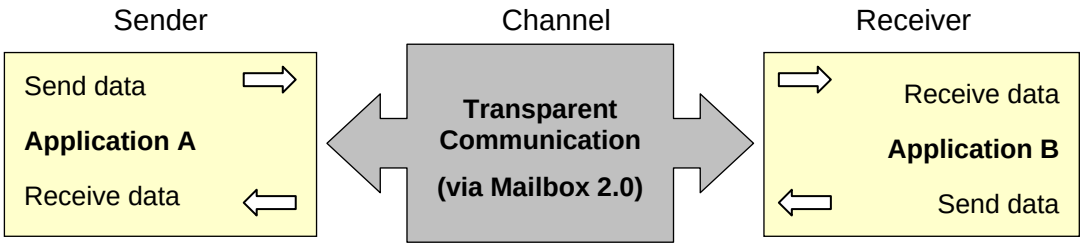


Figure 28: Communication via Mailbox 2.0

Example:
A sender wants to transfer 10 bytes (the character string "Hello Wago") to a receiver via a 4-byte wide channel.

11.1.1.1 Message

The Mailbox 2.0 method packages the data in messages. A message contains a header and user data.

There are two message types.

Message with simple header:

xx	„H“	„e“	„l“	„l“	„o“	„ “	„W“	„a“	„g“	„o“

Message with extended header:

xx	xx	xx	„H“	„e“	„l“	„l“	„o“	„ “	„W“	„a“	„g“	„o“

Structure of the simple header:

Table 34: Structure of the simple header

Simple header							
Bit 7	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
0	Length						

Data element length max. 127 bytes

0: Simple header

Structure of the extended header:

Table 35: Structure of the extended header

Extended header				
Bit 7	**Bit 6**	**Bit 5..0**	**Bit 7..0**	**Bit 7..0**
1	0	Length High	Length Low	Protocol ID

Protocol ID 0..255

Data element length max. 16383 bytes

10: Extended header

A message that uses this header can contain 16383 bytes of user data. In addition, the message can have a protocol ID. This protocol ID allows the message to include a logical meaning.

11.1.1.2 Transmission channel

To transfer a message over a narrow channel, synchronization between sender and receiver is required. Therefore, the transmission channel is divided into a synchronization part and a data part.

For synchronization, a so-called handshake byte (HB) is defined.

The handshake byte occupies the first byte of the transmission channel while part of the message is always delivered in the remaining bytes.

HB	Part of the message

There is always one transmission channel from the sender to the receiver and one transmission channel from the receiver to the sender. Both channels do not have to be the same size. However, the minimum size is 1 byte.

11.1.1.2.1 The Handshake Byte

In general, a distinction is made between Control (C) and Toggle (T) mode (bit 7). The Control mode is used to synchronize the subscribers. The Toggle mode is used to exchange data.

Structure of the handshake byte:

Table 36: Structure of the handshake byte

Handshake byte							
Bit 7	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
Status				**Control**			
C/T	**Response**			**C/T**	**Command**		
	T	**0x0**			**T**	**0x0**	

The following figure shows the basic use of the handshake byte.

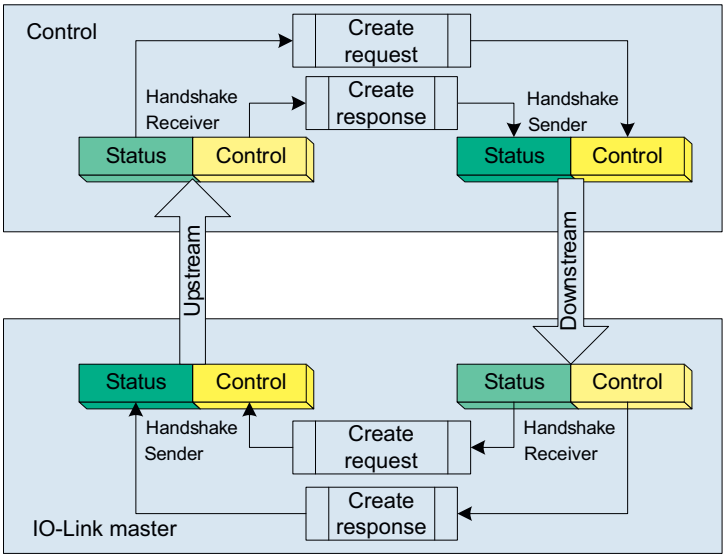


Figure 29: Use of the handshake byte

11.1.1.3 Communication Phases

The Mailbox 2.0 mechanism defines two communication phases:

- Synchronization
- Data exchange

Only after successful synchronization from sender to receiver can the actual user data be exchanged.

11.1.1.3.1 Synchronization

In the synchronization phase, the handshake byte is used in Control mode.

A distinction is made between interpretation as signaling mode and interpretation as command acknowledgement mode.

In command acknowledgement mode, the handshake byte appears as follows:

Status nibble			
Bit 3	Bit 2	Bit 1	Bit 0
0	Acknowledgement		

Control nibble			
Bit 3	Bit 2	Bit 1	Bit 0
0	Acknowledgement		

The Control nibble is used to transfer a request while the Status nibble contains the response to the request.

11.1.1.3.1.1 Mailbox Commands

The following commands are defined:

Table 37: Commands

Value	Meaning	Description
0	INVALID	Signals that the control has not started operations again after a reset.
1	HOLD REQUEST	Notice that the channel is ready, but data is not currently being transferred (e.g. because the send buffer is still empty)
2	RESET REQUEST	Prompt to reset
3..7	-	(not supported, ignore)

11.1.1.3.1.2 Acknowledgement

The following acknowledgements are defined:

Table 38: Acknowledgement

Value	Meaning	Description
0	INVALID	Signals that the IO-Link master has not started operations again after a reset.
1	HOLD ACKNOWLEDGE	Signal or confirmation that the channel is ready, but data is not currently being transferred (e.g. because there is not any data yet).
2	RESET ACKNOWLEDGE	Response to "RESET REQUEST" when Mailbox in reset.
3..7	-	(not supported, ignore)

11.1.1.3.1.3 Signaling

In signal mode, the handshake byte appears as follows:

Table 39: Structure of the handshake byte

Handshake byte							
Bit 7	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
0	0	Signal					

Table 40: Signaling

Value	Meaning	Description
0x00	INVALID SIGNAL	Status of the process image without any effect by Mailbox 2.0
0x32	RESET SIGNAL	Shows that the local Mailbox is in the process of restarting
0x33	ERROR SIGNAL	Shows that the local Mailbox is in the fault condition
(other)	-	Other values are not considered as signals and are processed separately in the Status or Control nibble.

11.1.1.3.1.4 Finite Automation

Synchronization follows the chart below:

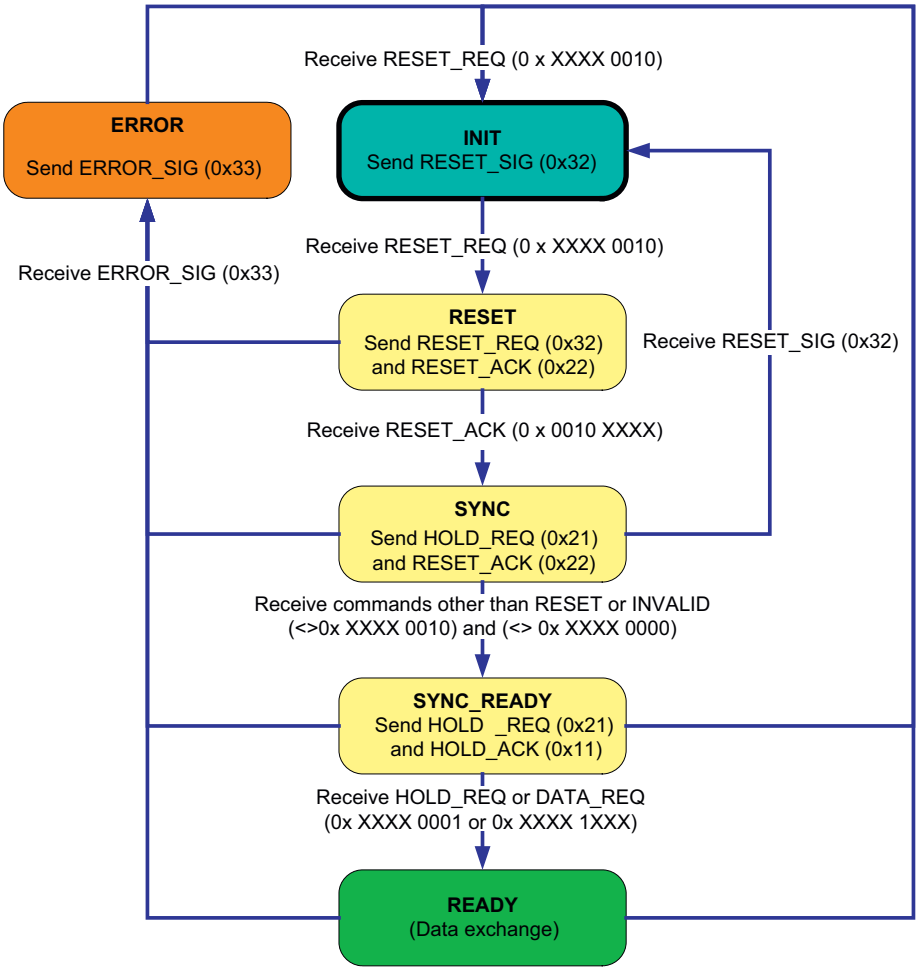


Figure 30: Finite Automation

11.1.1.3.2 Data Exchange

In the data exchange phase, the handshake byte is used in Toggle mode. Because a message is normally larger than the data part of the transmission channel, the message must be transferred in several cycles (fragmentation).

Status nibble			
Bit 3	**Bit 2**	**Bit 1**	**Bit 0**
1	T	0x00	

Control nibble			
Bit 3	**Bit 2**	**Bit 1**	**Bit 0**
1	T	0x00	

Send fragment:

The first toggle bit expected by the IO-Link master after synchronization has the value 0. The toggle bit in the second fragment receives a 1, the toggle bit in the third fragment again a 0, etc. Only when the status of the toggle bit matches in the received status nibble is receipt of the fragment confirmed by the IO-Link master. Only then can a new fragment be sent. As long as there is no confirmation, the fragment remains unchanged in the process image.

For the special case that the content of the send buffer is no longer sufficient to fill the transmission channel completely, the transmission channel is filled with zeros to the end.

Receive fragment:

The control now has to confirm receipt of this fragment. Receipt is confirmed by inverting the toggle bit of the status nibble to be sent.

Because the Mailbox 2.0 mechanism can handle full duplex, sending and receiving can occur simultaneously.

11.1.1.3.2.1 Example

The following example shows use of the transmission channel during a send operation (no full-duplex transmission):

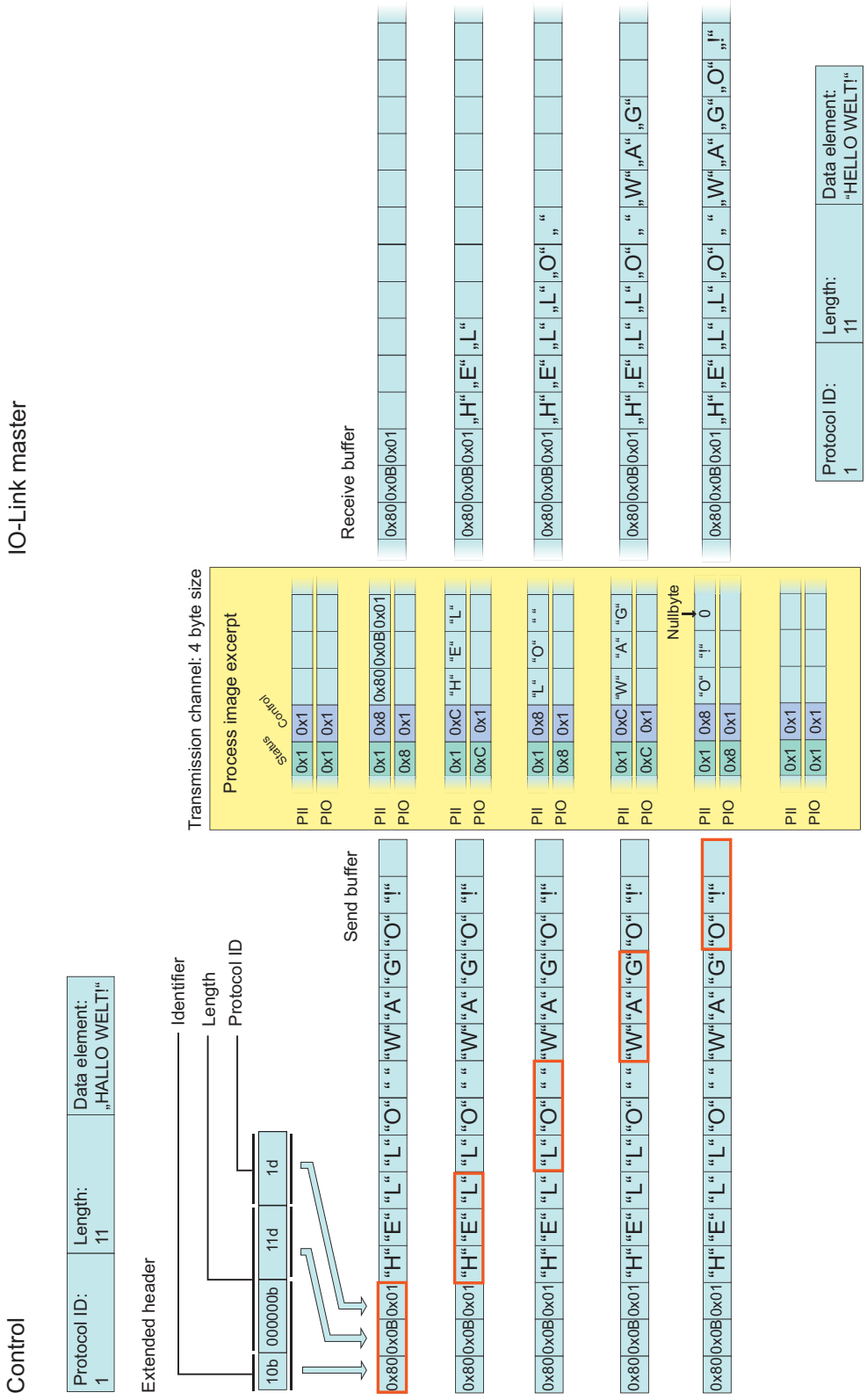


Figure 31: Example of send operation

11.1.2 Communication via Acyclic Services

The IO-Link master has two different I/O module-specific services via the acyclic channel of "Mailbox 2.0" for parameters and diagnosis:

1. **Parameter access service "IOL_CALL":**
   Access to the various data areas in the master or access to the data of the IO-Link devices.

