

WAGO I/O System Field

8-Port IO-Link Master Class A; EtherCat; 24 V DC; 2.0 A;
8 × M12 Connection

765-4201/100-000



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

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Table of Contents

Provisions	7
1.1 Intended Use	7
1.2 Typographical Conventions	8
1.3 Legal Information	9
Safety	11
2.1 General Safety Rules	11
2.2 Electrical Safety	11
2.3 Mechanical Safety	11
2.4 Thermal Safety	11
2.5 Indirect Safety	12
Overview	13
Properties	14
4.1 View	14
4.2 Connections	15
4.2.1 Power supply	15
4.2.2 Communication Interfaces	16
4.2.2.1 IO-Link (Master)	16
4.2.3 Network Connections	16
4.2.3.1 ETHERNET Interfaces	16
4.3 Circuit Diagram	17
4.4 Technical data	17
4.4.1 Product	17
4.4.2 Mechanical Data	17
4.4.3 Connection Technology	18
4.4.4 Power Supply	19
4.4.5 Electrical Safety	20
4.4.6 Environmental Conditions	20
4.4.7 Communication	21
4.5 Derating	22
4.6 Regulations and Standards	23
4.7 Approvals	24
Functions	25
5.1 Process Image	25
5.2 Forcing	35
5.3 Monitoring Functions	36
5.4 Overload protection	37
5.5 Parameterization Tools	37
5.5.1 Overview	37
5.5.2 WAGO IO-Link Configurator	39

5.5.3	WAGO Webserver I/O Field	39
5.5.4	WAGO I/O Field app	40
5.6	Communication Interfaces.....	41
5.6.1	EtherCAT.....	42
5.6.2	OPC UA Server	42
Planning.....		43
6.1	Structure Guidelines.....	43
6.1.1	Data Security.....	43
6.1.2	EMC Installations	43
6.2	Power Supply Concept.....	44
6.2.1	Design Power Supply	44
6.2.2	Requirements on the Power Supply	48
6.2.3	Additional Measures	49
6.2.4	Power Supply Examples	49
6.3	Settings Options.....	51
6.3.1	Module Parameters	51
Transport and Storage.....		55
Installation and Removal.....		56
8.1	Installation	56
8.1.1	Tools Required for Installation.....	56
8.1.2	Before Installation.....	56
8.1.3	Installation Instructions.....	56
8.1.4	Note on Protecting against Heat Generation by the Product	57
8.1.5	Installation Distances	57
8.1.6	Installation	57
8.1.7	After Installation.....	57
8.1.8	Grounding.....	58
8.2	Removal	58
8.2.1	Tools Required for Removal.....	58
8.2.2	Before Removal.....	58
8.2.3	Removal	58
8.2.4	After Removal.....	58
Connection		59
9.1	General Information on Installation	59
9.2	Connect Power Supply.....	60
9.3	Connecting Cables	62
9.4	Connecting the Fieldbus	62
9.5	Connect Sensors/Actuators	64
Commissioning		68
10.1	Getting the IP Address from the EtherCAT Master	68
10.2	Configuration	69
10.2.1	Configuring EtherCAT	69
10.2.1.1	Selecting the Module	69

10.2.1.2	Configuring a Port.....	70
10.2.1.3	Setting Parameters	70
10.3	Parameterization	71
10.3.1	WAGO Webserver I/O Field	71
10.3.1.1	Call WAGO Webserver I/O Field	71
10.3.1.2	User Interface of the WAGO Webserver I/O Field.....	71
10.3.1.2.1	Maintenance Information	72
10.3.1.2.2	Advanced Module and Port Information	72
10.3.1.2.3	Displaying Licenses	72
10.3.1.3	Opening the Product Information via WAGO Webserver I/O Field.....	72
10.3.1.3.1	Displaying Port Information.....	72
10.3.1.3.2	Displaying Measured Values and Information on Connected IO-Link Devices	73
10.3.1.3.3	Displaying Port Status Information	75
10.3.1.3.4	State	76
10.3.1.3.5	Quality.....	76
10.3.1.3.6	Revision ID	76
10.3.1.3.7	Baud Rate	77
10.3.1.3.8	Cycle Time	77
10.3.1.3.9	Input Data Length	77
10.3.1.3.10	Output Data Length	77
10.3.1.3.11	Vendor ID.....	77
10.3.1.3.12	Device ID	77
10.3.1.3.13	Displaying Process Data.....	77
10.3.1.4	Parameterizing the Module via the WAGO I/O Field Webserver.....	79
10.3.1.4.1	Accessing a Connected IO-Link Device	79
10.3.1.4.2	Configure Ports.....	82
10.3.1.4.3	Configuring IP Parameters	86
10.3.1.4.4	Storing Maintenance Information	86
10.3.1.4.5	Updating Firmware	88
10.3.1.4.6	Resetting the Module to the Factory Settings	89
10.3.1.4.7	Configure Bluetooth	90
10.3.1.4.8	Logging Users on and off and Managing Them.....	93
10.3.1.4.9	Forcing Digital Inputs and Outputs	96
10.3.1.4.10	Forcing for IO-Link Ports.....	97
10.3.2	WAGO IO-Link Configurator.....	99
10.3.3	WAGO I/O Field app	99
10.3.3.1	Parameterizing a Module with the WAGO I/O Field App.....	99
10.3.4	OPC UA Server	99
10.3.4.1	Parameterizing the Product via OPC UA.....	100
10.3.4.1.1	Identifying Devices.....	100
10.3.4.1.2	Setting Device Parameters	101
10.3.4.1.3	Setting Port Parameters	101
10.3.4.1.4	Reading Measured Power Values	102
10.3.4.1.5	Reading out Diagnostic Information.....	103
10.3.4.1.6	Reading Statistics	103
10.3.4.1.7	NTP Client Configuration	104
10.3.4.1.8	I/O Forcing via OPC UA.....	104
10.3.4.1.9	Using OPC UA Client.....	105
10.3.4.2	Setting the Module Time.....	121
	Diagnostics.....	122
11.1	Diagnostics via Indicators.....	122
11.2	Diagnostics via EtherCAT	125
11.2.1	Diagnostic History	125
11.2.1.1	Subindex 0: Highest Supported Subindex.....	125
11.2.1.2	Subindex 1: Maximum Messages.....	125

11.2.1.3	Subindex 2: Newest Message	126
11.2.1.4	Subindex 3: Newest Acknowledged Message.....	126
11.2.1.5	Subindex 4: New Messages Available	127
11.2.1.6	Subindex 5: Flags	127
11.2.1.7	Subindexes 6–69: Diagnosis Message (Write-Protected)	128
11.2.1.8	Structure of a Diagnostic Message.....	128
11.2.1.9	Emergency Error Codes	129
11.2.1.10	Events Triggered by the IO-Link Master	131
11.2.1.11	Events Triggered by the IO-Link Device	132
11.2.2	Diagnostic Data of the Modules	133
Service	135	
12.1	Resetting to Factory Settings	135
12.2	Updating Firmware	135
Decommissioning	136	
13.1	Disposal and Recycling	136
Appendix.....	137	
14.1	ISDU Services via AoE.....	137
14.1.1	Addressing and Device Identification in AoE.....	137
14.1.1.1	Device Identification	137
14.1.1.2	Addressing the Objects in IO-Link Devices via AoE.....	138
14.1.2	AoE – Transfer of ADS Data in the Mailbox of the EtherCATFrame	138
14.1.3	Overview of the Structure of the AoE Frame.....	139
14.1.4	ISDU Read Service	140
14.1.5	ISDU Write Service	143
14.1.6	Error Handling	145
14.2	Installation Regulations Specified by Approvals	148
14.3	Operational Description.....	149
14.4	Protected Rights.....	151

Provisions

This document applies to the following product:

 **765-4201/100-000** (8 PORT IOL-A FLD EC 24 VDC 2.0 A) 8-Port IO-Link Master Class A; EtherCAT; 24 V DC; 2.0 A; 8 × M12 Connection

Product detail page

 www.wago.com/765-4201/100-000

The product must only be installed and operated in accordance with the operating instructions. Knowledge of the operating instructions is required for proper use. You can find all documents and information on the detailed product page.

Additional document

-  **WAGO IO-Link Configurator**

1.1 Intended Use

The product 765-4201/100-000 is used to capture field signals on sensors, actuators and hubs which have been sent or received by a higher-level controller and output them via IO-Link.

The product works as a decentralized input/output unit in EtherCAT networks.

- This product is intended for installation in automation technology systems.
- The product is intended for indoor and outdoor use.
- Operation of the products in industrial area is permitted.
- Operation of the product in other application areas is only permitted when corresponding approvals and labeling are present.

Improper Use

Improper use of the product is not permitted. The following cases in particular constitute improper use:

- Non-observance of the intended use
- Use without protective measures in an environment in which salt water, salt spray mist, icing, corrosive fumes, explosive gases, direct sunlight and ionizing radiation can occur
- Use of the product in areas with special risk that require continuous fault-free operation and in which failure of or operation of the product can result in an imminent risk to life, limb or health or cause serious damage to property or the environment (such as the operation of nuclear power plants, weapons systems, aircraft and motor vehicles)

Warranty and Liability

The terms set forth in the General Business and Contract Conditions for Delivery and Service of WAGO GmbH & Co. KG and the terms for software products and products with integrated software stated in the WAGO Software License Contract – both available at

 www.wago.com – shall apply. In particular, the warranty is void if:

- The product is improperly used.
- The deficiency (hardware and software configurations) is due to special instructions.
- Modifications to the hardware or software have been made by the user or third parties that are not described in this documentation and that has contributed to the fault.

Individual agreements always have priority.

Obligations of Installers/Operators

The installers and operators bear responsibility for the safety of an installation or a system assembled with the products. The installer/operator is responsible for proper installation and safety of the system. All laws, standards, guidelines, local regulations and accepted technology standards and practices applicable at the time of installation, and the instructions in the the products' Instructions for Use, must be complied with. In addition, the Installation regulations specified by Approvals must be observed. In the event of non-compliance, the products may not be operated within the scope of the approval.

1.2 Typographical Conventions

Number Notation

100	Decimals: Normal notation
0x64	Hexadecimals: C-notation
'100'	Binary: In single quotation marks
'0110.0100'	Nibbles separated by a period

Text Formatting

<i>italic</i>	Names of paths or files
bold	Menu items, entry or selection fields, emphasis
Code	Sections of program code
>	Selection of a menu point from a menu
"Value"	Value entries
[F5]	Identification of buttons or keys

Cross References / Links

	Cross references/links to a topic in a document
	Cross references / links to a separate document
	Cross references / links to a website
	Cross references / links to an email address

Action Instructions

- ✓ This symbol identifies a precondition.
- 1. Action step
- 2. Action step
 - ⇒ This symbol identifies an intermediate result.
 - ⇒ This symbol identifies the result of an action.

Lists

- Lists, first level
 - Lists, second level

Figures

Figures in this documentation are for better understanding and may differ from the actual product design.

Notes

DANGER

Type and source of hazard

Possible consequences of hazard that also include death or irreversible injury

- Action step to reduce risk

WARNING

Type and source of hazard

Possible consequences of hazard that also include severe injury

- Action step to reduce risk

CAUTION

Type and source of hazard

Possible consequences of hazard that include at least slight injury

- Action step to reduce risk

NOTICE

Type and source of malfunction (property damage only)

Possible malfunctions that may restrict the product's scope of functions or ergonomics, but do not lead to foreseeable risks to persons

- Action step to reduce risk

Note

Notes and information

Indicates information, clarifications, recommendations, referrals, etc.

1.3 Legal Information

Intellectual Property

Unless barred by applicable legal provisions, unauthorized copying and distribution of this document, as well as the use and communication of its content are strictly prohibited unless expressly authorized by prior agreement. Third-party products are always mentioned

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Third-party trademarks are referred to in the product documentation. The “®” and “TM” symbols are omitted hereinafter. The trademarks are listed in the Appendix:  **Protected Rights [► 151]**.

Subject to Change

The instructions, guidelines, standards, etc., in this manual correspond to state of the art at the time the documentation was created and are not subject to updating service. The installer and operator bear sole responsibility to ensure they are complied with in their currently applicable form. WAGO GmbH & Co. KG retains the right to carry out technical changes and improvements of the products and the data, specifications and illustrations of this manual. All claims for change or improvement of products that have already been delivered – excepting change or improvement performed under guarantee agreement – are excluded.

Licenses

The products may contain open-source software. The requisite license information is saved in the products. This information is also available under:  www.wago.com.

Safety

2.1 General Safety Rules

- This documentation is part of the product. Therefore, retain the documentation during the entire service life of the product. Pass on the documentation to any subsequent user of the product. In addition, ensure that any supplement to this documentation is included, if necessary.
- The product must only be installed and put into operation by qualified electrical specialists per EN 50110-1/-2 and IEC 60364.
- Comply with the laws, standards, guidelines, local regulations and accepted technology standards and practices applicable at the time of installation.

2.2 Electrical Safety

Power Supply

- Only operate the product with safe extra low voltage power sources (PELV or SELV).
- Connecting impermissible current or frequency values may destroy the product.

Grounding/Protection/Fuses

- Connect the product and system to functional ground (FE).
- When handling the product, please ensure that environmental factors (personnel, work space and packaging) are properly equalized. Do not touch any conducting parts.

Cables

- Maintain spacing between control, signal and data lines and the power supply lines.
- Only use conductor cross-sections sufficient for the current load.

Protection

- When working on the system (e.g., during maintenance), protect the facility part in question from accidental or unauthorized restart.

2.3 Mechanical Safety

- Cooling of the product must not be impaired. Ensure air can flow freely and that the minimum clearances from adjacent products/areas are maintained.
- Before startup, please check the product for any damage that may have occurred during shipping. Do not put the product into operation in the event of mechanical damage.

2.4 Thermal Safety

- The surface of the housing heats up during operation. Under special conditions (e.g., in the event of a fault or increased surrounding air temperature), touching the product may cause burns. Allow the product to cool down before touching it.
- If the surface temperature of the product can exceed 55 °C, wear protective gloves and attach protective covers and/or touch-proof protection.

2.5 Indirect Safety

- Only use a dry or cloth or a clothed dampened with water to clean the product. Do not use cleaning agents, e.g., abrasive cleaners, alcohols or acetone.
- Do not allow the product to come into contact with ketones (e.g., acetone) or chlorinated hydrocarbons (e.g., dichloromethane) under any circumstances.
- Do not use hard objects that could cause scratches for cleaning.
- Clean tools and materials are imperative for handling the product.
- If automation solutions are implemented that can cause personal injury or major property damage in the event of failure, you must take appropriate measures to ensure that the system remains in a safe operating state even in the event of failure.
- Before installation and operation, please read the product documentation thoroughly and carefully. In addition, note the information on the product housing and further information, e.g. at www.wago.com/<item number>.
- Only permit skilled personnel approved by WAGO to perform repair work.

Overview

The module is part of the WAGO I/O System Field 765. It is intended for industrial use within an EtherCAT® network and communicates with a central controller on the control level. Several sensors/actuators can be connected to the device for connection on the field level. The device electronics are protected from environmental influences by the completely encapsulated device housing.

The product has a metal housing and is suitable for screw mounting on a rack.

Function Overview

- EtherCAT® communication with the higher-level controller
 - Cyclic I/O data
 - Configuration and Parameterization via EtherCAT®
 - Emergency Telegrams
- Bluetooth® interface for diagnostics and configuration using the WAGO I/O Field app and a mobile device
- WAGO I/O Field Webserver: integrated Webserver, accessible via “Ethernet over EtherCAT (EoE)“, with the following functions: configuration, parameterization, diagnostics, testing and firmware update
- Forcing function: Forcing output signals, simulating input signals
- Measured values by channel:
 - Output and supply current
 - Supply voltage
 - Temperature measurement
- Monitoring functions by channel:
 - Maximum current
 - Over and undervoltage
 - Over and undertemperature
 - Line break detection
- Total current monitoring
- Protective functions: Shutdown of the switching or supply outputs if the maximum current at this pin is exceeded.
- Integrated OPC UA server in compliance with “IO-Link Companion Specification” expanded to include diagnostic functions
- 8 ports
 - IO-Link Master Class A
 - Pin 4 can be configured as an IO-Link Master, digital input or digital output
 - Pin 2 can be configured as a digital input or digital output

Properties

4.1 View

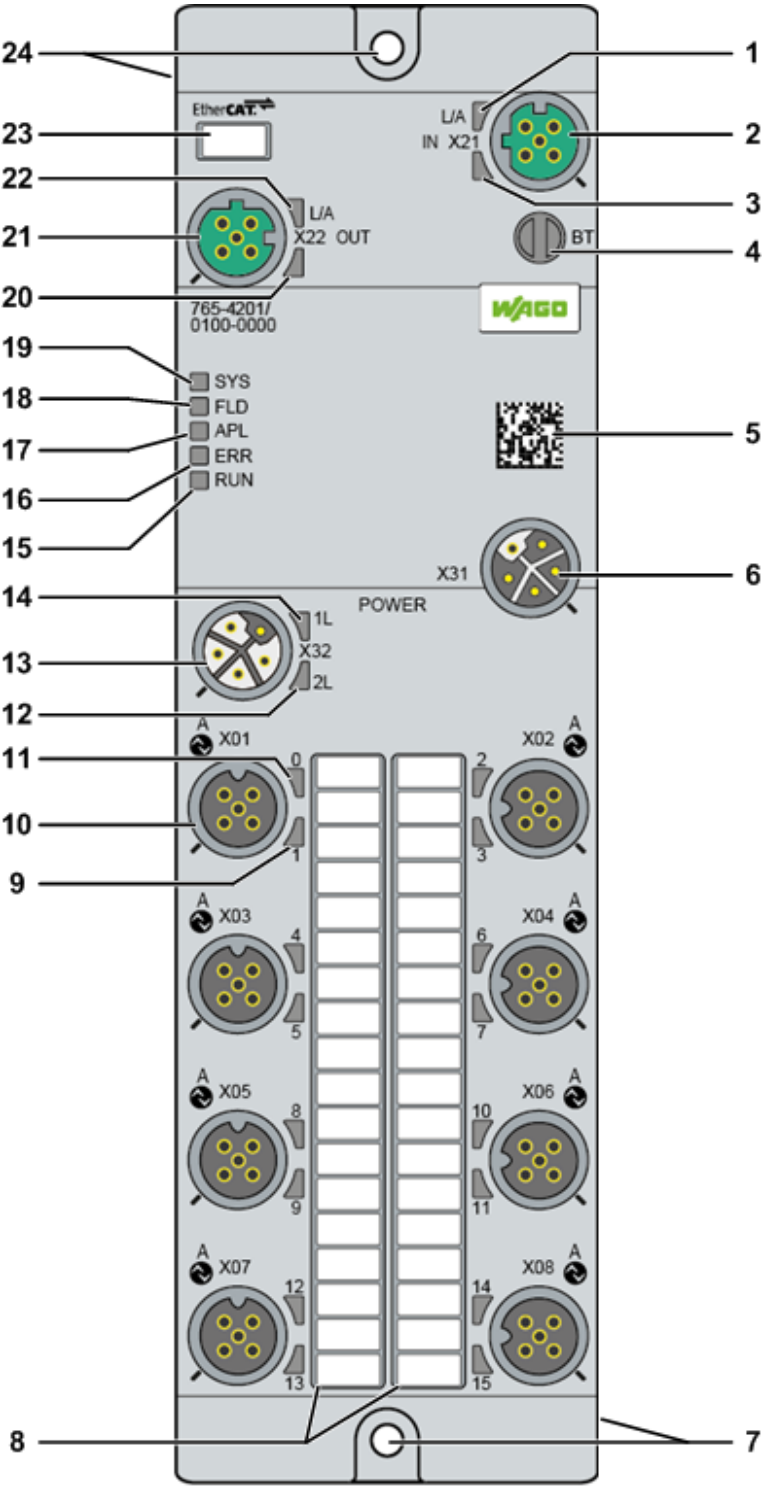


Figure 1: View

Table 1: Legend for “View” Figure

Function	Position	Custom Name	Description
ETHERNET	2	X21	ETHERNET interface, M12, D-coded, EtherCAT®-IN port

Function	Position	Custom Name	Description
	1	L/A (X21)	Link/activity LED for port X21
	3	-	LED with no function
	21	X22	ETHERNET interface, M12, D-coded, EtherCAT® OUT port
	22	L/A (X22)	Link/activity LED for port X22
	20	-	LED with no function
Bluetooth®	4	BT	Bluetooth® antenna, including Bluetooth® LED
Indicators	19	SYS	System LED
	18	FLD	Field LED
	17	APL	Application LED
	16	ERR	EtherCAT® error status LED
	15	RUN	EtherCAT® slave status LED
Identification	5	-	Data Matrix Code (DM Code) Contains the serial number of the module (UII)
Supply voltage	6	X31	Power supply input (Power In)
	13	X32	Power supply output (Power Out)
	14	1L (X32)	1L power supply LED (24 VDC)
	12	2L (X32)	2L power supply LED (24 VDC)
IO-Link Class A	10	X01 ... X08	IO-Link port, ports X01 ... X08, M12, A-coded
	9	1, 3, 5, 7, 9, 11, 13, 15	IO-Link port LEDs for ports X01 ... X08, channel (pin 2)
	11	0, 2, 4, 6, 8, 10, 12, 14	IO-Link port LEDs for ports X01 ... X08, IO-Link or channel A (pin 4)
Marking	8	-	Port marking (WMB Inline and marking strips)
	23	-	Module marking (WMB Inline)
Assembly	7	-	Mounting hole for front or side mounting
	24	-	Mounting hole for front or side mounting

4.2 Connections

4.2.1 Power supply

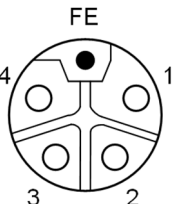
The product is powered through the X31 connection (Power in). Two supply cables can be connected to the plug:

- Supply cable 1: 1L+ (U_{1L}) and reference potential 1L–
- Supply cable 2: 2L+ (U_{2L}) and reference potential 2L–

Both supply cables are electrically isolated from each other and functional ground.

Each pin of plug X31 (Power in) is connected to the same pin of socket X32 (Power out) and makes it possible to pass the power on to the next device.

Table 2: Supply Voltage

Supply Voltage Input	Supply Voltage Output	Pin	Signal	Description
 M12, L-coded, plug, 5-pin (4 + FE)	 M12, L-coded, socket, 5-pin (4 + FE)	1	1L+	24 VDC supply voltage U_{1L} for system and sensor/actuator
		2	2L–	Reference potential for 2L
		3	1L–	Reference potential for 1L
		4	2L+	24 VDC auxiliary/control voltage U_{2L}
		FE	FE	Functional ground

Note

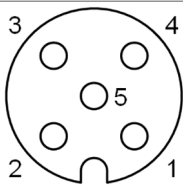
Upper limit on current consumption from X32 (Power out)

Before connecting one or more products to the power supply on socket X32 (Power out), read section [Power Supply Examples \[p. 49\]](#). There you will find information on the maximum permitted current consumption.

4.2.2 Communication Interfaces

4.2.2.1 IO-Link (Master)

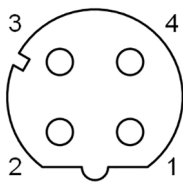
Table 3: IO-Link (class A)

IO-Link (Class A)	Pin	Signal	Description	Wire Color
 M12, A-coded, socket, 5-pin	1	1L+	24 VDC supply voltage U_{1L} for sensor/actuator	Brown
	2	DIO B (DI B/ DQ B)	Digital input/output channel B	White
	3	1L–	Reference potential for 1L+	Blue
	4	C/Q DIO A (DI A/ DQ A)	IO-Link data or digital input/output channel A	Black
	5	n. c.	Not connected	-

4.2.3 Network Connections

4.2.3.1 ETHERNET Interfaces

Table 4: ETHERNET Interfaces

ETHERNET	Pin	Signal	Description
 M12, D-coded, socket, 4-pin	1	TX+	Positive send data
	2	RX+	Positive receive data
	3	TX–	Negative send data
	4	RX–	Negative receive data
	Housing	Shield	Shield connection; housing is connected to functional ground

4.3 Circuit Diagram

The following figure shows the schematic circuit diagram of the product.

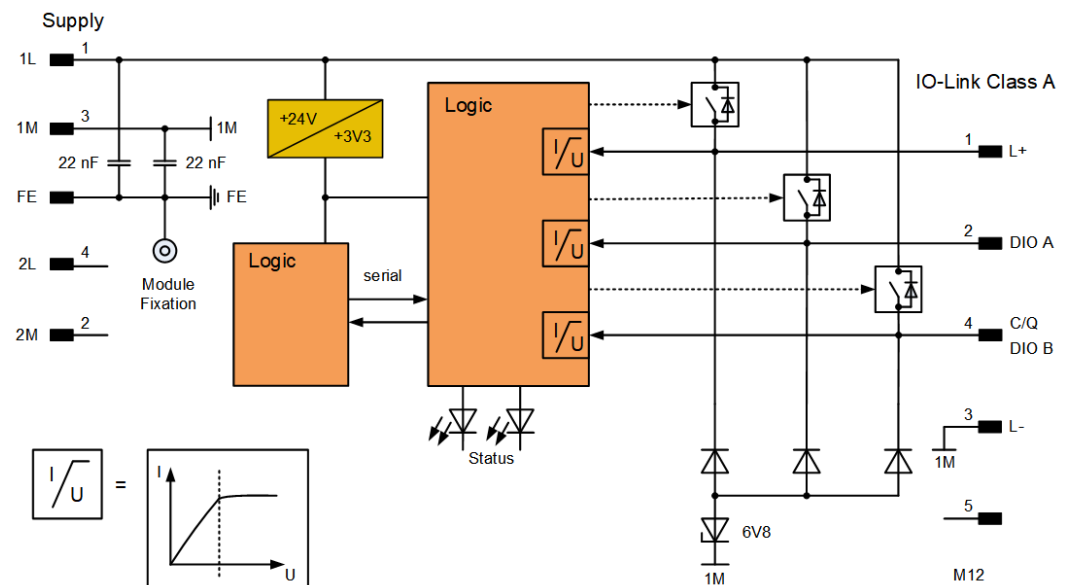


Figure 2: Circuit Diagram for Each Port

4.4 Technical data

4.4.1 Product

Table 5: Product

Property	Value
Item Number	765-4201/100-000
Product function	8-Port-IO-Link Master Class A
Product name (short)	8 PORT IOL-A FLD EC 24 VDC 2.0 A
Product name (long)	8-Port IO-Link Master Class A; EtherCAT; 24 V DC; 2.0 A; 8 × M12 connection

4.4.2 Mechanical Data

Table 6: Mechanical Data

Property	Value
Width	60 mm
Height	30 mm
Length	210 mm
Weight	576.8 g
Housing	Zinc Die Casting
Mounting type	Screw mount, 2 × M4
Tightening torque	M4: 1.2 Nm
Mounting holes	Diameter: 4.5 mm
	Distance from each: 198.0 mm ± 0.2 mm

4.4.3 Connection Technology

Table 7: Connection technology

Property	Value
Power Connection	PWR IN: M12 L-coded, 5-pin, plug
	PWR OUT: M12 L-coded, 5-pin, socket
EtherCAT Connection	2 × M12, D-coded, socket, 4-pin
IO-Link ports	8 × M12, A-coded, socket, 5-pin
Tightening Torque	M12: 1.0 Nm

IO-Link Port (Class A)

Table 8: IO-Link Port (Class A)

Property	Value	Value (per UL)
IO-Link Master (Class A)		
Specification	V1.1	
Port mode	Pin 4: IO-Link: autoconfig, manual, tool-based; DI, DO Pin 2: DI, DO, disabled	
Transmission mode	COM 1, COM 2, COM 3	
Min. cycle time	400 μs (IO-Link frame type_2_1 with transmission mode COM 3)	
Digital Input		
Characteristic	Type 3 (IEC 61131-2)	
Parameter	Digital software input filter: without, 3 ms, 15 ms, 20 ms The input signal change must be at most 2.5 kHz for correct device-internal detection of changes. However, it should be noted that the transfer and processing of the process data (in the device and in the controller) also take time and reduce the maximum input signal change.	
Recording cycle	200 μs	
Circuit	The digital input is not resistant to feedback. The input voltage must not exceed the supply voltage.	
Indicators	On/off status LED	
Digital Output		
Output voltage	24 VDC, 1L powered	
Current	Normal operation: max. 2.0 A per channel Overload operation: max. 2.4 A per channel, per IEC 61131-2	
Residual current	Less than 1 mA	
Circuit	High-side driver The digital output is not resistant to feedback. The input voltage must not exceed the supply voltage.	
Voltage drop through high-side path	Less than 250 mV	
Self-protection	Overcurrent, overload, overtemperature and overvoltage	
Maximum capacitive load	100 μF parallel to 12 Ω; 10 Hz	
Maximum inductive load	1.15 H / 2 A; 0.2 Hz; DC13	1.15 H / 2 A; 1 Hz; DC13; Pilot Duty
Indicators	On/off status LED	
Diagnostics	Events: overcurrent, overload and overtemperature	
Actuator/Sensor Supply		

Property	Value	Value (per UL)
Output voltage	24 VDC, 1L powered	
Output current, L1	Maximum: 4.0 A per channel per IEC 61131-2	
Output current, L1 with IO-Link operating mode	Maximum 1.0 A with conductor size AWG 22/0.34 mm ² and cable length of up to 20 m (per IO-Link specification)	
	Maximum 4.0 A with increased conductor cross-section or reduced cable length (max. voltage drop of 1.2 V for both feed and return line individually)	
Output current, L2	Maximum: 4.0 A per channel per IEC 61131-2	
Output current, L2 with IO-Link operating mode	Maximum 1.0 A with conductor size AWG 22/0.34 mm ² and cable length of up to 20 m (per IO-Link specification)	
	Maximum 4.0 A with increased conductor cross-section or reduced cable length (max. voltage drop of 1.2 V for both feed and return line individually)	
Circuit	High-side driver The 1L+/2L+ output is not resistant to feedback. The input voltage must not exceed the supply voltage.	
Self-protection	Overcurrent, overload, overtemperature and overvoltage	
Voltage drop through high-side path	Less than 200 mV	
Maximum capacitive load	1000 µF parallel to 24 Ω; 0.1 Hz	
	470 µF parallel to 12 Ω; 0.1 Hz	
	220 µF parallel to 6 Ω; 0.1 Hz	
Maximum inductive load	1.15 H / 2 A; 0.2 Hz; DC13	1.15 H / 2 A; 1 Hz; DC13; Pilot Duty
Diagnostics (1L+)	Events: overcurrent, overload, overtemperature and overvoltage	

Table 9: Total Load

Parameters	Value	Value (per UL)
Maximum total load current (sum of all currents of connections X01–X08)	15.7 A	11.7 A