2. **Diagnostic service "IOL_DIAG":**
   Diagnostic messages of the I/O module

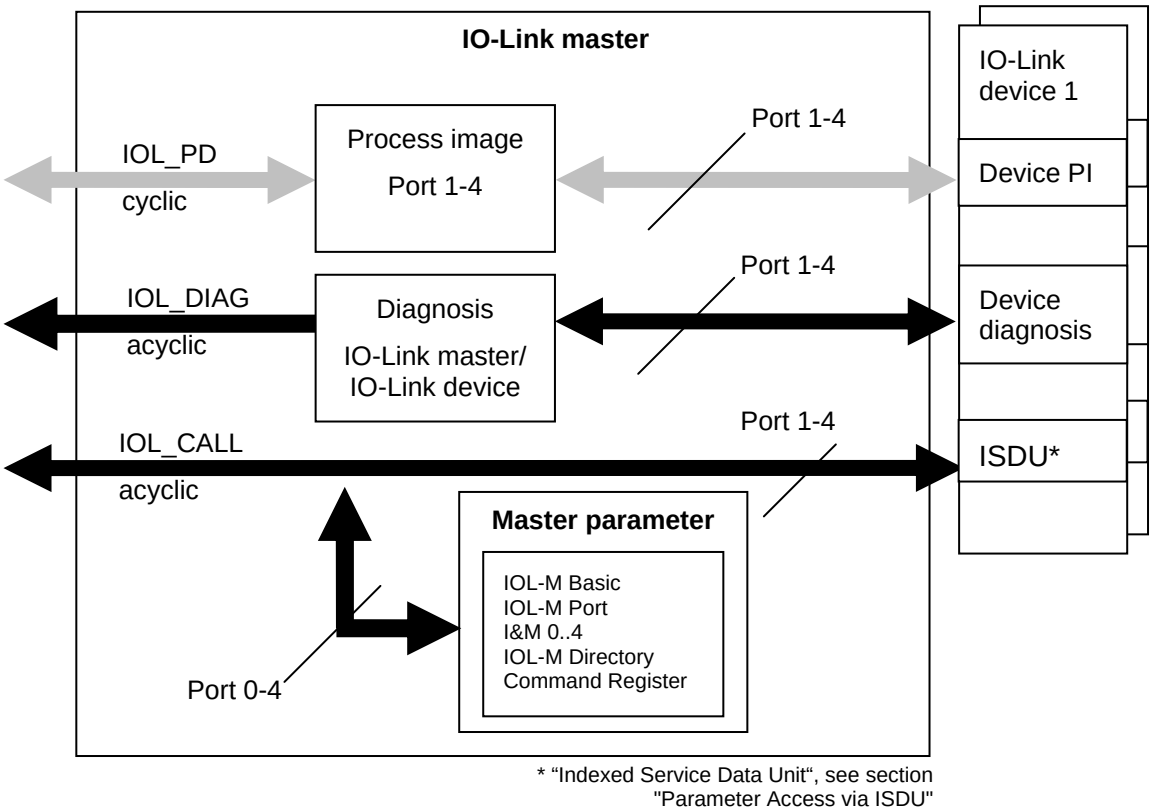


Figure 32: Communication via Acyclic Services

The telegrams are transmitted in the form of a message and structured as follows:

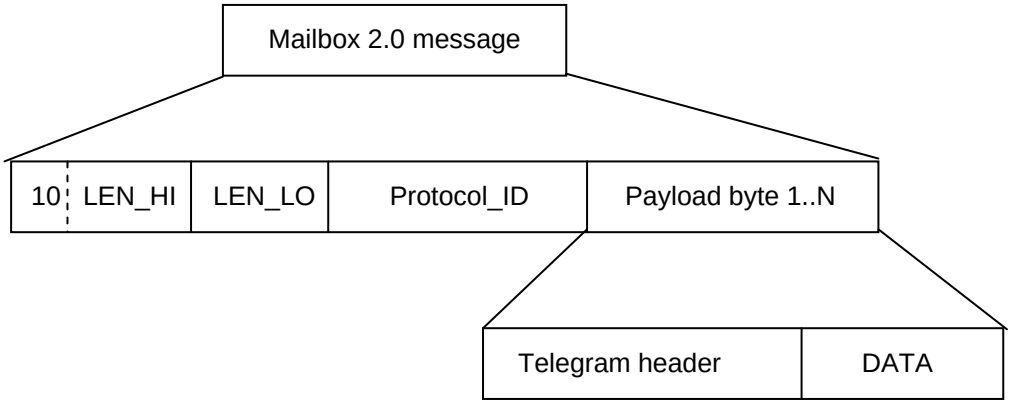


Figure 33: Telegram structure of a Mailbox 2.0 message

11.1.2.1 Parameter Access Service "IOL_CALL"

The "IOL_CALL" service is identified by Mailbox Protocol ID 1.

The message is structured as follows:

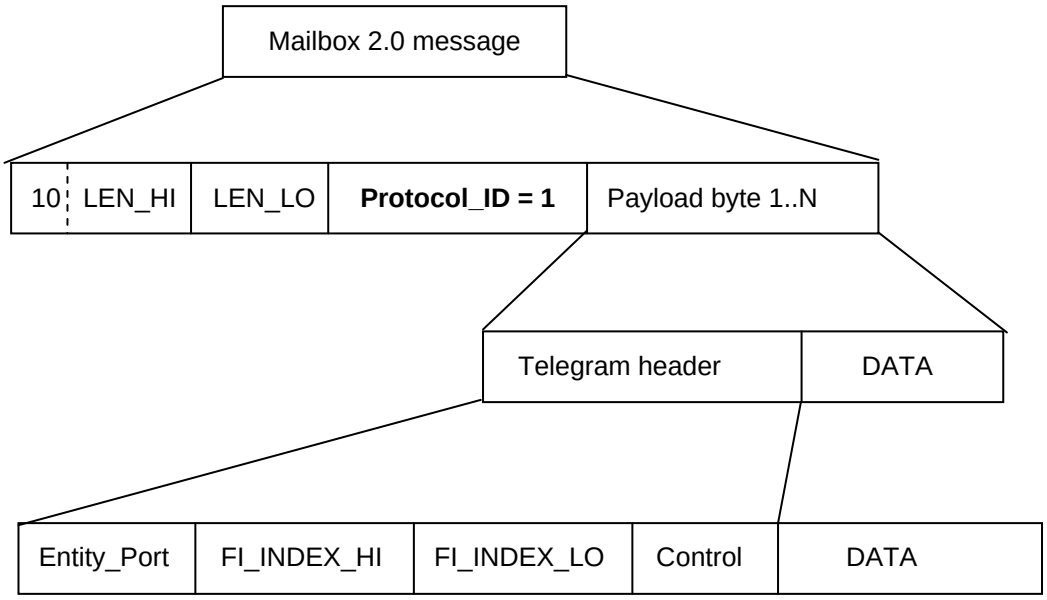


Figure 34: Telegram structure, parameter access with "IOL_CALL"

The data is received as part of request/response communication from the I/O module.

The request is:

Table 41: IOL_CALL, request telegram (header)

Byte	0	1	2	3
Content	Entity_Port	FI_Index		Control/State

The response if there is no error is:

Table 42: IOL_CALL, response telegram if there is no error

Byte	0	1	2	3	4 … 237
Content	Entity_Port	FI_Index		State = 0	Data

The response if there is an error:

Table 43: IOL_CALL, response telegram if there is an error

Byte	0	1	2	3	4	5	6	7
Content	Entity_Port	FI_Index		State = 128 (0x80)	IOL-M_error_code		IOL-D_error_code	IOL-D_add_error_code

11.1.2.1.1 Telegram Header

The fields of the telegram header have the following function:

Table 44: IOL_CALL, Telegram header

Parameter	Data type	Description
Entity_Port	UNSIGNED8	Port number of the request
FI_Index	UNSIGNED16	Function index of the request
Control/State	UNSIGNED8	Control/status byte of the request

11.1.2.1.1.1 Entity_Port

The port number of the receiver is addressed via the "Entity_Port" field.
The structure is shown in the following table:

Table 45: IOL_CALL, Entity_Port data structure

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	0	ENTITY_PORT					

Table 46: IOL_CALL, Entity_Port data structure, description

Bit field	Value	Description
ENTITY_PORT	0	IO-Link master (module)
	1	Port 1
	2	Port 2
	3	Port 3
	4	Port 4
	5…63	Not used
	64..255	Reserved

11.1.2.1.1.2 FI_Index

The "FI_Index" field defines which record should be accessed. FI_Index 98 has a special meaning. In this case, the telegram header of the request is structured as follows:

Table 47: IOL_CALL (request), telegram structure

Byte	0	1	2	3	4	5	6	7 … 239
Content	Entity_Port	FI_Index		Control	IOL_Index		IOL_Subindex	IOL_Data_Object

The response if there is no error is:

Table 48: IOL_CALL (response), telegram structure

Byte	0	1	2	3	4	5	6	7 … 239
Content	Entity_Port	FI_Index		State	IOL_Index		IOL_Subindex	IOL_Data_Object

The response if there is an error:

Table 49: IOL_CALL (response), telegram structure

Byte	0	1	2	3	4	5	6	7	8	9	10
Content	Entity_Port	FI_Index		State	IOL_Index		IOL_Subindex	IOL-M_error_code		IOL-D_error_code	IOL-D_add_error_code

The following applies to the message:

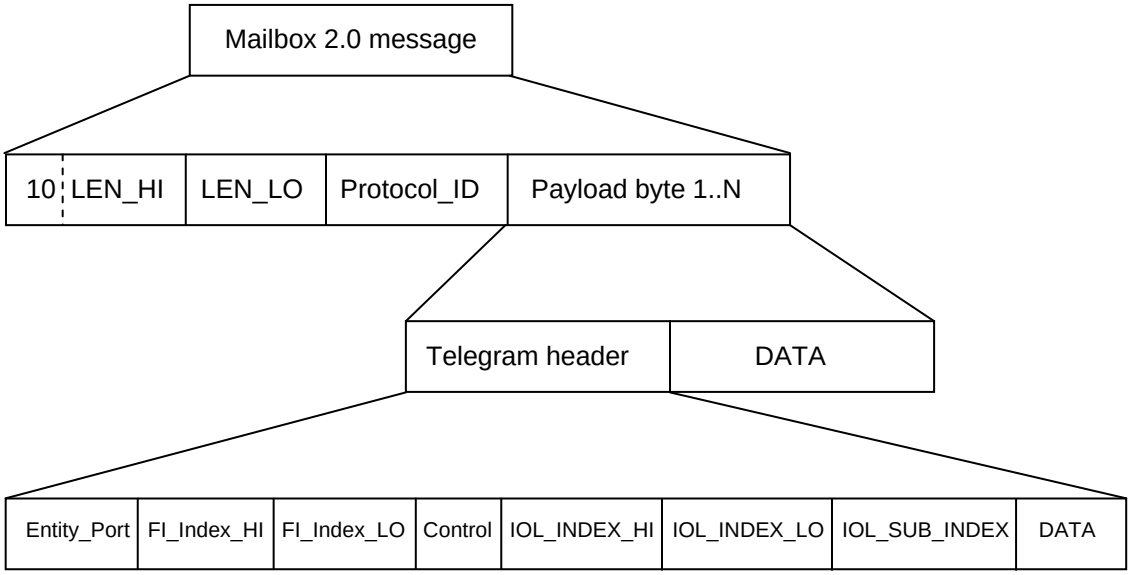


Figure 35: Data area ISDU, IOL-M, command register

The IOL_Index, IOL_Subindex and IOL_Data_Object bit arrays are described as follows:

Table 50: IOL_CALL, ISDU

Bit field	Data type	Value	Description
IOL_Index	UNSIGNED16	0 - 32767	IO-Link ISDU index of the request
		65535	Port function invocation
IOL_Subindex	UNSIGNED8	0-255	If IOL_Index = ISDU index of the request: IO-Link ISDU subindex of the request
IOL_Data_Object	UNSIGNED8 [1…239]	Var.	For write request: User data to be written
			For read request: Read user data or IO-Link error PDU

11.1.2.1.1.2.1 Parameter Access via ISDU

ISDUs (Indexed Service Data Unit) are in the service units defined in the IO-Link specification for identification of parameter data. Indexes/subindexes are specified in the ISDU. Some indexes are already predefined by the IO-Link specification. Other indexes such as "Vendor Name" are required and others are optional, e.g. "Serial Number".

The IO-Link master codes write and read requests to an IO-Link-specific ISDU and transfers them to the IO-Link device. In the IO-Link device, defined indexes are used for parameter data access.

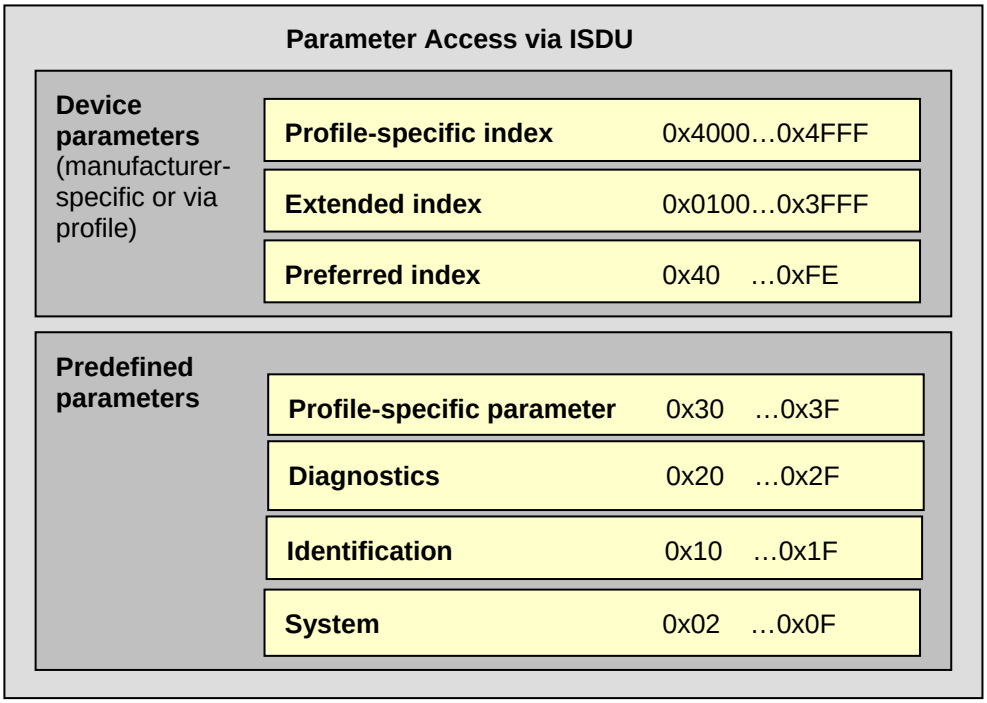


Figure 36: ISDU areas (see also IO-Link specification)

11.1.2.1.1.3 Control/State

The communication mechanisms of an "IOL_CALL" runs according to the request/response operation.