4.4.4 Power Supply

Table 10: Power Supply

Parameters	Value	Value (per UL)
Supply voltage, 1L, 2L	24 VDC, –25 %/+30 % (18 VDC ... 31.2 VDC)	
	24 VDC, –25 %/+20 % (18 VDC ... 28.8 VDC)	
	Voltages above 34 V can permanently damage the device. Voltages below approx. 11 V lead to device reset.	
Undervoltage warning, 1L	18.0 V (± 5 % at 25 °C) message on	
	18.3 V (± 5 % at 25 °C) message off	
Overvoltage warning, 1L	30.0 V (± 5 % at 25 °C) message on	
	29.7 V (± 5 % at 25 °C) message off	
Module current consumption	1L: 100 mA (at 24 VDC)	
	2L: 10 mA (at 24 VDC)	
Current consumption of supply connections	Max. 16 A; ensure external limitation or use fuses in the cables	External fuses in lines 1L and 2L: max. 16 A, time-delay, min. 30 VDC

Parameters	Value	Value (per UL)
	The maximum total current of the device, including transmission between the power supply connections, must not exceed 16 A for both 1L and 2L individually. If additional modules are connected to X32 (PWR OUT), it may be necessary for the maximum total current to be monitored with external power supply management. Maximum current: Observe derating as a function of ambient temperature.	The maximum total current of the device, including transmission between the power supply connections, must not exceed 12 A (the sum of 1L and 2L). If additional modules are connected to X32 (PWR OUT), it may be necessary for the maximum total current to be monitored with external power supply management.
Conductor cross-section	0.5 ... 2.5 mm ² Note: Observe the current carrying capacity and cable length!	2.5 mm ²
Reverse voltage protection	Yes	
Power source	24 VDC PELV (Protective Extra Low Voltage) or SELV (Safety Extra Low Voltage) power source	

4.4.5 Electrical Safety

Table 11: Electrical Safety

Property	Value
Insulation resistance	60 VDC
Test voltage	550 VAC RMS
Min. creepage distance	0.7 mm

Requirements

- Use of PELV/SELV power supplies
- When SELV power supplies are used: SELV power supplies with supply via the same network phase
- If PELV (Protective Extra Low Voltage) power supplies are used: PELV (Protective Extra Low Voltage) power supplies with a secondary power supply connection to the common reference point

4.4.6 Environmental Conditions

Table 12: Environmental Requirements

Property	Value	Value (per UL)
Ambient temperature (operation)	–25 °C ... +70 °C	
Ambient temperature (storage)	–40 °C ... +80 °C	
Maximum temperature change	3 K/min	
Relative humidity (operation)	5 % ... 95 %	
Pollution degree	3 (EN 60664-1)	
Operating altitude	0 ... 2000 m	

Property	Value	Value (per UL)
Overvoltage category	II (EN 60664-1)	
Protection type	IP67 (EN 60529)	Indoor use (enclosure type 12, 13; IP67)
Protection class	III (EN 61140)	
Vibration resistance	5g (IEC 60068-2-6)	
Shock resistance	50g (IEC 60068-2-27)	

4.4.7 Communication

Table 13: Communication

Property	Value
Communication Interfaces	ETHERNET, IO-Link, Bluetooth®
Protocols	EtherCAT®, HTTP, OPC UA, IO-Link

Table 14: EtherCAT® Slave

Parameters	Value
Input data	11 ... 267 bytes Operation with 8 IO-Link 32 Is / 32 Os: 267 bytes Operation with 16 DIs: 19 bytes Operation with 16 DOs: 11 bytes
Output data	2 ... 258 bytes Operation with 8 IO-Link 32 Is / 32 Os: 258 bytes Operation with 16 DIs: 2 bytes Operation with 16 DOs: 10 bytes
Type	Complex slave
Features	Emergency
SYNC manager	4
Supported protocols	SDO server CoE (CANopen over EtherCAT) EoE (Ethernet over EtherCAT) FoE (File Access over EtherCAT)
Transmission rate	100 MBit/s
Data transport layer	ETHERNET II, IEEE 802.3
Interface type	100BASE-TX, potential-free
Autonegotiation, autocrossover	Yes

Table 15: OPC UA Server

Parameters	Value
OPC UA Server	Per "IO-Link Companion Specification": http://opcfoundation.org/UA/IOLink/ Manufacturer-specific information model with diagnostic functions: http://www.wago.com/UA/Diagnostics/
Server profile	Micro Embedded Device
Protocol	OPC UA TCP
User access	Anonymous (read access only) Username/password (read and write access)
Number of sessions	2

Parameters	Value
Number of subscriptions per session	2
Number of “monitored items” per session	20
Data coding	UA binary

Table 16: Communication – Bluetooth® transmitter

Property	Value
Modulation	GFSK
Data rate	1 Mbit/s
Operating frequency	2402 ... 2480 MHz
Maximum power, including tune-up tolerance	Output power: +8 dBm Tolerance: +2 dBm / -3 dBm
Antenna type	PCB monopole
Maximum antenna gain	1.25 dBi

We declare that we meet the EN 62479 standard with respect to the limiting value for low powers less than 20 mW. Therefore, the product fundamentally corresponds to the European limiting values for high-frequency radiation.

4.5 Derating

Please note the derating for use of the product. The surrounding air temperature and the current affect the product's heat generation.

The derating curve was created with the following conditions of use: “without air movement and with 0.5 m/s air movement” and “mounting on wall with poor heat conductivity.” The real conditions of use may lead to better heat dissipation from the product, e.g. due to greater air movement or better dissipation of heat to the mounting wall. The product provides measured values for temperature and current, which you can display with WAGO Webserver I/O Field or read out via OPC UA.

The following figure shows the maximum permissible current (I) that can flow into the product as a function of the surrounding air temperature (T).

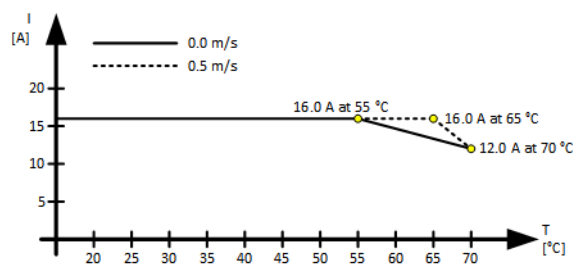


Figure 3: Derating, 765-4201/100-000

Also note the derating curve for the individual contacts (pins) of the L-coded connections X31 and X32. The following figure shows the maximum permissible current (I) that can flow through the contact (pin) as a function of the ambient temperature (T).

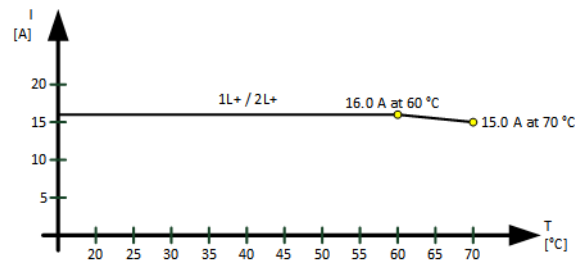


Figure 4: Derating of a Contact (Pin) of L-Coded Connections X31 and X32 (For Core Cross-Section = $0.25 \text{ mm}^2/\text{AWG } 14$)

Also note the derating curve for the individual contacts (pins) of the A-coded connections port X01, X02 etc. The following figure shows the maximum permissible current (I) that can flow through the contact (pin) as a function of the ambient temperature (T).

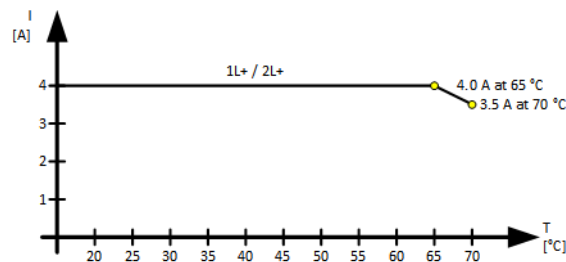


Figure 5: Derating of a Contact (Pin) of the A-Coded Connections Port X01, X02, ... (for Core Cross-Section = $0.34 \text{ mm}^2/\text{AWG } 22$)

High currents may occur on connections port X01, X02, ... on pin 1 and pin 3.

4.6 Regulations and Standards

The following regulations and standards were used in the development of the module:

Table 17: Standards and Regulations

Standard	Title
EN 61000-6-2	Electromagnetic compatibility (EMC) – Immunity for industrial environments
EN 61000-6-4	Electromagnetic compatibility (EMC) – Emission standard for industrial environments
EN 61131-2	Programmable logic controllers
IEC 61158	EtherCAT®
IEC 60068-2-27 / 2008-02	Shock testing
IEC 60068-2-6 / 2007-12	Vibration testing (sinusoidal)

4.7 Approvals

The following approvals have been granted for the product:

	Conformity marking
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	UL	UL 61010-1 and UL 61010-2-201, "Ordinary Location"	Pending
---	----	--	---------

	Bluetooth®	This module has an RF transmitter with the following specifications: - Operating frequency: 2402–2480 MHz - Maximum RF output power: < 20 mW	
---	------------	--	--

RED	Certificate number: R20-0935-01-TEC (Wideline)
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FCC	FCC ID: 2AKUE-WIDELINE
-----	------------------------

ISED	Certificate number: 22322-WIDELINE
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Note

More information on approvals

You can find detailed information on the approvals online at:

 www.wago.com/<item number>

Functions

5.1 Process Image

EtherCAT® uses process data objects (PDO) to transfer process data. Process data is transferred from the EtherCAT® master to the EtherCAT® slave with objects 0x1600, 0x1601 etc.; these data objects are called receive PDOs (RxPDOs). Process data is transferred from the EtherCAT® slave to the EtherCAT® master with objects 0x1A00, 0x1A01 etc.; these data objects are called send PDOs (TxPDOs).

Input Process Data

The 765-4201/100-000 module uses multiple TxPDOs for transferring input process data:

- One object 0x1A0x per port with the IO-Link input data or the value of the digital input
- Object 0x1A10 for transferring the digital inputs of all ports
- Object 0x1A11 with status “New Message Available”
- Object 0x18A0 with the status of the IO-Link ports

Input Process Data

The 765-4201/100-000 module uses multiple RxPDOs for transferring output process data:

- One object 0x160x for each port with the IO-Link output data or the value of the digital output
- Object 0x1610 for transferring the digital outputs of all ports (pin 2 in each case)

Input Process Data

Objects 0x1A0x:

The content of objects 0x1A00 to 0x1A07 depends on the operating mode settings of the corresponding ports. Object 0x1A0x contains the port operating modes “IO-Link” and “Digital input.” The assignment is as follows:

- Object 0x1A00 is assigned to port X01.
- Object 0x1A01 is assigned to port X02.
- ...
- Object 0x1A07 is assigned to port X08.

Objects 0x1A0x with port operating mode “IO-Link”:

The following table describes the assignment of input process data to port for the “IO-Link” port operating mode.

Table 18: Objects 0x1A0x: Assignment of the IO-Link input data

Index Subindex	Size	Name	Description
0x6000.01	1 byte	Input byte 0	Object 0x1A00 with input process data of port X01
0x6000.02	1 byte	Input byte 1	
...	...	...	
0x6000.20	1 byte	Input byte 31	IO-Link input data of the IO-Link device on port X01. For a description of the data, see the manual from the manufacture of the IO-Link device used. The number of “Input bytes” corresponds to the length of the module used in slot “IO-Link Port X01” and can be 1, 2, 4, 8, 16 or 32 bytes.

Index Subindex	Size	Name	Description
0x6010.01	1 byte	Input byte 0	Object 0x1A01 with input process data of port X02
0x6010.02	1 byte	Input byte 1	
...	...	...	
0x6010.20	1 byte	Input byte 31	IO-Link input data of the IO-Link device on port X02. For a description of the data, see the manual from the manufacture of the IO-Link device used. The number of "Input bytes" corresponds to the length of the module used in slot "IO-Link Port X02" and can be 1, 2, 4, 8, 16 or 32 bytes.
...	...	...	...
0x6070.01	1 byte	Input byte 0	Object 0x1A07 with input process data of port X08
0x6070.02	1 byte	Input byte 1	
...	...	...	
0x6070.20	1 byte	Input byte 31	IO-Link input data of the IO-Link device on port X08. For a description of the data, see the manual from the manufacture of the IO-Link device used. The number of "Input bytes" corresponds to the length of the module used in slot "IO-Link Port X08" and can be 1, 2, 4, 8, 16 or 32 bytes.

Objects 0x1A0x with port operating mode "Digital input":

The following table describes the assignment of input process data to ports X01 to X08 for the "Digital input" port operating mode.

Table 19: Objects 0x1A0x: Assignment of the Digital Input

Index Subindex	Size	Name	Description
0x6000.01	1 byte	PD (C/Q pin 4)	Port X01 (pin 4) functions as a digital input Object 0x1A00 contains object 0x6000.01 and transfers the input data of the digital input connected to port X01 (pin 4). Bit 0 = 0: input off. Bit 0 = 1: input on.
0x6010.01	1 byte	PD (C/Q pin 4)	Port X02 (pin 4) functions as a digital input Object 0x1A01 contains object 0x6010.01 and transfers the input data of the digital input connected to port X02 (pin 4). Bit 0 = 0: input off. Bit 0 = 1: input on.
...	...	...	...
0x6070.01	1 byte	PD (C/Q pin 4)	Port X08 (pin 4) functions as a digital input Object 0x1A07 contains object 0x6070.01 and transfers the input data of the digital input connected to port X08 (pin 4). Bit 0 = 0: input off. Bit 0 = 1: input on.

Object 0x1A10:

Object 0x1A10 contains the digital inputs (pin 2 and pin 4) of all ports.

Table 20: Object 0x1A10: Assignment of the Digital Inputs

Index Subindex	Size	Name	Description
0x3000.01	2 bytes	PD (I/Q Pin 2 + C/Q Pin 4)	The port and pin assignment of process data depends on the process data layout setting: pin-based or port-based. See the following tables.

The process data of the digital inputs can be transferred on a port basis (default) or pin basis. The following tables show the port and pin assignment.

Table 21: Input Process Data (port-based assignment)

Byte	Bit	Input Process Data
Byte 1	0	Port X01, pin 4: DI A or DO A
	1	Port X01, pin 2: DI B or DO B
	...	...
	6	Port X04, pin 4: DI A or DO A
	7	Port X04, pin 2: DI B or DO B
byte 2	0	Port X05, pin 4: DI A or DO A
	1	Port X05, pin 2: DI B or DO B
	...	...
	6	Port X08, pin 4: DI A or DO A
	7	Port X08, pin 2: DI B or DO B

Table 22: Input Process Data (pin-based assignment)

Byte	Bit	Input Process Data
Byte 1	0	Port X01, pin 4: DI A or DO A
	1	Port X02, pin 4: DI A or DO A
	...	...
	6	Port X07, pin 4: DI A or DO A
	7	Port X08, pin 4: DI A or DO A
Byte 2	0	Port X01, pin 2: DI B or DO B
	1	Port X02, pin 2: DI B or DO B
	...	...
	6	Port X07, pin 2: DI B or DO B
	7	Port X08, pin 2: DI B or DO B

Object 0x1A11:

Object 0x1A11 transfers the status “New Message Available.”

Table 23: Object 0x1A11: Assignment of “New Message Available”

Index Subindex	Size	Name	Description
0x10F3.04	1 bit	New Message Available Flag	New message available Overwrite mode: 0: newest message has been read 1: newest message has not been read Acknowledgment mode: 0: no unacknowledged message 1: diagnostic messages are present that can be acknowledged
-	7 bits	-	-

Object 0x1A80:

Object 0x1A80 transfers the status of the IO-Link port

Table 24: Object 0x1A80: assignment of the IO-Link port status

Index Subindex	Size	Name	Description
0x1F00.01	1 byte	State of IO-Link port X01	Bit 0...3 IO-Link status 0: Port inactive
0x1F00.02	1 byte	State of IO-Link port X02	1: SIO mode digital input 2: SIO mode digital output 3: communication OP 4: communication STOP
...	...	...	Bit 4...7 ErrorCode
0x1F00.08	1 byte	State of IO-Link port X08	0: No error 1: Watchdog error 2: Buffer overrun 3: Invalid device ID 4: Invalid manufacturer ID 5: Invalid IO-Link version 6: Invalid "Frame Capability" 7: Invalid cycle time 8: Invalid length: input process data 9: Invalid length: output process data 10: No IO-Link device detected 11: PreOP error

Output Process Data

Objects 0x160x:

The content of objects 0x1600 to 0x1607 depends on the operating mode settings of the corresponding ports. Object 0x160x contains the port operating modes "IO-Link" and "Digital output." The assignment is as follows:

- Object 0x1600 is assigned to port X01.
- Object 0x1601 is assigned to port X02.
- ...
- Object 0x1607 is assigned to port X08.

Objects 0x160x with port operating mode "IO-Link":

The following table describes the assignment of output process data to the port for the "IO-Link" port operating mode.

Table 25: Object 0x160x: Assignment of the IO-Link Output Data

Index Subindex	Size	Name	Description
0x7000.01	1 byte	Output byte 0	Object 0x1600 with output data of port X01
0x7000.02	1 byte	Output byte 1	IO-Link output data of the IO-Link device on port X01. For a description of the data, see the manual from the manufacture of the IO-Link device used.
...	...	...	The number of "Output bytes" corresponds to the length of the module used in slot "IO-Link Port X01" and can be 1, 2, 4, 8, 16 or 32 bytes.
0x7010.01	1 byte	Output byte 0	Object 0x1601 with output data of port X02
0x7010.02	1 byte	Output byte 1	IO-Link output data of the IO-Link device on port X02. For a description of the data, see the manual from the manufacture of the IO-Link device used.
...	...	...	

Index Subindex	Size	Name	Description
0x7010.20	1 byte	Output byte 31	The number of "Output bytes" corresponds to the length of the module used in slot "IO-Link Port X02" and can be 1, 2, 4, 8, 16 or 32 bytes.
...	...	...	...
0x7070.01	1 byte	Output byte 0	Object 0x1607 with output data of port X08 IO-Link output data of the IO-Link device on port X08. For a description of the data, see the manual from the manufacture of the IO-Link device used.
0x7070.02	1 byte	Output byte 1	
...	...	...	
0x7070.20	1 byte	Output byte 31	The number of "Output bytes" corresponds to the length of the module used in slot "IO-Link Port X08" and can be 1, 2, 4, 8, 16 or 32 bytes.

Objects 0x160x with port operating mode "digital output"

The following table describes the assignment of output process data of ports X01 to X08 for the "digital output" port operating mode.

Table 26: Objects 0x160x: Assignment of the Digital Output

Index Subindex	Size	Name	Description
0x7000.01	1 byte	PD (C/Q pin 4)	Port X01 (pin 4) functions as digital output: Object 0x1600 contains object 0x7000.01 and transfers the outputs data to the digital output connected to port X01 (pin 4). Bit 0 = 0: output off. Bit 0 = 1: output on.
0x7010.01	1 byte	PD (C/Q pin 4)	Port X02 (pin 4) functions as digital output: Object 0x1601 contains object 0x7010.01 and transfers the outputs data to the digital output connected to port X02 (pin 4). Bit 0 = 0: output off. Bit 0 = 1: output on.
...	...	...	...
0x7070.01	1 byte	PD (C/Q pin 4)	Port X08 (pin 4) functions as digital output: Object 0x1607 contains object 0x7070.01 and transfers the outputs data to the digital output connected to port X08 (pin 4). Bit 0 = 0: output off. Bit 0 = 1: output on.

Object 0x1610:

Object 0x1610 contains the digital outputs (pin 2) of all ports.

Table 27: Object 0x1610: Assignment of the Digital Outputs

Index Subindex	Size	Name	Description
0x3000.01	2 bytes	PD (I/Q pin 2)	The port and pin assignment of process data depends on the process data layout setting: pin-based or port-based. See the following tables.

The process data of the digital outputs can be transferred on a port basis (the default) or pin basis. The following tables show the port and pin assignment.

Table 28: Output Process Data (Port-Based Assignment)

Byte	Bit	Output Process Data
Byte 1	0	0
	1	Port X01, pin 2: DO B
	...	...
	6	0
	7	Port X04, pin 2: DO B
Byte 2	0	0
	1	Port X05, pin 2: DO B
	...	...
	6	0
	7	Port X08, pin 2: DO B

Table 29: Output Process Data (Pin-Based Assignment)

Byte	Bit	Output Process Data
Byte 1	0	0
	1	0
	...	...
	6	0
	7	0
Byte 2	0	Port X01, pin 2: DO B
	1	Port X02, pin 2: DO B
	...	...
	6	Port X07, pin 2: DO B
	7	Port X08, pin 2: DO B

Input Process Data

Objects 0x1A0x:

The content of objects 0x1A00 to 0x1A07 depends on the operating mode settings of the corresponding ports. Object 0x1A0x contains the port operating modes "IO-Link" and "Digital input." The assignment is as follows:

- Object 0x1A00 is assigned to port X01.
- Object 0x1A01 is assigned to port X02.
- ...
- Object 0x1A07 is assigned to port X08.

Objects 0x1A0x with port operating mode "IO-Link":

The following table describes the assignment of input process data to port for the "IO-Link" port operating mode.

Table 30: Objects 0x1A0x: Assignment of the IO-Link input data

Index Subindex	Size	Name	Description
0x6000.01	1 byte	Input byte 0	Object 0x1A00 with input process data of port X01
0x6000.02	1 byte	Input byte 1	
...	...	...	IO-Link input data of the IO-Link device on port X01. For a description of the data, see the manual from the manufacture of the IO-Link device used.

Index Subindex	Size	Name	Description
0x6000.20	1 byte	Input byte 31	The number of "Input bytes" corresponds to the length of the module used in slot "IO-Link Port X01" and can be 1, 2, 4, 8, 16 or 32 bytes.
0x6010.01	1 byte	Input byte 0	Object 0x1A01 with input process data of port X02
0x6010.02	1 byte	Input byte 1	
...	...	...	
0x6010.20	1 byte	Input byte 31	IO-Link input data of the IO-Link device on port X02. For a description of the data, see the manual from the manufacture of the IO-Link device used. The number of "Input bytes" corresponds to the length of the module used in slot "IO-Link Port X02" and can be 1, 2, 4, 8, 16 or 32 bytes.
...	...	...	...
0x6070.01	1 byte	Input byte 0	Object 0x1A07 with input process data of port X08
0x6070.02	1 byte	Input byte 1	
...	...	...	
0x6070.20	1 byte	Input byte 31	IO-Link input data of the IO-Link device on port X08. For a description of the data, see the manual from the manufacture of the IO-Link device used. The number of "Input bytes" corresponds to the length of the module used in slot "IO-Link Port X08" and can be 1, 2, 4, 8, 16 or 32 bytes.

Objects 0x1A0x with port operating mode "Digital input":

The following table describes the assignment of input process data to ports X01 to X08 for the "Digital input" port operating mode.

Table 31: Objects 0x1A0x: Assignment of the Digital Input

Index Subindex	Size	Name	Description
0x6000.01	1 byte	PD (C/Q pin 4)	Port X01 (pin 4) functions as a digital input Object 0x1A00 contains object 0x6000.01 and transfers the input data of the digital input connected to port X01 (pin 4). Bit 0 = 0: input off. Bit 0 = 1: input on.
0x6010.01	1 byte	PD (C/Q pin 4)	Port X02 (pin 4) functions as a digital input Object 0x1A01 contains object 0x6010.01 and transfers the input data of the digital input connected to port X02 (pin 4). Bit 0 = 0: input off. Bit 0 = 1: input on.
...	...	...	...
0x6070.01	1 byte	PD (C/Q pin 4)	Port X08 (pin 4) functions as a digital input Object 0x1A07 contains object 0x6070.01 and transfers the input data of the digital input connected to port X08 (pin 4). Bit 0 = 0: input off. Bit 0 = 1: input on.

Object 0x1A10:

Object 0x1A10 contains the digital inputs (pin 2 and pin 4) of all ports.

Table 32: Object 0x1A10: Assignment of the Digital Inputs

Index Subindex	Size	Name	Description
0x3000.01	2 bytes	PD (I/Q Pin 2 + C/Q Pin 4)	The port and pin assignment of process data depends on the process data layout setting: pin-based or port-based. See the following tables.

The process data of the digital inputs can be transferred on a port basis (default) or pin basis. The following tables show the port and pin assignment.

Table 33: Input Process Data (port-based assignment)

Byte	Bit	Input Process Data
Byte 1	0	Port X01, pin 4: DI A or DO A
	1	Port X01, pin 2: DI B or DO B
	...	...
	6	Port X04, pin 4: DI A or DO A
	7	Port X04, pin 2: DI B or DO B
byte 2	0	Port X05, pin 4: DI A or DO A
	1	Port X05, pin 2: DI B or DO B
	...	...
	6	Port X08, pin 4: DI A or DO A
	7	Port X08, pin 2: DI B or DO B

Table 34: Input Process Data (pin-based assignment)

Byte	Bit	Input Process Data
Byte 1	0	Port X01, pin 4: DI A or DO A
	1	Port X02, pin 4: DI A or DO A
	...	...
	6	Port X07, pin 4: DI A or DO A
	7	Port X08, pin 4: DI A or DO A
Byte 2	0	Port X01, pin 2: DI B or DO B
	1	Port X02, pin 2: DI B or DO B
	...	...
	6	Port X07, pin 2: DI B or DO B
	7	Port X08, pin 2: DI B or DO B

Object 0x1A11:

Object 0x1A11 transfers the status "New Message Available."

Table 35: Object 0x1A11: Assignment of "New Message Available"

Index Subindex	Size	Name	Description
0x10F3.04	1 bit	New Message Available Flag	New message available Overwrite mode: 0: newest message has been read 1: newest message has not been read Acknowledgment mode: 0: no unacknowledged message 1: diagnostic messages are present that can be acknowledged
-	7 bits	-	-

Object 0x1A80:

Object 0x1A80 transfers the status of the IO-Link port

Table 36: Object 0x1A80: assignment of the IO-Link port status

Index Subindex	Size	Name	Description
0x1F00.01	1 byte	State of IO-Link port X01	Bit 0...3 IO-Link status
0x1F00.02	1 byte	State of IO-Link port X02	0: Port inactive 1: SIO mode digital input 2: SIO mode digital output 3: communication OP 4: communication STOP
...	...	...	Bit 4...7 ErrorCode
0x1F00.08	1 byte	State of IO-Link port X08	0: No error 1: Watchdog error 2: Buffer overrun 3: Invalid device ID 4: Invalid manufacturer ID 5: Invalid IO-Link version 6: Invalid "Frame Capability" 7: Invalid cycle time 8: Invalid length: input process data 9: Invalid length: output process data 10: No IO-Link device detected 11: PreOP error

Output Process Data

Objects 0x160x:

The content of objects 0x1600 to 0x1607 depends on the operating mode settings of the corresponding ports. Object 0x160x contains the port operating modes "IO-Link" and "Digital output." The assignment is as follows:

- Object 0x1600 is assigned to port X01.
- Object 0x1601 is assigned to port X02.
- ...
- Object 0x1607 is assigned to port X08.

Objects 0x160x with port operating mode "IO-Link":

The following table describes the assignment of output process data to the port for the "IO-Link" port operating mode.

Table 37: Object 0x160x: Assignment of the IO-Link Output Data

Index Subindex	Size	Name	Description
0x7000.01	1 byte	Output byte 0	Object 0x1600 with output data of port X01 IO-Link output data of the IO-Link device on port X01. For a description of the data, see the manual from the manufacture of the IO-Link device used.
0x7000.02	1 byte	Output byte 1	
...	...	...	
0x7000.20	1 byte	Output byte 31	The number of "Output bytes" corresponds to the length of the module used in slot "IO-Link Port X01" and can be 1, 2, 4, 8, 16 or 32 bytes.
0x7010.01	1 byte	Output byte 0	Object 0x1601 with output data of port X02 IO-Link output data of the IO-Link device on port X02. For a description of the data, see the manual from the manufacture of the IO-Link device used.
0x7010.02	1 byte	Output byte 1	
...	...	...	

Index Subindex	Size	Name	Description
0x7010.20	1 byte	Output byte 31	The number of "Output bytes" corresponds to the length of the module used in slot "IO-Link Port X02" and can be 1, 2, 4, 8, 16 or 32 bytes.
...	...	...	...
0x7070.01	1 byte	Output byte 0	Object 0x1607 with output data of port X08
0x7070.02	1 byte	Output byte 1	IO-Link output data of the IO-Link device on port X08. For a description of the data, see the manual from the manufacture of the IO-Link device used.
...	...	...	...
0x7070.20	1 byte	Output byte 31	The number of "Output bytes" corresponds to the length of the module used in slot "IO-Link Port X08" and can be 1, 2, 4, 8, 16 or 32 bytes.

Objects 0x160x with port operating mode "digital output"

The following table describes the assignment of output process data of ports X01 to X08 for the "digital output" port operating mode.

Table 38: Objects 0x160x: Assignment of the Digital Output

Index Subindex	Size	Name	Description
0x7000.01	1 byte	PD (C/Q pin 4)	Port X01 (pin 4) functions as digital output: Object 0x1600 contains object 0x7000.01 and transfers the outputs data to the digital output connected to port X01 (pin 4). Bit 0 = 0: output off. Bit 0 = 1: output on.
0x7010.01	1 byte	PD (C/Q pin 4)	Port X02 (pin 4) functions as digital output: Object 0x1601 contains object 0x7010.01 and transfers the outputs data to the digital output connected to port X02 (pin 4). Bit 0 = 0: output off. Bit 0 = 1: output on.
...	...	...	...
0x7070.01	1 byte	PD (C/Q pin 4)	Port X08 (pin 4) functions as digital output: Object 0x1607 contains object 0x7070.01 and transfers the outputs data to the digital output connected to port X08 (pin 4). Bit 0 = 0: output off. Bit 0 = 1: output on.

Object 0x1610:

Object 0x1610 contains the digital outputs (pin 2) of all ports.

Table 39: Object 0x1610: Assignment of the Digital Outputs

Index Subindex	Size	Name	Description
0x3000.01	2 bytes	PD (I/Q pin 2)	The port and pin assignment of process data depends on the process data layout setting: pin-based or port-based. See the following tables.

The process data of the digital outputs can be transferred on a port basis (the default) or pin basis. The following tables show the port and pin assignment.

Table 40: Output Process Data (Port-Based Assignment)

Byte	Bit	Output Process Data
Byte 1	0	0
	1	Port X01, pin 2: DO B
	...	...
	6	0
	7	Port X04, pin 2: DO B
Byte 2	0	0
	1	Port X05, pin 2: DO B
	...	...
	6	0
	7	Port X08, pin 2: DO B

Table 41: Output Process Data (Pin-Based Assignment)

Byte	Bit	Output Process Data
Byte 1	0	0
	1	0
	...	...
	6	0
	7	0
Byte 2	0	Port X01, pin 2: DO B
	1	Port X02, pin 2: DO B
	...	...
	6	Port X07, pin 2: DO B
	7	Port X08, pin 2: DO B

5.2 Forcing

This section describes the “Force” function for the module’s input and output data.

In forcing, the physical states of the inputs or the output values of the higher-level controller are “forcibly” overwritten with other values. The user provides these values and identifies them as forcing values. This method is helpful for commissioning systems and troubleshooting.

The “Forcing” function can be accessed through the following tools:

- WAGO I/O Field Webserver
- WAGO I/O Field app on mobile devices

Systems like SPS, TIA Portal and the like also have forcing functions. Such forcing functions should not be confused with the ones described in this section and will not be considered within the context of this section.

A distinction is made between two types of forcing:

1. Input simulation means overwriting input data with replacement values.
2. Overwriting output data with replacement values means setting or resetting the module outputs independent of the module’s process image.

Forcing Outputs

To force output data for test purposes, you can control all the outputs independent of the actual process data value and set them to a specified alternative value.

For digital outputs, you can force pin 2 and pin 4.

For IO-Link, you can force port 16 data bytes.

Simulating Inputs

To simulate input data, you can set alternative values that are used for the input instead of the actual process data values. This allows you to test how the system (i.e., the module and a connected controller) responds to specific inputs.

With digital inputs, you can simulate pin 2 and pin 4.

For IO-Link, you can simulate port 16 data bytes.

Simultaneous Access

A device-internal mechanism prevents simultaneous access by multiple instances. This ensures that only one single instance at a time ever has write access.

“Forcing” Operating Mode Must Be Enabled in the Parameterization

“Forcing” operating mode can be switched off by the higher-level controller. This is done with the “Force Mode Setting” parameter – see [🔗 Module Parameters \[► 51\]](#). To enable forcing, the “Force Mode Setting” parameter value must be set to 0 (“Enable Force Mode”). This is the default setting in the device description file provided with the device.

5.3 Monitoring Functions

The 765 Series modules have extensive internal sensors for measuring:

- Temperatures
- Currents
- Voltages

The measurements are performed for the module and for pin 1, pin 2 and pin 4 of each port. The measured values can be displayed in the WAGO I/O Field Webserver or the WAGO I/O Field app. Alternatively, an OPC UA client can read out the measured values and display them.

In the module, the measured values are compared to limiting values. An alarm or event is generated if a value falls above or below a limiting value (e.g., a temperature limiting value). The module can send this alarm/event

- EtherCAT®: Send emergency telegram to the controller, or the controller can read the diagnostic history object (Index 0x10F3),
- to the OPC UA client upon: OPC UA: event.

The OPC UA client application can use the measured values, for example to implement load management. You can find information on load management in [🔗 Design Power Supply \[► 44\]](#).

5.4 Overload protection

The module has built-in overload protection and periodically measures the current, voltage and temperature.

If the output current, supply voltage or temperature exceeds the maximum value, the module switches off a pin/port

5.5 Parameterization Tools

5.5.1 Overview

There are several ways to set the product's parameters. The following table provides an overview of the tools.

Table 42: Overview of Parameterization Tools

Tool	Description
Controller with EtherCAT® Master	The EtherCAT master must be configured to exchange process data with the 765 Series modules. The <i>WAGO_series765.xml</i> and <i>WAGO_series765_diag.xml</i> device description files contain the WAGO I/O System Field modules. The configuration software of the EtherCAT® master imports these XML files, and the user can select and parameterize a module (or multiple modules) of the 765 Series. For each of ports X01, X02, ..., the user specifies in the configuration how much process data the connected IO-Link device transfers, or whether a digital input or output is connected to the port. The user loads the configuration onto the EtherCAT® master. The EtherCAT® master configures and parameterizes the 765 Series modules via EtherCAT®.
WAGO I/O Field Web-server	The WAGO I/O Field Webserver is a Webserver that is integrated into the 765 Series module. Using a Web browser, the user can view the Web pages and display and modify parameters.
WAGO I/O Field App	The WAGO I/O Field app is an app for mobile devices that can communicate with a 765 module via Bluetooth®. With the app, the user can parameterize the IO-Link master and the connected IO-Link devices, read and write process data and display diagnostics.
WAGO IO-Link Configurator	WAGO IO-Link Configurator is software for configuring the WAGO IO-Link master and the IO-Link devices.

Three domains are distinguished for configuration and parameterization:

1. **EtherCAT configuration:** select EtherCAT® module
2. **Port configuration:** IO-Link master (and the amount of IO-Link process data: 1, 2, 4, 8, 16, or 32 bytes), digital input or output.
3. **IO-Link device configuration**

The following table shows which tool can influence which section.

Table 43: Parameterization Overview

Tool	EtherCAT® Module	Port Configuration	IO-Link Device Configuration
EtherCAT® Master	The EtherCAT® master configures the 765 Series module.	The EtherCAT® master sets the parameter selected by the user on the basis of the parameters in the XML file <code>WAGO_series765.xml</code> . For each port, the configuration determines whether the port is used as an IO-Link master, a digital input or a digital output (or is disabled).	-
WAGO I/O Field Webserver	–	Yes	Input fields to read/write index; Objects can be read and written by means of the object index and subindex. This requires expert knowledge and the object description for the IO-Link device used. The I/O Field Webserver does not evaluate an IODD.
WAGO I/O Field App	–	Yes	Yes IODD can be used by the app to parameterize an IO-Link device.
WAGO IO-Link Configurator	-	Yes	Yes IODD can be used by the WAGO IO-Link Configurator to parameterize an IO-Link device.

Note

Parameters via EtherCAT® are always rewritten upon restart

Each time EtherCAT® communication starts up, the master transfers the configuration and parameters to the module. Port configuration parameters that were set by the WAGO I/O Field Webserver, the WAGO I/O Field app, the WAGO IO-Link Configurator or the OPC UA client are overwritten.

If you have changed parameters of the port configuration via the WAGO I/O Field Webserver, the WAGO I/O Field app, the WAGO IO-Link Configurator or the OPC UA Client, please note that these changes are initially applied by the module, but the EtherCAT® master overwrites the port configuration again at the next start-up. If you want to change parameters of the port configuration, set them in the configuration software of the EtherCAT® master.

5.5.2 WAGO IO-Link Configurator

The WAGO IO-Link Configurator product is an independent commissioning, configuration and management software program. The software replaces the earlier IO-Link plug-in for WAGO-I/O-CHECK.

The WAGO IO-Link Configurator software is used for configuring and parameterizing IO-Link devices. It supports a large number of IO-Link masters and IO-Link sensors/actuators. Within the software, you can switch between the IO-Link masters of a node that are used without having to switch back to WAGO-I/O-CHECK. In addition, the handling of IODD (device description files for IO-Link modules) is more flexible. For example, you can access the IODD server directly to import IODDs.

The WAGO IO-Link Configurator software can be launched from the Start menu or desktop icon, either as an independent program or in connection with WAGO-I/O-CHECK. It then provides the necessary functions for connecting to or searching for WAGO IO-Link masters.

You can find further information in the product manual WAGO IO-Link Configurator.

The manual is available in the download area for the WAGO IO-Link Configurator software at www.wago.com, item number 765-4201/100-000.

5.5.3 WAGO Webserver I/O Field

The WAGO I/O System Field module has an integrated Webserver. It can be accessed with a standard Web browser in order to use the following functions:

- Display port information for ports X01, X02 etc.
- Display and modify module settings.
- User setup and management, as well as user login and logout
- Reset module to factory settings and restart firmware.
- Simulating inputs; forcing outputs

Examples of port information include:

- Display current measured values for the ports: temperature, voltage, current and state on pins 1, 2 and 4
- Display information about the connected IO-Link module
- Display the status information for the entire port
- Configure ports, e.g. set operating mode
- Read and write access to the connected IO-Link devices
- Show process data

The module settings include:

- Select method for obtaining IP address
- Select the origin of the configuration data used
- Display and enter maintenance information
- Reset module to factory settings.
- Load firmware onto the module
- Display and set parameters for Bluetooth® connection to the module
- Update Bluetooth® firmware

Function overview

The following overview shows the functions offered by WAGO Webserver I/O Field that is integrated into the product and the menu items/tabs in the user interface that can be used to address these functions:

Table 44: Function Overview for WAGO I/O Field Webserver and WAGO IO-Link Modules

Menu	Tab	Description	Section
Dashboard	-	Display product information	
Port X01, X02, ...	(All)	Port information and settings for IO-Link ports X01, X02, ...	 Configure Ports [> 82]
	Information	Display measured values of a port and information on the connected IO-Link device (temperature, voltage, current and state on pins 1, 2 and 4)	
	Status	Display status information for the entire port	
	Configuration	Make port settings (such as operating mode or product check for validation and backup)	
	IOL	Access to connected IO-Link devices	 Accessing a Connected IO-Link Device [> 79]
	Process Data	Display the process data (input/output)	 Configure Ports [> 82]
Settings	(All)	Product Settings	
	Device Configuration	Configure parameters for IP connection	 Configuring IP Parameters [> 86]
	Maintenance Information	Save maintenance information	 Storing Maintenance Information [> 86]
	Firmware Upgrade	Update firmware	 Updating Firmware [> 88]
	Factory Reset	Resetting the product to factory settings	 Resetting the Module to the Factory Settings [> 89]
	Bluetooth®	Access via Bluetooth®	 Configure Bluetooth [> 90]
DIO Forcing	-	Forcing for digital inputs and outputs	 Forcing Digital Inputs and Outputs [> 96]
IOL Forcing	-	Forcing for IO-Link ports	 Forcing for IO-Link Ports [> 97]
User Administration	-	Set up and manage users	 Logging Users on and off and Managing Them [> 93]
Sign in, Sign out	-	Log users on and off	

5.5.4 WAGO I/O Field app

The WAGO I/O Field app is an app for maintenance, diagnostics, operation and monitoring of installed WAGO I/O System Field modules and IO-Link devices.

This app allows you to display product information, read and write process data and adjust settings and parameters for both fieldbus modules and IO-Link devices. The communication this requires takes place through the Bluetooth® interface of the mobile device once a Data Matrix code has been scanned to select the product.

Users and the associated access rights can be set up and managed. Outputs can be forced and inputs set in order to support commissioning of systems. The current measured values of a port can be displayed (temperature, voltage, current and states) and configured (including operating mode and filters). Products can be reset to the factory settings and firmware restarted.

Short Overview

- Scanning a data matrix code of a module for product selection
- Establishing a Bluetooth® BLE (Bluetooth Low Energy) connection for wireless communication
- Querying product information including serial number (UII – Unique Item Identifier)
- Managing known devices for direct selection without scanning the DM code
- Querying sensor/actuator data (diagnostics, manufacturer, configuration, status, cycle time etc.)
- Parameterizing ports (input, input filters, output and substitute value strategy)
- Forcing outputs (DO)
- Simulating inputs (DI)
- Parameterizing WAGO□ IO-Link Masters*
- Guided download of IODDs from the Internet for IO-Link devices (IODDfinder)*
- Importing the device description file (IODD) of the IO-Link device*
- Parameterizing IO-Link devices*
- Managing customer-specific product names
- Displaying diagnostic and status information
- Managing product-specific documents (datasheets, manuals etc.)
- User and rights management

* Only applies to modules with integrated IO-Link master ports

The functional scope described can vary depending on the module type.

Note

Read the online help!

You can find Product-specific information on the WAGO App I/O Field in the online help for the app.

An iOS version of the WAGO I/O Field app is available for free in the Apple App Store, and an Android version in the Google Play Store.

5.6 Communication Interfaces

The module has the following interfaces and supports the following protocols:

- ETHERNET Interfaces
 - EtherCAT®
 - HTTP for the WAGO Webserver I/O Field
 - TCP for the OPC UA server

- UDP for the WAGO IO-Link Configurator
- Bluetooth® for the WAGO I/O Field app

5.6.1 EtherCAT

The module exchanges the process data with the controller via EtherCAT®. The process data communication requires the controller and module to be configured and parameterized.

5.6.2 OPC UA Server

The module has an integrated OPC UA server.

Function Overview

- Read module identification
- Read configuration
- Read measured values: current, voltage, temperature
- Events: overcurrent, overload and overtemperature
- Read status information
- Read process data
- Read statistics: minimum/maximum current per pin, minimum/maximum voltage per pin, minimum/maximum temperature
- User access: anonymous (only read access) or username/password (read and write access)

Planning

6.1 Structure Guidelines

6.1.1 Data Security

Professional planning and design is an important requirement for securing data confidentiality, availability and integrity.

Random Influences

Data transmission and processing can be disrupted by random influences, such as temporary electromagnetic disturbances. Proper setup can significantly reduce the likelihood of corruption or destruction of data.

For additional information see:  [EMC Installations \[p. 43\]](#).

Deliberate Influences

Use in ETHERNET Areas

ETHERNET products are designed for use in local networks. Please note the following when using ETHERNET products in your system:

- Do not connect control components and control networks to an open network such as the Internet or an office network.
WAGO recommends putting control components and control networks behind a fire-wall.
- In the control components, close all ports and services not required by your application to minimize the risk of cyber attacks and to enhance cybersecurity.
Only open the ports and services for the duration of the commissioning/configuration.
- Limit physical and electronic access to all automation components to authorized personnel only.
- To reduce the risk of unauthorized access to your system, change the default passwords during initial commissioning.
- To reduce the risk of unauthorized access to your system, regularly change the passwords used.
- To verify that the measures taken meet your security requirements, regularly perform threat analyses.
- To restrict access to and control of individual products and networks, employ a “defense-in-depth” mechanism in your system’s security configuration.

Additional document

-  [White Paper Cybersecurity in Production Facilities](#)

All the documentation and information is available at:  www.wago.com.

6.1.2 EMC Installations

- **Use shielded cables for data and signal lines.**

Electromagnetic interference is reduced and signal quality increased. Measurement errors, data transmission faults and interference due to excessive voltage can be prevented!

- **Keep data and signal lines separate from interference sources.**
Route data and signal lines separately from all power supply cables and other sources of high electromagnetic emissions (e.g., frequency converters or drives).
- **Connect the cable shielding with the ground potential.**
Integrated shielding is mandatory to meet technical specifications regarding measurement accuracy. Establish the connection between the cable shielding and ground potential at the inlet of the cabinet or housing. This grounding allows induced interferences to dissipate and be kept away from devices in the cabinet or housing.
- **Improve shielding performance with a large contact area.**
Greater shielding performance is achieved via low-impedance connection between shielding and ground. For this purpose, connect the shielding over a large surface area, e.g., using the WAGO 790 Shield Connection System. This is especially recommended for large-scale systems where equalizing or high impulse currents may occur.

6.2 Power Supply Concept

6.2.1 Design Power Supply

NOTICE

Device damage if permissible current feedthrough exceeded

There is a risk of damage to the device and/or other devices connected to it if the maximum permissible current feedthrough is exceeded.

Power Supply of the Module and the Connected Sensors/Actuators

The 24 V power supply is fed in via the X31 (PWR IN) supply input. The module has two electrically isolated supply cables.

- Supply cable 1 connects 1L+ (pin 1) to 1L- (pin 3).
- Supply cable 2 connects 2L+ (pin 4) to 2L- (pin 2).

The sensors or actuators are powered through ports X01, X02 etc. The design of the power supply must take the demand of the connected sensors and actuators into account.

Successive devices can be powered through the X32 (PWR OUT) supply output. This current feedthrough must also be taken into account in the design of the power supply.

Protective Functions

The module has integrated protective functions (see  **Overload protection [► 37]**) to prevent damage in overload situations such as overcurrent or short circuit. However, it is important not to rely on these protective functions alone, but also to limit the currents externally, because these protective functions do not cover the current feedthrough for powering successive devices through the supply output (X32). The maximum supply current including the current feedthrough through X31 and X32 must be limited through fuse protection (see datasheet).

Consumption

For each supply cable, it is necessary to take into account the consumption that depends on the connected devices.

Supply Cable 1:

- Logic supply (about 200 mA)
- Power supply of all connected sensors/actuators via 1L
- Power supply of successive devices via 1L

Supply Cable 2:

- Power supply of all connected sensors/actuators via 2L
- Power supply of successive devices via 2L

Maximum Currents

Note

Note maximum currents

The following rules and calculations use the maximum currents. The ambient temperature and the requirements for UL-compliant use in particular use the maximum currents.

For planning and use of the product, always observe the information in section  **Technical data** [\[► 17\]](#).

Rules

In addition to the consumption of the connected devices, rules for the maximum load capacity must be followed. Comply with the following rules to prevent damage to the product:

- Supply voltage input X31 (PWR IN) and supply voltage input X32 (PWR OUT)
 - Rule 1: Take maximum load capacity of each connection contact (pin) into account
 - Rule 2: Take 1L and 2L current feedthrough into account
- Ports X01, X02 etc.
 - Rule 3: The current load of pin 3 must not exceed 4 A, since the sum of the pin 1, 2 and 4 currents flows back through pin 3.

Rules 1 and 2: Supply Input X31 and Output X32

The currents for the electrically isolated supply cables 1 and 2 should be considered separately. The two supply cables 1 are defined as follows:

- Supply cable 1 corresponds to the current flow path that starts from pin 1 (signal 1L+) of supply voltage connection PWR IN (X31) and passes through the device to pin 3 (signal 1L-) of PWR IN. This is shown in blue in the current flow figure under  **Connect Sensors/Actuators** [\[► 64\]](#).
- Supply cable 2 corresponds to the current flow path that starts from pin 4 (signal 2L+) of supply voltage connection PWR IN (X31) and passes through the device to pin 2 (signal 2L-) of PWR IN. This is shown in red in the current flow figure under  **Connect Sensors/Actuators** [\[► 64\]](#).

The following rule applies to both supply cables:

Rule 1 – upper limit of 16 A for current in the entire supply cable (1L or 2L)

An upper limit of 16 A applies to the total current in a supply cable. If this upper limit is exceeded, there is a risk of destruction of or damage to the module. To avoid this, protect each supply line with a fuse or circuit breaker. In connection with this, also read section [🔗 Requirements on the Power Supply \[► 48\]](#).

Also observe the derating, i.e. the maximum current as a function of the ambient temperature.

The following partial currents contribute to the total current in supply cable 1:

1. The I_{logic} current for powering the device's internal electronics (the device is powered via supply cable 1)
2. The I_{X0i_1L} currents for powering the connected devices, sensors and actuators (for each port i)
3. The I_{X32_1L} current that flows through the PWR OUT (X32) supply voltage output to other connected devices (current feedthrough)

The following partial currents contribute to the total current in supply cable 2:

1. The I_{X0i_2L} currents for powering the connected devices, sensors and actuators (for each port i)
2. The I_{X32_2L} current that flows through PWR OUT (X32) the supply voltage output to other connected devices

The following rule applies to both supply cables:

Rule 2 – current feedthrough limiting

The supply voltage for the devices of a supply cable that are connected to the PWR OUT output supply connection is passed on through the device via the input supply connection. The maximum permissible current feedthrough for the respective supply cable is determined by the current load capacity of the pluggable connector on the input supply connection and the PCB. This is max. 16 A. The total current must not exceed this current load capacity.

Note the following:

1. When using digital outputs, the current feedthrough must be reduced by the current that flows through these outputs, for example.
2. In the worst case, the permissible current feedthrough may reach a value of **0 A!**
3. The passthrough connection between the supply voltage input and output has **no internal protective device** against overcurrent!

Therefore, the safety measures given in [🔗 Requirements on the Power Supply \[► 48\]](#) (fuse protection, regulated power supply with current limitation and additional monitoring of the measured values of the sensors) are necessary.

Rule 3: Ports X01, X02 etc.

The following rules apply to each port of the product individually:

Rule 3 – Upper limits for current on the individual pins of the ports

The following upper limits apply to the currents on the pins of the individual ports:

Table 45: Upper Limits for Current on the Individual Pins of the Connections

Pin	Normal Operation	Overload Operation
1	4 A	4 A
2	2 A	2.4 A
3	4 A	4 A

Pin	Normal Operation	Overload Operation
4	2 A	2.4 A

The device is designed in such a way that it can be used in overload operation according to the following table “Module 765-4201/100-000 – Currents in Supply Cable 1” without time limit. The following applies to all pins:

If the maximum load capacity (upper limit of overload operation) of the pin is exceeded, there is a risk of destruction of or damage to the pluggable connector or PCB of the device.

CAUTION

Note significance of pin 3

Note that the sum of the currents of pins 1, 2 and 4 flows to pin 3.

Product-Specific Information

For supply cable 1 of the 765-4201/100-000 IO-Link Module, the currents declared in the following table must be taken into account:

Table 46: Module 765-4201/100-000 – Currents in Supply Cable 1

Current	Description
I_{X31_1L}	Current to connection PWR IN (X31): current 1L+ / reverse current 1L–
I_{X32_1L}	Current to connection PWR OUT (X32): current 1L+ / reverse current 1L–
I_{logic}	Logic supply
$I_{X01_1L}, I_{X02_1L}, \dots, I_{X08_1L}$	Total current for supply cable 1 at digital input/output port X0i (i.e., port X01, X02, ..., X08) corresponds to the current $I_{X0i_pin3_1L}$ at pin 3 (ground). This current is the sum of the currents on pins 1, 2 and 4 of port X0i: $I_{X0i_1L} = I_{X0i_pin3_1L} = I_{X0i_pin1_1L} + I_{X0i_pin2_1L} + I_{X0i_pin4_1L}$
I_{module_1L}	Module current $I_{module_1L} = I_{X01_pin3_1L} + I_{X02_pin3_1L} + \dots + I_{X08_pin3_1L}$

For supply cable 2 of the 765-4201/100-000 IO-Link Module, the currents declared in the following table must be taken into account:

Table 47: Module 765-4201/100-000 – Currents in Supply Cable 2

Current	Description
I_{X31_2L}	Current to connection PWR IN (X31): current 2L+ / reverse current 2L–
I_{X32_2L}	Current to connection PWR OUT (X32): current 2L+ / reverse current 2L–
I_{module_2L}	Module current $I_{module_2L} = 0$

For this module, supply cable 2 is only used for transmission between the PWR IN (X31) and PWR OUT (X32) connections.

During operation of the 765-4201/100-000 IO-Link Module, the rules below for the currents in supply cables 1 and 2 must be followed at all times:

Table 48: Rules for Supply Cables 1 and 2

Current	Supply Cable 1	Supply Line 2
Total current for the supply cable (rule 1)	$I_{X31_1L} \leq 16 \text{ A}$ $I_{X31_1L} = I_{logic} + I_{X32_1L} + I_{module_1L}$	$I_{X31_2L} \leq 16 \text{ A}$ $I_{X31_2L} = I_{X32_2L} + I_{module_2L}$

Current	Supply Cable 1	Supply Line 2
Permissible current feedthrough (rule 2)	$I_{X32_1L} \leq 16 \text{ A} - I_{\text{logic}} - I_{\text{module_1L}}$	$I_{X32_2L} \leq 16 \text{ A} - I_{\text{module_2L}}$
Ports	Ports X01, ... , X08 (henceforth summarized as port X0i for $1 \leq i \leq 8$)	-
Supply current on pin 1 (rule 3)	$I_{X0i_pin1_1L} \leq 4 \text{ A}$	-
Signal current on pin 2/4 in normal operation (rule 3)	$I_{X0i_pin2_1L} \leq 2 \text{ A}$ $I_{X0i_pin4_1L} \leq 2 \text{ A}$	-
Signal current on pin 2/4 in overload operation (rule 3)	$I_{X0i_pin2_1L} \leq 2.4 \text{ A}$ $I_{X0i_pin4_1L} \leq 2.4 \text{ A}$	-
Reverse current to pin 3 (ground) (rule 3)	$I_{X0i_pin3_1L} \leq 4 \text{ A}$	-

6.2.2 Requirements on the Power Supply

Power Source

Note

PELV or SELV power source required

Only device the product with 24 VDC PELV (Protective Extra Low Voltage) or SELV (Safety Extra Low Voltage) voltage sources. Failure to do so may result in electric shock.

If 1L and 2L are to be supplied separately (e.g., for safe switch-off of 2L), then either central grounding must be implemented using two power supply units, or the power supply connection must be made on the same phase. However, the use of two separate power supply units is not mandatory.

Note

Note the following when 1L and 2L are supplied separately:

If 1L and 2L are to be supplied separately (e.g., for safe switch-off of 2L), then either central grounding must be implemented using two power supply units, or the power supply connection must be made on the same phase. Use of two separate power supply units is not mandatory.

Fuse Protection

Always protect the power supply lines from the power supply unit to the first module with a device circuit breaker or fuse. For this purpose, use a 24 VDC / max. 16 A fuse or circuit breaker with type B trip characteristics.

Note

Device damage if maximum supply current exceeded

The maximum supply current must not be exceeded. Otherwise, there is a risk of damage to the PCB of the device and the pluggable connector.

6.2.3 Additional Measures

The setup must ensure that the total current that flows back through pin 3 does not exceed the load limit.

The values of all currents on all pins of all connections (except for pin 3 = ground pin) and the calculated total currents of the two supply cables are measured by the chip used in the 765 Series products and thus can be recorded by a monitoring application. These values can be accessed via the OPC UA server, for example.

On the basis of these measured values, a monitoring application with integrated current management can be implemented. This can regularly verify that all monitoring functions are satisfied on the basis of the measured current values and also monitor the temperatures and voltages on the connections.

6.2.4 Power Supply Examples

The product can be powered alone with its operating voltage or form part of a power supply group along with multiple products.

Power supply groups of multiple products can be formed in two ways:

1. Via the PWR OUT connection:
One or more additional products can be powered via the PWR OUT (X32) power supply output and then form a power supply group together with the product.
2. Through an IO-Link hub*:
One product forms a common power supply group with IO-Link hubs (765-170x/200-000) connected via IO-Link.

* Only applies to modules with integrated IO-Link master ports

In what follows, we present one example for the 765-4204/0100-000 product with four IO-Link inputs/outputs for each of the following:

- Individual power supply
- Power supply group via PWR OUT connection (with calculation of the permissible current feedthrough)
- Power supply group with IO-Link hubs

These examples assume that the IO-Link inputs/outputs are configured as digital outputs.

Supply cable 1 then has a total current consumption of $2 \times 2 \text{ A} + 0.2 \text{ A} = 4.2 \text{ A}$, and supply cable 2 has a total current consumption of $2 \times 2 \text{ A} = 4.0 \text{ A}$.

These do not exceed the maximum permissible value of 16 A per supply cable and are thus permissible.

Example of a Power Supply Group via PWR OUT

If you connect another device to the PWR OUT (X32) power supply output, this forms a supply group. The maximum permissible current feedthrough that this module can require is $16 \text{ A} - 4.2 \text{ A} = 11.8 \text{ A}$ for supply cable 1 (1L) and $16 \text{ A} - 4.0 \text{ A} = 12 \text{ A}$ for supply cable 2 (2L).

Example of Individual Power Supply

This example considers a single 765-4201/100-000 module where no additional devices are powered through its PWR OUT connection (X32).

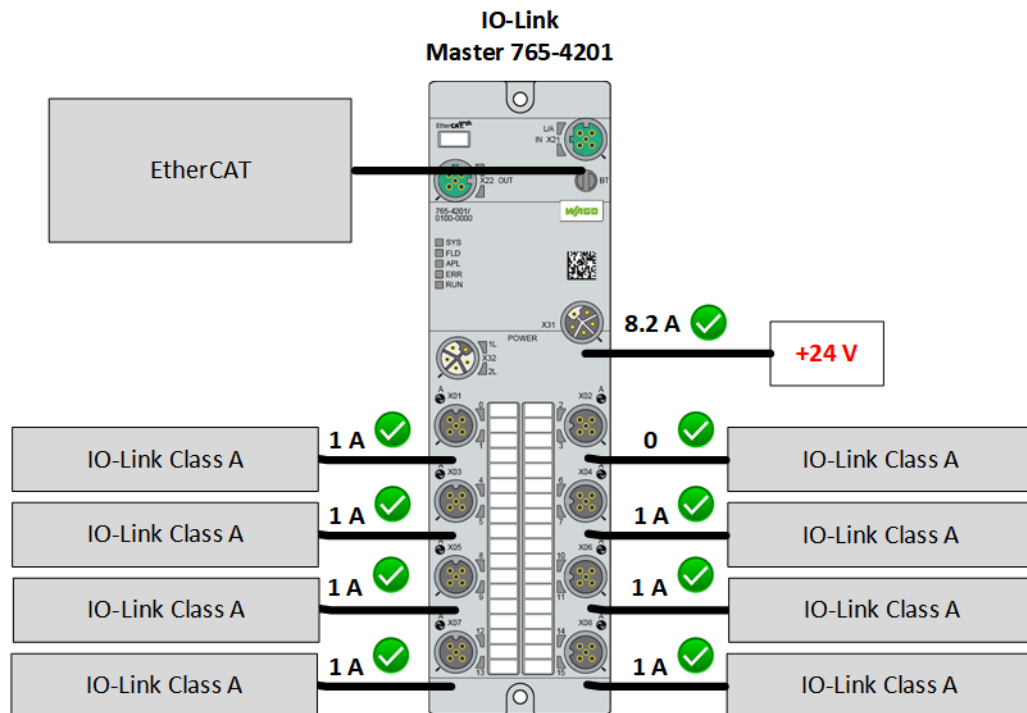


Figure 6: Connection Example for 765-4201/100-000 Module with Individual Power Supply

One IO-Link class A device with max. current consumption of 1 A is connected to each of ports X01 through X08 of the module. The module's current consumption is 0.2 A.

Example of a Power Supply Group with an IO-Link Hub

In what follows, we consider a power supply group consisting of a 765-4201/100-000 IO-Link Master and a 765-1701/200-000 IO-Link Hub. The two products are connected via IO-Link.

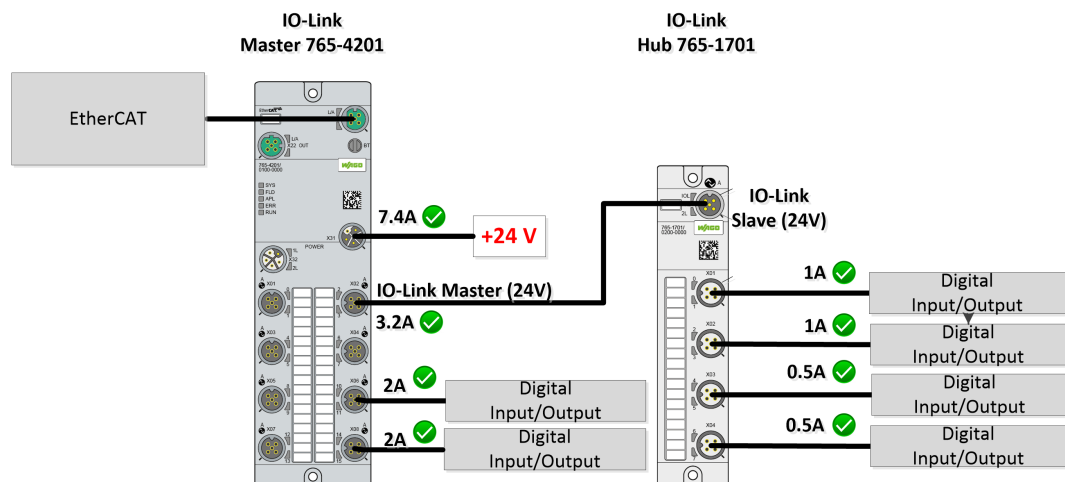


Figure 7: Power Supply Group with 765-4201/100-000 – Connection Example 1

Three devices are connected to the 765-4201/100-000 module:

- On port X01: the 765-1701/200-000 IO-Link Hub
- On port X03: one digital input/output with max. current demand of 2 A (on pin 1)
- On port X04: one digital input/output with max. current demand of 2 A (on pin 1)

Four devices are connected to the 765-1701/200-000 IO-Link Hub:

- On port X01: one digital input/output with max. current demand of 1 A (on pin 1)

- On port X02: one digital input/output with max. current demand of 1 A (on pin 1)
- On port X03: one digital input/output with max. current demand of 0.5 A (on pin 1)
- On port X04: one digital input/output with max. current demand of 0.5 A (on pin 1)

The current demand of each of the two WAGO 765 Series products is 0.2 A.