The data byte is always "CONTROL" for communication from the control to the I/O module. The CONTROL byte used for this purposes has the following structure:

Table 51: IOL_CALL, CONTROL data structure

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0						CONTROL	

Table 52: IOL_CALL, CONTROL data structure, description

Bit field	Wert	Description
CONTROL	0	Cancel /Release IOL_CALL
	1	IDLE sequence
	2	Write request
	3	Read request
	4…255	Reserved

The data byte is always "STATE" for communication from the I/O module to the control. The STATE byte used for this purposes has the following structure:

Table 53: IOL_CALL, Control data structure

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
IOL_ERROR_ PDU	0	0	0	0	0	STATE	

Table 54: STATE, Description

Bit field	Value	Description
STATE	0	Data transfer completed
	1	IDLE sequence
	2…127	Reserved
	128	IOL error PDU
	128...255	Reserved
IOL_ ERROR_PDU	0	No Error
	1	Error

If the I/O module returns an "IOL_Error_PDU" as the response, extended error information can be taken from the other four bites ("IOL-M_error_code" (2 bytes), "IOL-D_error_code" and "IOL-D_(add)_error_code"), see section "Error Messages".

11.1.2.1.2 Access to Data Areas

Access to the different data areas is shown in the following table:

Table 55: Access to Data Areas

Data area	Entity_Port	FI_Index	IO-Link index	IO-Link subindex
I&M0	0	0	*	*
I&M1	0	1	*	*
I&M2	0	2	*	*
I&M3	0	3	*	*
I&M4	0	4	*	*
IOL-M Basic Configuration	0	98	0x100	0
IOL-M-Port 1	0	98	0x200	0
IOL-M-Port 2	0	98	0x300	0
IOL-M-Port 3	0	98	0x400	0
IOL-M-Port 4	0	98	0x500	0
Command register	0	98	0x1000	0
IOL-M Directory	0	99	*	*
ISDU	1	98	Acc. to IOL spec.	Acc. to IOL spec.
ISDU	2	98	Acc. to IOL spec.	Acc. to IOL spec.
ISDU	3	98	Acc. to IOL spec.	Acc. to IOL spec.
ISDU	4	98	Acc. to IOL spec.	Acc. to IOL spec.

* Not required

11.1.2.1.3 Command Register

The command register provides various non-IO-Link-related commands, which are executed by the I/O module. Commands can be sent across systems to the master via the command register – the only requirement is that access via "IOL_CALL" is possible by means of the software used.

The command register is addressed via an ISDU telegram with Entity_Port "0" and is located at address 0x1000.

Table 56: IOL_CALL, request telegram

Byte	0	1	2	3	4	5	6	7	8	9
Content	Entity_Port = 0	FI_Index = 98		Control / State	IOL_Index = 0x1000		IOL_Subindex = 0	Command	Command_Paylod	Command Payload

Table 57: Command register, data structure

Parameter	Data type	Access	Description
COMMAND	UNSIGNED8	wo	Action to be executed by the I/O module
COMMAND_PAYLOAD	UNSIGNED16	wo	Parameter data (optional and dependent on COMMAND)

The following commands can be executed:

Table 58: List of all commands

Command	Description	COMMAND_ PAYLOAD	Description
0x18	LoadFactorySettings		Loads factory settings
0x1D	SaveAsUserSettings	0x1235 (required)	Saves current configuration as user settings
0x22	LoadUserSettings	0x1235 (required)	Loads user settings
0x3C	CommitPending-Changes	0x1235 (required)	Applies the written record(s)

To apply written records to the I/O module, the "CommitPendingChanges" command must be initiated after writing a record. The payload then has to be 0x1235.

The following figure illustrates the different memory areas for data storage:

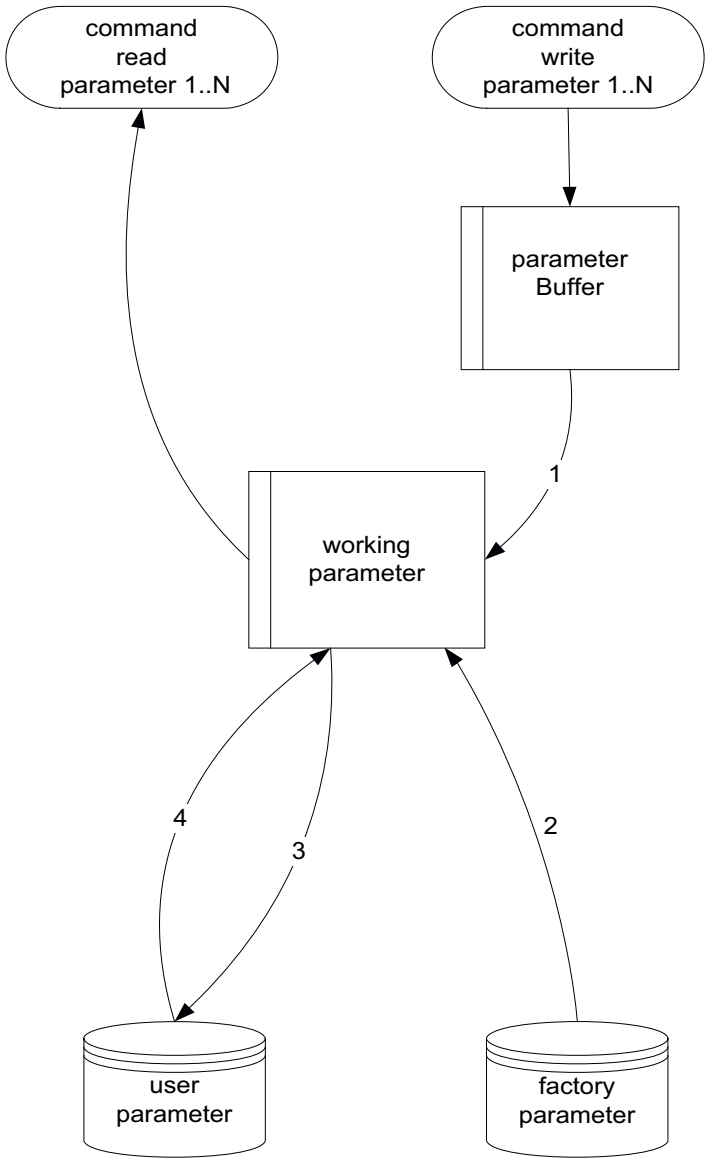


Figure 37: Memory areas for data storage

Table 59: Memory areas for data storage

No.	Commands
1	CommitPendingChanges
2	LoadFactorySettings
3	SaveAsUserSettings
4	LoadUserSettings

If the command cannot be executed without error, an error code is returned (see the following section).

11.1.2.1.4 Error Messages

In case of error, 4 bytes in the original data part of the telegram are returned that provide detailed information about the error:

Table 60: IOL_CALL response telegram in case of error for **FI_INDEX 65000-65004, 65099**

Byte	0	1	2	3	4	5	6	7
Content	Entity_Port	FI_Index		State = 128 (0x80)	IOL-M_error_code		IOL-D_error_code	IOL-D_add_error_code

Table 61: IOL_CALL response telegram in case of error for **FI_INDEX 65098**

Byte	0	1	2	3	4	5	6	7	8	9	10
Content	Entity_Port	FI_Index		State = 128 (0x80)	IOL_Index		IOL_Subindex	IOL-M_error_code		IOL-D_error_code	IOL-D_add_error_code

Possible values for the "IOL-M_error_code" field are listed in the following table:

Table 62: IOL-M_error_code

Code (hex)	Designation	Cause	Possible solution
0000	NO_ERROR	No error	-
1000	ERR_ST_FACT_SET	Error when saving the factory settings Error when loading the factory settings Error when saving the user settings Error when loading the user settings	Enter correct password.
1001	ERR_LD_FACT_SET		Enter correct password.
1002	ERR_ST_USER_SET		Enter correct password.
1003	ERR_LD_USER_SET		Enter correct password.
11nn	ERR_CM_PEND_ CHNG		Enter correct password. Check configuration.

Table 62: IOL-M_error_code

Code (hex)	Designation	Cause	Possible solution
7000	ERR_IOL_CALL_ CONFLICT	Error when applying the configuration. Extended error information is available from the low byte (see the following table). An attempt is made to write a read-only record.	Check IOL_CALL
7001	ERR_WRONG_IOL_ CALL	An incorrect IOL_CALL was transmitted. Wrong value for Control byte or FI index.	Check IOL_CALL
7002	ERR_PORT_ BLOCKED	Error during ISDU communication. Service handler busy. Incorrect value in the IOL-CALL.	Repeat ISDU request at a later time. Check IOL_CALL
8001	ERR_WRONG_ INDEX	IOL_Index is equal to or greater than the value 32768 (0x8000). Request to the master port does not contain indexes 0x100, 0x200, 0x300, 0x400, 0x500.	Check IOL_Index.
8002	ERR_WRONG_ PORT_ADDRESS	Invalid port number	Check IOL_CALL. Valid port numbers are 0..4.

If the error "R_CM_PEND_CHNG" (0x11nn) is returned, extended error information can be taken from the low byte of the "IOL-M_error_code":

Table 63: ERR_CM_PEND_CHNG, extended error information

Code (hex)	Designation	Cause	Possible solution
00	MG_ERR_CM_PE ND_CHNG	Password incorrect	Check password.
01	RET_ERR_SIO_BY TE_OFFSET	Offset of the SIO byte is incorrect.	Check SIO byte offset. It must be >= Mailbox length + 1.
02	RET_ERR_TOTAL _SEGM_LEN	Total length of the segmentation surpasses the total length of the internal bus telegram.	Check segmentation.
03	RET_ERR_PORT1_ UPSTREAM_LEN_ AND_OFFSET	Length and offset of the upstream segmentation from port 1 is faulty. Segmentation overlaps other data segments. Segmentation overlaps internal bus data width.	Check segmentation.
04	RET_ERR_PORT1_ DOWNSTREAM_L EN_AND_OFFSET	Length and offset of the downstream segmentation from port 1 is faulty. Segmentation overlaps other data segments. Segmentation overlaps internal bus data width.	Check segmentation.
05	RET_ERR_PORT1_ CYCL_MBX_LEN	Length of the fragmented data segment for port 1 is faulty.	Check the length of the segment. Length must be > 0 bytes. Both upstream and downstream lengths cannot be 1 byte.

Table 63: ERR_CM_PEND_CHNG, extended error information

Code (hex)	Designation	Cause	Possible solution
06	RET_ERR_PORT2_ UPSTREAM_LEN_ AND_OFFSET	Length and offset of the upstream segmentation from port 2 is faulty. Segmentation overlaps other data segments. Segmentation overlaps internal bus data width.	Check segmentation.
07	RET_ERR_PORT2_ DOWNSTREAM_L EN_AND_OFFSET	Length and offset of the downstream segmentation from port 2 is faulty. Segmentation overlaps other data segments. Segmentation overlaps internal bus data width.	Check segmentation.
08	RET_ERR_PORT2_ CYCL_MBX_LEN	Length of the fragmented data segment for port 2 is faulty.	Check the length of the segment. Length must be > 0 bytes. Both upstream and downstream lengths cannot be 1 byte.
09	RET_ERR_PORT3_ UPSTREAM_LEN_ AND_OFFSET	Length and offset of the upstream segmentation from port 3 is faulty. Segmentation overlaps other data segments. Segmentation overlaps internal bus data width.	Check segmentation.
0A	RET_ERR_PORT3_ DOWNSTREAM_L EN_AND_OFFSET	Length and offset of the downstream segmentation from port 3 is faulty. Segmentation overlaps other data segments. Segmentation overlaps internal bus data width.	Check segmentation.
0B	RET_ERR_PORT3_ CYCL_MBX_LEN	Length of the fragmented data segment for port 3 is faulty.	Check the length of the segment. Length must be > 0 bytes. Both upstream and downstream lengths cannot be 1 byte.
0C	RET_ERR_PORT4_ UPSTREAM_LEN_ AND_OFFSET	Length and offset of the upstream segmentation from port 4 is faulty. Segmentation overlaps other data segments. Segmentation overlaps internal bus data width.	Check segmentation.
0D	RET_ERR_PORT4_ DOWNSTREAM_ LEN_AND_ OFFSET	Length and offset of the downstream segmentation from port 4 is faulty. Segmentation overlaps other data segments. Segmentation overlaps internal bus data width.	Check segmentation.
0E	RET_ERR_PORT4_ CYCL_MBX_LEN	Length of the fragmented data segment for port 4 is faulty.	Check the length of the segment. Length must be > 0 bytes. Both upstream and downstream lengths cannot be 1 byte.

Overview of allowed error types "IOL_D_error_code" (column 1) and "IOL_D_add_error_code" (column 2):

Table 64: IOL_D_error_code, IOL_D_add_error_code

Error code	Additional code	Designation	Cause	Possible solution*
0x10	0x00	COM_ERR	Communication error	(1)
0x56	0x00	M ISDU CHECKSUM	Master – ISDU checksum error	(1)
0x57	0x00	M_ISDU_ILLEGAL	Master – ISDU, illegal service element	(1)
0x80	0x00	APP_DEV	Device program error	(2)
0x80	0x11	IDX_NOTAVAIL	Index is not available	(3)
0x80	0x12	SUBIDX_NOTAVAIL	Subindex is not available	(3)
0x80	0x20	SERV_NOTAVAIL	Service is currently not available	(4)
0x80	0x21	SERV_NOTAVAIL_ LOCCTRL	Master service is currently not available	(5)
0x80	0x22	SERV_NOTAVAIL_ DEVCTRL	Device service is currently not available	(4)
0x80	0x23	IDX_NOT_ WRITABLE	Access denied	(3)
0x80	0x30	PAR_VALOUTOFRNG	Parameter not in value range	(6)
0x80	0x31	PAR_VALGTLIM	Parameter value upper limit	(6)
0x80	0x32	PAR_VALLTLIM	Parameter value lower limit	(6)
0x80	0x33	VAL_LENOVRRUN	Parameter value too long	(6)
0x80	0x34	VAL_LENUNDRUN	Parameter value too short	(6)
0x80	0x35	FUNC_NOTAVAIL	Function is not available	(4)
0x80	0x36	FUNC_ UNAVAILTEMP	Function is temporarily not available	(4)
0x80	0x40	PAR_SETINVALID	Parameter set is invalid	(7)
0x80	0x41	PAR_SETINCONSIST	Parameter set is not consistent	(7)
0x81	0x82	APP_DEVNOTRDY	Application is not available	(4)
0x81	0x00	UNSPECIFIC	Manufacturer specific	(2)
0x80	0x01 - 0xFF	VENDOR_SPECIFIC	Manufacturer specific	(2)

*** Explanation of "Possible causes" column**

(1) Contact WAGO Support.
(2) Contact the device manufacturer
(3) User error, IOL index/subindex is not supported by the device
(4) Contact the device manufacture if the error message appears again.
(5) Contact WAGO Support if the error message appears again.
(6) User error, select value range according to device documentation
(7) User error, select parameter set according to device documentation

11.1.2.2 Diagnostic service "IOL_DIAG"

The "IOL_DIAG" service is identified by Mailbox Protocol ID 2. The data is automatically sent from the I/O module when an event occurs.

Telegram structure:

Table 65: Diagnostic telegram

Byte	0	1	2	3	4	5
Content	Service ID	Sequence ID	Event Code		Channel Number	Event Qualifier

A diagnostic message looks as follows:

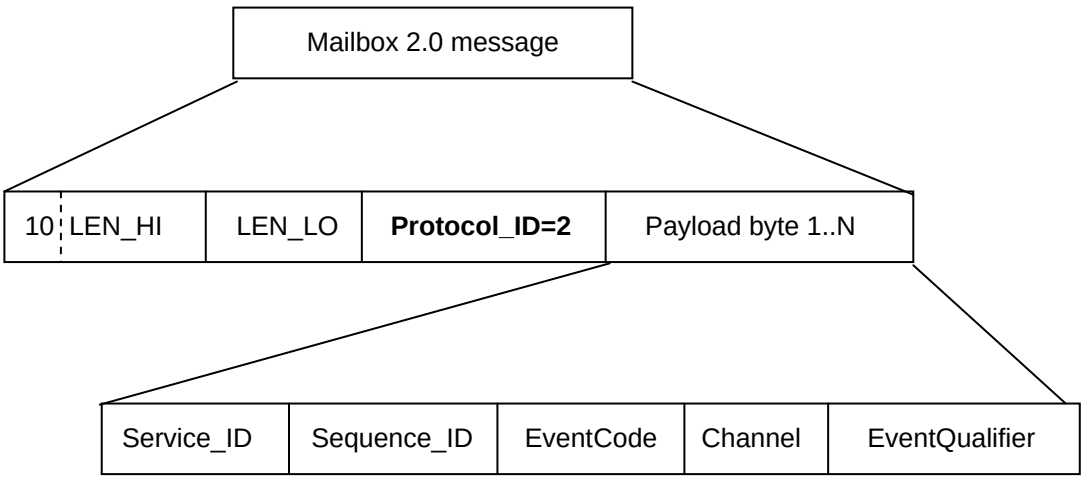


Figure 38: Telegram structure for IO-Link events

More information about the diagnosis is available in section "Diagnosis" > "Diagnosis via the Mailbox" > "Diagnostics Telegram".

11.1.3 Communication via the Cyclic Services

In addition to the usual cyclic transfer of a statically mapped process image per port, another service provides the option of fragmented transfer of cyclic process data. Fragmentation is required if the data width of the device is larger than the possible or configured segment of the port in the process image.

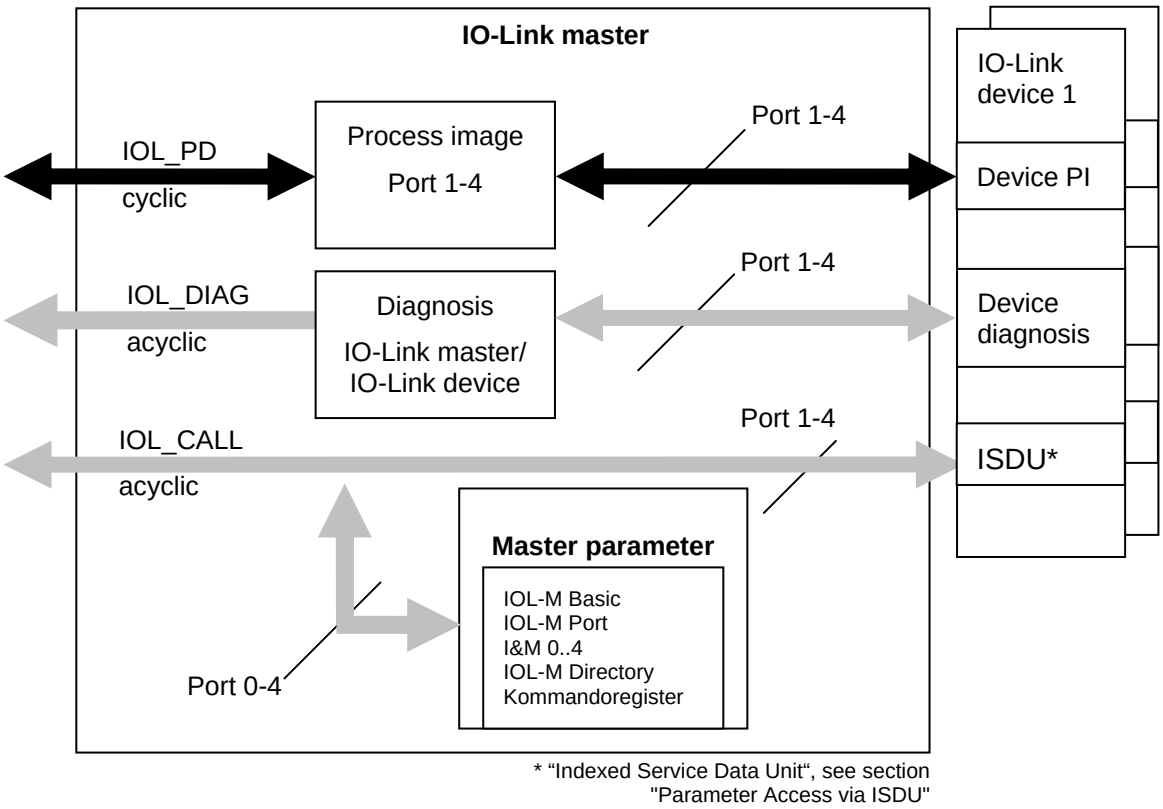


Figure 39: Communication via the Cyclic Services

11.1.3.1 Fragmentation service "IOL_PD"

The "IOL_PD" service is identified by Protocol ID 0 and can be used within a segment of the cyclic process image if the segment of a port is smaller than the process image of an IO-Link device (e.g. segment width 4 bytes and process image of the device 16 bytes).
It is used to transfer the process data of the IO-Link devices in a fragmented manner.
The simple message header is used because the user data of an IO-Link device is max. 32 bytes.

Telegram structure for fragmented process data:

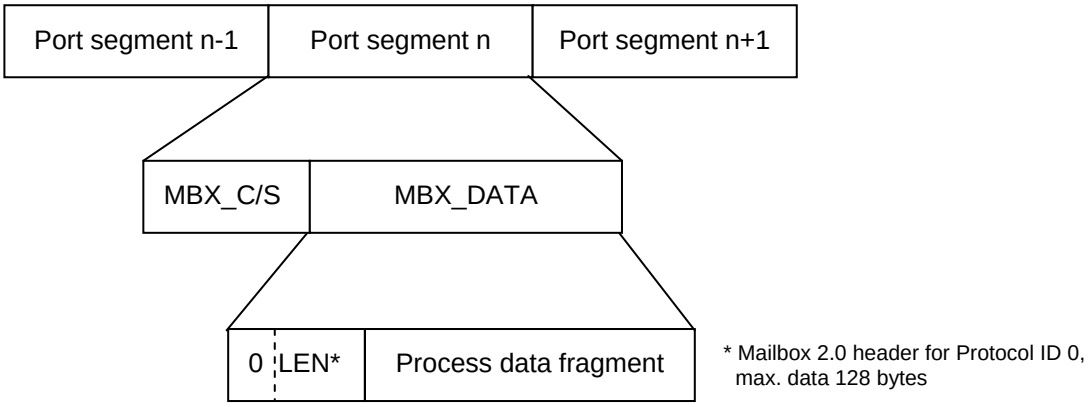


Figure 40: Telegram structure for fragmented process data

Example:

An IO-Link device has a process data length of **8 bytes**, which should be transferred in a 4-byte port segment.

- Port segment length = 4 Byte
- Byte 0 = MBX_C/S (1 Byte)
- Byte1 bis 3 = MBX_DATA (3 Byte)

The following data is transferred sequentially:

- 1st cycle: MBX_Header (simple header from Protocol ID 0 and length) + process data fragment 1 (**2 bytes**)
- 2nd cycle: Process data fragment 2 (**3 bytes**)
- 2nd cycle: Process data fragment 3 (**3 bytes**)

More information about fragmenting is available in sections "Fragmented Process Data" and "Data Exchange".

The "IOL_PD" service can then be used to transport cyclically, e.g. 16 bytes of the process image of an IO-Link device in 4 cycles via a 5-byte port segment (1 byte is used to control fragmentation).

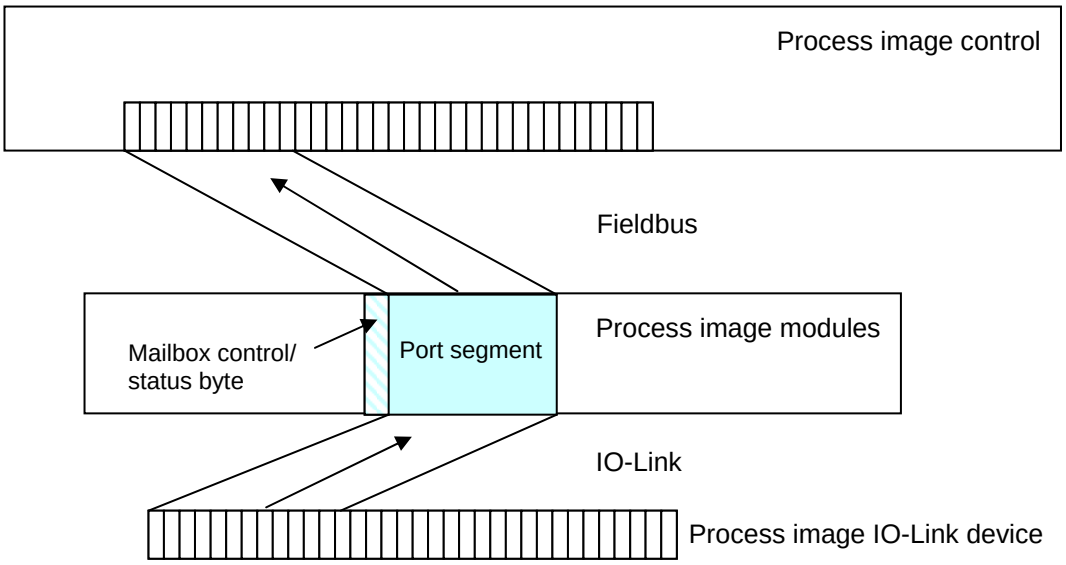


Figure 41: Fragmentation service

The data of the port segment is transferred via Mailbox 2.0.

A Mailbox instance is required to transfer the data per IO-Link port to be fragmented. If you work with WAGO-I/O-*PRO*, use the "IOL_Data_IO_Fragmented" function block.

More information about using the Mailbox in connection with WAGO-I/O-*PRO* is available in section "Mailbox 2.0 Transmission Method".

11.2 Register Communication

Register communication (control byte, but 7 = 1) can be used to access an internal data structure of the I/O module consisting of 64 registers each with 2 bytes (data type WORD). No automated handshake mechanism is used. That means that register communication is shown via bit 7 of the control byte (bit 7 = 1) and must be hidden again after receipt of the response (bit 7 = 0) to continue exchanging process data.

Note

Change password register before write access to the register!
Write to the password register before write access to the register with the value "0x1235".

Note

Reset password register after write access to the register!
After writing to the registers, password register 31 must be reset to "0x0000". Otherwise, further write access to these registers is possible until the supply voltage is disconnected.

Note

Check set values!
After writing to the register, check the set values by reading out the register.

Note

Process data during register communication invalid!
During register communication, the remaining data on the I/O module is invalid for both data directions.

11.2.1 Control/Status Byte

The control byte has the following structure:

Table 66: Control byte

Control byte							
Bit 7	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
1	0 = Read Register 1 = Write Register	Register number					

During register communication, the register query response is contained in the status byte.

Table 67: Status byte

Status byte							
Bit 7	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
1	reserved	Register number (Acknowledgement)					

The register data is transferred in the subsequent 2 bytes (byte 1 and byte 2) of the internal bus process image.

11.2.2 Register Overview

The following section provides an overview of the I/O module registers.

Table 68: Overview of I/O module registers

No.	Memory Area	Access	Default value	Description
01-05	---	---	0x0000	Reserved
06	RAM	ro	Var.	Status byte of the internal bus
07	---	---	0x0000	Reserved
08	ROM	ro	0x028F	WAGO article number (without 0750-)
09	ROM	ro	0x3031	Software index (String)
10	RAM	ro	Var.	Number of physical channels
11	RAM	ro	Var.	Number of logical channels
12	RAM	ro	Var.	Fieldbus process data widths
13	RAM	ro	Var.	Data type register
14	ROM	ro	0x1000	Software version
15	RAM	ro	Var.	Alignment
16	EEPROM	ro	0x0001	Hardware version
17-26	---	---	0x0000	Reserved
27	RAM	ro	Var.	Reserved
28	EEPROM	ro	0x0000	WAGO order number, digits 10 - 12
29	EEPROM	ro	0x0000	WAGO order number, digits 7 - 9
30	EEPROM	ro	0x19AA	WAGO order number, digits 4 - 6
31	RAM	r/w	Var.	Code word
32	EEPROM	r/w	Var.	Reserved
33	EEPROM	r/w	Var.	Process data layout
34	EEPROM	ro	0x0001	Mailbox 2.0 offset
35-52	---	---	0x0000	Reserved
53	RAM	ro	Var.	Parameter channel error code
54-55	---	---	0x0000	Reserved
56	EXTERN	r/w	Var.	Parameter channel, Data
57	EXTERN	r/w	Var.	Parameter channel, Control
58	EEPROM	ro	Var.	WAGO serial number (LSW)
59	EEPROM	ro	Var.	WAGO serial number (MSW)
60-62	---	---	---	Reserved
63	ROM	ro	Var.	Date of the firmware compilation

11.2.3 Example: Read register 08 (WAGO article number)

In this example, you read register 08 from the I/O module.
The internal bus process data width in the example is 8 bytes.

Table 69: Control byte, read register 08

Byte	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Content	Control byte	D0	D1	invalid	invalid	invalid	invalid	invalid
HEX	0x89	DC*	DC*	-	-	-	-	-

* DC = Don't Care. The data is ignored by the I/O module.

As feedback, the status byte returns:

Table 70: Status byte, read register 08

Byte	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Content	Status byte	D0	D1	invalid	invalid	invalid	invalid	invalid
HEX	0x89	0x91	0x02	-	-	-	-	-

The value 0291_{hex} corresponds with $0657_{dez.}$ Accordingly, the WAGO article number of the I/O module is 0750-0657 (IO-Link master).

11.2.4 Example: Set internal bus process data width via register 33

The internal bus process data width can be set via register 33.

Note

Internal bus reset is required when change the process data length!
If you change the process data width via register communication, the node has to be restarted for the changes to apply. Restart the node.

Note

Change password register before write access to the register!
Write to the password register 31 before write access to the register with the value "0x1235".

The following settings are possible for register 33:

Table 71: Register 33, possible values

Value	Internal bus process data width
0x0204	4 Bytes
0x0208	8 Bytes
0x020A	10 Bytes
0x020C	12 Bytes
0x0210	16 Bytes
0x0214	20 Bytes
0x0218	24 Bytes

Note

Check set values after write access!
After writing to the register, check the set values by reading out the register.

Note

Reset password register after write access!
After writing to the registers, password register 31 must be reset to "0x0000". Otherwise, further write access to these registers is possible until the supply voltage is disconnected.