Since the 765-1701/200-000 IO-Link Hub gets its operating voltage from the 765-4201/100-000 IO-Link master, port X01 (pin 1) of the module has a load of $3.2\text{ A} = 1\text{ A} + 1\text{ A} + 0.5\text{ A} + 0.5\text{ A} + 0.2\text{ A}$, which is below the maximum load capacity of 4 A and thus permissible.

Port X02 is unused.

Ports X03 and X04 each have a load of 2 A, which is also below the maximum load capacity of 4 A and thus permissible.

Connection Example 2

Now we increase the current demand on the two ports X01 and X02 of the 765-1701/200-000 IO-Link Hub to 2 A and check whether this is permissible:

The ports of the 765-1701/200-000 IO-Link Hub can withstand a constant load of 2 A. However, the effects on the 765-4201/100-000 product must be considered.

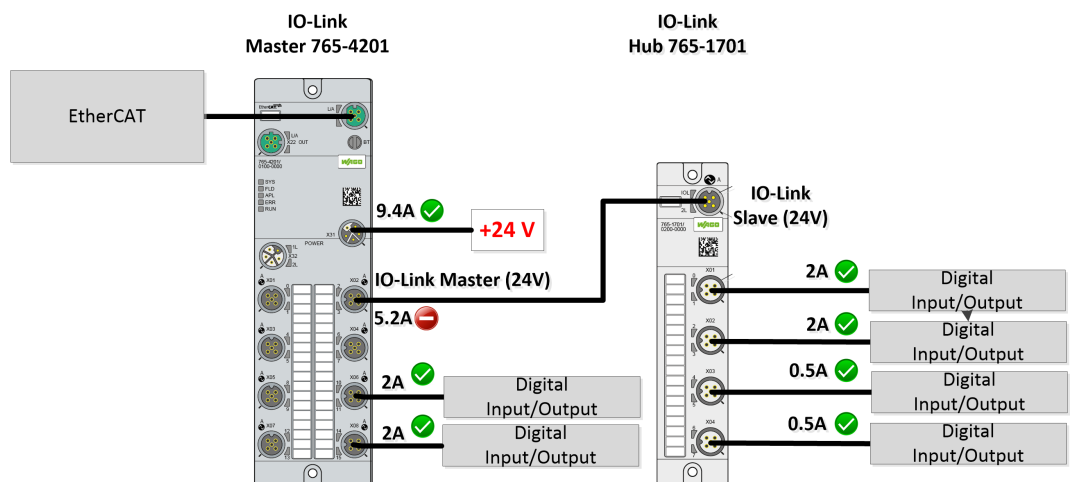


Figure 8: Power Supply Group with 765-4201/100-000 – Connection Example 2

To do so, we consider port X01 of the 765-4201/100-000 module:

This has a load of $5.2\text{ A} = 2\text{ A} + 2\text{ A} + 0.5\text{ A} + 0.5\text{ A} + 0.2\text{ A}$ on pin 1. This exceeds the maximum load capacity of 4 A and it thus not permitted.

If the currents on X01 and X02 of the 765-1701/200-000 IO-Link Hub were increased, the overload protection would constantly activate and could threaten destruction of the 765-4201/100-000 IO-Link Master on its port X01.

6.3 Settings Options

6.3.1 Module Parameters

Indexes 0x2000 to 0x2003

Parameters with indexes 0x2000 to 0x2003 configure the module.

Table 49: Module Parameters

Index Subindex	Parametername	Value Range	Default	Description
0x2000.00	Force mode setting	0: Force mode enable	0	The "Forcing" operating mode may be used.
		1: Force mode disable		The "Forcing" operating mode must not be used.
0x2001.00	PD layout configuration	0: port-based	0	Order of the process data of the digital inputs and digital outputs: Bit 0 = port X01 pin 4, bit 1 = port X01 pin 2, bit 2 = port X02 pin 4, bit 3 = port X02 pin 2, ...
		1: pin-based		Order of the process data of the digital inputs and digital outputs: Bit 0 = port X01 pin 4, Bit 1 = port X02 pin 4, bit 2 = port X03 pin 4, bit 3 = port X04 pin 4, ... bit 8 = port X01 pin 2, bit 9 = port X02 pin 2, ...
0x2002.01	DO substitute mode	0: Set to low	0	Set all digital outputs to low level in the event of error
		1: Use substitute values		Set digital outputs to a pre-defined substitute value in the event of error. If this setting is used, the value of the "DO substitute value" parameter determines the substitute value.
		2: hold last		Hold digital outputs at their last value in the event of error
0x2002.02	DO substitute value	0 ... 65535	0	Substitute value for the digital outputs if the "Use substitute values" setting is used. The input depends on the "PD layout configuration" parameter. Use a binary-to-decimal converter to calculate this value.
0x2003.01	Disable BT	0: Activation of BT interface is allowed	0	The Bluetooth® interface can be enabled by an optical signal of a mobile device and in connection with the WAGO I/O Field app.
		1: Disable activation of BT interface		The Bluetooth® interface cannot be enabled by an optical signal of a mobile device and in connection with the WAGO I/O Field app.
0x2003.02	BT timeout	6 ... 59 [s]	30	Switch-off time of the Bluetooth® interface if not used; a new Bluetooth® connection can be established by an optical signal after the Bluetooth® interface is reactivated. The unit for the switch-off time is seconds. Entering 0 is not allowed, since the Bluetooth® interface must always switch off after the switch-off time elapses.

Indexes 0x2100 to 0x2170

Parameters with index 0x2100 configure port X01.

Parameters with index 0x2110 configure port X02.

...

Parameters with index 0x2170 configure port X08.

Table 50: Port Parameters

Index Subindex	Parametername	Value Range	Default	Description
0x2100.01, 0x2110.01, ...	Port X01/X02/... DI invert CQ pin	0: Digital input NO Normally open	0	Pin 4 is a digital input. The input signal is not inverted.
		1: Digital input NC Normally closed		Pin 4 is a digital input. The input signal is inverted.
0x2100.02, 0x2110.02, ...	Port X01/X02/... Digital input filter CQ pin	0: No filter	0	No filter active for detecting a signal change of the pin 4 digital input signal.
		30: 3 ms filter time		Filter time setting for detecting a signal change of the pin 4 digital input signal. The filter time is the amount of time the signal must be present in order for a signal change to be detected.
		150: 15 ms filter time		
		200: 20 ms filter time		
0x2100.03, 0x2110.03, ...	Port X01/X02/... DO Static on CQ pin	0 (OFF)	0	Pin 4 is a digital output.
		1: On		Pin 4 is a digital output and switched on (+24 VDC).
0x2100.04, 0x2110.04, ...	Port X01/X02/... Digital mode IQ pin	0: Digital input NO Normally open	4	Pin 2 is a digital input. The input signal is not inverted.
		1: Digital input NC Normally closed		Pin 2 is a digital input. The input signal is inverted.
		2: digital output		Pin 2 is a digital output.
		3: static on		Pin 2 is a digital output and switched on (+24 VDC).
		4: Not supported		Pin 2 is deactivated.
0x2100.05, 0x2110.05, ...	Port X01/X02/... Digital input filter IQ pin	0: No filter	0	No filter active for detecting a signal change of the pin 2 digital input signal.
		30: 3 ms filter time		Filter time setting for detecting a signal change of the pin 2 digital input signal. The filter time is the amount of time the signal must be present in order for a signal change to be detected.
		150: 15 ms filter time		
		200: 20 ms filter time		
0x2100.24, 0x2110.24, ...	Port X01/X02/... Configuration IOL input length	0 ... 32	0	Length of the input data Set automatically by the configuration software. Please do not change.
0x2100.24, 0x2110.24, ...	Port X01/X02/... Configuration IOL output length	0 ... 32	0	Length of the output data Set automatically by the configuration software. Please do not change.

The "Port Cycle Time" parameter contains a factor (bits 0 to 5) and a time basis (bits 6+7). The following table describes how the port cycle time is calculated from the factor and the time basis.

Table 51: "Port Cycle Time"

Value Range	Time Basis (Bits 6+7)	Factor (Bits 0 ... 5)	Port Cycle Time (Formula)	Example
0	—	0	As fast as possible	0
1 ... 3	—	—	This value range is reserved.	—
4 ... 63	0.1 ms (00)	4 ... 63	0.1 ms × factor	4: 400 µs
				16: 1.6 ms
				32: 3.2 ms
				48: 4.8 ms
64 ... 127	0.4 ms (01)	0 ... 63	6.4 ms + 0.4 ms × factor	68: 8.0 ms
				93: 18.0 ms
				100: 20.8 ms
128 ... 191	1.6 ms (10)	0 ... 63	32 ms + 1.6 ms × factor	133: 40.0 ms
				158: 80.0 ms
				183: 120.0 ms
192 ... 255	Reserved (11)	0 ... 63	This value range is reserved.	-

Transport and Storage

The original packaging offers optimal protection during transport and storage.

- Store the product in suitable packaging, preferably the original packaging.
- Only transport the product in suitable containers/packaging.
- Make sure the product contacts are not contaminated or damaged during packing or unpacking.
- Observe the specified ambient climatic conditions for transport and storage.

Installation and Removal

8.1 Installation

8.1.1 Tools Required for Installation

The following tools are required for installation:

- Allen wrench for the M4 hex head mounting screws

The following additional items are only required for installation where no threaded hole is present:

- M4 thread cutter (bottoming tap or hand tap set)
- Drill (for pre-drilling mounting holes for the module and installing the system)

You also need two M4 cylinder head hex screws per DIN 912 / ISO 4762 of adequate length.

8.1.2 Before Installation

Always note the following information:

- The product must only be installed and put into operation by qualified electrical specialists per EN 50110-1/-2 and IEC 60364.
- Observe the safety information in section  **Safety [▶ 11]**.
- Before installation, check the product for damage, such as transport damage. Damaged products must not be put into operation.

8.1.3 Installation Instructions

Note the following for selection of the installation location:

- Install the product in such a way that it is protected against weather exposure (no direct sunlight; no salt water or spray).
- Note that the module should not be installed in the immediate vicinity of objects or devices that can get hot. For a high level of module utilization, the temperature-dependent operating range can be extended by installing metal surfaces or profiles or the like, or by installation in a ventilated outdoor environment. The modules' internal temperature measurement can be used for optimization.
- Screw the product down only on flat contact surfaces to protect it from mechanical warping.
- To protect the product from tensile forces that may arise, do not bridge spaces with it.
- To avoid damaging the product, do not mount it in shearing zones of moving devices. Furthermore, lay the cables in such a way that they cannot get into the shearing zone of movable equipment parts.
- Leave sufficient space for easy product replacement and for hooking up the pluggable connections.
- Ensure that the requirements on the product concerning exposure to vibration and shock are met at the installation location.
- Install the product in such a way that the product's diagnostic LEDs remain visible.

Note the following concerning the installation procedure:

- Disconnect the power supply from the system before beginning mounting
- Ensure sufficient potential equalization in your system

- When mounting, be sure not to contaminate the connections. The contamination damages the contacts, which can limit the reliability of the contacts.

8.1.4 Note on Protecting against Heat Generation by the Product

During operation, the product can get hot! Therefore, always note the following information:

- Cooling of the product must not be impaired
- Ensure that the air supply is unobstructed
- Do not install the product near sources of strong heat
- Do not install the product on or in the vicinity of easily flammable materials

8.1.5 Installation Distances

No particular distances need to be maintained between the modules, or between a module and a cabinet door or cover. The installation distances are determined exclusively by the plugs and cables used and their bending radii. Depending on the housing, a field-assembled pluggable connector may protrude past the edge of the housing.

Where high surrounding air temperatures occur at the same time as high current loads, modules should not be installed directly next to each other, to prevent them from each other and to give them a large surface to dissipate heat to the surrounding air.

8.1.6 Installation

You can install the product directly on your equipment with screws. Mount the product on a flat, fixed surface with two screws, each of which screws into a threaded hole. You can find the tightening torque specifications in  **Mechanical Data** [▶ 17](#).

The procedure for this is as follows:

1. Hold the product up to the desired position and mark the two locations where the threads should be cut. Ensure that there is sufficient space around the product to enable you to connect all cables without difficulty.
2. With the M4 thread cutter, cut one M4 thread at each of the marked locations. If applicable, pre-drill with the drill.
3. Use the Allen key to screw the product into the threaded holes with two M4 cylinder head screws of adequate length on the top and bottom. Observe the tightening torque.

8.1.7 After Installation

Note the information on grounding.

8.1.8 Grounding

Functional Ground

The L-coded M12 pluggable connectors of the product's power supply have one FE (functional ground) pin, which is connected to the metal housing of the product. The metal housing in turn has a central grounding point for functional ground. You can ground the module as follows:

- Grounding via the metal housing, and/or
- Grounding via functional ground of the power supply connection, and/or
- Grounding can be done separately via a cable lug and the mounting hole if the module is installed on a non-conductive subsurface

Ensure proper contacts and a sufficient cable cross-section.

8.2 Removal

8.2.1 Tools Required for Removal

For removal, you need an Allen key to unscrew the M4 cylinder head hex screws per DIN 912/ISO 4762.

8.2.2 Before Removal

CAUTION

Device gets hot

During operation, high surface temperatures can arise on the metal housing and metal connection sockets. If the product has been in operation, allow it to cool before touching it, or use gloves.

Prepare for removal as follows:

1. If the product is contaminated, clean it before removal. It is especially important to clean contaminated screw-clamp connections.
2. Before removal, loosen all screw connections on the connectors and disconnect the cables.
3. Ensure that the equipment part on which you mounted the product is de-energized.
4. Unscrew the two M4 cylinder head screws and remove the product.

8.2.3 Removal

To remove the product, e.g., when replacing a device, proceed as follows:

1. Ensure that the equipment part on which you mounted the module is de-energized.
2. Unscrew the two M4 cylinder head screws with the Allen key.
3. Remove the product.

8.2.4 After Removal

If the product that has been removed is defective, mark it as defective to prevent reuse of the product.

Connection

9.1 General Information on Installation

When laying cables, the local conditions and the applicable regulations are crucial for implementation.

Be sure to maintain the minimum clearances between the cabling and possible sources of interference (including machines, welding equipment and power lines) to prevent loss and corruption of data. For planning and installation of a system, observe the regulations and standards.

Mechanical Stress

Protect the cables against mechanical stress. Observe the following information:

- Select the correct type of cable for the application. Ensure a sufficient wire cross-section.
- Take the minimum bending radius into account.
- Ensure that cables cannot get in the shearing zone of movable machine parts.
- Do not lay the cables across transport paths and the paths of machine movements.
- Use cable ducts or cable bridges.

Interference

Follow the following instructions to reduce interference:

- Lay network cables (e.g., fieldbus cables) in their own cable ducts.
- Do not lay network cables parallel to power supply cables through which high power flows.
- When installing shielded pluggable connectors (screws, cap nuts), ensure the best possible contact between the shielding and ground. Before initial commissioning, check the grounding or shielding connection of the cables for low-resistance conductivity.

Protective Caps

Cover all unused connections with protective caps to protect the connections and ensure compliance with the requirements of protection type IP67.

Grounding Concept

There are basically two grounding options, which can also be used simultaneously:

- Via cable
- Via the housing

The I/O System Field operates in the extra-low voltage range (SELV/PELV). In these devices, interference is discharged via functional ground (FE). Functional ground (FE) is merely for discharging interference. It does not provide touch-proof protection for persons. Functional grounding is essential for fault-free operation of the device.

If you wish to perform additional grounding via the metal housing:

- Use conductive mounting screws on the mounting holes and ensure there is a good contact there.
- Ensure that the mounting surface is level.

9.2 Connect Power Supply

Two voltages are distinguished for the I/O System Field:

- 1L to power the logic and sensors/actuators
- 2L to power actuators (separate actuator supply)

All supply voltages are connected via L-coded M12 pluggable connectors.

NOTICE

Damage to electronics

Connect each of the supply voltages (each to +24 V and 0 V) completely. Connecting multiple supply voltages through one 0 V connection is not permitted, since this would exceed the current load capacity of the contacts.

Power Supplies 1L and 2L

The voltages 1L and 2L are electrically isolated and are fed in on connection X31.

The 1L power supply is required to power the module electronics and the connected sensors/actuators. Connect it to connection X31. If you want to power additional products through this current path, connect the cable for the additional power supply to connection X32.

The following procedure is especially advantageous:

- Install the power supply for the module electronics independently of the power supply for the actuators
- Provide independent fuse protection for the power supplies

This allows the network to continue to run even when peripheral parts are switched off.

NOTICE

Damage to electronics

The current load capacity of the L-coded M12 pluggable connector is 16 A per current path (1L or 2L). This value must not be exceeded. To limit the sum of current paths 1L and 2L even in the event of short circuit, it may be necessary to provide fuse protection for them. For the calculation of the maximum permissible current feedthrough, see

 **Power Supply Examples** [\[► 49\]](#).

Note that the connection for the additional supply voltage is not monitored for overload. If the maximum current carrying capacity is exceeded, this can damage the pluggable connectors.

WAGO recommends using pre-assembled cables.

The following figure gives an example of feeding in and passing on the supply voltages:

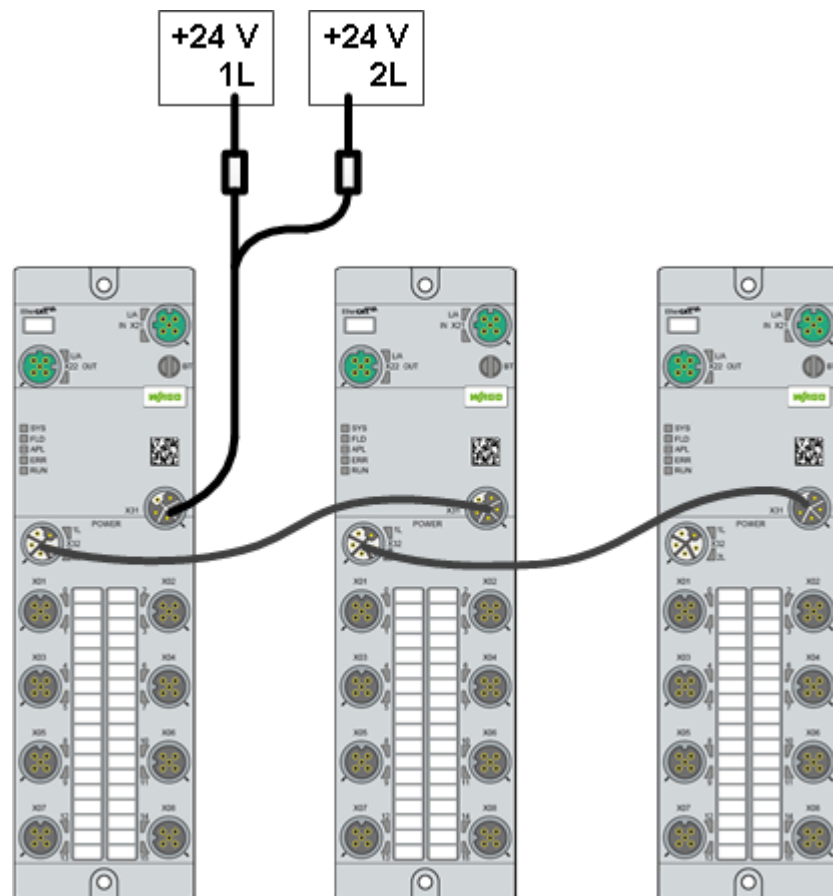


Figure 9: Example of Feeding in and Passing on the Supply Voltages

In connection with this figure, note that the cables illustrated for current paths 1L and 2L are realized not as separate cables, but rather as separate wires within one common cable.

Supply Cable and Power Supply (M12)

Take the current load capacities into account. In this regard, see [🔗 Design Power Supply \[► 44\]](#).

! NOTICE

Damage to electronics

For passthrough of the supply voltage, the following should be noted:

The maximum total current permitted on 1L is 16 A.

The maximum total current permitted on 2L is 16 A.

The temperature also affects the permissible total current. To take the effects of higher temperatures into account, note the information on temperature-dependent derating in [🔗 Derating \[► 22\]](#).

Example Calculations

You can find examples for calculating the maximum permissible current feedthrough under [🔗 Power Supply Examples \[► 49\]](#).

To determine whether long cable lengths still supply the product with sufficient voltage, the voltage losses on the cable can be calculated as follows:

$$U = 2 \times I \times R$$

where:

U	Voltage drop
2	Factor for feed and return lines
I	Current
R _L	Cable resistance

For WAGO 4 × 1.5 mm² supply cables, the cable resistance R_L per wire R_L ≤ 13.7 Ω/km.

Example of Voltage Drop for Feed and Return Lines with a Current of 8 A on the WAGO 4 × 1.5 mm² Supply Cable

$$U = 2 \times 8 \text{ A} \times 13.7 \text{ Ω/km} = 219.2 \text{ V/km}$$

This corresponds to a voltage drop of 2.19 V per 10 m of cable length for feed and return lines.

Example of Voltage Drop per Wire with a Current of 16 A on a 4 × 2.5 mm² Supply Cable

$$U = 2 \times 16 \text{ A} \times 8.22 \text{ Ω/km} = 263 \text{ V/km}$$

This corresponds to a voltage drop of 2.63 V per 10 m of cable length.

If the resistance of the cable used is not known, it can be calculated approximately with the following formula:

$$R_L = l / (K \times A)$$

where:

R _L	Cable resistance
l	Cable length
K	Specific cable resistance of the conductor material (usually copper) according to manufacturer's specifications
A	Cable cross-section

9.3 Connecting Cables

WAGO recommends using 765 Series connecting cables, pluggable connectors and accessories for 756 Series products, which have been tailored specifically to the WAGO I/O System Field.

The tightening torques given in section [🔧 Connection Technology \[▶ 18\]](#) apply to the pluggable connectors of the connecting cables.

9.4 Connecting the Fieldbus

To establish a connection to an EtherCAT® master, it is necessary to connect the module to an EtherCAT® network.

To establish a connection to an IO controller, connect the product to a network with a transmission rate of 100 Mbit/s in full duplex operation.

You can find the connection assignment for the ETHERNET ports under  **ETHERNET Interfaces** [▶ 16].

If you do not use a pre-assembled ETHERNET cable, a shielded M12 plug with protection type IP 67 should be connected to it.

For a cable that is pre-assembled on one end only (e.g., item no. 756-1201/060-xxx), proceed as follows to connect it to an RJ45 plug (e.g., item no. 750-975):

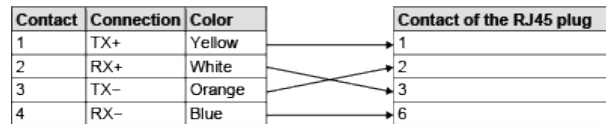


Figure 10: RJ45 Pin Assignment

Because the Auto MDI(X) functionality is enabled for the respective ETHERNET connection, a crossover cable is not necessary. This functionality automatically detects the direction for sending data and receiving data, so it is irrelevant which cable type is used (crossed or uncrossed).

Connecting an Individual Product to an ETHERNET Network

To connect the product to the ETHERNET network, proceed as follows:

1. Disconnect the power supply from the equipment parts on which you have mounted the module.
2. Connect the port of the EtherCAT® master to X21 (IN) of the EtherCAT® slave using an ETHERNET cable.
3. Tighten the pluggable connector using the knurled-head screw.

Connecting Multiple Products to One ETHERNET Network

The fieldbus module of the WAGO I/O System Field has two connections, IN and OUT, to allow wiring of a line topology.

Multiple products can be connected to the ETHERNET network as shown in the following example:

1. De-energize the section of your system on which you wish to mount the product.
2. Connect the port of the EtherCAT® master to X21 (IN) of the first EtherCAT® slave using an ETHERNET cable. Then tighten the plugs of the ETHERNET cable.
3. Next, use an ETHERNET cable to connect the X22 (OUT) terminal of the first EtherCAT® slave to X21 (IN) of the next EtherCAT® slave. Then tighten the plugs of the ETHERNET cable.
4. For each additional EtherCAT® slave, connect its OUT to the IN of the following slave.

The EtherCAT® modules of the WAGO I/O System Field are wired in a line topology, as shown in the following figure:

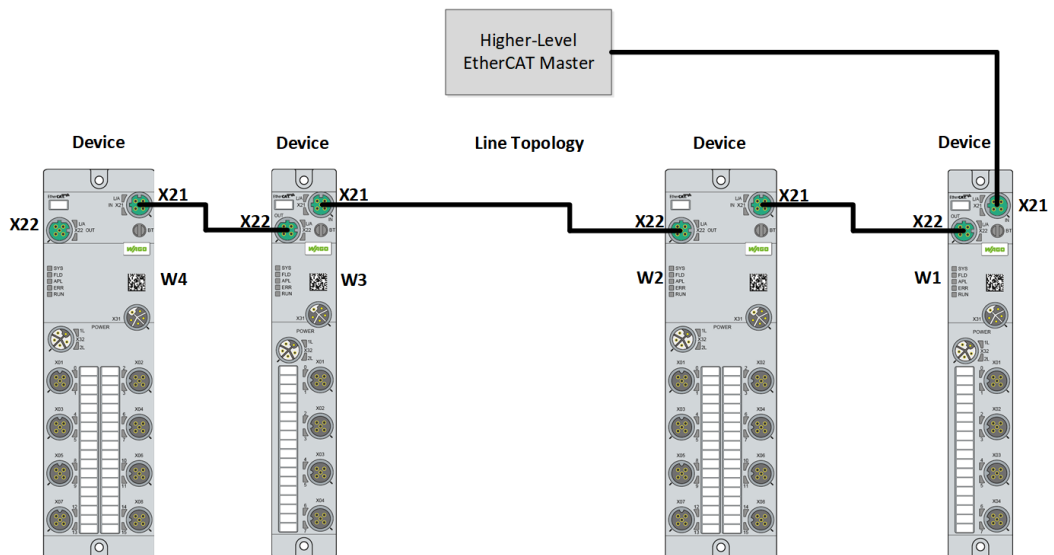


Figure 11: Line Topology for EtherCAT® Networks (Module Image May Differ)

9.5 Connect Sensors/Actuators

The sensor/actuator cable powers the connected sensors/actuators and transfers the sensor and actuator signals.

Note the current load capacity of the supply contacts; see “Rule 3,” section *Rule 3: Ports X01, X02 etc.* in [🔗 Design Power Supply \[► 44\]](#).

The following figure shows the potential routing of the two load circuits within the module.

If a port is operated in IO-Link mode, then at most 1 A can flow through pin 1 and pin 3 without additional measures. The use of standard cables allows lengths up to 20 m as long as the current remains under 1 A.

Higher currents are possible and require a larger cable cross-section or shorter cable length to keep the voltage drop for the outgoing and return paths below 1.2 V.

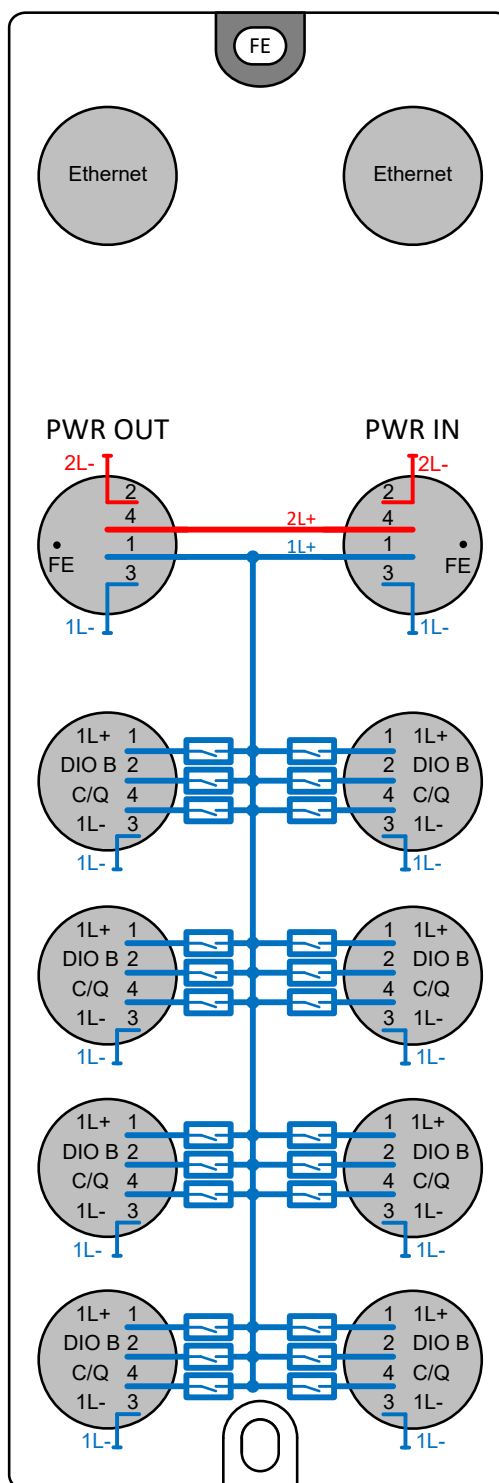
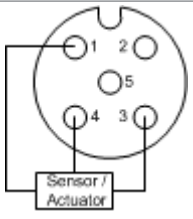
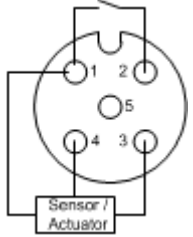
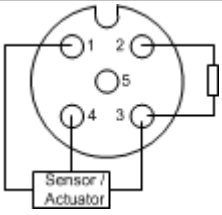
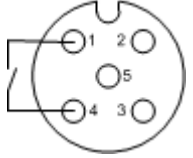
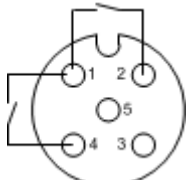
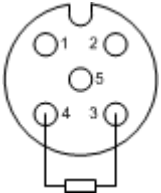
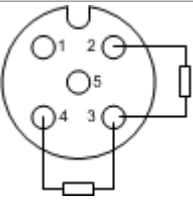
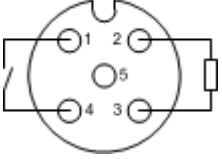
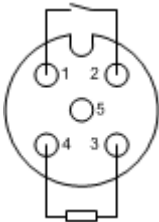


Figure 12: Schematic Circuit Diagram of the Power Supply

The following table shows the connection options for IO-Link devices (class A) and digital inputs and outputs.