11.3 IO-Link Master Tables

A distinction is made between the following records:

Table 72: Master and port configuration

Data records	Description
IOL-M Basic Configuration	Information and configuration data of the IO
IOL-M Port Configuration	Configurations of IO

Support tables for PROFIBUS:

Table 73: Support tables for PROFIBUS

Data records	Description
I&M0	Electronic type plate with base information about the device
I&M1	Device functions, installation location
I&M2	Installation date
I&M3	Device description
I&M4 (optional)	Key for secure data access
IOL-M Directory	Information about the IO-Link master itself

11.3.1 "IOL-M Basic Configuration" Record

The "IOL-M Basic Configuration" record contains information and configuration data from the IO-Link master. The record can read or written via the Mailbox, parameter access service "IOL_CALL" (see section "Parameter Access Service "IOL_CALL"):

Table 74: “IOL-M Basic Configuration“, Access

Entity Port	FI_Index	IOL-Index	Description
0	65098_{dez}	0x0100	IOL-M Basic Configuration

Note

Execute "CommitPendingChanges" to apply values!
To apply the records written to the I/O module, execute the "CommitPending-Changes" command via the command register (see section "Command Register"). For retentive memory, then execute the "SaveUserSettings" command.

The following table provides an overview of the data fields of the IOL-M record "Basic Configuration".

Table 75: Data record “IOL-M Basic Configuration“

No	Offset	ID	Access User	Access Factory	Default value	Size (byte)	Active
0	0	NO_CHANNEL	ro	ro	4	1	-
2	1	COM_MODE	ro	ro	3	1	-
26	2	MASTER_MIN_CYCL	ro	ro	0x11	1	-
27	3	IOL_REV	ro	ro	0x11	1	-
28	4	IOLM_FEATURE	r/w	r/w	2	2	Start-up
29	6	IOLM_RESERVED	r/w	r/w	0	2	Start-up
31	8	IOLM_PAB_STRUCT	r/w	r/w	s.u.	37	Start-up

The individual fields are described below.

11.3.1.1 NO_CHANNEL

The NO_CHANNEL data field returns the number of available IO-Link-enabled ports of the I/O module.

Table 76: IOL-M Basic Configuration, NO_CHANNEL

Name	Data type	Access	Value
NO_CHANNEL	UNSIGNED8	ro	0x04

11.3.1.2 COM_MODE

The COM_MODE data field indicates which modes of communication are available in IO-Link mode. The value COM3 (230.4 kBaud) includes the slower modes COM2 (38.4 kBaud) and COM1 (4.8 kBaud).

Table 77: IOL-M Basic Configuration, COM_MODE

Name	Data type	Access	Value
COM_MODE	UNSIGNED8	ro	0x03

The following table provides an overview of the data structure.

Table 78: COM_MODE, Data structure

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	0	0	0	0	0	COM_MODE	

Table 79: COM_MODE, Description

Bit field	Access	Value	Description
COM_MODE	ro	0	Reserved
		1	The IO-Link master supports max. COM1 (4.8 kBaud).
		2	The IO-Link master supports max. COM2 (38.4 kBaud) and COM1 (4.8 kBaud).
		3	The IO-Link master supports max. COM3 (230.4 kBaud), COM2 (38.4 kBaud) and COM1 (4.8 kBaud).

11.3.1.3 MASTER_MIN_CYCL

The MASTER_MIN_CYCL data field indicates the shortest time frame with which the I/O module queries the attached IO-Link devices. Slower devices are queried at a slower speed.

Table 80: IOL-M Basic Configuration, MASTER_MAX_CYCL

Name	Data type	Access	Value
MASTER_MIN_CYCL	UNSIGNED8	ro	0x11 (corresponds to 1.7ms)

The following provides an overview of the structure:

Table 81: MASTER_MIN_CYCL, Data structure

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
TIMEBASE		MULTIPLIER					

The fields within the structure mean the following:

Table 82: MASTER_MIN_CYCL, structure description

Bit	Value (hex)	Value (time)	Calculation of the Master Cycle Time
TIMEBASE	0	0,1 ms	0 ms + MULTIPLIER * TIMEBASE
	1	0,4 ms	6,4 ms + MULTIPLIER * TIMEBASE
	2	1,6 ms	32,0 ms + MULTIPLIER * TIMEBASE
MULTIPLIER	Var.	Multiplier for master cycle time	

11.3.1.4 IOL_REV

The IOL_REV data field provides the version of the IO-Link specification supported by the I/O module. A value of 0x11 means IO-Link Revision 1.1.

Table 83: IOL-M Basic Configuration, IOL_REV

Name	Data type	Access	Value
IOL_REV	UNSIGNED8	ro	0x11

The following table provides an overview of the data structure.

Table 84: COM_MODE, Data structure

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
IOL_REV							

Table 85: COM_MODE, Description

Bit field	Access	Value	Description
IOL_REV	ro	0x10	IO-Link master according to IO-Link specification v1.0
		0x11	IO-Link master according to IO-Link specification v1.1

11.3.1.5 IOLM_FEATURE

The IOLM_FEATURE data field contains various control bits for configuring the IO-Link master.

Table 86: IOL-M Basic Configuration, IOLM_FEATURE

Name	Data type	Access	Value
IOLM_FEAT	UNSIGNED16	r/w	Var.

The table below provides an overview of the individual bits.

Table 87: IOLM_FEATURE, Data structure

Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8
0	0	0	0	0	0	0	0
Bit 7	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
0	0	0	0	0	0	KBUS_ DIAG_EN	IOLM_ DIAG_EN

Table 88: IOLM_FEATURE, Structure description

Bit	Value	Description
IOLM_DIAG_EN	0	No diagnostic telegrams are transferred to the control via the Mailbox.
	1	Diagnoses of the I/O module are transferred to the control via the Mailbox.
KBUS_DIAG_EN	0	No fault condition is transferred via the status byte of the internal bus.
	1	The fault status of the I/O module and attached IO-Link devices is transferred cyclically via the status byte of the internal bus.

11.3.1.6 IOLM_PAB_STRUCT

The IOLM_PAB_STRUCT data field contains the configuration for the internal bus process image. Access occurs via an IOL-CALL.

Table 89: IOLM_PAB_STRUCT, Data structure

Byte	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Content	SEGMENT_MODE	SIO_OFFSET		SIO_LENGTH		PORT1_OUT_ SEGM_OFFSET		PORT1_OUT_ SEGM_LENGTH		PORT2_OUT_ SEGM_OFFSET		PORT2_OUT_ SEGM_LENGTH		PORT3_OUT_ SEGM_OFFSET		PORT3_OUT_ SEGM_LENGTH		PORT4_OUT_ SEGM_OFFSET		PORT4_OUT_ SEGM_LENGTH		PORT1_IN_ SEGM_OFFSET		PORT1_IN
Byte	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**	-	-	-	-	-	-	-	-	-	-	-
Content	SEGM_LENGTH	PORT2_IN_ SEGM_OFFSET		PORT2_IN_ SEGM_LENGTH		PORT3_IN_ SEGM_OFFSET		PORT3_IN_ SEGM_LENGTH		PORT4_IN_ SEGM_OFFSET		PORT4_IN_ SEGM_LENGTH												

The parameters are specified in the "Bit" unit. The offset refers to the start of the internal bus process image. For a segment length of 0, no process data from the attached IO-Link device is written to the internal bus process image (IN) or process by the internal bus process image (OUT).

A few rules must be followed during fragmentation:

- When switching on fragmentation, the minimum size for a segment is 2 bytes (for one direction) or 1 byte (for the other direction).
- When switching on fragmentation, 1 byte is always required for control information in both data directions.
- The SIO byte should untouched in terms of its offset and length, i.e. OFFSET = 24, length = 8.
- The Mailbox cannot be changed in its position and length. It always occupies byte 1 and 2 n the internal bus process image (for both data directions).
- The segments may no overlap.
- The sum of all segment lengths (for both data directions) must be smaller than the data width available on the internal bus. The control/status byte and 2 bytes for the Mailbox are to be included.

The SEGMENT_MODE byte has the value "0x00" by default and the following structure:

Table 90: SEGMENT_MODE, Data structure

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	0	0	0	FRAG_ PORT4	FRAG_ PORT3	FRAG_ PORT2	FRAG_ PORT1

The following table describes the individual bits.

Table 91: SEGMENT_MODE, Description

Bit	Value	Description
FRAG_PORT1	0	Fragmentation for data segments (IN, OUT) for port 1 OFF.
	1	Fragmentation for data segments (IN, OUT) for port 1 ON.
FRAG_PORT2	0	Fragmentation for data segments (IN, OUT) for port 2 OFF.
	1	Fragmentation for data segments (IN, OUT) for port 2 ON.
FRAG_PORT3	0	Fragmentation for data segments (IN, OUT) for port 3 OFF.
	1	Fragmentation for data segments (IN, OUT) for port 3 ON.
FRAG_PORT4	0	Fragmentation for data segments (IN, OUT) for port 4 OFF.
	1	Fragmentation for data segments (IN, OUT) for port 4 ON.

11.3.2 "IOL-M Port Configuration" record

The "IOL-M Port Configuration" record contains configuration and parameterization data of the respective IO-Link ports. The record can read or written via the Mailbox, parameter access service "IOL_CALL" (see section "Parameter Access Service "IOL_CALL"):

Table 92: IOL-M Port configuration, Access

Entity Port	FI_Index	IOL Index	Description
1	65098_{dez}	0x0200	IOL_M Port Configuration, Port 1
2		0x0300	IOL_M Port Configuration, Port 2
3		0x0400	IOL_M Port Configuration, Port 3
4		0x0500	IOL_M Port Configuration, Port 4

The following table provides an overview of the data fields of the IOL-M record "Port Configuration". The data structure is provided for each port and can be reached via the Mailbox (see section "Mailbox 2.0 Transmission Method"):

Table 93: IOL-M-Port-Configuration Data record

Offset	ID	IOL	Access User	Access Factory	Default Value	Size (Byte)	Active
0	PORT_CONFIG	1.0	r/w	r/w	Byte 1: 0x00, Byte 0: 0xC1	2	immediate
2	COMP_DATA	1.0/ 1.1	r/w	r/w	0	24	immediate
26	MASTER_CMD	1.0	wo	wo	0	1	immediate
27	PORT_INSPECTION_ LEVEL	1.0	r/w	r/w	0	1	immediate
28	PARAM_SERV_MODI	1.1	r/w	r/w	0	1	immediate
29	IOLD_FEATURE	1.0	r/w	r/w	0	2	Start-up
31	IOLD_RESERVED	1.0	r/w	r/w	0	2	Start-up

The individual fields are described in more detail below.

11.3.2.1 PORT_CONFIG

The PORT_CONFIG data field contains configuration settings for the IO-Link port. At delivery, PORT_CONFIG has the value "0x00C1", i.e. all ports are configured as digital inputs. After connecting an IO-Link device, the "IO-Link" operating mode must be activated (byte = 0x00C3).

If no IO-Link sensor is connected, 0x00C3 is returned when reading back. The port is still in SCAN mode. However, if an IO-Link device is detected, 0x00C4, 0x00C5 or 0x00C6 is returned when reading. This corresponds to COM1, COM2 or COM3.

So that the master applies the value as the port cycle time (e.g. 0x80 for 32 ms), the fixed value "2" must be set for the port cycle mode and the operating mode set to "3" (SCAN mode), e.g. PORT_CONFIG = 0x80C3.

This value is active when the power supply is switched on next. The written value can then be read back in the PORT_CONFIG port parameter.

Settings for the port cycle time are available in section 11.3.1.3.

Table 94: PORT_CONFIG, Data structure

Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8
PORT_CYCLE_TIME							
Bit 7	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
PORT_PHYSICS		PORT_CYCLE_MODE		PORT_OPERATION_MODE			

Table 95: SEGMENT_MODE, Description

Bit field	Access	Value	Description
PORT_OPERATION_MODE	r/w	0	Port is inactive
		1	Port is DI (digital input, default)
		2	Port is DO (digital output)
		3	Port mode SCAN (IO-Link)
	ro	4	Port mode COM1 (IO-Link)
		5	Port mode COM2 (IO-Link
		6	Port mode COM3 (IO-Link)
	-	7..15	Reserved
PORT_CYCLE_MODE	ro	0	Free (default)
		1	Synchronous (not supported)
		2	Fixed value
		3	Reserved
PORT_PHYSICS	ro	0..2	Reserved
		3	IO-Link PHY 2 (default)
PORT_CYCLE_TIME	r/w	Var.	This is the required value for the cycle time on an IO-Link port. With a value of "0x00", the minimum cycle type of the attached IO-Link device is used if the master supports the MIN_CYLCE_TIME of the device.

11.3.2.2 COMP_DATA

The COMP_DATA data field contains data from the IO-Link device connected to the port. The data is used (partially) used when starting a device to check validity.

By default, all data bytes have the value 0x00.

Table 96: IOLM_PAB_STRUCT, Data structure

Byte	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Content	Revision ID	Vendor ID		Device ID			Serial Number																PDIn Length	PDOut Length

Table 97: COMP_DATA, Description

Data field	Data type	Access	Description
Revision ID	UNSIGNED8	r/w	Revision ID of the attached IO-Link device
Vendor ID	UNSIGNED16	r/w	Manufacturer ID of the attached IO-Link device
Device ID	UNSIGNED24	r/w	Article number of the attached IO-Link device
Serial Number	STRING[16]	r/w	Serial number of the attached IO-Link device
PDIn Length	UNSIGNED8	r/w	Data size of the process input data (in [byte]) of the attached IO-Link device
PDOut Length	UNSIGNED8	r/w	Data size of the process output data (in [byte]) of the attached IO-Link device

11.3.2.3 MASTER_CMD

The MASTER_CMD contains the command to be sent from the I/O module to the attached IO-Link device. The commands supported by an IO-Link device are available in the respective device documentation. By default, the field has the value "0x00".

Table 98: MASTER_CMD, Description

Data field	Data type	Access	Description
MASTER_CMD	UNSIGNED8	wo	"Master Command" for the attached IO-Link device

11.3.2.4 PORT_INSPECTION_LEVEL

The "Inspection Level" indicates which parameters of an attached IO-Link device have to match those of the current port configuration to be recognized as valid and if necessary, a parameter upload or download occurs (see the following section).

The following table provides an overview of the data structure.

Table 99: PORT_INSPECTION_LEVEL, Data structure

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	0	0	0	LENGTH_CHECK		TYPE_CHECK	

Table 100: PORT_INSPECTION_LEVEL, Description

Bit field	Access	Value	Description
TYPE_CHECK	r/w	0	No Check
		1	Compatible (TYPE_COMP) DeviceID + VendorID have to match
		2	Identical (IDENTICAL) DeviceID + VendorID + SerialNo have to match
		3	Reserved
LENGTH_ CHECK	r/w	0	No Check
		1	PD Length Strict: Process data lengths must be equal.
		2	PD Length Loose: Process data lengths must be equal to or smaller than the available buffer sizes.
		3	Reserved

11.3.2.5 PARAM_SERV_MODI

The PARAM_SERV_MODI data field contains the configuration settings for the mode of the IO-Link parameter server. This is active by default.

The following table provides an overview of the data structure.

Table 101: PARAM_SERV_MODI, Data structure

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	0	0	0	0	0	PARAM_SERV_MODI	

The data fields are described in more detail below.

Table 102: PARAM_SERV_MODI, Description

Bit field	Access	Value	Description
PARAM_ SERV_ MODI	r/w	0	Parameter server enabled (factory setting)
		1	Parameter server disabled
		2	Disable Upload: Prevents parameter upload The upload request of the IO-Link device is suppressed by the I/O module.
		3	Disable Download: Prevents parameter download The download request of the control is not sent to the IO-Link device by the I/O module.

Application parameter upload:
The IOL-D parameters are uploaded to the parameter server of the IO-Link master if the device parameters have been changed.
This occurs either "remotely" via the bus or "locally" on the device. In this case, an internal flag is set in the device that is queried by the master when starting next.

Application parameter download:
When uploading to the IO-Link device, the master checks the identity of the device (DeviceID, VendorID, SerialNumber).
When successful, the parameter server synchronizes the parameters:

- For devices without ISDU support, parameters are always downloaded.
- For devices with ISDU support, parameters are only downloaded if the checksums do not equal the parameter sets.

11.3.2.6 IOLD_FEATURE

The IOLD_FEATURE data field is reserved for various configuration bits. Only one is used currently for activation/deactivation of device diagnosis. By default, transmission of diagnostic message via the internal bus to the control is enabled.

The following table provides an overview of the data field.

Table 103: IOLD_DEATURE, Data structure

Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8
0	0	0	0	0	0	0	0
Bit 7	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
0	0	0	0	0	0	0	IOLD_ DIAG_EN

Table 104: IOLD_FEATURE, Description

Bit	Access	Value	Description
IOLD_DIAG_EN	r/w	0	IO-Link diagnosis (IOL events) disabled: No diagnostic messages (IOL events) are transferred via the Mailbox to the control from the IO-Link device attached to the port.
		1	IO-Link diagnosis (IOL events) enabled: Incoming diagnoses (IOL events) are sent via the Mailbox to the control from the IO-Link device attached to the port.

11.3.2.7 IOLD_RESERVED

The data field is reserved for future enhancements. By default, the data field has the value "0x0000".

11.3.3 "I&M0" record

The "Identification and Maintenance" (I&M) independent of the manufacturer according to the "PROFIBUS Identification & Maintenance Guideline" and are uniformly defined records for unique device identification. A record contains 64 bytes.

The I/O module supports the I&M0 record for identification purposes as an electronic type plate. Only read access is possible.

The following table provides an overview of the I&M0 record.

Table 105: I&M0 record, structure

Parameter	Data type	Contents	Description
Manufacturer ID	UNSIGNED16	$011D_{hex}$	Unique manufacturer ID (specified by the PNO*)
Order ID	STRING[20]	See the following section	Order ID
Serial Number	STRING[16]		Serial number of the I/O module
Hardware Revision	UNSIGNED16		Hardware version number
Software Revision	UNSIGNED8[4]		Software version number
Revision Counter	UNSIGNED16	0	Not used
Profile ID	UNSIGNED16	$4E00_{hex}$	IO-Link
Profile Specific Type	UNSIGNED16	0005_{hex}	Interface Module
I&M Version	UNSIGNED8[2]	01_{hex} 01_{hex} (v1.1)	I&M version
I&M supported	UNSIGNED16	$001F_{hex}$	I&M supported

* PROFIBUS User Organization

Information

More information about "Identification & Maintenance Functions"!
More information about "Identification & Maintenance Functions" is available on the Internet in the document "Profile Guideline Part 1: Identification & Maintenance Functions" at http://www.profibus.com under "Downloads" → Technology → PROFIBUS.

11.3.3.1 Order ID

The "Order ID" provides the order number of the I/O module as an ASCII string. Unused data bytes are populated with "0x20".

Example article number of the IO-Link master: 750-657

Table 106: I&M0 record, field: "Order ID"

Byte	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Content	0x37	0x35	0x30	0x2D	0x36	0x35	0x37	0x20	0x20	0x20	0x20	0x20	0x20	0x20	0x20	0x20	0x20	0x20	0x20	0x20
ASCII	7	5	0	-	6	5	7													

11.3.3.2 Serial Number

The "Serial Number" provides the serial number of the I/O module as an ASCII string. The serial number (UNSIGNED32, format: hex) is written to the I/O module during the manufacturing process and is unique.
Unused data bytes are populated with "0x20".

Example serial number of the IO-Link master: $005E871C_{hex}$

Table 107: I&M0 record, field: "Serial Number"

Byte	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Content	0x30	0x30	0x35	0x45	0x38	0x37	0x31	0x43	0x20	0x20	0x20	0x20	0x20	0x20	0x20	0x20
ASCII	0	0	5	E	8	7	1	C								

11.3.3.3 Hardware Revision

The "Hardware Revision" provides the revision number of the hardware as an UNSIGNED16 value.

Example hardware revision: 0001

Table 108: I&M0 record, "Hardware Revision"

MSB	LSB
0x00	0x01

11.3.3.4 Software Revision

The "Software Revision" provides the revision number of the software as an UNSIGNED8 array. The first byte is always populated with a "v" (76_{hex}). The following numbers are not converted into an ASCII string.

Example software revision of the IO-Link: v1.2.3

Table 109: I&M0 record, field: "Software Revision"

Byte	0	1	2	3
Content	0x76	0x01	0x02	0x03
ASCII	v	---	---	---

11.3.4 "I&M1" to "I&M4" Records

The "Identification and Maintenance" (I&M) independent of the manufacturer according to the "PROFIBUS Identification & Maintenance Guideline" and are uniformly defined records for unique device identification. Each record contains 54 bytes.

The I/O module supports the (optional) manufacturer-specific I&M0 to I&M4 records. Read and write access are both possible. By default, the records are populated with "0x20" (space).

11.3.4.1 I&M1

Table 110: I&M1, Data structure

Byte	Name	Data type	Access
0..31	TAG_FUNCTION	UNSIGNED8[32]	r/w
32..53	TAG_FUNCTION	UNSIGNED8[22]	r/w

11.3.4.2 I&M2

Table 111: I&M2, Data structure

Byte	Name	Data type	Access
0..15	INSTALLATION_DATE	UNSIGNED8[16]	r/w
16..53	RESERVED	UNSIGNED8[38]	r/w

11.3.4.3 I&M3

Table 112: I&M3, Data structure

Byte	Name	Data type	Access
0..53	DESCRIPTOR	UNSIGNED8[54]	r/w

11.3.4.4 I&M4

Table 113: I&M4, Data structure

Byte	Name	Data type	Access
0..53	SIGNATURE	UNSIGNED8[54]	r/w

In generally, the following information for an IO-Link device is saved in the I/O module:

Table 114: IOL-M Port Configuration, Data

Parameter	Data type	Description
Revision ID	UNSIGNED8	Revision ID
Vendor ID	UNSIGNED16	Vendor ID
Device ID	UNSIGNED24	Device ID
Serial Number	STRING[16]	Serial Number
Hardware Revision		Hardware Revision
PD Input	UNSIGNED8	Length of the process input data
PD Output	UNSIGNED8	Length of the process output data

11.3.4.4.1 Revision ID

Table 115: Revision-ID, Structure

Bit 7	…	Bit 4	Bit 3	…	Bit 0
Major Revision			Minor Revision		

11.3.4.4.2 Index CAP 1

Table 116: Master Configuration, Index CAP 1

Name	Access	Value	Description
Index CAP 1	ro	0xFF (255)	Index of Client access points

11.3.5 IOL-M Directory Record

Note

Do not confuse the "IOL-M Directory" record with "IOL-M Basic/Port Configuration"!
Do not confuse the "IOL-M directory" record with the data of the "OL-M Basic configuration" and "IOL-M Port configuration" records.
The "IOL-M directory" only contains information about the IO-Link master itself and is read only.

Table 117: IOL-M Directory Record

Parameter	Data type	Access	Description
IO-Link Version	UNSIGNED8	ro	Supported IO-Link revision of the master
IO-Link Profile Version	UNSIGNED8	ro	IO-Link profile
IO-Link Feature Support	UNSIGNED32	ro	Bit fields that display features
Number of Ports	UNSIGNED8	ro	Number of IO-Link ports available
REF Port Config	UNSIGNED8	ro	Index to port configuration
REF IO Mapping	UNSIGNED8	ro	Index to I/O mapping
REF iPar Directory	UNSIGNED8	ro	Index to iPar director
REF IOL M	UNSIGNED8	ro	Index to IOL-M parameters
Number of CAP	UNSIGNED8	ro	Number of client access points

11.3.5.1 IO-Link Version

Table 118: Master configuration, “IO-Link Version“

Name	Access	Value	Description
IO-Link-Version	ro	0x10: IO-Link 1.0 0x11: IO-Link 1.1	Supported IO-Link revision of master

11.3.5.2 IO-Link Profile Version

Table 119: Master configuration, “IO-Link Profile Version“

Name	Access	Value	Description
IO-Link Profile Version	ro	0x00	IO-Link profile

11.3.5.3 IO-Link Feature Support

Table 120: Master configuration, “IO-Link Feature Support”

Name	Access	Value	Description
IO-Link Feature Support	ro	0x00000000	IO-Link feature support

11.3.5.4 Number of Ports

Table 121: Master configuration, Number of Ports

Name	Access	Value	Description
Number of Ports	ro	4	Number of IO-Link ports available

11.3.5.5 REF Port Config

Table 122: Master configuration, REF Port Config

Name	Access	Value	Description
REF Port Config	ro	0xF4 (240)	Index to port configuration

11.3.5.6 REF IO Mapping

Table 123: Master configuration, REF Port Config

Name	Access	Value	Description
REF IO-Mapping	ro	0x00	Reference to the IO mapping

Note

"REF IO-Mapping" not supported!
The ""REF IO-Mapping" entry is not supported by the IO-Link master.

11.3.5.7 REF iPar Directory

Table 124: Master configuration, REF iPar Directory

Name	Access	Value	Description
REF iPar Directory	ro	0x00	Reference to the iPar directory

Note

"REF iPar Directory" not supported!
The ""REF iPar Directory" entry is not supported by the IO-Link master.

11.3.5.8 REF IOL M

Table 125: Master configuration, REF_IOL_M

Name	Access	Value	Description
REF_IOL_M	ro	0xFF (255)	Reference to IOL-M parameters

11.3.5.9 Number of CAP

Table 126: Master configuration, Number of CAP

Name	Access	Value	Description
Number of CAP	ro	0x01	Number of client access points

11.4 Fieldbus-Specific Additions

IO-Link is a fieldbus-independent system that you can integrate in any fieldbus system. You need the IO-Link master, the manufacturer and device-specific device description file IODD of the IO-Link device to be attached, the WAGO-I/O-*CHECK 3* configuration software and if necessary, other device description files, e.g. GSD/GSE files for integration in a PROFIBUS environment.

The IODD file is provided by the manufacturer of the IO-Link device.

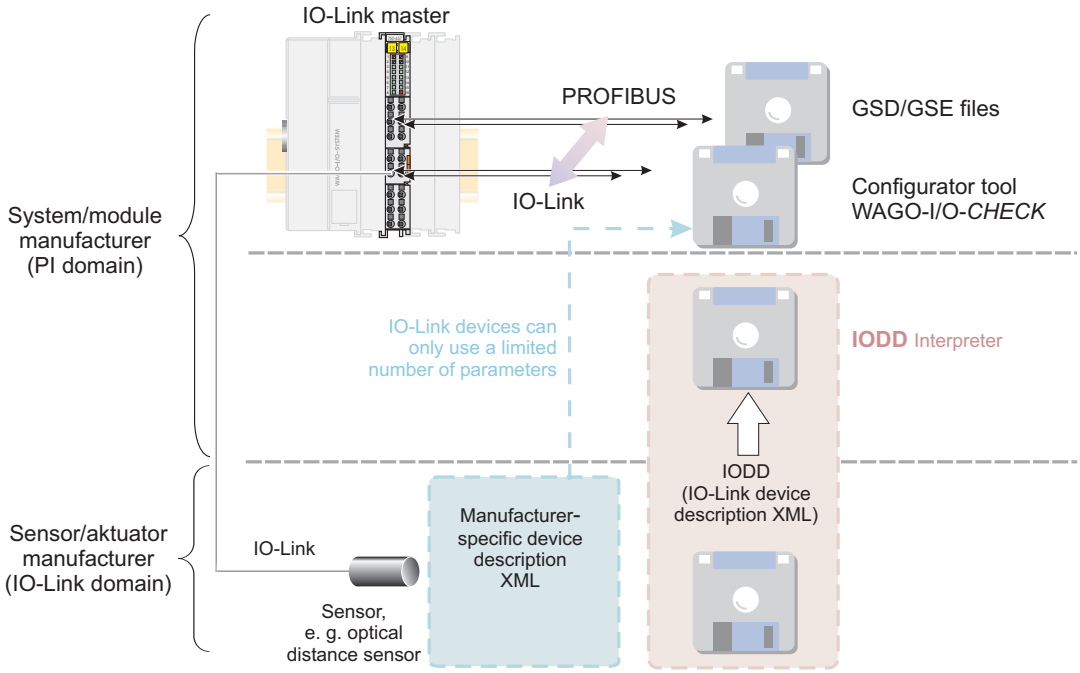


Figure 42: Fieldbus integration

The following sections point out features relating to the use of the IO-Link master with various fieldbuses.

11.4.1 PROFIBUS

If you use the IO-Link master on a PROFIBUS coupler, the process image is 2 bytes shorter. The acyclic channel of the I/O module does not appear in the cyclic process image.

Note

Connect max. 16 I/O modules to PROFIBUS couplers!
When using a PROFIBUS fieldbus coupler, max. 16 I/O modules can be operated with an acyclic channel (Mailbox 2.0).□

11.4.1.1 Process Image

The structure of the process image for PROFIBUS is defined as follows:

Control/Status byte	SIO byte	Port 1	Port 2	Port 3	Port 4

Figure 43: Process image

11.4.1.2 Configuring with PROFIBUS GSD/GSE

If the I/O module is operated on a PROFIBUS coupler, the IO-Link master can be configured via PROFIBUS DP/V1. An associated GSD/GSE file is provided (see the following section).

To exploit the PROFIBUS parameter assignment message most efficiently, two variants with different parameterization range are provided – P00 and P02.

11.4.1.2.1 GSD/GSE File

The GSD/GSE file contains the characteristics of the fieldbus coupler/controller, information about communication capabilities and the connectable I/O modules. You need the GSD/GSE file to attempt a configuration of the fieldbus coupler/controller as well as of all I/O modules via the class 1 DP master.

Information

Additional Information
The PROFIBUS GSD/GSE files are available on the Internet at http://www.wago.com under Service → Downloads → AUTOMATION → WAGO-I/O-SYSTEM 750/753.
GSD/GSE installation instructions are available in the documentation for the configuration software you use.

The GSD/GSE file is imported and installed from the configuration software.

The entries of the file are displayed in the configuration software based on the respective width of the process image (see the following figure).

Note

Note the special data structure for PROFIBUS!
Pay attention to the special data structure for PROFIBUS:
PROFIBUS supports a 2-byte Mailbox size. The process image is smaller by the size of the Mailbox.