Table 52: Connecting an IO-Link Device or Digital Input or Output

Connection Option	Description
	Connection of an IO-Link device Required port configuration: IO-Link master and pin 2 disabled.
	Connection of an IO-Link device and a digital input on channel B. Required port configuration: IO-Link master and pin 2 as a digital input.
	Connection of an IO-Link device and a digital output on channel B. Required port configuration: IO-Link master and pin 2 as a digital output.
	Connection of a digital input at channel A. Required port configuration: pin 4 as digital input and pin 2 disabled.
	Connection of two digital inputs on channels A and B. Required port configuration: pin 4 and pin 2 as digital inputs.
	Connection of a digital output on channel A. Required port configuration: pin 4 as a digital output and pin 2 disabled.
	Connection of two digital outputs on channels A and B. Required port configuration: pin 4 and pin 2 as digital outputs.
	Connection of a digital input on channel A and a digital output on channel B. Required port configuration: pin 4 as a digital input and pin 2 as a digital output.

Connection Option	Description
	Connection of a digital output on channel A and a digital input on channel B. Required port configuration: pin 4 as a digital output and pin 2 as a digital input.

Commissioning

Note

The figures and descriptions below are an example configuration

The figures and descriptions this section contains are based on an example configuration.

Your configuration, and thus the content shown, may differ from the content illustrated here.

10.1 Getting the IP Address from the EtherCAT Master

The module requires an IP address if IP-based communication is to be used. This is the case, for example, if the WAGO I/O Field Webserver or the OPC UA server of the module is used. The module has no IP address when delivered. The module gets the IP address from the EtherCAT® master.

The module does not need an IP address if it is to communicate with the master exclusively via EtherCAT®.

Setting the IP address for the Module for the EtherCAT® Master

You can set the IP address for the module in the configuration software of the EtherCAT® master, e.g., TwinCAT. To do so, create a configuration project as described under

 [Configuring EtherCAT \[p. 69\]](#).

1. Open the configuration software of the EtherCAT® master.
2. Open the window with the EtherCAT® properties of the WAGO module.
3. Open the advanced settings.
4. Select Mailbox > EoE (Ethernet over EtherCAT).
⇒ The window for setting the IP address (for the module) is displayed.
5. Enter the IP address, the subnet mask and the IP address of the default gateway (typically the default gateway is the IP address of the EtherCAT® master).

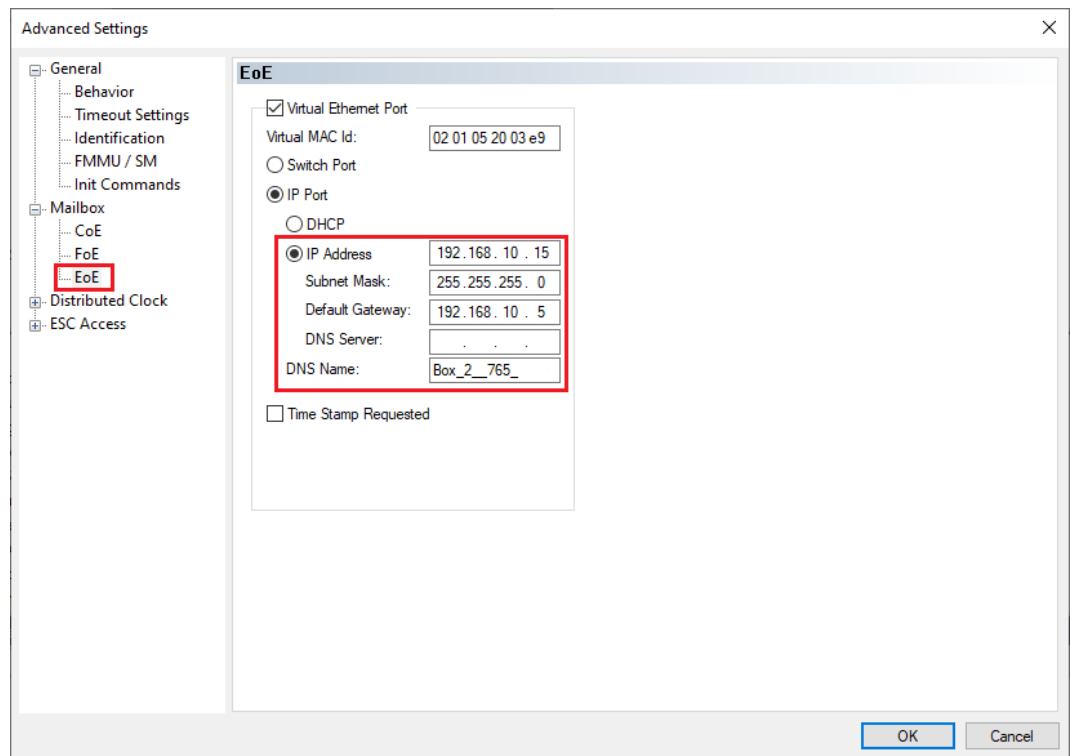


Figure 13: Setting the IP Address

6. Load the configuration onto EtherCAT® master.

⇒ The IP address has been set.

10.2 Configuration

10.2.1 Configuring EtherCAT

To configure the EtherCAT® master, you need the ESI (EtherCAT® Slave Information) files in XML format:

WAGO_series765.xml and *WAGO_series765_diag.xml*

The file *WAGO_series765.xml* contains a reference to the file *WAGO_series765_diag.xml*, which contains diagnostic texts. Perform the following steps in the configuration software of the EtherCAT® master used:

- Import the XML files.
- Select the module from the device catalog.
- Configure the ports
- Set the parameters.

10.2.1.1 Selecting the Module

Select the module used from the device catalog.

Module: 765-4201/100-000

Designation: 8 PORT IOL-A FLD EC 24 VDC 2.0 A

10.2.1.2 Configuring a Port

In the configuration software of the EtherCAT master, each IO-Link port of the 765 module corresponds to a slot. For each IO-Link port X01/X02/... , specify what is connected to it:

- IO-Link device and how much process data it transmits
- Digital Input
- Digital Output
- whether nothing is connected

The following table lists the selection options for the device type connected to IO-Link port X01/X02/... .

Table 53: Configuration of the IO-Link Port

Slot/Module	Description
Clear slot	Nothing is connected to the IO-Link port.
Digital_IN	Digital input (pin 4).
Digital_OUT	Digital output (pin 4).
IOL_1/0_I/O byte	IO-Link device with 1 bytes of of input process data
IOL_2/0_I/O byte	IO-Link device with 2 bytes of of input process data
IOL_4/0_I/O byte	IO-Link device with 4 bytes of of input process data
IOL_8/0_I/O byte	IO-Link device with 8 bytes of of input process data
IOL_16/0_I/O byte	IO-Link device with 16 bytes of of input process data
IOL_32/0_I/O byte	IO-Link device with 32 bytes of of input process data
IOL_0/1_I/O byte	IO-Link device with 1 bytes of output process data
IOL_0/2_I/O byte	IO-Link device with 2 bytes of output process data
IOL_0/4_I/O byte	IO-Link device with 4 bytes of output process data
IOL_0/8_I/O byte	IO-Link device with 8 bytes of output process data
IOL_0/16_I/O byte	IO-Link device with 16 bytes of output process data
IOL_0/32_I/O byte	IO-Link device with 32 bytes of output process data
IOL_1/1_I/O byte	IO-Link device with 1 bytes of input process data and 1 bytes of output process data
IOL_2/2_I/O byte	IO-Link device with 2 bytes of input process data and 2 bytes of output process data
IOL_4/4_I/O byte	IO-Link device with 4 bytes of input process data and 4 bytes of output process data
IOL_8/8_I/O byte	IO-Link device with 8 bytes of input process data and 8 bytes of output process data
IOL_16/16_I/O byte	IO-Link device with 16 bytes of input process data and 16 bytes of output process data
IOL_32/32_I/O byte	IO-Link device with 32 bytes of input process data and 32 bytes of output process data

10.2.1.3 Setting Parameters

You can set the parameters for the module in the configuration software of the EtherCAT® master. The existing parameters contain the basic settings for the module, which you can adapt to your application. Set the module and port parameters in the start-up parameters in the configuration software of the EtherCAT® master. The EtherCAT® master sends these parameters to the module when communication starts up.

You can find all the module parameters in [🔗 Module Parameters \[p 51\]](#).

10.3 Parameterization

The following tools are described below:

-  **WAGO Webserver I/O Field** [► 71]
-  **WAGO IO-Link Configurator** [► 99]
-  **WAGO I/O Field app** [► 99]
-  **OPC UA Server** [► 99]

10.3.1 WAGO Webserver I/O Field

10.3.1.1 Call WAGO Webserver I/O Field

This section describes how you can use the integrated software WAGO I/O Field Webserver to get access to detailed information on the current operating state of the product and make settings to affect the product's behavior.

- ✓ Requirement: Opening the user interface of WAGO I/O Field Webserver requires that product's IP address is configured and known.

- Proceed as follows:

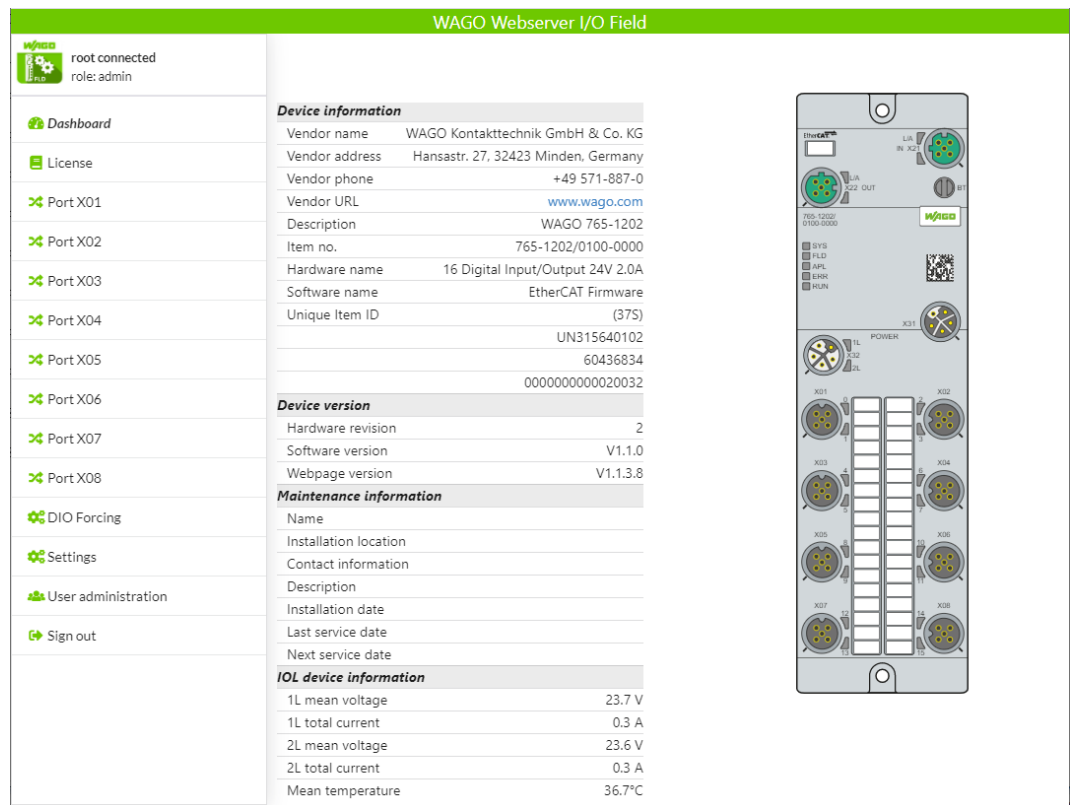
Enter the following text in the address bar of your Web browser to address the product:

`http://<IP-address-according-to-configuration>`

e.g., `http://192.168.10.2.`

- ⇒ The WAGO I/O Field Webserver **Dashboard** appears. You can now use the functions described below.

10.3.1.2 User Interface of the WAGO Webserver I/O Field



WAGO Webserver I/O Field

root connected
role: admin

Dashboard

License

Port X01

Port X02

Port X03

Port X04

Port X05

Port X06

Port X07

Port X08

DIO Forcing

Settings

User administration

Sign out

Device information

Vendor name WAGO Kontakttechnik GmbH & Co. KG

Vendor address Hansastr. 27, 32423 Minden, Germany

Vendor phone +49 571-887-0

Vendor URL www.wago.com

Description WAGO 765-1202

Item no. 765-1202/0100-0000

Hardware name 16 Digital Input/Output 24V 2.0A

Software name EtherCAT Firmware

Unique Item ID (37S)

UN315640102

60436834

0000000000020032

Device version

Hardware revision 2

Software version V1.1.0

Webpage version V1.1.3.8

Maintenance information

Name

Installation location

Contact information

Description

Installation date

Last service date

Next service date

IOL device information

1L mean voltage 23.7 V

1L total current 0.3 A

2L mean voltage 23.6 V

2L total current 0.3 A

Mean temperature 36.7°C

Terminal diagram showing connections for X01, X02, X03, X04, X05, X06, X07, X08, and POWER.

Figure 14: Dashboard Menu Item, Main Page (Example View)

When the user interface of the WAGO I/O Field Webserver opens, the main page of the **Dashboard** appears first.

It shows the following product information:

Table 54: Data on the "Dashboard" Page

Section	Information Displayed
Device information	Product data and WAGO contact information
Device version	Information on the product version: Hardware name and version number Software name and version number Website version number
Maintenance information	Maintenance information in text form
IOL device information	Advanced module and port information (measurement data on the module state)

10.3.1.2.1 Maintenance Information

The maintenance information includes information in text form that the user can set, e.g., the product name, installation location and date, contact information, description and date of the last and next product service. The texts can be edited by selecting **Settings** from the menu on the **Maintenance information** tab.

10.3.1.2.2 Advanced Module and Port Information

The advanced module and port information includes the following measurement data that is measured by the integrated sensors in the module:

- The module temperature
- The supply voltage (for supply cables 1L and 2L)
- The sum of all currents (for supply cables 1L and 2L)

10.3.1.2.3 Displaying Licenses

The **Licenses** menu item displays the page of the same name.

The menu item contains the following information:

- A list of the licensed software components the product contains
- A link for each licensed software component to the associated license terms

10.3.1.3 Opening the Product Information via WAGO Webserver I/O Field

10.3.1.3.1 Displaying Port Information

For each of the module's IO-Link ports (port X01, port X02 etc.), individual port information can be found on the **Information**, **Status**, **Configuration**, **IOL** and **Process data** tabs.

The **Configuration** tab also offers the option of making port settings.

You can access the port information as follows:

1. From the main menu of the Webserver (left), select the menu item „Port X0i“ which you want to view information about.
⇒ The **Information** tab opens.
2. Click the desired tab.

⇒ You can now access information about the desired port.

For each port, you can select from the following five tabs:

Table 55: Tabs for Port Information and Settings (IO-Link Ports X01, X02 etc.)

Tab	Description
Information	Displays the current measured values for temperature, voltage and current, as well as the port state, individually for each of pin 1, pin 2 and pin 4. If an IO-Link device is connected to the port via pin 4, its product data is also shown. This tab is pre-configured.
Status	Displays status information for the entire port
Configuration	For displaying and setting port parameters, such as the operating time or cycle time of the port
IOL	Read/write access to data of one of the IO-Link devices connected to the port
Process data	Displays the process data

10.3.1.3.2 Displaying Measured Values and Information on Connected IO-Link Devices

The screenshot shows the WAGO Webserver I/O Field interface. On the left is a sidebar menu with the following items: Dashboard, Port X01, Port X02, Port X03 (with a green checkmark and 'Ifm electronic gmbh OSD150'), Port X04 (with a green checkmark and 'Wago Kontakttechnik GmbH u. Co KG H'), Port X05, Port X06, Port X07, Port X08, DIOForcing, IOLForcing, Settings, and Sign out. The main content area is titled 'WAGO Webserver I/O Field' and 'Port X01'. It has five tabs: Information (selected), Status, Configuration, IOL, and Process Data. The Information tab displays 'Port Diagnosis - Pin 1', 'Port Diagnosis - Pin 2', and 'Port Diagnosis - Pin 4'. Each pin diagnosis shows the following data:

Pin	Temperature	Voltage	Current	Connector
Pin 1	40.4°C	23.4 V	0.1 A	OK
Pin 2	45.2°C	22.6 V	0.1 A	OK
Pin 4	40.4°C	-0.1 V	0.0 A	OK

Figure 15: Information Tab, Port X0i Menu Item (Example View)

The **Information** tab shows the following information:

- The measured values and states of the port diagnostics
- The information on connected IO-Link devices

Displaying Pin- and Port-Specific Measured Values and States

The **Information** tab shows the following current measured values for each of pin 1, pin 2 and pin 4 of the selected port:

- Temperature of the pin, measured in °C
- Voltage on the pin, measured in volts
- Current flowing through the pin, measured in amperes
- State of the connection pin

States of the Connection Pin

The possible states of the connection pin are:

- OK
- Short circuit
- Module-internal overload protection has triggered
- Module-internal overtemperature protection has triggered
- Module-internal overvoltage protection has triggered
- Overcurrent
- Undercurrent
- Overtemperature
- Undertemperature
- Overvoltage
- Undervoltage
- Module-internal watchdog timer has elapsed

Displaying Information on Connected IO-Link Devices

On IO-Link ports on which an IO-Link device is connected and recognized by the product's firmware, the following product information is also displayed in the **Device information** block:

The screenshot shows the WAGO Webserver I/O Field interface. On the left is a sidebar with a menu including 'Dashboard', 'Port X01' through 'Port X08', 'DIOForcing', 'IOLForcing', 'Settings', and 'Sign out'. The main area is titled 'WAGO Webserver I/O Field' and 'Port X04'. It has tabs for 'Information', 'Status', 'Configuration', 'IOL', and 'Process Data'. The 'Information' tab is active, showing a 'Device information' section (highlighted with a red box) with the following data:

Device information	
Min cycle time	0x14
Function ID	0
Number of profile IDs	1
Vendor name	Wago Kontakttechnik GmbH u. Co KG
Vendor text	Wago IO-Link Hubline
Product name	Hubline 765-1703/0200-0000
Product ID	765-1703
Product text	IO-Link DIO Hubline Slave Device
Serial number	0000000000020010
Hardware revision	V1.0
Firmware revision	IO-Hub V1.0.0.5

Below the device information, 'Port Diagnosis' data is shown for pins 1, 2, and 4:

Port Diagnosis - Pin 1	
Temperature	40.1°C
Voltage	23.5 V
Current	0.1 A
Connector	OK

Port Diagnosis - Pin 2	
Temperature	45.3°C
Voltage	22.7 V
Current	0.1 A
Connector	OK

Port Diagnosis - Pin 4	
Temperature	40.1°C
Voltage	19.1 V
Current	0.0 A
Connector	OK

Figure 16: **Information** Tab, **Port X0i** Menu Item (Example View)

Table 56: Additional Information on the Products Connected to the Selected Port

Information	Description
Min cycle time	Minimum cycle time supported by the connected product, in units of 0.1 milliseconds
Function ID	Function ID of the connected product
Number of profile IDs	Number of profile IDs in the profile characteristic (index 0x000D) of the connected product

Information	Description
Vendor name	Detailed name of the manufacturer/vendor of the connected device (up to 64 characters)
Vendor text	Additional text for description of the manufacturer/vendor (up to 64 characters)
Product name	Complete name of the connected product (up to 64 characters)
Product ID	Manufacturer-specific product or type information on the connected product (up to 64 characters)
Product text	Additional text for description of the connected product (up to 64 characters)
Serial number	Individual manufacturer-specific unique serial number of the connected product (up to 16 characters)
Hardware revision	Manufacturer-specific information on the hardware version (up to 64 characters)
Firmware revision	Manufacturer-specific information on the firmware version (up to 64 characters)

10.3.1.3.3 Displaying Port Status Information

The screenshot shows the WAGO Webserver I/O Field interface. On the left is a sidebar menu with options: Dashboard, Port X01, Port X02, Port X03 (with a green checkmark), Port X04 (selected, with a green checkmark), Port X05, Port X06, Port X07, Port X08, DIOForcing, IOLForcing, Settings, and Sign out. The main area is titled 'Port X04' and has tabs for Information, Status (selected), Configuration, IOL, and Process Data. The Status tab displays a table of port parameters:

Parameter	Value
State	Operate
Quality	0x2
Revision ID	0x11
Baudrate	230.4 kbps
Cycle time	0x14
Input data length	2
Output data length	2
Vendor ID	0x11D
Device ID	0x8006A5

Figure 17: **Port X0i** Menu Item, **Status** Tab (Example View)

The **Status** tab shows status information for pins 2 and 4 of the selected port.

This tab answers the following questions about the selected port:

- What is the current port status of the port?
- Is the process data valid for input/output?
- Is a product connected to the selected port? If so, what is this product's version ID?
- How high is the data transmission rate between the port and a product connected there?
- How long is the communication cycle time in the **Operate** operating mode?
- What is the true input/output data length of the connected product in bytes?
- What is the manufacturer ID or product ID of the product connected to the IO-Link port?

Proceed as follows to display the status information on a specific port:

1. From the main menu of the Webserver (left), select the menu item which you want to view information about.
 2. Open the **Status** tab.
- ⇒ The **Status** tab opens. The current port status information appears.

10.3.1.3.4 State

This shows the current port status information of the IO-Link port. The following table contains all possible values for the status of the IO-Link port:

Table 57: Possible Values of "State" (Port Status Information)

Value	Port Status	Description
0	No Device	No product is connected to the port, or there is no communication with the connected product
1	Disabled	The port is inactive
2	Incorrect Device	The version or compatibility check failed
3	Preoperate	The product is ready for communication
4	Operate	The product is communicating
5	DI CQ	The port is in digital input mode
6	DO CQ	The port is in digital output mode
7	Reserved	Reserved
8	Reserved	Reserved
9	Incorrect Cycle Time	The cycle time according to the configuration does not correspond to the connected product
254	Port Power Off	The port voltage is switched off
255	Not Available	The port is not available

10.3.1.3.5 Quality

This shows the **Port Quality Info**, including information on the validity of the process data for input and output (separately). The content is binary coded.

Table 58: Meaning of the Individual Bits

Bits of Port Quality Info	Description
Bit 0	0 = input process data valid 1 = input process data invalid
Bit 1	0 = output process data valid 1 = output process data invalid
Bit 2 to bit 7	Reserved

10.3.1.3.6 Revision ID

This shows the version ID of the connected device.

A value of 0 means: no device connected.

All other values must be interpreted as the version ID of the connected device.

10.3.1.3.7 Baud Rate

If an IO-Link device is connected to the port, its data transmission rate appears here. For IO-Link, the transmission rate of the communication between the port and a connected device can have the following values:

- 4.8 kbps (COM1)
- 38.4 kbps (COM2)
- 230.4 kbps (COM3)

If no IO-Link device is connected to the port, the text `Not connected` appears here.

10.3.1.3.8 Cycle Time

The cycle time of the master is bit-coded as follows:

- Bits 0 ... 5 specify a whole-number multiplier between 0 and 63.
- Bits 6 ... 7 specify the calculation formula to use according to the following table:

Table 59: Cycle Time of the Master – Bits 6 ... 7

Bits 6 ... 7	Calculation Formula
0	Multiplier × 0.1 ms
1	6.4 ms + multiplier × 0.4 ms
2	32.0 ms + multiplier × 1.6 ms
3	Reserved

10.3.1.3.9 Input Data Length

This shows the actual input data length of the connected product in bytes.

10.3.1.3.10 Output Data Length

This shows the actual output data length of the connected product in bytes.

10.3.1.3.11 Vendor ID

This value is the manufacturer ID of the connected product.

10.3.1.3.12 Device ID

This value is the device ID of the connected product.

10.3.1.3.13 Displaying Process Data

You can view the process data associated with a specific port on the **Process Data** tab.

Proceed as follows to view the process data for a port:

1. From the main menu of the Webserver (left), select the menu item which you want to view information about.
2. Open the **Process Data** tab.
 - ⇒ The **Process Data** tab opens. The current values of the process data configured for input/output appear in hexadecimal format under Input/Output. If no process data has been configured for a data direction (input or output), the corresponding field remains empty.

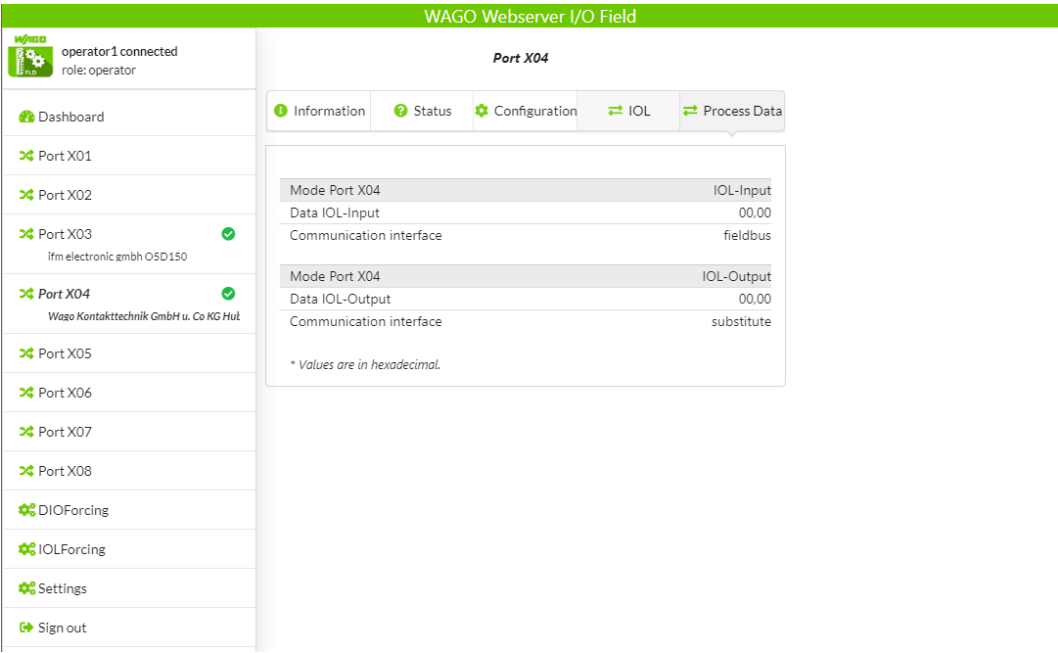


Figure 18: Port X0i Menu Item, Process Data Tab (Example View)

10.3.1.4 Parameterizing the Module via the WAGO I/O Field Webserver

You can make the following settings on the module with WAGO Webserver I/O Field:

-  [Accessing a Connected IO-Link Device \[► 79\]](#)
-  [Configure Ports \[► 82\]](#)
-  [Configuring IP Parameters \[► 86\]](#)
-  [Storing Maintenance Information \[► 86\]](#)
-  [Updating Firmware \[► 88\]](#)
-  [Resetting the Module to the Factory Settings \[► 89\]](#)
-  [Configure Bluetooth \[► 90\]](#)
-  [Logging Users on and off and Managing Them \[► 93\]](#)
-  [Forcing Digital Inputs and Outputs \[► 96\]](#)
-  [Forcing for IO-Link Ports \[► 97\]](#)

10.3.1.4.1 Accessing a Connected IO-Link Device

The **IOL** tab allows read and write access to the IO-Link device connected to an IO-Link port via index and subindex. The ISDU message format (ISDU = Indexed Service Data Unit) is used for this purpose.

Note

You can find the meaning of the index and subindex values in the documentation of the connected IO-Link device.

You can find a description of the ISDU message format in the IO-Link specification.

Required Rights

Changes to settings require operator or admin rights. If you do not have these, the tab is grayed out, and the displayed values cannot be edited.

Access to IO-Link Device

To access the data of an IO-Link device connected to the selected IO-Link port via index and subindex (ISDU message format), proceed as follows:

1. Select the port to which the IO-Link device is connected from the menu on the left.
 2. Open the **IOL** tab.
- ⇒ The **IOL** tab appears.

Read Access

WAGO Webserver I/O Field

Port X04

Information Status Configuration **IOL** Process Data

IOL asynchronous data exchange

Index

Subindex

Input data

Read Write

* All values are in hexadecimal without spaces. ** Subindex set to 0x00 by default.

Clear history

14:32:27 - 0:0 - Read OK: 00141401111010011d8006a500000000
 14:32:33 - 1:0 - Read OK: 000102030405060708090a0b0c0d0e0f
 14:32:39 - 3:0 - Read OK: 00000000046f07a8cd3000c00001800004000004b0000410000490000000000

Figure 19: Ports X0i – Read Access to IO-Link Device (Example View)

To read data from the connected IO-Link device, proceed as follows:

1. On the **IOL** tab, enter the index of the connected IO-Link device you want to access into the **Index** field as a hexadecimal value.
2. On the **IOL** tab, enter the subindex of the connected IO-Link device you want to access into the **Subindex** field as a hexadecimal value; the default setting is 00
3. Click the **[Read]** button.

⇒ The read operation is performed. An entry is written to the history at the bottom of the tab and logged there with the current time.

If the operation was successful, the text `Read ok:` and the result appear in the history.

The entries in the history then have the following structure:

Time - Index:Subindex - Read ok: <Result>

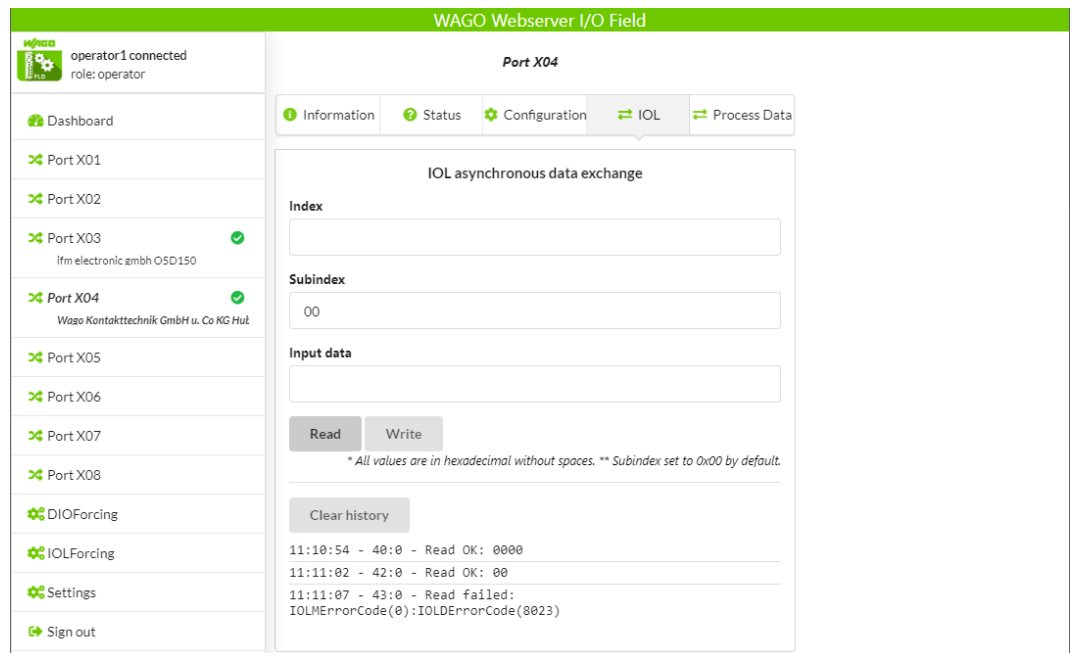


Figure 20: Ports X0i – Read Access to IO-Link at Index 43 and Subindex 0 Unsuccessful (Read Failed, Example View)

If the operation was not successful, an error message appears in the history with error codes from the IO-Link master and IO-Link device.