The GSD/GSE entry "75x-657 IOL-M 22 Byte PA P00" denotes a process image of 24 bytes, the entry at set Mailbox size of 2 bytes.
Other GSD/GSE entries:
- "75x-657 IOL-M SIO-Mode PA P00" → PA of the IO-Link master 4 bytes
- "75x-657 IOL-M 4 Byte PA P00" → PA of the IO-Link master 6 bytes
- "75x-657 IOL-M 6 Byte PA P00" → PA of the IO-Link master 8 bytes

etc.

The correct process image size appears when you read the I/O module data using WAGO-I/O-*CHECK* for example.

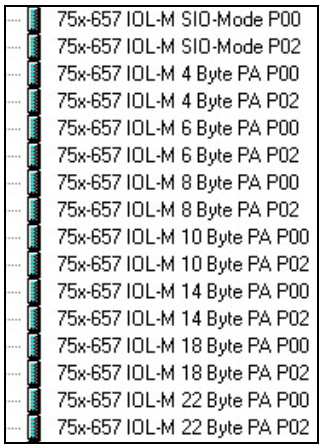


Figure 44: GSD/GSE entries

Note

Observe the maximum number of I/O modules!
Due to the large volume of data (configuration data), max. 11 IO-Link masters can be operated on a PROFIBUS fieldbus coupler in this variant P02.
For variant P00, max. 16 IO-Link masters can be operated on one PROFIBUS fieldbus coupler.

11.4.1.2.1.1 Simple Configuration Record

A simple configuration record P00 has the following parameters:

- Diagnosis
- Port x > Diagnosis
- Port x > Fragmentation

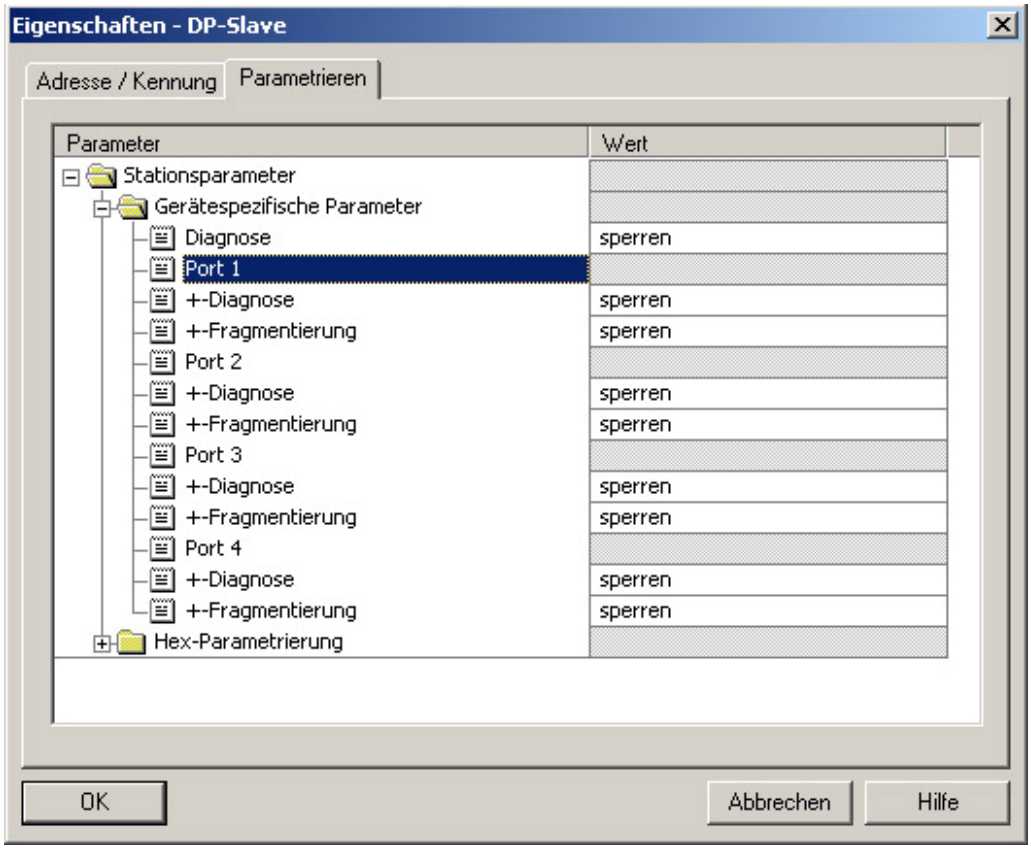


Figure 45: GSD/GSE – Simple configuration record

"Diagnosis" parameter
Using the "Diagnosis" parameter, the diagnosis for the IO-Link master can be locked or unlocked via the status byte.
More information about the control/status byte is available in the section "Process Image".

Parameter "Port x > Diagnosis"
Using the "Port x > Diagnosis" parameter, port-specific diagnosis is enabled.
More information about the Mailbox is available in the section "Mailbox 2.0 Transmission Method". Further explanations about the subject of diagnoses is available in the section "Diagnoses".

Parameter "Port x > Fragmentation"
If fragmentation for a port is ON, the process data of the port is transmitted to the control and back in a fragmented manner via a Mailbox service.

11.4.1.2.1.2 Extended Configuration Record

In addition to the simple configuration record, extended configuration record P02 has the following additional parameters.

- Multiplier for cycle time
- Master cycle time [ms]
- Operating mode
- Length of the input process image [byte]

- Length of the output process image [byte]

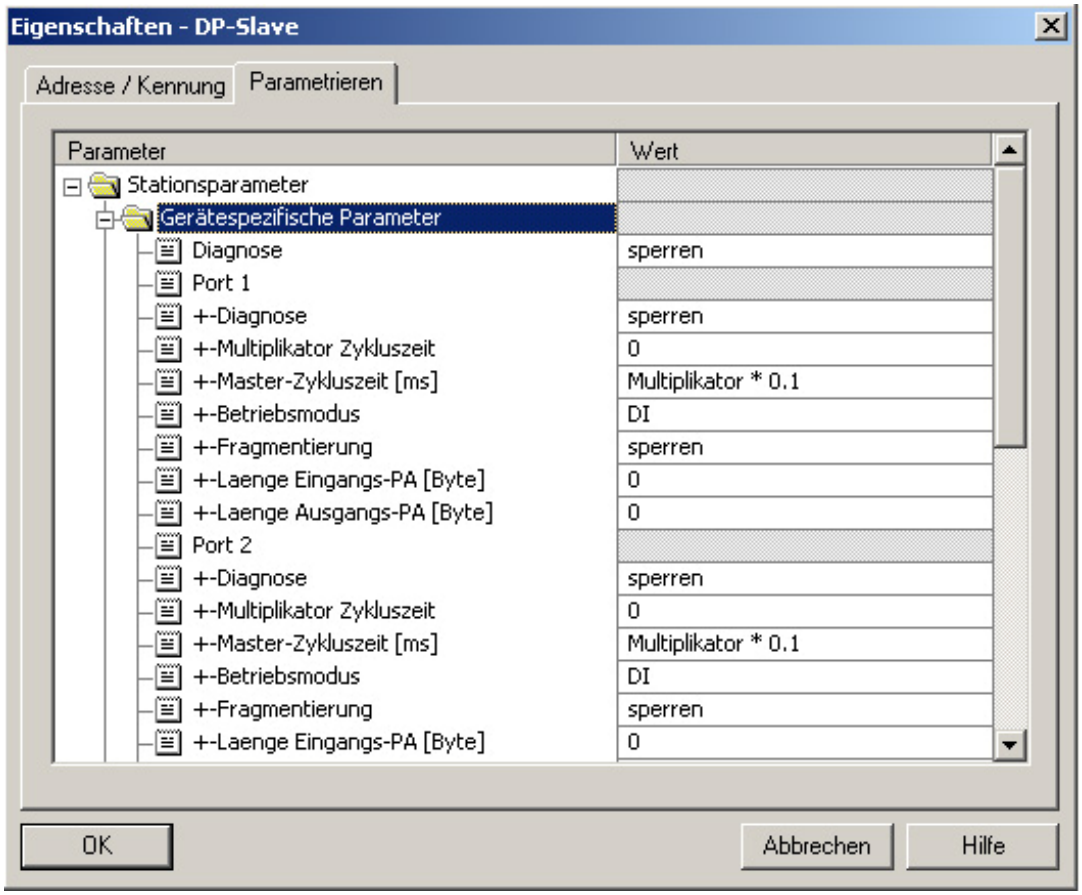


Figure 46: GSD/GSE – Extended configuration record

Parameter "Port x > Multiplier cycle time"
The cycle time multiplier is used to calculate the master cycle time. The adjustable number range reaches from 0 to 63.

Parameter "Port x > Master cycle time"
The master cycle time is calculated as follows:

Table 127: PROFIBUS DP/V1, calculation of the master cycle time

Master cycle time	Unit
Multiplier * 0.1	ms
6.4 + multiplier * 0.4	ms
32.0 + multiplier * 1.6	ms

Parameter "Port x > Operating mode"
This parameter is used to set the operating mode of a port.

Table 128: PROFIBUS DP/V1, operating mode

Operating Modes
Inactive
DI (Digital Input)
DO (Digital Output)
IO-Link

Parameter "Port x > Length of the input process image"
This parameter is used to set the size of a port segment for the process input data on the internal bus in the unit "Byte". With a segment length of 0, no process data from the IO-Link device (when connected) appears. The maximum width of a segment is 15 bytes.

The segments of all ports are one right after the other. The settings are saved in retentive memory.

Note

Enable fragmentation when the segment width is too small!
When the process data width of an attached IO-Link device is greater than the segment width available, enable fragmentation for the port concerned.
If fragmentation is enabled, the process data is transmitted cyclically in a fragmented manner per port.
If you do not enable fragmentation, only the available segment width is used and all other data is lost.
If fragmentation is ON, the input process data must be defragmented by a suitable function block in the PLC.

Parameter "Port x > Length of the output process image"

Table 129: PROFIBUS DP/V1, parameter "Port x / Length of the output process image"

Name	Value	Data Type	Lower limit	Upper limit	Def.
Portx/Length of the output process image	Var.	BitArea	0	15	0

This parameter is used to set the size of a port segment for the process output data on the internal bus in the unit "Byte". The settings are made in units of 1 byte. With a segment length of 0, no process data from the IO-Link device (when connected) appears. The maximum width of a segment is 15 bytes.
The segments of all ports are one right after the other. The settings are saved in retentive memory.

Note

Enable fragmentation when the segment width is too small!
When the process data width of an attached IO-Link device is greater than the segment width available, enable fragmentation for the port concerned.
If fragmentation is enabled, the process data is transmitted cyclically in a fragmented manner per port.
If you do not enable fragmentation, only the available segment width is used and all other data is lost.
If fragmentation is ON, the output process data must be fragmented by a suitable function block in the PLC.

11.4.1.3 Configuring with Function Blocks

11.4.1.3.1 SIMATIC Step 7

For the functionality of the acyclic channel, the acyclic PROFIBUS DP/V1 service is to be used in the PROFIBUS environment.

In addition, Siemens has made an "IOL_CALL" function block available. This block can be used to read or write different data areas accessible with the FI-Index "98" (see section "Parameter Access Service IOL_CALL"). The **input parameter "CAP"** always used the **value "255"**.

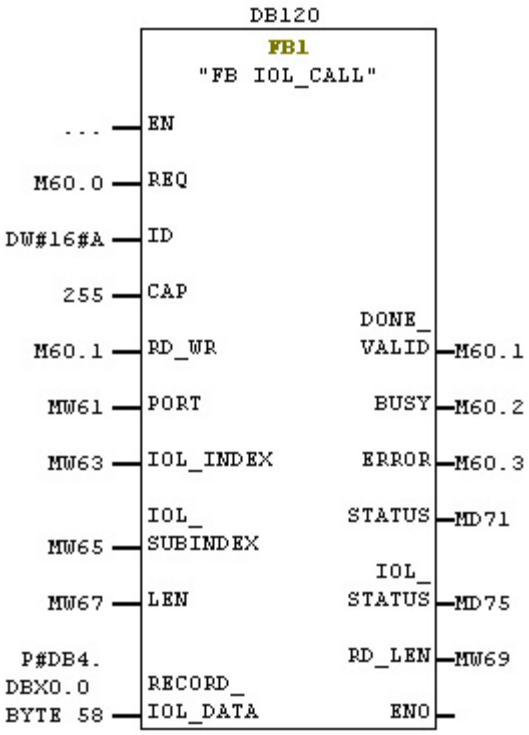


Figure 47: "IOL_CALL" function block (Siemens)

Access to data areas with FI_Index not equal to 98 is achieved using the PROFIBUS DP/V1 "Read" and "Write" services.

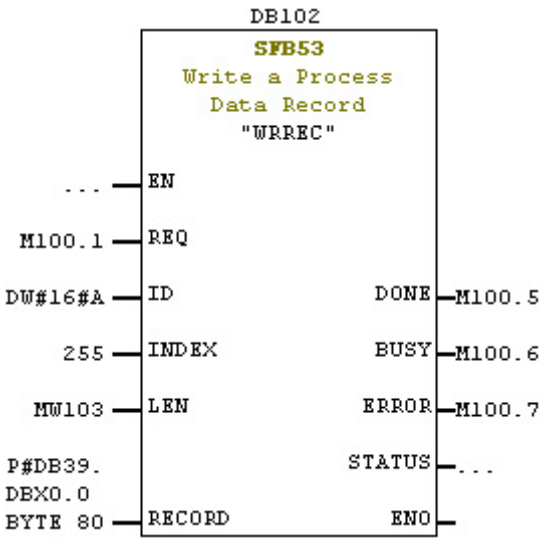


Figure 48: Function block for DP/V1 Write

According to the PROFIBUS specification, the "RECORD" parameter is defined as follows:

Table 130: Parameter „RECORD“

Data	Data type	ExtFunc	Description	
Extended_Function_Num	1 Octet	08h	Indicates „CALL“, fix	Call-Header
Entity_Number	1 Octet	0...63	IO-Link port	
FI_Index	2 Octets	650xx	IO-Link profile specific	
IO-Link specific extensions	236 Octets	IO-Link	Extensions comprise an IO-Link header with „State“, „IOL_Index“ and „IOL_Subindex“	Body

For access to the different data areas:

Table 131: Access to data areas

Topic	Index	ExtFunc	Entity	FI-Index
IOL-M-Directory	255	0x08	0	65099
I&M 0	255	0x08	0	65000
I&M 1..4	255	0x08	0	65001-65004

11.4.1.3.2 PROFIBUS Master (general)

Depending on the communication modules of a control manufacturer available, use of an IOL_Call block is possible or if necessary, implemented on the basis of the standardized PROFIBUS DP/V1 "Read" and "Write" services.

Table 132: PROFIBUS master (general)

Topic	Index	ExtFunc	Entity	FI-Index
IOL-CALL	255	0x08	0..4	65098
IOL-M-Directory	255	0x08	0	65099
I&M 0	255	0x08	0	65000
I&M 1..4	255	0x08	0	65001-65004

11.4.1.4 Diagnosis when Using a PROFIBUS Coupler

If the IO-Link master is operated on a PROFIBUS coupler (e.g. 750-333), some IO-Link diagnosis events are converted into corresponding PROFIBUS error codes directly. Assignment between event and error code is available in the following table.