In this case, the entries in the history have the following structure:

Time - Index:Subindex - Read failed: IOLMasterCode(<error code of the IO-Link master>): IOLDeviceCode(<error code of the IO-Link device>)

Note

You can find information on the meaning of the error codes of IO-Link masters (IOLMasterCode) and IO-Link devices (IOLDeviceCode) in the IO-Link specification.

The following applies in both cases:

- The time appears in HH:MM:SS format
- The index and subindex appear in hexadecimal format

Write Access

To write data to the connected IO-Link device, proceed as follows:

1. On the **IOL** tab, enter the index of the connected IO-Link device you want to access into the **Index** field as a hexadecimal value.
 2. On the **IOL** tab, enter the subindex of the connected IO-Link device you want to access into the **Subindex** field as a hexadecimal value; the default setting is 00
 3. On the **IOL** tab, enter the data to write in the **Input data** field.
 4. Click the **[Write]** button.
- ⇒ The write operation is performed.

If the operation was successful, the text `Write ok:` and the result appear in the history. The entries in the history then have the following structure:

```
Time - Index:Subindex - Write ok: <Result>
```

If the operation was not successful, an error message appears in the history with error codes from the IO-Link master and IO-Link device. The entries in the history then have the following structure:

```
Time - Index:Subindex - Write failed: IOLMErrorCode(<error code of the IO-Link master>): IOLDErrorCode(<error code of the IO-Link device>)
```

Deleting the Read and Write Access History

To delete the logged history of read and write operations:

- Click the **[Clear history]** button.
- ⇒ The history of read and write access operations is deleted.

10.3.1.4.2 Configure Ports

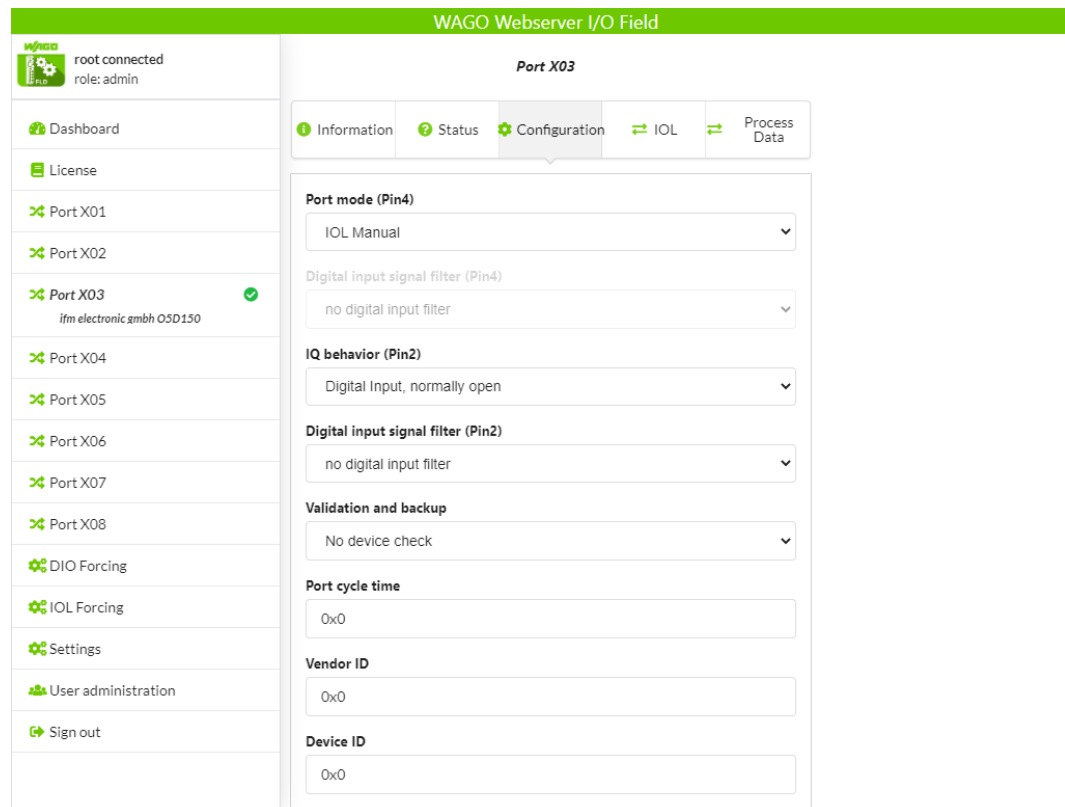


Figure 21: **Port X0i** Menu Item, **Configuration** Tab (Example View)

The **Configuration** tab is used to display and modify the following port settings for the selected port of the device:

Table 60: Port Configuration Settings for IO-Link Devices

Name	Type	Description
Port mode (pin 4)	Drop-down menu	Port operating mode (configuration of pin 4)
Digital input signal filter (pin 4)	Drop-down menu	Filter time for digital input signals on pin 4 (only for "Port mode (pin 4)" on digital input)

Name	Type	Description
IQ behavior (pin 2)	Drop-down menu	IQ behavior of the port (configuration of pin 2)
Validation and backup	Drop-down menu	Validation and Backup Settings for Device Check When Replacing Devices
PortCycleTime	Input field	Expected cycle time of the port
VendorID	Input field	Expected manufacturer ID of the connected device
DeviceID	Input field	Expected device ID of the connected device

The **Validation and Backup**, **PortCycleTime**, **VendorID** and **DeviceID** settings only appear for the IOL Manual selection in the **Port mode (pin 4)** drop-down menu.

Changes to settings require operator or admin rights. If you do not have these, the **Configuration** tab is grayed out, and the displayed values cannot be edited.

If cyclic data exchange takes place via EtherCAT, no configuration is possible. In this case, a message appears:

Note: Changing configuration not allowed because interface state is "communicating."

To make changes to a port's configuration, proceed as follows:

1. Select the desired port (port X01, port X02 etc.) from the menu
 2. Open the **Configuration** tab.
 3. Configure pin 4 by setting the port operating mode.
 4. If applicable, configure the filter time for the signals of the digital inputs.
 5. If applicable, configure the device check for validation and backup.
 6. If applicable, configure pin 2 by setting the I/Q behavior.
 7. If applicable, enter the expected vendor ID.
 8. If applicable, enter the expected device ID.
 9. If applicable, set the expected cycle time.
 10. Click the **[Apply]** button.
- ⇒ Your changes now take effect.

Configuring the Operating Mode for Pin 4 of the Port

You can select the port operating mode for pin 4 of the selected IO-Link port from the **Port mode** drop-down menu. The following operating modes are available:

Table 61: "Port Mode" Drop-Down Menu: Selecting the Operating Mode for Pin 4 of the Selected IO-Link Port

Selection Option	Description
Deactivated	The port is disabled. L+ is switched off. The process data (both input and output) is set to 0. The master no longer performs actions related to this port.
IOL Manual	The port is used as an IO-Link port with manual (user-defined) configuration. The vendor ID, device ID and version ID are validated.
IOL Autostart	The port is used as an IO-Link port with automatic start. No configuration or device validation occurs.
Digital input, normally open	The port is used as a digital input. All elements of the port configuration are ignored except for the input and output data length.
Digital input, normally closed	The port is used as a digital input. The signals on the port are inverted. All elements of the port configuration are ignored except for the input and output data length.

Selection Option	Description
Digital Output	The port is used as a digital output. All elements of the port configuration are ignored except for the input and output data length.
Digital output, static on	The port is used as a digital output. The signal on pin 4 is permanently set to logic 1 (for testing purposes only).

Setting the Filter Time for Digital Inputs

The filter time for the digital inputs can be selected from the **Digital input signal filter** drop-down menu. You can select from the following values:

- No digital input filter
- 3 ms
- 15 ms
- 20 ms

If the **No digital input filter** option is selected, no filtering occurs.

Configure Pin 2 (I/Q)

The behavior of pin 2 (I/Q) can be selected from the **IQ behavior** drop-down menu. For your IO-Link class A device, the following configuration options are available for using pin 2 as a digital input or output:

Table 62: **IQ Behavior** Drop-Down Menu – Configuration of Pin 2 (I/Q) for IO-Link Class A Devices

Selection Option	Explanation
Not supported	Pin 2 is not used.
Digital input, normally open	Pin 2 is a digital input.
Digital input, normally closed	Pin 2 is a digital input. The signal is inverted.
Digital Output	Pin 2 is a digital output.
Digital output, static on	Pin 2 is a digital output. The signal is permanently set to logic 1 (for testing purposes only).

Configuring the Device Check for Validation and Backup

Note

In the “IOL Autostart” operating mode (see above), this drop-down menu has no effect.

The **Validation and backup** drop-down menu can be used to determine whether a validation (device check) is performed and, if so, at what level (Inspection Level) when a connected device is replaced, and whether or not the stored operating parameters of the old device are carried over to the new one.

The following table explains the possible values for Inspection Level:

Table 63: Possible Values of the **Inspection Level** Parameter

Inspection Level	Description
NO_CHECK	No device check is performed.

Inspection Level	Description
TYPE_COMP	A device check for type compatibility is performed. For the device check, the actual vendor ID is compared to the vendor ID setting in the configuration, and the actual device ID is compared to the device ID setting in the configuration.
IDENTICAL	A device check for device identity is performed. For this purpose, a device check for type compatibility is performed. Furthermore, the actual serial number is compared to the serial number setting of the configuration.

The **Backup Level** parameter determines the system behavior when a device connected to the port is replaced in terms of continued operation with unmodified device parameters.

This parameter can have three different values:

Table 64: Possible Values of the **Backup Level** Parameter

Backup Level	Description
Commissioning ("Disable")	Parameter data of the old device is not saved for transfer to the new device. Therefore, if the device is replaced, the new device must be parameterized anew.
Production ("Backup/Restore")	Changes to all active parameters within the device are copied and saved. Thus all parameter data of the old device is stored for transfer to a new device. Device replacement with automatic or semi-automatic data storage is supported.
Production ("Restore")	Changes to all active parameters within the device are not copied and saved. Only special parameter data of the old device is stored for transfer to a new device. Device replacement with automatic or semi-automatic data storage is only supported for these "frozen" parameters.

The **Validation and Backup** drop-down menu offers the following options for setting the **Inspection Level** and **Backup Level** parameters:

Table 65: Setting the **Inspection Levels** and **Backup Levels** for Device Check during Validation and Backup

Selection Option	Inspection Level	Backup Level	Description
No device check	NO_CHECK	Disable	No device check is performed.
Type compatible device (V1.0)	TYPE_COMP	Disable	Device check for type-compatible device per IO-Link specification 1.0
Type compatible device (V1.1)	TYPE_COMP	Disable	Device check for type-compatible device per IO-Link specification 1.1
Type compatible device (V1.1) with backup + restore	TYPE_COMP	Backup + Restore	Device check for type-compatible device per IO-Link specification 1.1 with backup & restore functionality
Type compatible device (V1.1) with restore	TYPE_COMP	Restore	Device check for type-compatible device per IO-Link specification 1.1 with restore functionality

VendorID Input Field

This element contains the expected manufacturer ID (VendorID, 2 bytes) of the connected device. The permissible values range from 1 to 0xFFFF. This information is required for the device check for type compatibility. It can be omitted if **[No device check]** is selected.

DeviceID Input Field

This element contains the expected device ID (DeviceID, 3 bytes) of the connected device. The permissible values range from 1 to 0xFFFFFF. This information is required for the device check for type compatibility. It can be omitted if **[No device check]** is selected.

PortCycleTime Drop-Down Menu

Depending on the selected operating mode, the expected cycle time of the port either can be selected from the **PortCycleTime** drop-down menu or is merely displayed. The encoding corresponds to the one in the port status.

10.3.1.4.3 Configuring IP Parameters

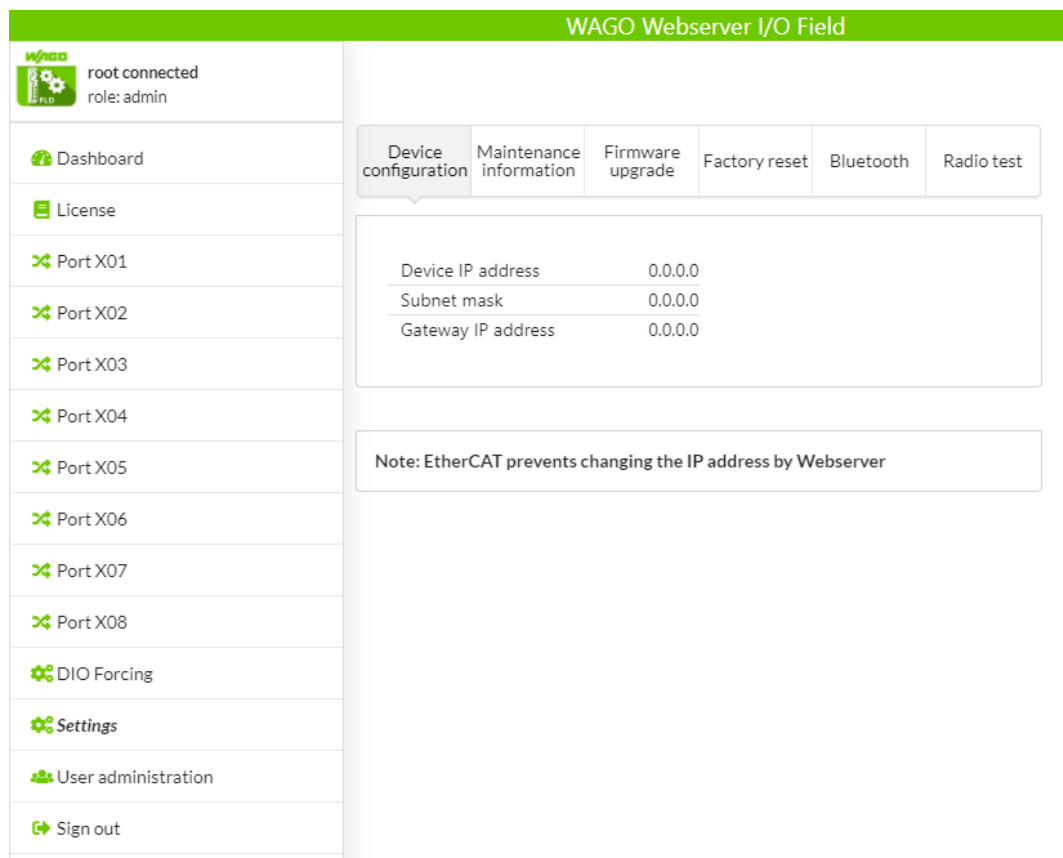


Figure 22: Settings **Menu Item**, Device Configuration **Tab** (Example View)

The EtherCAT® master configures the module's IP address. Therefore, with EtherCAT® modules, no manual IP address configuration is necessary.

Other tabs under the menu item **Settings** are described below.

10.3.1.4.4 Storing Maintenance Information

On the **Maintenance Information** tab, you can store maintenance information, such as the device name, the installation location and date, contact information, a description text or the date of the last and next product service.

Figure 23: **Settings** Menu Item, **Maintenance Information** Tab (Example View)

Changes to settings require operator or admin rights. If you do not have these, the **Maintenance Information** tab is grayed out and cannot be edited.

The maintenance information includes:

Table 66: Maintenance Information

Name	Data Format and Length	Description	Corresponding I&M Field
Name	Printable ASCII string, max. 64 characters	Uniform label (string) in the system for the function of this device	I&M1:TAG_FUNCTION
Installation Location	Printable ASCII string, max. 32 characters	Uniform label (string) in the system for the location where the device is installed	I&M1: TAG_LOCATION
Installation Date	ASCII time indication, max. 32 characters	Installation or commissioning date of this device; the format can be determined by the fieldbus organization.	I&M2: INSTALLATION_DATE
Contact Information	Printable ASCII string, max. 32 characters	Text for identification of a contact person for this managed node of the system, together with information on how to contact this person.	
Description	Printable ASCII string, max. 64 characters	Readable comment field (plain text) to store free text containing individual state information and comments.	I&M3: DESCRIPTOR
Signature	Printable ASCII string, max. 128 characters	Signature	I&M4: SIGNATURE

Name	Data Format and Length	Description	Corresponding I&M Field
Number of changes (Change Count)	ASCII decimal number, max. 32 characters	Counter for changes to the hardware or the device parameters; only needs to be incremented if the data has really changed.	I&M0: REV_COUNTER
Date/time of the last service (Last Service Date)	ASCII time indication, max. 32 characters	Date/time of the last service, e.g., firmware update.	
Date of the next service (Next Service Date)	ASCII time indication, max. 32 characters	Date/time of the next service, e.g., firmware update	

To make changes to the maintenance information:

1. From the Webserver main menu (left), select the **Settings** menu item
⇒ The **Device Configuration** tab appears.
2. Select the **Maintenance Information** tab.
3. Modify the relevant fields there.
4. Click the **[Apply]** button.
⇒ Your changes take effect.

10.3.1.4.5 Updating Firmware

With the **Firmware upgrade** tab, WAGO Webserver I/O Field provides an option for updating the product firmware.

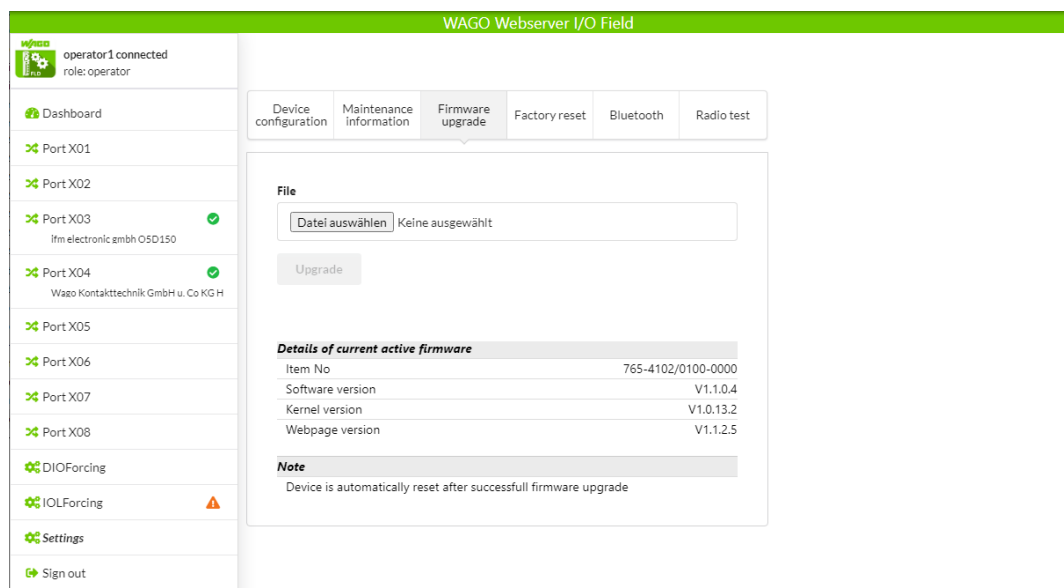


Figure 24: Settings Menu Item, Firmware Upgrade Tab (Example View)

! NOTICE

Put system in safe operating mode

Never perform a firmware update during ongoing operation of the system in which the product is installed. Before any firmware update, the system must first be properly shut down or put in a safe operating state.

 Note**Create backup before update**

When you update your product's firmware, the state of your product before the update, including the firmware used up to that point, can no longer be reconstructed unless a firmware and configuration data backup exists.

Changes to settings require operator or admin rights. If you do not have these, the **Settings** tab is grayed out and cannot be edited.

To update the firmware, you need a firmware container file: `FWUPDATE.ZIP`. You can get it from the Downloads section of the WAGO website:  <http://www.wago.com>.

Proceed as follows to update the firmware:

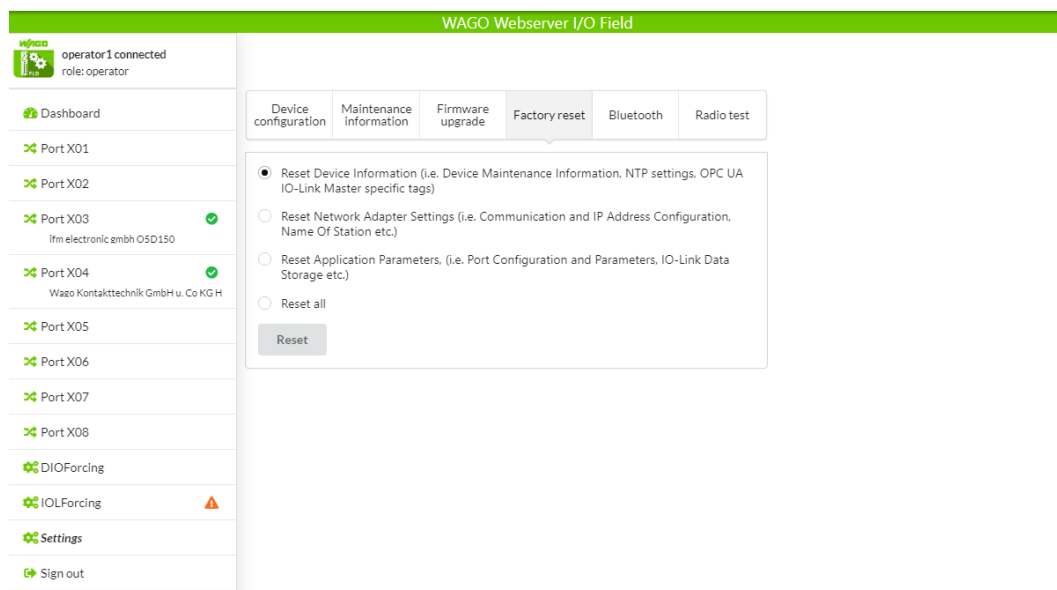
1. In the left-hand column of the WAGO I/O Field Webserver, click the **Settings** menu item.
⇒ The **Device configuration** tab appears.
2. Select the **Firmware upgrade** tab.
3. Click the **[Select file]** button.
⇒ A file selection dialog opens.
4. Select the firmware container file `FWUPDATE.ZIP` from this dialog.
⇒ The name of the selected firmware container file appears in the **File** field.
5. Click the **[Upgrade]** button.
⇒ The firmware update is performed. After that, the port must be configured anew.

The firmware update procedure is as follows:

1. The firmware from the `FWUPDATE.ZIP` firmware container file is stored in the module's flash memory.
2. An internal reset is triggered.
3. Then the device maintenance firmware starts; this edits the firmware container file and installs the new firmware, including the module's configuration files.
4. You are notified when the installation procedure finishes.
5. The module then resets again.
6. The new firmware that has just been loaded starts.

10.3.1.4.6 Resetsetting the Module to the Factory Settings

In many cases, it can be helpful to reset the module to the factory settings. This can be done for various selectable classes of settings with the **Settings** menu item on the **Factory reset** tab.

Figure 25: **Settings** Menu Item, **Factory Reset** Tab (Example View)

Changes to settings require operator or admin rights. If you do not have these, the **Settings** tab is grayed out and cannot be edited.

Various settings can be reset according to the radio button selection:

Table 67: Options for Resetting the Module to the Factory Settings

Option	Reset Settings
Reset Device Information	Module settings (e.g., maintenance information, system time settings)
Reset Network Adapter Settings	Network adapter settings (communication settings, IP address configuration, station name)
Reset Application Parameters	Application-specific data (port configuration and parameters, remanent parameters)
Reset All	All Settings

To reset the module to the factory settings, proceed as follows:

1. In the left-hand column of the WAGO I/O Field Webserver, click the **Settings** menu item.
⇒ The **Device configuration** tab appears.
2. Select the **Factory reset** tab.
3. Use the radio buttons to select the settings that you want to reset to their factory setting values.
4. Click the **[[Reset]]** button.
⇒ The selected settings are reset to the factory settings.

10.3.1.4.7 Configure Bluetooth

The **Bluetooth®** tab provides the following functions:

- Displaying information on the product's Bluetooth® interface module
- Displaying diagnostic information
- Activating the Bluetooth® interface via DM code
- Starting a Bluetooth® firmware update
- Resetting the Bluetooth® firmware

- Switching the Bluetooth® wireless connection on/off
- Switching the Bluetooth® LED on/off

Proceed as follows to access these Bluetooth® functions on the WAGO I/O Field Webserver:

- Open the **Bluetooth®** tab.
- ⇒ The **Bluetooth®** tab appears.

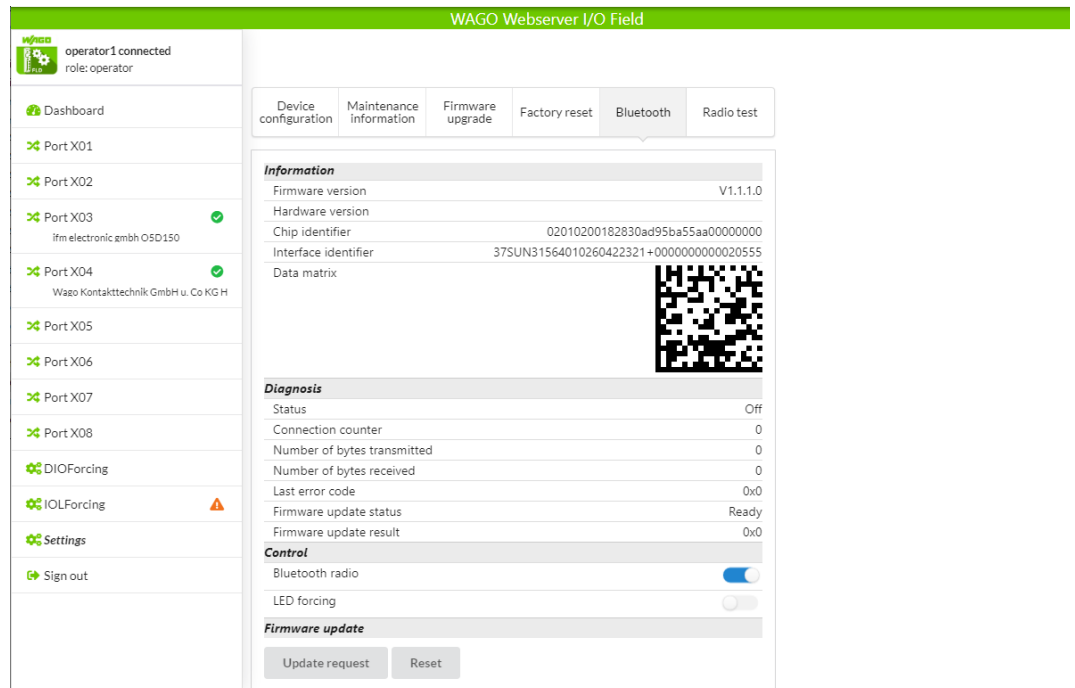


Figure 26: **Settings** Menu Item, **Bluetooth®** Tab (Example View)

Displaying Information on the Product's Bluetooth® Interface Module

The **Information** section of the **Bluetooth®** tab shows the following information on the product's Bluetooth® interface module:

- Current version of the Bluetooth® firmware used
- Current version of the Bluetooth® hardware used
- Chip identifier of the Bluetooth® chip used
- Interface identifier of Bluetooth® interface module
- Individual DM code of the product
(can be scanned by a smartphone or tablet to launch an app on it for communication with the product)

Displaying Diagnostic Information

The **Diagnostics** section of the **Bluetooth®** tab shows the following diagnostic information on the Bluetooth® connection:

- Connection state
- Connection counter; is set to 0 with each new Bluetooth® connection.
- Number of bytes sent over the Bluetooth® connection
- Number of bytes received over the Bluetooth® connection
- Last error code that occurred during operation of the Bluetooth® connection
- Status of the last Bluetooth® firmware update
- Result of the last Bluetooth® firmware update

The status of the last Bluetooth® firmware update is indicated as follows:

Table 68: Status of the Last Bluetooth® Firmware Update

Value	Status
0	Ready for operation
1	Firmware file is being checked
2	Firmware update is being performed

Activating the Bluetooth® Interface Using the DM Code Displayed

Note

Never use the product in areas where operation of radio equipment is prohibited.

Never use the Bluetooth® interface in areas where operation of radio equipment is prohibited. The module contains a Bluetooth® radio transmitter that can impair the function of medical electronic equipment such as hearing aids and pacemakers. Disable the Bluetooth® interface in these cases.

Note

Only use the product with Bluetooth® if the product has an approval for the specific country or region.

To enable the Bluetooth® interface, you must have the WAGO I/O Field app installed on the smartphone or tablet. Proceed as follows:

- A DM code appears in the “Information” section of the **Bluetooth®** tab. Scan it with the smartphone or tablet.
 - ⇒ The smartphone or tablet then sends an optical sequence (flash code) to the device’s integrated light sensor.
 - ⇒ The light sensor registers this sequence. If the sequence is recognized as correct, the Bluetooth® interface is enabled, and the product attempts to establish a Bluetooth® connection to the smartphone or tablet.

Starting a Bluetooth® Firmware Update

Proceed as follows to start a Bluetooth® firmware update:

1. Click **Update Request**.
 - ⇒ A dialog appears for selecting the Bluetooth® firmware file.
2. Select the firmware file.
 - ⇒ The Bluetooth® firmware update starts.

Performing a Reset

Proceed as follows to reset the Bluetooth® firmware:

- Click **Reset**.
 - ⇒ The Bluetooth® firmware is reverted and restarts.

Switching the Bluetooth® Interface Wireless Transmitter on/off

To switch the Bluetooth® interface wireless transmitter on:

- Slide the **Bluetooth Radio** switch to the right.
- ⇒ The Bluetooth® interface wireless transmitter switches on.

To switch the Bluetooth® interface wireless transmitter off, slide the **Bluetooth Radio** switch to the left.

Switching LED Forcing on/off

Proceed as follows to switch LED forcing (externally controlled LED mode) on:

- Slide the **LED Forcing** switch to the right.
- ⇒ LED forcing switches on. The LED on the Bluetooth® interface can now be externally controlled.

To switch LED forcing off, slide the **LED Forcing** switch to the left.

10.3.1.4.8 Logging Users on and off and Managing Them

Logging Users on

Proceed as follows to log users on:

1. From the Webserver main menu (left), select the **Sign in** menu item.
- ⇒ The input screen for username and password appears:

The screenshot shows the WAGO Webserver I/O Field interface. On the left, a sidebar menu lists various options: Dashboard, Port X01, Port X02, Port X03 (with a green checkmark and 'Ifm electronic gmbh OSD150'), Port X04 (with a green checkmark and 'Wago Kontakttechnik GmbH u. Co KG H'), Port X05, Port X06, Port X07, Port X08, Settings, and Sign in (highlighted). The main content area on the right is titled 'WAGO Webserver I/O Field' and contains a login form with 'Username' and 'Password' input fields and a 'Sign in' button. At the bottom left of the interface, the URL '192.168.10.99/files/index.htm#/userlogin' is visible.

Figure 27: **Sign in** Menu Item – Input Screen for Username and Password (Example View)

2. Enter your username and password into the corresponding fields.
3. Click the **[Sign in]** button.

- ⇒ If you have entered a known username correctly, you can now work with the WAGO I/O Field Webserver with this user's specified rights. The username that was used to log on is shown in the upper left-hand corner. The **Sign in** menu item changes to **Sign out**.

Logging Users off

Proceed as follows to log a user off:

- From the Webserver main menu (left), select the **Sign out** menu item.
- ⇒ You can now no longer work in the WAGO I/O Field Webserver with the rights you had been using till this point. The username used to log on is no longer shown in the upper left-hand corner. The **Sign out** menu item changes back to **Sign in**.

Guest User Access

By default, the Webserver recognizes the user `guest` without a password; this was set up for initial access or guest access.

Initial Login as Administrator

Upon delivery or after a reset to the factory settings, the WAGO I/O Field Webserver can be accessed with the username `root` and password `password`. This combination has administrator rights.

Note

Change the administrator password immediately after commissioning. The factory default setting is widely known and does not provide adequate protection.

The **Administration** tab provides role-based user administration. It allows you to create and delete users and assign them roles, which their rights depend on. Users can be divided into three roles:

- Maintenance
- Operator
- Administrator

Creating a New User

When "User administration" opens, the following screen appears:

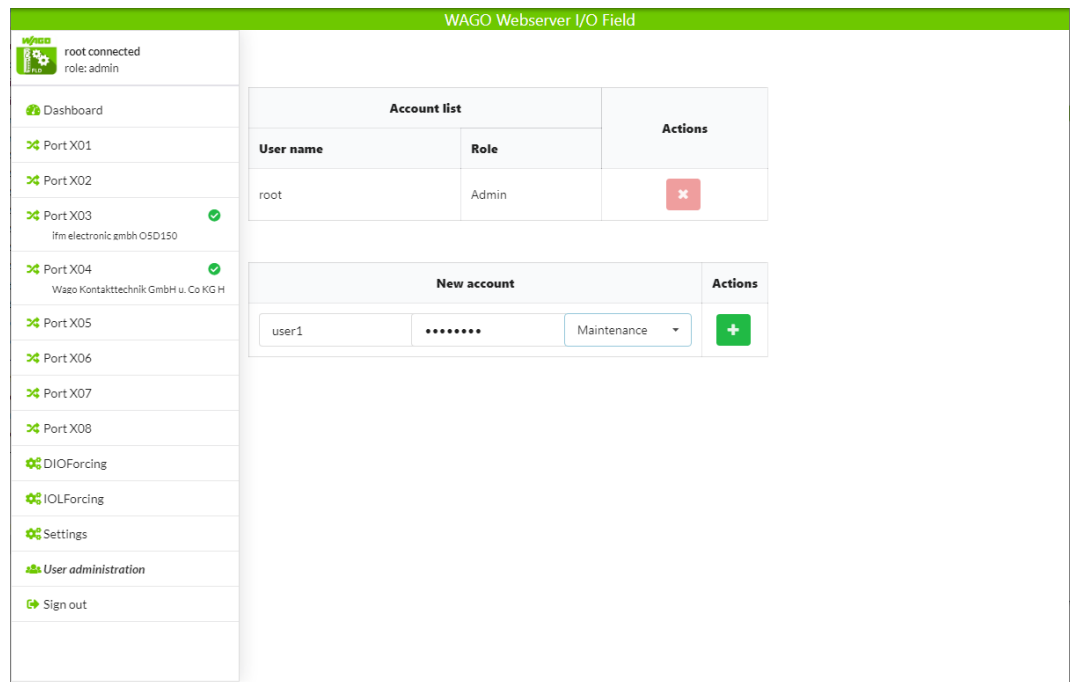


Figure 28: User Administration Menu Item (Initial State) (Example View)

The user `root` with pre-set password `password` exists by default; see first row.

An additional user can be created in the second row. Proceed as follows:

1. In the **Username** field, enter the username to use for the user. Users that are already in use are not allowed here.
2. In the **Password** field, enter the password for this username.
3. Using the combo box on the right, select the role for the new user being created (the available roles are *Maintenance*, *Operator* and *Administrator*).
4. Click the green field to finish.

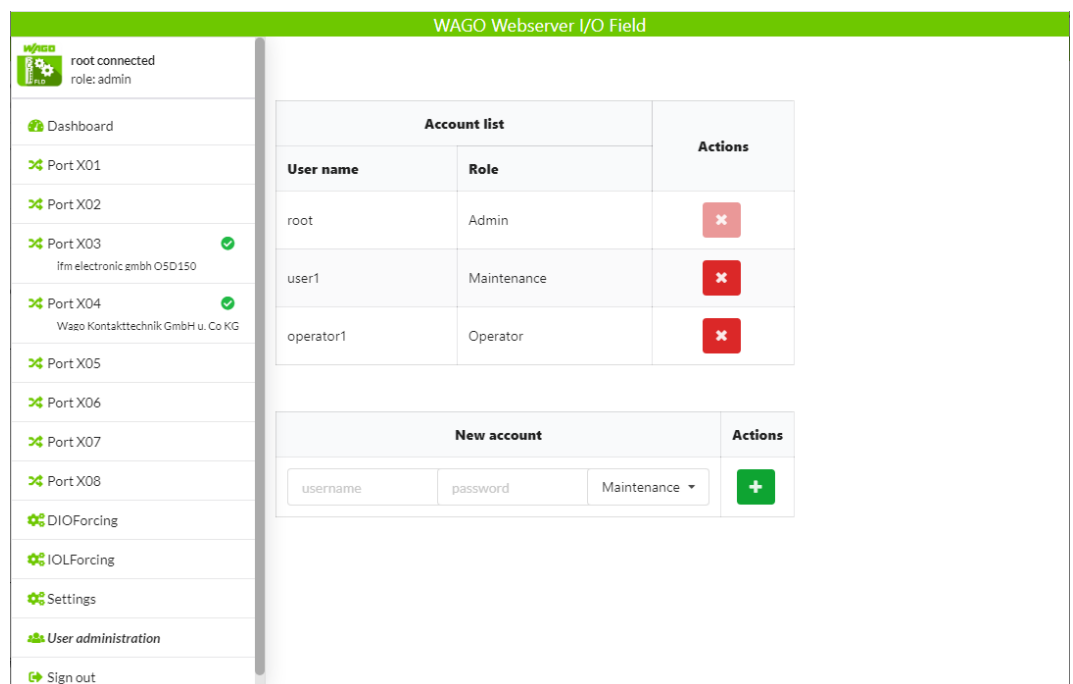


Figure 29: User Administration Menu Item (Example View)

⇒ The new user is created and assigned the selected role.

Removing Users

To remove an existing user from the product's user administration, proceed as follows:

- Click the red square with the white "x" to the right of the user you want to remove.

⇒ The user is deleted.

The user `root` cannot be deleted, so the red deletion button is grayed out there.

10.3.1.4.9 Forcing Digital Inputs and Outputs

To access the forcing functionality for the digital inputs and outputs via the Webserver, you must be logged in there with operator or administrator rights. To perform forcing, proceed as follows:

- From the Webserver main menu (left), select the **DIO Forcing** menu item.
- Check the **Forcing enable** box.

⇒ Unless another user is already accessing it, access to the forcing functionality is now enabled. A table with checkboxes in some of its cells appears on the screen:

WAGO Webserver I/O Field

operator1 connected
role: operator

Dashboard

Port X01

Port X02

Port X03
Ifm electronic gmbh OSD150

Port X04
Wago Kontakttechnik GmbH u. Co KG H

Port X05

Port X06

Port X07

Port X08

DIOForcing

IOLForcing

Settings

Sign out

Forcing enable

Port	Output process data				Input process data			
	Pin 4	no Pin 2	Pin 4	no Pin 2	Pin 4	no Pin 2	Pin 4	no Pin 2
	force	set/clr	force	set/clr	force	set/clr	force	set/clr
Port X01	☐	0	---	---	☐	0	---	---
Port X02	☐	0	---	---	☐	0	---	---
Port X03	☐	0	---	---	☐	0	---	---
Port X04	☐	0	---	---	☐	0	---	---
Port X05	☐	0	---	---	☐	0	---	---
Port X06	☐	0	---	---	☒	0	---	---
Port X07	☒	1	---	---	☐	0	---	---
Port X08	☐	1	---	---	☐	0	---	---

Figure 30: DIO Forcing Menu Item, "DIO Forcing" Screen (Example View)

You have three options for each pin that supports the forcing function:

Table 69: Input Options for Forcing for Each Pin of a Port

Option	"Force" Checkbox	"Set/Clr" Checkbox
Forcing – substitute value bit is set (1)	Checked	Checked
Forcing – substitute value bit is deleted (0)	Checked	Not checked
No forcing for this pin	Not checked	No meaning

For entering these, there are two checkboxes in the table for each pin of a port: **force** for switching the forcing functionality on/off, and **set/clr** for setting or deleting the setpoint (1 bit); the latter checkbox is only relevant if the **force** box is checked. The following applies to this:

- All inputs for input simulation are entered in the right half of the table under “Input process data”; all the inputs for output forcing are then entered in the left half of the table under “Output process data.”

You can find a description of and more information on the forcing function and explanations of terms under  **Forcing** [► 35].

Each of the eight ports (X01 ... X08) has its own table row.

Concurrent Access

As long as one user is accessing the forcing functionality through a forcing medium, e.g., the WAGO I/O Field Webserver, it is locked for all other users of the module. They cannot access the forcing functionality until the user that is active now terminates his or her access.

In this case, the Web browser displays a message box with the text “Somebody else is already forcing. Try again later.” When the forcing functionality is being accessed, a small orange icon also appears in the forcing option entry in the menu bar on the left.

10.3.1.4.10 Forcing for IO-Link Ports

To access the forcing functionality for the IO-Link module via the Webserver, you must be logged in there with operator or administrator rights. To perform forcing, proceed as follows:

- Select the **IOL Forcing** option from the main menu of the Webserver on the left and check the **Forcing enable** box at the top.
- ⇒ Unless another user is already accessing it, access to the forcing functionality is now enabled. The screen shows a table with checkboxes in the **force** columns and should look something like this:

WAGO Webserver I/O Field

operator1 connected
role: operator

Dashboard

Port X01

Port X02

Port X03
Ifm electronic gmbh OSD150

Port X04
Wago Kontakttechnik GmbH u. Co KG H

Port X05

Port X06

Port X07

Port X08

DIOForcing

IOLForcing !

Settings

Sign out

☒ Forcing enable
 Port-Selection: ☒ X01-X04 ☐ X05-X08

Ports	Output process data				Input process data					
	force	set value (hexadecimal)				force	set value (hexadecimal)			
Port X01	☒	00-07 0 0 0 0	08-15 0 0 0 0	16-23 0 0 0 0	24-31 0 0 0 0	☐	00-07 0 0 0 0	08-15 0 0 0 0	16-23 0 0 0 0	24-31 0 0 0 0
Port X02	☐	00-07 0 0 0 0	08-15 0 0 0 0	16-23 0 0 0 0	24-31 0 0 0 0	☐	00-07 0 0 0 0	08-15 0 0 0 0	16-23 0 0 0 0	24-31 0 0 0 0
Port X03	☐	00-07 0 0 0 0	08-15 0 0 0 0	16-23 0 0 0 0	24-31 0 0 0 0	☐	00-07 0 a1 0 0	08-15 0 0 0 0	16-23 0 0 0 0	24-31 0 0 0 0
Port X04	☐	00-07 0 0 0 0	08-15 0 0 0 0	16-23 0 0 0 0	24-31 0 0 0 0	☐	00-07 0 0 0 0	08-15 0 0 0 0	16-23 0 0 0 0	24-31 0 0 0 0

Figure 31: IOL Forcing Menu Item, "IOL Forcing" Screen (Example View)

You can find a description of and more information on the forcing function and explanations of terms under [Forcing](#) ▶ 35.

You can use the **force** checkbox to specify for each port of the port group X01...X04 or X05...X08 in its own row whether port forcing applies to this port. You can do this separately for the input and output process data. You can switch between the two port groups X01...X04 and X05...X08 with the **X01-X04** and **X05-X08** radio buttons at the top.

To enable forcing for a port and enter forcing data (i.e., substitute values) for it, proceed as follows:

1. Check the **force** box for the port in question.
2. For this port, you can enter 16 byte substitute values in hexadecimal format in the **set value (hexadecimal)** input fields of the column.

Concurrent Access

As long as one user is accessing the forcing functionality through a forcing medium, e.g., the WAGO I/O Field Webserver, it is locked for all other users of the module. They cannot access the forcing functionality until the user that is active now terminates his or her access.

In this case, the Web browser displays a message box with the text "Somebody else is already forcing. Try again later." When the forcing functionality is being accessed, a small orange icon also appears in the forcing option entry in the menu bar on the left.

10.3.2 WAGO IO-Link Configurator

WAGO IO-Link masters can be used in various system environments. They can be either gateways that link IO-Link to higher-level fieldbus or ETHERNET systems, modules in modular remote I/O Systems or a fixed component of devices like controllers.

In most cases, a higher-level engineering tool is used in the relevant system environment. Often, however, there is none or at least no uniform integration option. Various options are implemented for the IO-Link device tool as easy-to-use solutions for the respective cases.

The WAGO IO-Link Configurator software can be operated as a stand-alone program or via WAGO-I/O-CHECK.

You can find further information in the product manual WAGO IO-Link Configurator.

The manual is available in the download area for the WAGO IO-Link Configurator software at www.wago.com, item number 765-4201/100-000.

10.3.3 WAGO I/O Field app

10.3.3.1 Parameterizing a Module with the WAGO I/O Field App

Note

Read the online help!

You can find Product-specific information on the WAGO App I/O Field in the online help for the app.

10.3.4 OPC UA Server

The device has an OPC UA server. An OPC UA client can establish a connection with the device and access the following parameters, among others:

- Device identification
- Configuration parameters
- Process Data
- Measured values
- Diagnostic information
- Statistical information

The OPC UA client establishes a connection via the following URL:

```
opc.tcp://IP-address:4840
```

For IP-address, use the IP address of the device.

The client can access device parameters anonymously (only read access) or with a username/password (read/write access). The username and password are set with the WAGO Webserver IO Field.

The following figure shows an excerpt from the device's information model.

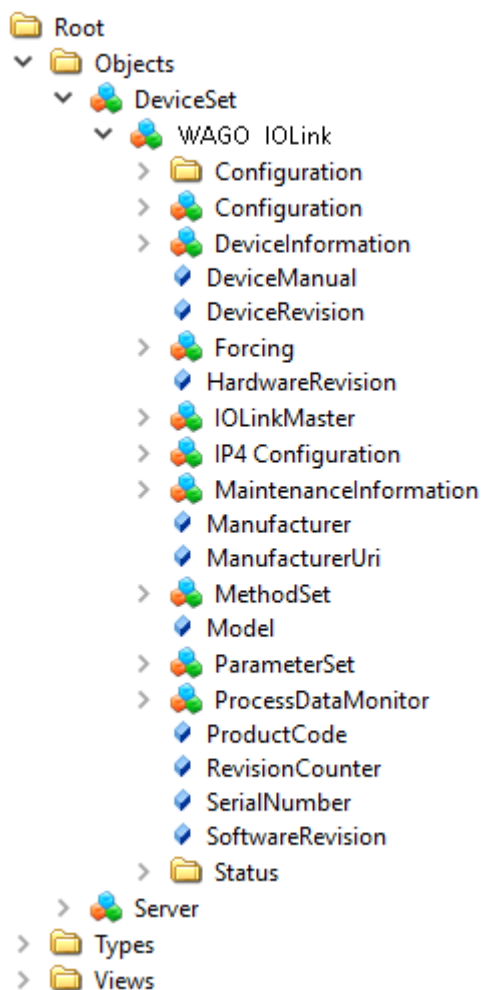


Figure 32: OPC UA: Device Information Model

10.3.4.1 Parameterizing the Product via OPC UA

10.3.4.1.1 Identifying Devices

The device provides nodes for device identification. For example, the OPC UA client can read out the version of the device firmware used in the `SoftwareRevision` node. The path to this node is:

Root > Object > DeviceSet > [device name]

Table 70: Identify Devices

Node Name	Node Class	Access	Description
Manufacturer	Variable	Read	Device manufacturer
ManufacturerUri	Variable	Read	URL of the device manufacturer
Model	Variable	Read	Short name of the device
ProductCode	Variable	Read	Product code of the device: "765-xxxx/xxxx-xxxx"
RevisionCounter	Variable	Read	Hardware version of the device
SerialNumber	Variable	Read	Serial number of the device
SoftwareRevision	Variable	Read	Revision/version of the device firmware

10.3.4.1.2 Setting Device Parameters

The OPC UA server provides nodes with configuration parameters for the device. For example, the OPC UA client can read out the upper limiting value for temperature in the `OverTemperature` node.

The path to this node is:

```
Root > Object > DeviceSet > [device name] > IOLinkMaster > Diagnostics > Configuration
```

The following table lists device-specific configuration parameters.

Table 71: Device-Specific Configuration Parameters

Node Name	Node Class	Access	Default	Description
CurrentHysteresis	Variable	Read	10 mA	Current hysteresis; unit: mA If the current exceeds the limiting value, the current must fall back below the limiting value by the hysteresis value before the diagnosis is revoked.
OverTemperature	Variable	Read	70 °C	Upper limiting value for the temperature of a port; unit: 0.1 °C
OverVoltage1L	Variable	Read	30000 mV	Upper limiting value for the voltage in supply cable 1; pins with the following functions can be monitored: L+, DI, DO, DIO, IO-Link; unit: mV
OverVoltage2L	Variable	Read	30000 mV	Upper limiting value for the voltage in supply cable 2; unit: mV
TemperatureHysteresis	Variable	Read	2 °C	Temperature hysteresis; unit: 0.1 °C If the temperature exceeds the limiting value, the temperature must fall back below the limiting value by the hysteresis value before the diagnosis is revoked.
UnderTemperature	Variable	Read	-25 °C	Lower limiting value for the temperature of a port; unit: 0.1 °C
UnderVoltage1L	Variable	Read	18000 mV	Lower limiting value for the voltage in supply cable 1; pins with the following functions can be monitored: L+, DI, DO, DIO, IO-Link; unit: mV
UnderVoltage2L	Variable	Read	18000 mV	Lower limiting value for the voltage in supply cable 2; unit: mV
VoltageHysteresis	Variable	Read	300 mV	Voltage hysteresis; unit: mA If the voltage exceeds the limiting value, the voltage must fall back below the limiting value by the hysteresis value before the diagnosis is revoked.

10.3.4.1.3 Setting Port Parameters

The OPC UA server provides nodes with configuration parameters for each port.

The path to this node is:

```
Root > Object > DeviceSet > [device name] > IOLinkMaster > Diagnostics > PortXX > Configuration
```

The following table lists port-specific configuration parameters.

Table 72: Port-Specific Configuration Parameters

Node Name	Node Class	Access	Default	Description
OverCurrentPin1	Variable	Read	0	Warning level for current upper limit on pin 1; unit: 1 mA 0: monitoring not enabled
OverCurrentPin2	Variable	Read	0	Warning level for current upper limit on pin 2; unit: 1 mA 0: monitoring not enabled
OverCurrentPin4	Variable	Read	0	Warning level for current upper limit on pin 4; unit: 1 mA 0: monitoring not enabled
UnderCurrentPin1	Variable	Read	0	Warning level for current lower limit on pin 1; unit: 1 mA 0: monitoring not enabled
UnderCurrentPin2	Variable	Read	0	Warning level for current lower limit on pin 2; unit: 1 mA 0: monitoring not enabled
UnderCurrentPin4	Variable	Read	0	Warning level for current lower limit on pin 4; unit: 1 mA 0: monitoring not enabled

10.3.4.1.4 Reading Measured Power Values

The OPC UA server provides nodes with calculated measured values. For example, the OPC UA client can read out the calculated total current of supply cable 1 in the `SumCurrentL` node.

The path to this node is:

```
Root > Object > DeviceSet > [device name] > IOLinkMaster > Diagnostics > Current
```

The following table lists device-specific (calculated) measured current values.

Table 73: Device-Specific (Calculated) Measured Current Values

Node Name	Node Class	Access	Description
SumCurrent1L	Variable	Read	Total current in supply cable 1 calculated from individual measurements; unit: mA
SumCurrent2L	Variable	Read	Total current in supply cable 2 calculated from individual measurements; unit: mA
MeanTemperature	Variable	Read	Average value for the temperature of the assembly, calculated from the temperature values measured individually on the three chips; unit: °C
MeanVoltage1L	Variable	Read	Average voltage in supply cable 1; unit: mV
MeanVoltage2L	Variable	Read	Average voltage in supply cable 2; unit: mV

The path to the node of the measured temperature value is:

```
Root > Object > DeviceSet > [device name] > IOLinkMaster > Diagnostics > Temperature
```

The following table lists device-specific (calculated) measured temperature values.

Table 74: Device-Specific (Calculated) Measured Temperature Values

Node Name	Node Class	Access	Description
MeanTemperature	Variable	Read	Average value for the temperature of the assembly, calculated from the temperature values measured individually on the three chips; unit: °C

The path to the node of the measured voltage values is:

```
Root > Object > DeviceSet > [device name] > IOLinkMaster > Diagnostics > Voltage
```

The following table lists device-specific (calculated) measured voltage values.

Table 75: Device-Specific (Calculated) Measured Voltage Values

Node Name	Node Class	Access	Description
MeanVoltage1L	Variable	Read	Average voltage in supply cable 1; unit: mV
MeanVoltage2L	Variable	Read	Average voltage in supply cable 2; unit: mV

10.3.4.1.5 Reading out Diagnostic Information

The OPC UA server provides nodes with diagnostic information. For example, the OPC UA client can read out whether the device has detected an overcurrent on pin 1 of a port in the `DiagnosticsPin1` node.

The path to this node is:

```
Root > Object > DeviceSet > [device-name] > IOLinkMaster > PortXX > Diagnostics > Flags
```

The following table lists port-specific diagnostic information.

Table 76: Port-Specific Diagnostics

Node Name	Node Class	Access	Description
DiagnosticsPin1, DiagnosticsPin2, DiagnosticsPin4	Variable	Read	Diagnostics on pin 1, pin 2 or pin 4; the numerical value contains bit-coded information: - Bit 0: short circuit - Bit 1: overload protection - Bit 2: overtemperature protection - Bit 3: overvoltage protection - Bit 4: overcurrent - Bit 5: undercurrent - Bit 6: overtemperature - Bit 7: undertemperature - Bit 8: overvoltage - Bit 9: undervoltage - Bit 10: watchdog 0: diagnostics inactive 1: diagnostics active

10.3.4.1.6 Reading Statistics

This device does not offer the option of reading out statistical information via OPC UA.

10.3.4.1.7 NTP Client Configuration

The OPC UA server provides nodes for the configuration of the NTP client. The path to this node is:

Root > Object > DeviceSet > [device name] > Configuration > Ntp-Client

Table 77: NTP Client Configuration

Node Name	Node Class	Access	Default	Description
NtpClientServerIpAddress	Variable	Read/write	0	IP address of the NTP server The NTP client uses the IP address setting to retrieve the time from an NTP server. The IP address must be converted to a decimal number. The calculation is described below the table. A value of 0 disables the function.
NtpClientServerIpAddressFallback	Variable	Read/write	0	IP address of the NTP server (fallback) Optional additional IP address in case the NTP server cannot be reached via the IP address in the NtpClientServerIpAddress node. The IP address must be converted to a decimal number. The calculation is described below the table. A value of 0 disables the function.
NtpClientUpdate-Configuration	Method	Write	-	Method for writing the NtpClientServerIpAddress and NtpClientServerIpAddressFallback nodes.

Use the following formula to convert the IP address to a decimal number. For an IP address in the format "A.B.C.D.":

$$((A \times 256 + B) \times 256 + C) \times 256 + D = \text{IP address as decimal number}$$

Example for IP address 192.53.103.108:

$$((192 \times 256 + 53) \times 256 + 103) \times 256 + 108 = 3224725356$$

10.3.4.1.8 I/O Forcing via OPC UA

The OPC UA client can force output data and simulate input data. In what follows, forcing output data and simulating input data are referred to together as the Force function. From the product's point of view, there must be only one external instance that uses the Force function. Therefore, the OPC UA client must first obtain a Force ID from the product and send this Force ID with each Force function call. If the Force ID is incorrect, the product does not execute the Force function.

The path in the information model is:

Root > Objects > DeviceSet > [device name] > Forcing

The OPC UA client calls the "GetForcingID" method to get a Force ID and enable the Force function. The OPC UA client can now use the following methods:

- InputSimulationPin2
- InputSimulationPin4
- OutputPin2
- OutputPin4
- IoLinkInputSimulation

- IoLinkOutput

Each of these methods has a Force ID parameter.

The module monitors the Force function with a watchdog timer. If the OPC UA client becomes inactive, or the connection via OPC UA is lost, the watchdog timer expires, and the product switches the Force function off. The watchdog timer has the value 10 s.

While the Force function is enabled, the watchdog timer needs to be triggered regularly. Triggering occurs each time an input simulation and output method is called. The watchdog timer is also triggered when the “AssignedForceID” node is read. This means that regular reading of the “AssignedForceID” node triggers the watchdog timer and keeps the Force function active.

To terminate the Force function, the OPC UA client calls the “DisableForcing” method, using the previous Force ID again. This makes value of the Force ID invalid. The OPC UA client or another instance can request a new Force ID from the product in order to reenable the Force function.

10.3.4.1.9 Using OPC UA Client

The module has an integrated OPC UA server. You can communicate with the module with an OPC UA client.

For text purposes, you can, for example, use UaExpert from Unified Automation GmbH, which is available at <http://www.unifiedautomation.com>.

An OPC UA client can have read access to the module with the authentication “anonymous.” An OPC UA client can have read and write access to the module with the authentication “username and password” if the user in question has write permission.

10.3.4.1.9.1 Connecting to the Module

Requirements

- You must have an OPC UA client.
- For write access to the module: You must know the username and password and have write permission.
- You must know the module’s IP address.

Without a username and password, you can use “anonymous” to access the module and read data.

Establishing a Connection to the Module

1. Start UaExpert.
2. Create a new project with **File > New**.
3. Add a new server with **Server > Add**.
⇒ The **Add Server** dialog appears with the **Discovery** tab.

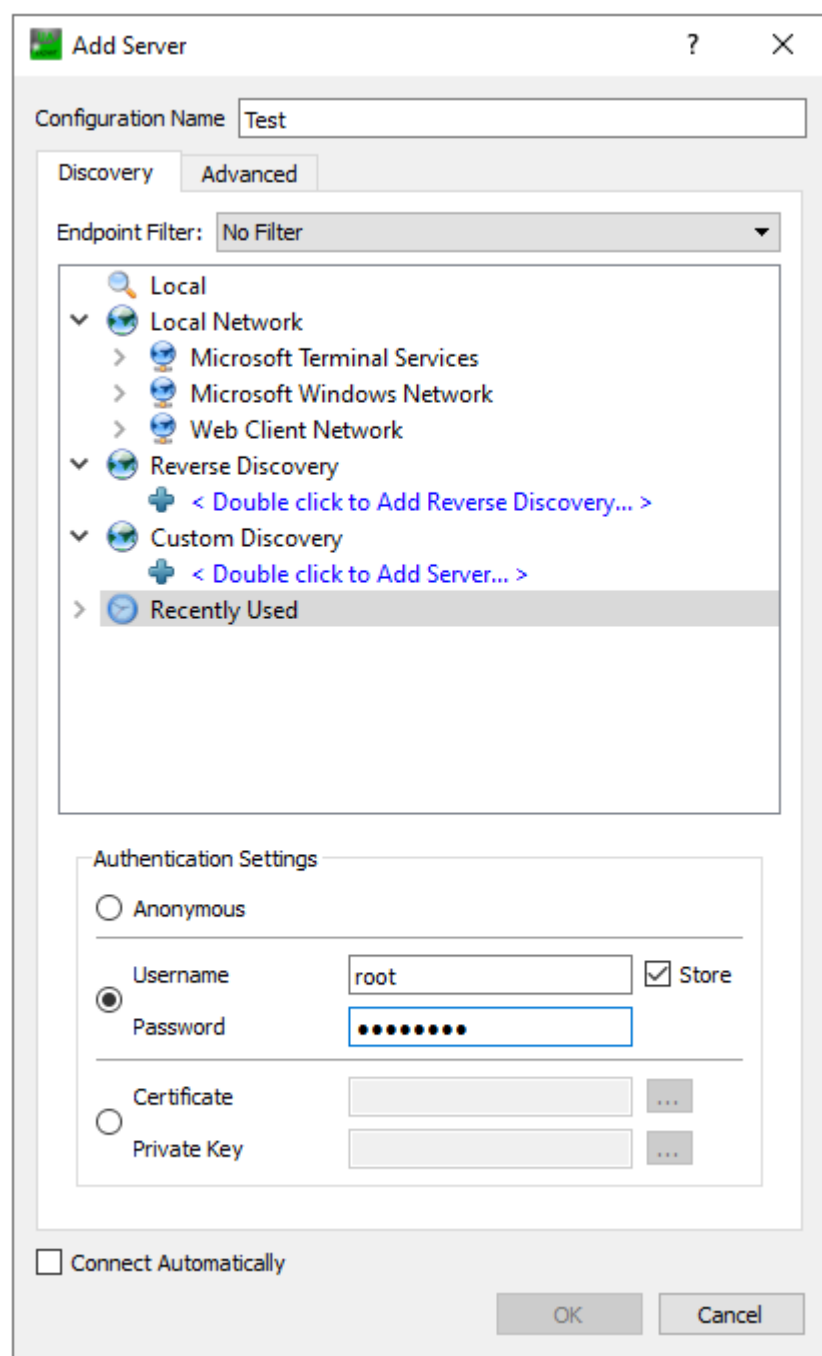


Figure 33: Add Server Dialog – Discovery Tab (Default)

Add Server

Configuration Name:

Discovery | **Advanced**

Server Information

Endpoint Url:

Reverse Connect: ☐

Security Settings

Security Policy:

Message Security Mode:

Authentication Settings

☐ Anonymous

☒ Username/Password

Username: ☐ Store

Password:

☐ Certificate

Private Key:

Session Settings

Session Name:

☐ Connect Automatically

Figure 34: Add Server Dialog – Advanced Tab

4. In the **Configuration Name** field, enter a name for your configuration, e.g. “Test.”
5. Select the **Advanced** tab.
6. In the **Server Information** section of the **Advanced** tab, enter the following information in the **Endpoint URL** field: `opc.tcp://<IP address>:4840`. For <IP address>, use the module’s IP address.
7. In the **Authentication Settings** section, select the **Username/Password** option for write access to the module or **Anonymous** for read access.
8. If you selected the **Username/Password** option, enter your username and, if applicable, password there.

9. Click **OK**.

⇒ In the project window, UaExpert enters the server under **Project > Servers** e.g., "Test."