Table 133: PROFIBUS event codes

IOL event code	Meaning	Solution	IOL type	IOL mode	PROFIBUS DP Channel Diagnostics	
					Error code	Error text
0x0000	No malfunction		Alarm		-	-
0x1000	General malfunction	Unknown error	Error	coming/ going	9	Error
0x1001 … 0x17FF	Reserved	-	-	-	-	-
0x1800 … 0x18FF	Manufacturer specific	-	-	-	-	-
0x1900 … 0x3FFF	Reserved	-	-	-	-	-
0x4000	Temperature error	Overload	Error	coming/ going	4	Overload
0x4001 … 0x420F	Reserved	-	-	-	-	-
0x4210	Allowable device temperature exceeded	Eliminate the heat source	Warning	coming/ going	5	Overtem perature
0x4211 … 0x421F	Reserved	-	-	-	-	-
0x4220	Allowable device temperature not met	Insulate the device	Warning	coming/ going	17	Warning
0x4221 … 0x4FFF	Reserved	-	-	-	-	-
0x5000	Device hardware defective	Replace the device	Error	coming/ going	9	Error
0x5001 … 0x500F	Reserved	-	-	-	-	-
0x5010	Component malfunction	Repair or replace the component	Error	coming/ going	9	Error

Table 133: PROFIBUS event codes

IOL event code	Meaning	Solution	IOL type	IOL mode	PROFIBUS DP Channel Diagnostics	
					Error code	Error text
0x5011	Loss of volatile memory contents	Check the batteries	Error	coming/ going	9	Error
0x5012	Weak batteries	Replace the batteries	Warning	coming/ going	17	Warning
0x5013 … 0x50FF	Reserved	-	-	-	-	-
0x5100	General power supply error	Check availability	Error	coming/ going	17	No field voltage
0x5101	Blown fuse or no fuse	Replace the fuse	Error	coming/ going	18	Fuse defective
0x5102 … 0x510F	Reserved	-	-	-	-	-
0x5110	Allowable primary power supply exceeded	Check the tolerance of the power supply	Warning	coming/ going	3	Over-voltage
0x5111	Allowable primary power supply not met	Check the tolerance of the power supply	Warning	coming/ going	2	Over-voltage
0x5112	Secondary power supply error	Check the tolerance of the power supply	Warning	coming/ going	17	Warning
0x5113 … 0x5FFF	Reserved	-	-	-	-	-
0x6000	Device software faulty	Check the firmware version used	Error	coming/ going	9	Error
0x6001 … 0x630F	Reserved	-	-	-	-	-
0x6310	Record: Parameter loss			coming/ going	16	Configu-ration error
0x6001 … 0x631F	Reserved	-	-	-	-	-
0x6320	Record: Configuration error	Use the manual to check the configuration	Error	coming/ going	16	Configu-ration error
0x6321	Missing configuration	Use the manual to check the configuration	Error	coming/ going	15	Parame-ter missing
0x6322 … 0x634F	Reserved	-	-	-	-	-
0x6350	Parameterization change	Check the configuration	Error	coming/ going	9	Error
0x6351 … 0x76FF	Reserved	-	-	-	-	-
0x7700	Line break in a subordinate device	Check the wiring	Error	coming/ going	6	Line break

Table 133: PROFIBUS event codes

IOL event code	Meaning	Solution	IOL type	IOL mode	PROFIBUS DP Channel Diagnostics	
					Error code	Error text
0x7701 … 0x770F	Line break in a subordinate device 1 - 15	Check the wiring	Error	coming/ going	6	Line break
0x7710	Short Circuit	Check the wiring	Error	coming/ going	1	Short Circuit
0x7711	Ground fault	Check the wiring	Error	coming/ going	26	External error
0x7712 … 0x8BFF	Reserved	-	-	-	-	-
0x8C00	Technology of a specific application error	Reset the device	Error	coming/ going	9	Error
0x8C01	Simulation enabled	Check the operating mode	Warning	coming/ going	-	-
0x8C02 … 0x8C0F	Reserved	-	-	-	-	-
0x8C10	Process value exceeded	Undefined process data	Warning	coming/ going	7	Process value exceeded
0x8C11 … 0x8C1F	Reserved	-	-	-	-	-
0x8C20	Measuring Range Overflow	Check the application	Error	coming/ going	7	Process value exceeded
0x8C21 … 0x8C2F	Reserved	-	-	-	-	-
0x8C30	Process value not met	Undefined process data	Warning	coming/ going	8	Process value exceeded
0x8C31 … 0x8C3F	Reserved	-	-	-	-	-
0x8C40	Maintenance required	Cleaning	Alarm	once	-	-
0x8C41	Maintenance required	Refill	Alarm	once	-	-
0x8C42	Maintenance required	Replace the wear parts	Alarm	once	-	-
0x8C43 … 0x8C9F	Reserved	-	-	-	-	-
0x8CA0 … 0x8CA1	Manufacturer specific	-	-	-	-	-
0x8CA2	Signature error on the port of an IOL-PDU	-	Error	coming/ going	9	Error
0x8CA2 … 0x8CAF	Manufacturer specific	-	-	-	-	-

Table 133: PROFIBUS event codes

IOL event code	Meaning	Solution	IOL type	IOL mode	PROFIBUS DP Channel Diagnostics	
					Error code	Error text
0x8CB0	The IOL connection to a device has been interrupted	Device was disconnected from the IO-Link master	Error	coming/ going	6	Line break
0x8CB1	Manufacturer specific	-	-	-	-	-
0x8CB2	The settings of the attached IOL device do not match the settings in the port configuration.	1. Check if a port "Inspection Level" is activated and if the settings are correct. 2. Cycle times of the IOL device to not match those in the IOL master. 3. Process data check is enabled and contains incorrect values. Check correctness.	Error	coming/ going	9	Error
0x8CB3	The attached IOL device does not respond. An attempt is made to communicate with the device again. There may be a connection problem or error in the device.	1. Check connection to the IOL device. 2. Check IOL device for errors.	Warning	once	-	-
0x8CB4	1. A short circuit on the respective port has been detected. The short circuit may result from a defective IOL device or line. 2. If the field supply is too low, an undervoltage occurs on the IOL driver, which generates this error message.	1. Check attached IOL device and line. 2. Check field supply.	Error	coming/ going	1	Short Circuit
0x8CB5 ... 0x8CB7	Manufacturer specific	-	-	-	-	-
0x8CB8	The specified port has been disabled.	In the port configuration, check if disabling the port was intended.	Alarm	once	-	-
0x8CB9	A FALLBACK command was sent to the device.	The operating mode of a port has been set from "IO-Link" to "Digital Input".	Alarm	once	-	-

Table 133: PROFIBUS event codes

IOL event code	Meaning	Solution	IOL type	IOL mode	PROFIBUS DP Channel Diagnostics	
					Error code	Error text
0x8CBA	This event is reported with an attached IOL device with IO-Link V1.1 if set in the PREOPERATE state.	-	Alarm	once	-	-
0x8CBB	The connection to an IOL device has been established and the parameter server is ready.	-	Alarm	once	-	-
0x8CBC	The Vendor ID of the request does not match the ID in the record.	Check the Vendor ID.	Warning	once	-	-
0x8CBD	The length of the data is greater than the maximum available memory size in the EEPROM.	Check data length.	Warning	once	-	-
0x8CBE	An error has occurred while uploading data to the parameter server.	Possible causes: - Checksum error during the ISDU transfer - Other error in the ISDU telegram	Warning	once	-	-
0x8CBF	An error has occurred while downloading data from the parameter server.	Possible causes: - Checksum error during the ISDU transfer - Other error in the ISDU telegram	Warning	once	-	-
0x8CC0 … 0x8CC2	Manufacturer specific	-	-	-	-	-
0x8CC3	1. The new operating mode of the port corresponds to the current one, but the new master cycle time corresponds to the old one. 2. IOL masterstack-internal problem with the fallback of the IOL device 3. IOL masterstack-internal problem with the master cycle time	Check new port configuration.	Error	once	-	-

Table 133: PROFIBUS event codes

IOL event code	Meaning	Solution	IOL type	IOL mode	PROFIBUS DP Channel Diagnostics	
					Error code	Error text
0x8CC4 ... 0x8CC5	Manufacturer specific	-	-	-	-	-
0x8CC6	The frequency of the events or with which the events are written to the queue is higher than the readout frequency of the queue. The oldest events are overwritten and are thus lost.	Prevent events.	Error	coming/ going	9	Error
0x8CC7	1. IOL device, whose process data length is greater than the segmentation set, is connected. 2. Segmentation is set smaller than the process data length of the attached IOL device. 3. The SIO byte and port-specific segmentation have a length of 0 byte and the port is in the DI, DO or SIO state.	Following solutions: 1. Set segmentation to available process data length. 2. Set segmentation to available process data length. 3. SIO byte must have a length of 1 byte or segmentation must be set to the process data length.	Warning	once	-	-
0x8CC8 … 0x8DFF	Manufacturer specific	-	-	-	-	-
0x8E00 … 0xAFFF	Reserved	-	-	-	-	-
0xB000 … 0xBFFF	Reserved for profiles	-	-	-	-	-
0xC000 … 0xFEFF	Reserved	-	-	-	-	-
0xFF00 … 0xFFFF	SCSI-specific event codes					

11.4.2 CANopen

To use the IO-Link master in CANopen systems, the following settings for data access must be observed:

Table 134: Data access CANopen

Process image size	CANopen object
4 Bytes	4 Byte Special
6 Bytes	6 Byte Special
8 Bytes	8 Byte Special
10 Bytes	9 Byte Plus
12 Bytes	9 Byte Plus
16 Bytes	9 Byte Plus
20 Bytes	9 Byte Plus
24 Bytes	9 Byte Plus

Note

Coordinate segment limits of the process image and PDO limits!
As CAN telegrams are transferred in 8-byte segments, make sure that the segment limits of the process image match the PDO limits when areas to be transferred > 1 byte. Possible delayed processing of adjacent segments can otherwise lead to data inconsistency.

11.4.2.1 PDO Mapping

The data of the IO-Link master can be achieved by different entries per process image size. For example, the data is achieved by the entry "9 byte plus" for a process image length of 12 bytes (see the following figure).

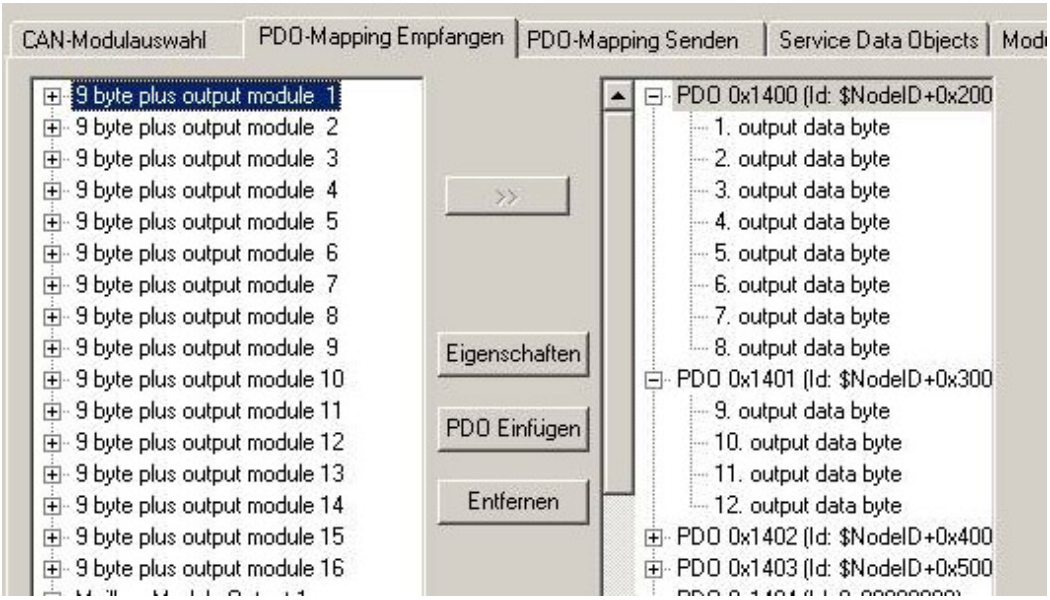


Figure 49: Receive PDO Mapping

If the process image length is 4 bytes, use an entry from the category "4 byte special" (see the following figure).

Figure 50: Send PDO Mapping

11.4.3 sercos

The 4-channel IO-Link master 750-657 is mapped in sercos via the sercos IO profile ("Function Specific Profile IO" (FSP_IO)) and function group S-0-1507 "Complex Protocol" and makes available 24-byte process data via the fieldbus parameters (IDN) in the input and output range.

The process data consists of 20 bytes user date and another 4 bytes control and status information (see section 6 "Process Image" and is displayed in sercos as follows:

Table 135: sercos process data

IDN/S-0-1507.x.03 “Channel quantity PDOUT“		1
IDN/S-0-1507.x.04 “Channel width PDOUT“		176
IDN/S-0-1507.x.05 “PDOUT“		
Byte	**Designation**	**Note**
0	FC0	Acyclic channel / register byte 0
1	MB0	Mailbox byte / register byte 1
2	SIO	SIO byte
3	D0	Data bytes
…	…	
22	D19	
IDN/S-0-1507.x.07 “Channel quantity PDIN“		1
IDN/S-0-1507.x.08 “Channel width PDIN“		176
IDN/S-0-1507.x.09 “PDIN“		
Byte	**Designation**	**Note**
0	FC0	Acyclic channel / register byte 0
1	MB0	Mailbox byte / register byte 1
2	SIO	SIO byte
0	D0	Data bytes
...	...	
22	D19	
IDN/S-0-1507.x.11 “Channel quantity DIAGOUT“		1
IDN/S-0-1507.x.12 “Channel width DIAGOUT“		8
IDN/S-0-1507.x.13 “DIAGOUT“		
Byte	**Designation**	**Note**
0	C0	Control byte
1	-	Empty byte
IDN/S-0-1507.x.15 “Channel quantity DIAGIN“		1
IDN/S-0-1507.x.16 “Channel width DIAGIN“		8
IDN/S-0-1507.x.17 “DIAGIN“		
Byte	**Designation**	**Note**
0	S0	Status byte
1	-	Empty byte

Table 135: sercos process data

IDN/S-0-1500.0.05 “Container OutputData“ (Default)		
Byte	**Designation**	**Note**
0	C0	Steuerbyte
1	FC0	Acyclic channel / register byte 0
2	MB0	Mailbox byte / register byte 1
3	SIO	SIO byte
4	D0	Data bytes
…	…	
23	D19	
IDN/S-0-1500.0.09 “Container InputData“ (Default)		
Byte	**Designation**	**Note**
0	S0	Status byte
1	FC0	Acyclic channel / register byte 0
2	MB0	Mailbox byte / register byte 1
3	SIO	SIO byte
4	D0	Data bytes
...	...	
23	D19	

Information

More information about sercos parameter model

More information about the parameter model in sercos and about using the listed fieldbus parameters is available in the sercos specification v1.1 (sercos International e.V., http://www.sercos.org) and in the user manual of the WAGO sercos fieldbus coupler 750-351 on the Internet at http://www.wago.com → Documentation → WAGO-I/O-SYSTEM 750.

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