10. Open the context menu of the server ("Test") and select **Connect**.

⇒ The connection is established.

10.3.4.1.9.2 Setting the Module Time via OPC UA

Requirements

- You must have an OPC UA client.
- You must know the username and password and have write permission.
- You must know the IP address of the NTP server.
- You must have converted the IP address of the NTP server into a decimal number as described below.
- You must have already established a connection to the module.

Example for an NTP Server

The NTP server `ptbtime1.ptb.de` of the Federal Institute of Physics and Metrology in Brunswick, Germany with IP address `192.53.103.108`

Alternate NTP server (optional) `ptbtime2.ptb.de` of the Federal Institute of Physics and Metrology in Brunswick, Germany with IP address `192.53.103.104`

Converting an IP Address to a Decimal Number

Use the following formula to convert the IP address to a decimal number. For an IP address in the format "A.B.C.D.":

$((A \times 256 + B) \times 256 + C) \times 256 + D = \text{IP address as decimal number}$

Example for IP address 192.53.103.108:

$((192 \times 256 + 53) \times 256 + 103) \times 256 + 108 = 3224725356$

Instructions

1. In the **Address Space** window, open the context menu:

Root > Objects > DeviceSet > [device name] > Configuration >
NtpClient > NtpClientUpdateConfiguration.

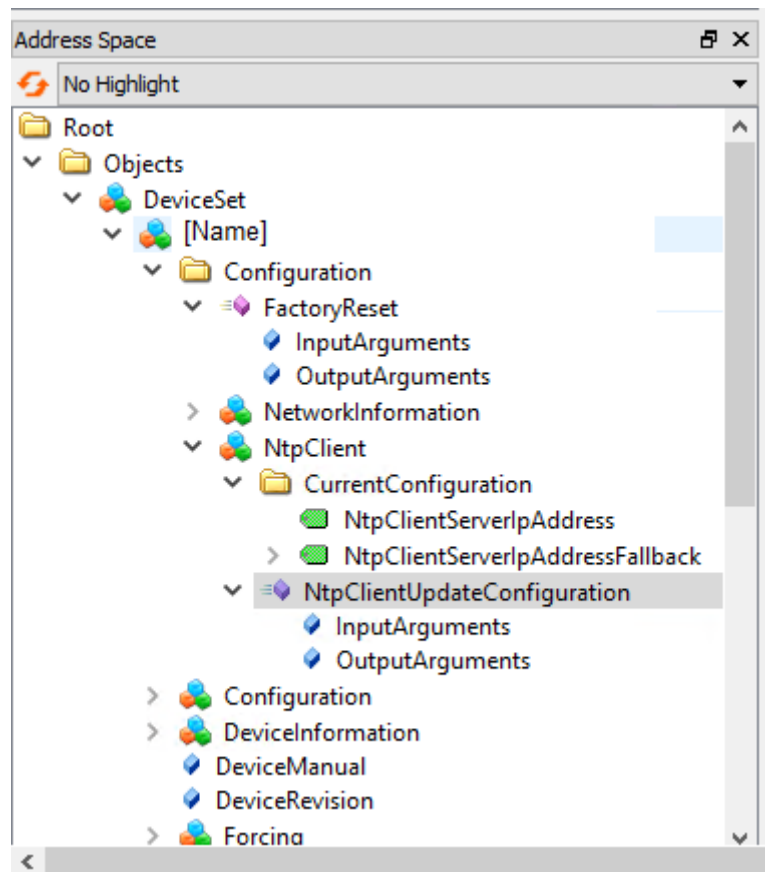


Figure 35: NtpClientUpdateConfiguration Node

2. In the context menu, select **Call**.

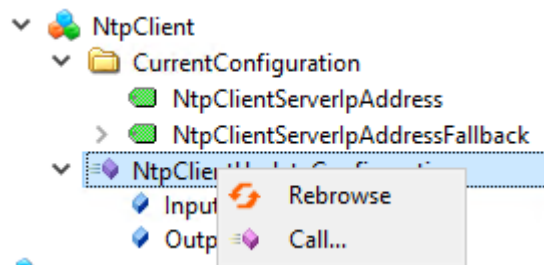


Figure 36: NtpClientUpdateConfiguration Node – Context Menu

⇒ The **Call NtpClientUpdateConfiguration on NtpClient** dialog appears.

Input Arguments			
Name	Value	DataType	Description
ServerIpAddress	3224725356	UInt32	
ServerIpAddressFallback	3224725352	UInt32	

Output Arguments			
Name	Value	DataType	Description
Status		Int32	

Result

Call Close

Figure 37: NTP Client Configuration Dialog

3. In the **Input Arguments** section, enter the value 3224725356 for the IP address of the NTP server in the **ServerIpAddress** field.
 4. In the **Input Arguments** section, enter the number 3224725352 for the IP address of the alternate NTP in the **ServerIpAddressFallback** field.
 5. Click **Call**.
- ⇒ If the function was successful, the output field in the **Output Arguments** section to the right of **Status** shows a value of 0.
- A green bar appears in the **Result** section with the text "Succeeded." The two variables **ServerIpAddress** and **ServerIpAddressFallback** are now set.
- The module retrieves the current time of the time server via NTP and synchronizes its internal time.

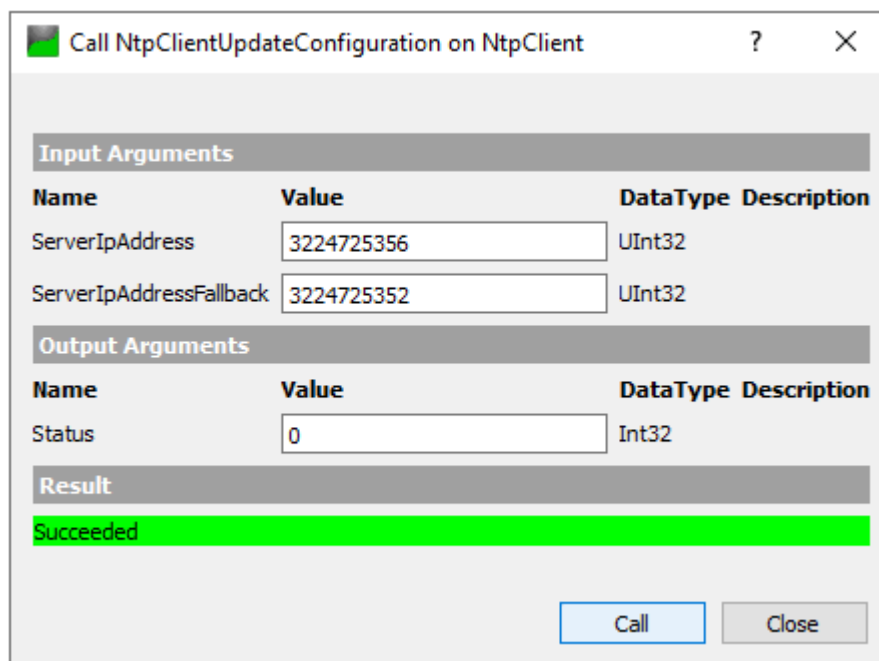


Figure 38: NTP Client Configuration Dialog (Succeeded)

10.3.4.1.9.3 Enabling Forcing

Requirements

- You must have an OPC UA client.
- You must know the username and password, and this user must have permission to execute methods.
- You must have already established a connection to the I/O module.

Step-by-Step Instructions

1. In the **Address Space** window, open the context menu: Root > Objects > DeviceSet > [device name] > Forcing > GetForcingID
2. In the context menu, select **Call**.
 - ⇒ The **Call GetForcingID on Forcing** window appears.

Name	Value	DataType	Description
Force Id		UInt32	
Message	... <input <="" td="" type="button" value="Save as..."/> <td>String</td> <td></td>	String	
Status		Int32	

Result

Figure 39: GetForcingID Method

3. Click **[Call]**.

⇒ If the method call was successful, then the Force ID is displayed, and “0” appears under Status. The FLD LED on the I/O module flashes at a rate of 1 Hz.

Name	Value	DataType	Description
Force Id	2205101162	UInt32	
Message	Forcing ID has been assigned ... <input <="" td="" type="button" value="Save as..."/> <td>String</td> <td></td>	String	
Status	0	Int32	

Result

Succeeded

Figure 40: GetForcingID Method: Successful

⇒ If the method call was not successful because the Force function is already in use, then “-1” appears under Status and “It’s being forced by someone else right now” under Message.

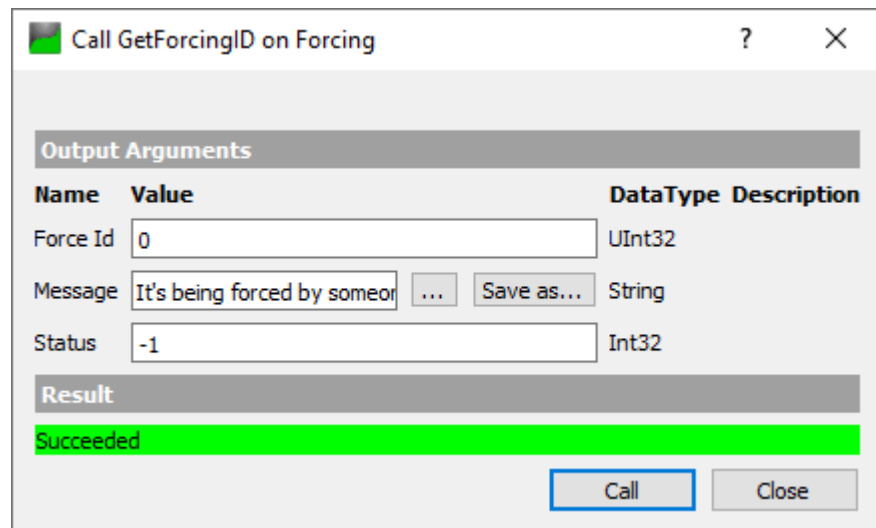


Figure 41: GetForcingID Method: Unsuccessful

4. In the OPC UA client, drag the “AssignedForceID” node into the **Data Access View** window so that the AssignedForceID is read regularly
 - ⇒ Regular reading of the AssignedForceID triggers the watchdog timer and keeps the Force function enabled.

10.3.4.1.9.4 Simulating Digital Inputs

Requirements

- You must have an OPC UA client.
- You must know the username and password, and this user must have permission to execute methods.
- You must have already established a connection to the I/O module.
- The Force function must be enabled, i.e. you must know the Force ID.
- The pin must be configured as a digital input.

Step-by-Step Instructions

1. In the **Address Space** window, open the context menu: Root > Objects > DeviceSet > [device name] > Forcing > InputSimulationPin4
2. In the context menu, select **[Call]**.
 - ⇒ The **Call InputSimulationPin4 on Forcing** window appears.

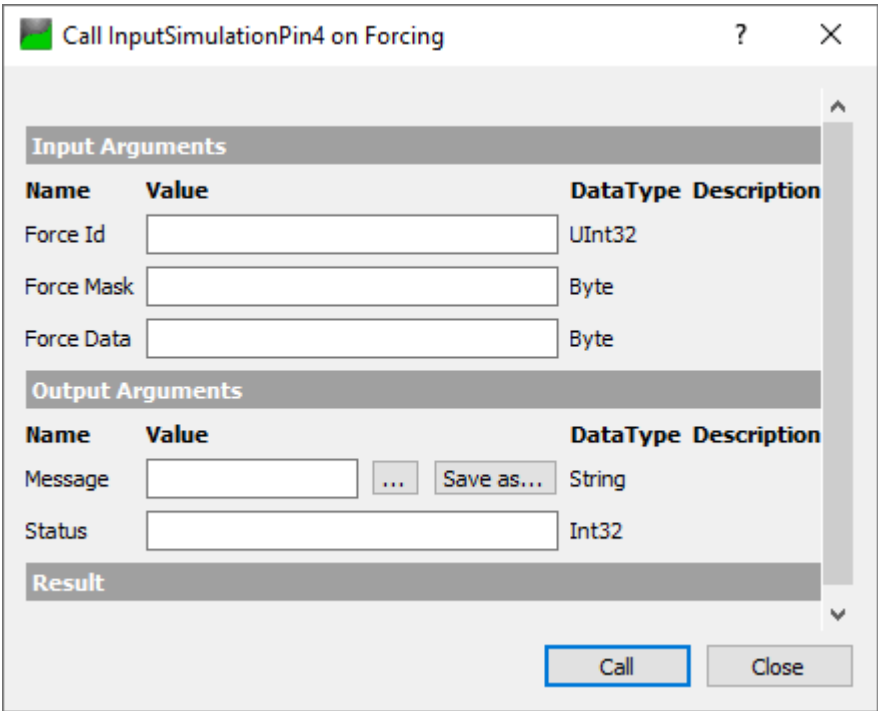


Figure 42: InputSimulationPin4 Method

- 3. Enter the **Force ID**, the **Force Mask** and the **Force Data** (the input arguments are described below, including an example).
- 4. Click **[Call]**.
 - ⇒ If the method call was successful, the input data is transmitted to the controller.
 - ⇒ If the method call was unsuccessful, then “-1” appears under Status.

Description of the Input Arguments

Table 78: Input Arguments of the InputSimulationPin Method

Input Arguments	Description
Force ID	Here the OPC UA client must use the Force ID that the OPC UA client had received after the GetForcingID method was called.
Force Mask	Ports for which simulation should be enabled. Bit mask and port assignment: Bit 0: port X01, Bit 1: port X02, Bit 2: port X03, ... Bit value 0: Simulation disabled for this port. Bit value 1: Simulation enabled for this port. Example 1: A value of 4 enables simulation for port X03. Example 2: A value of 7 enables simulation for ports X01, X02 and X03.

Input Arguments	Description
Force Data	Input value Bit mask and port assignment: Bit 0: port X01, Bit 1: port X02, Bit 2: port X03, ... Bit value 0: The pin has an input value of 0. Bit value 1: The pin has an input value of 1. Example 1 (Force Mask has a value of 4): A value of 0 sets the input value of port X03 to 0. A value of 4 sets the input value of port X03 to 1. Example 2 (Force Mask has a value of 7): A value of 0 sets the input value of ports X01, X02 and X03 to 0. A value of 5 sets the input value of port X02 to 0 and the input value of ports X01 and X03 to 1.

Description of the Output Arguments

Table 79: Output Arguments of the InputSimulationPin Method

Output Arguments	Description
Status and Message	0: Forcing digital outputs successful
	-1: Forcing digital outputs failed

The InputSimulationPin2 method simulates the input value of pin 2 of one or more ports. The InputSimulationPin4 method simulates the input value of pin 4 of one or more ports.

10.3.4.1.9.5 Forcing Digital Outputs

The OutputPin2 method sets the output value of pin 2 of one or more ports. The OutputPin4 method sets the output value of pin 4 of one or more ports.

Requirements

- You must have an OPC UA client.
- You must know the username and password, and this user must have permission to execute methods.
- You must have already established a connection to the I/O module.
- The Force function must be enabled, i.e. you must know the Force ID.
- The pin must be configured as a digital output.

Step-by-Step Instructions

1. In the **Address Space** window, open the context menu: Root > Objects > DeviceSet > [device name] > Forcing > OutputPin4
2. In the context menu, select **Call**.
⇒ The **Call OutputPin4 on Forcing** window appears.
3. Enter the **Force ID**, the **Force Mask** and the **Force Data** (the input arguments are described below, including an example).

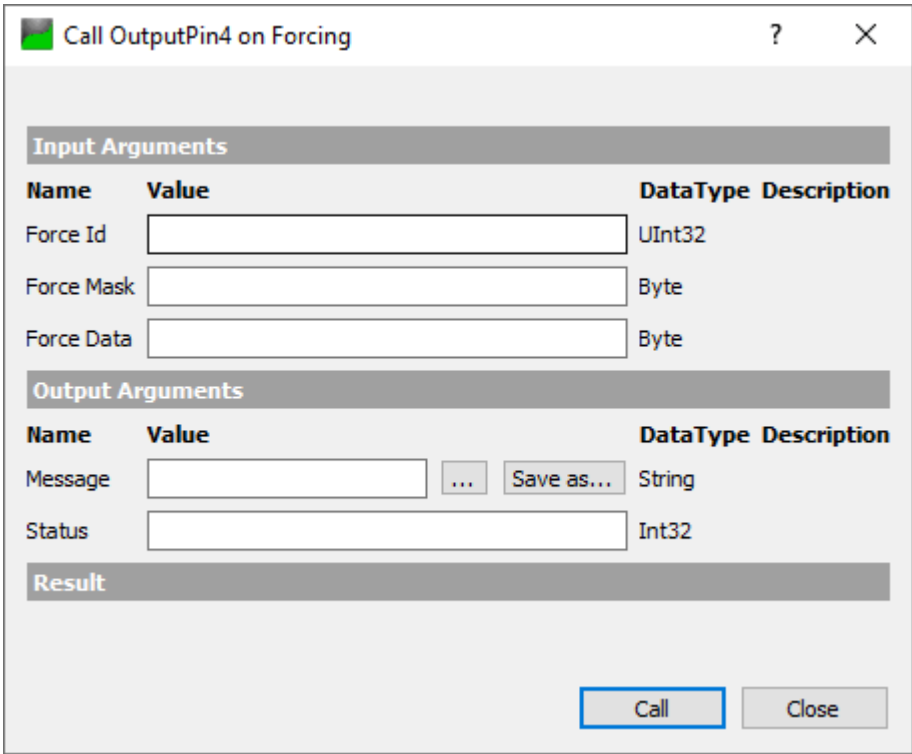


Figure 43: OutputPin4 Method

- 4. Click **[Call]**.
 - ⇒ If the method call was successful, then the output data on the module is forced.
 - ⇒ If the method call was unsuccessful, then “-1” appears under Status.

Description of the Input Arguments

Table 80: Input Arguments of the OutputPin Method

Input Arguments	Description
Force ID	Here the OPC UA client must use the Force ID that the OPC UA client had received after the GetForcingID method was called.
Force Mask	Ports for which forcing should be enabled. Bit mask and port assignment: Bit 0: port X01, Bit 1: port X02, Bit 2: port X03, ... Bit value 0: Forcing disabled for this port. Bit value 1: Forcing enabled for this port. Example 1: A value of 4 enables the Force function for port X03. Example 2: A value of 7 enables the Force function for ports X01, X02 and X03.
Force Data	Input value Bit mask and port assignment: Bit 0: port X01, Bit 1: port X02, Bit 2: port X03, ... Bit value 0: The pin has an input value of 0. Bit value 1: The pin has an input value of 1.

Input Arguments	Description
	Example 1 (Force Mask has a value of 4): A value of 0 sets the output value of port X03 to 0. A value of 4 sets the output value of port X03 to 1. Example 2 (Force Mask has a value of 7): A value of 0 sets the output value of ports X01, X02 and X03 to 0. A value of 5 sets the output value of port X02 to 0 and the output value of ports X01 and X03 to 1.

Description of the Output Arguments

Table 81: Output Arguments of the OutputPin Method

Output Arguments	Description
Status and Message	0: Forcing digital outputs successful
	-1: Forcing digital outputs failed

10.3.4.1.9.6 Simulating IO-Link Input Data

The “IoLinkInputSimulation” method simulates the IO-Link input data of a port.

Requirements

- You must have an OPC UA client.
- You must know the username and password, and this user must have permission to execute methods.
- You must have already established a connection to the I/O module.
- The Force function must be enabled, i.e. you must know the Force ID.
- The port must be configured as an IO-Link with input data.

Step-by-Step Instructions

1. In the **Address Space** window, open the context menu and select the port: Root > Objects > DeviceSet > [device name] > Forcing > PortX > IoLinkInputSimulation.
2. In the context menu, select **Call**.
⇒ The **Call IoLinkInputSimulation on PortX** window appears

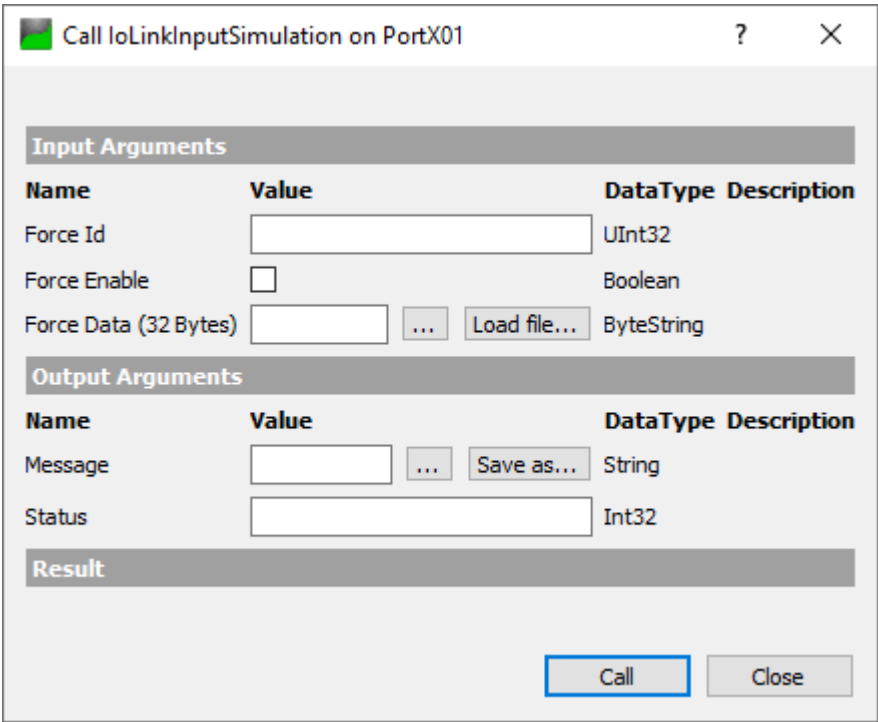


Figure 44: IoLinkInputSimulation Method

- 3. Enter the **Force ID**, check **Force Enable**, and enter the **Force Data** (the input arguments are described below).
- 4. Click **[Call]**.
 - ⇒ If the method call was successful, then the IO-Link input data is transmitted to the controller.
 - ⇒ If the method call was unsuccessful, then “-1” appears under Status.

Description of the Input Arguments

Table 82: Input Arguments of the IoLinkInputSimulation Method

Input Arguments	Description
Force ID	Here the OPC UA client must use the Force ID that the OPC UA client had received after the GetForcingId method was called.
Force Enable	False: simulation disabled for this port. True: simulation enabled for this port.
Force Data	IO-Link input data 1 to 32 bytes Example for 32 bytes: 0102030405060708090A0B0C0D0E0F10 1112131415161718191A1B1C1D1E1F20

Description of the Output Arguments

Table 83: Output Arguments of the IoLinkInputSimulation Method

Output Arguments	Description
Status and message	0: Forcing IO-Link successful -1: Forcing IO-Link failed

10.3.4.1.9.7 Forcing IO-Link Output Data

The IoLinkOutput method sets the IO-Link output data of a port.

Requirements

- You must have an OPC UA client.
- You must know the username and password, and this user must have permission to execute methods.
- You must have already established a connection to the I/O module.
- The Force function must be enabled, i.e. you must know the Force ID.
- The port must be configured as an IO-Link with output data.

Step-by-Step Instructions

1. In the **Address Space** window, open the context menu and select the port: Root > Objects > DeviceSet > [device name] > Forcing > PortX > IoLinkOutput.
2. In the context menu, select **Call**.
⇒ The **Call IoLinkOutput on PortX** window appears.

Input Arguments			
Name	Value	DataType	Description
Force Id		UInt32	
Force Enable	☐	Boolean	
Force Data (32 Bytes)	... Load file...	ByteString	

Output Arguments			
Name	Value	DataType	Description
Message	... Save as...	String	
Status		Int32	

Result			

Figure 45: IoLinkOutput Method

3. Enter the **Force ID**, check **Force Enable**, and enter the **Force Data** (the input arguments are described below).
4. Click **[Call]**.
⇒ If the method call was successful, then the IO-Link output data on the module is forced.
⇒ If the method call was unsuccessful, then “-1” appears under Status.

Description of the Input Arguments

Table 84: Input Arguments of the IoLinkOutput Method

Input Arguments	Description
Force ID	Here the OPC UA client must use the Force ID that the OPC UA client had received after the GetForcingID method was called.
Force Mask	False: simulation disabled for this port. True: simulation enabled for this port.
Force Data	IO-Link output data 1 to 32 bytes Example for 32 bytes: 0102030405060708090A0B0C0D0E0F10 1112131415161718191A1B1C1D1E1F20

Description of the Output Arguments

Table 85: Output Arguments of the IoLinkOutput Method

Output Arguments	Description
Status and message	0: Forcing IO-Link successful -1: Forcing IO-Link failed

10.3.4.1.9.8 Disabling Forcing

Requirements

- You must have an OPC UA client.
- You must know the username and password, and this user must have permission to execute methods.
- You must have already established a connection to the I/O module.
- You must have already enabled the Force function and know the Force ID.

Step-by-Step Instructions

1. In the **Address Space** window, open the context menu: Root > Objects > DeviceSet > [module name] > Forcing > DisableForcing.
2. In the context menu, select **Call**.
⇒ The **Call DisableForcing on Forcing** window appears.
3. Enter the **Force ID**.
4. Click **[Call]**.
⇒ If the method call was successful, then "0" appears under Status, the Force function is disabled, and the FLD LED on the module switches to the off state.

Figure 46: DisableForcing Method

⇒ If the method call was unsuccessful, then “-1” appears under Status.

Description of the Input Arguments

Table 86: Input Arguments of the DisableForcing Method

Input Arguments	Description
Force ID	Here the OPC UA client must use the Force ID that the OPC UA client had received after the GetForcingID method was called.

Description of the Output Arguments

Table 87: Output Arguments of the DisableForcing Method

Output Arguments	Description
Status and Message	0: Forcing IO-Link successful
	-1: Forcing IO-Link failed

10.3.4.2 Setting the Module Time

The module has an integrated clock that retrieves the time from an NTP server via NTP (Network Time Protocol). To do so, the module needs the IP address of the NTP server.

An OPC UA client is necessary in order to set the IP address of the NTP server.

The nodes of the OPC UA server for configuring the NTP client are described in [🔗 NTP Client Configuration \[▶ 104\]](#).

Diagnostics

11.1 Diagnostics via Indicators

Power Supply Status

The 1L and 2L LEDs indicate the status of the supply voltages.

Table 88: Supply Voltage Status, 1L and 2L

LED	Color	State	Description
1L	Duo LED, red/green		
	Green	On	1L supply voltage OK
	Red	On	1L undervoltage (voltage between 11 V and 18 V)
	Red	Flashing	1L overvoltage (voltage above 30 V)
	Off	Off	No 1L supply voltage
2L	Duo LED, red/green		
	Green	On	2L supply voltage OK
	Off	Off	No 2L supply voltage

System Status

The SYS LED indicates the status of the system (product).

Table 89: System Status

LED	Color	State	Description
SYS (system status)	Duo LED, yellow/green		
	Green	On	System status: OK Firmware is being executed.
	Yellow/green	Flashing 4 Hz, alternating colors	Firmware update active
	Yellow	On	During the firmware update, an error was detected, e.g., a checksum error.
	Off	Off	No power supply

Status of the Field-Side Functions

The FLD LED indicates the status of the field-side functions.

Table 90: Field LED

LED	Color	State	Description
FLD	Duo LED, green/yellow (yellow = simultaneously red and green)		
	Green	On	Normal operating state
	Green	Flashing (1 Hz)	Force mode is active
	Green	Flashing (4 Hz)	WAGO IO-Link Configurator is connected to the module
	Yellow	On	Configuration error
	Off	Off	Non-operational; no voltage

Application Status

The APL LED indicates the status of the application.

Table 91: APL LED

LED	Color	State	Description
APL	Duo LED, red/green/yellow (yellow = simultaneously red and green)		
	Off	Off	LED without function

EtherCAT® Slave Status

The following table describes the LED states of the EtherCAT® slave.

Table 92: EtherCAT® Slave Status

LED	Color	State	Description
RUN	Duo LED, red/green		
	Off	Off	INT: The module is in state INIT.
	Green	Flashing (2.5 Hz)	PRE-OPERATIONAL: The module is in state PREOPERATIONAL.
	Green	Single flash	SAFE-OPERATIONAL: The module is in state SAFE-OPERATIONAL.
	Green	On	OPERATIONAL: The module is in state OPERATIONAL.
ERR	Duo LED, red/green		
	Off	Off	No error: The EtherCAT® communication of the module is in operation.
	Red	Flashing (2.5 Hz)	Invalid configuration: General configuration error Possible cause: A status change required by the master is not possible due to register or object settings.
	Red	Single flash	Local error: The slave device application has changed the EtherCAT® state on its own. Possible cause 1: A host watchdog timeout has occurred. Possible cause 2: Synchronization error; the module switches automatically to Safe-Operational.
	Red	Double flash	Process data watchdog timeout: A process data watchdog timeout has occurred. Possible cause: Sync manager watchdog timeout.

Table 93: LED States of EtherCAT® slave

LED State	Definition
Flashing (1 Hz)	The indicator switches on and off in phases with a frequency of 2.5 Hz on for 200 ms and then off for 200 ms.
Single flash	The indicator flashes briefly (200 ms), followed by a long off phase (1000 ms).
Double flash	The indicator goes through a sequence of two short flashes (200 ms each), interrupted by a short off phase (200 ms). The sequence ends with a long off phase (1000 ms).

ETHERNET Status

The following table describes the LED states of the link/activity LEDs.

Table 94: ETHERNET Status

LED	Color	State	Description
L/A IN, L/A OUT	LED green		
	Green	On	Link: The module has a connection to the ETHERNET, but is not sending/receiving Ethernet frames.
	Green	Flickering (load-dependent)	Activity: The module has a connection to ETHERNET and is sending/receiving Ethernet frames.
	Off	Off	The module is not connected to the ETHERNET.
–	LED yellow		
	Off	Off	This LED is not used.

Table 95: LED States ETHERNET Status

LED State	Definition
Flickering (load-dependent)	The indicator switches on and off at a frequency of 10 Hz, indicating high ETHERNET activity: on for 50 ms and then off for 50 ms. The indicator switches on and off at irregular intervals to indicate low ETHERNET activity.

Bluetooth® Status

The Bluetooth® LED is integrated into the Bluetooth® antenna and indicates the connection status.

Table 96: LED States®

LED	Color	State	Description
BT	Duo LED, blue/red		
	Blue	On	Bluetooth® connection established
	Off	Off	Bluetooth® inactive

IO-Link Port Status

LEDs 0 (port X01), 2 (port X02), 4 (port X03), ..., 14 (port X08) indicate the status of the IO-Link Master or digital input/output channel A.

LEDs 1 (port X01), 3 (port X02), 5 (port X03), ..., 15 (port X08) indicate the status of the digital input/output channel B.

Table 97: IO-Link Port Status (Class A)

LED	Color	State	Description
0, 2, 4, ... IO-Link Port Channel A (pin 4)	Duo LED, yellow/red/green (yellow = simultaneously red and green)		
	yellow	On	Status of digital input/output channel A: 1
	Off	Off	Status of digital input/output channel A: 0
	green	On	IO-Link communication active
	green	Flashing 1 Hz	No IO-Link communication or incorrect IO-Link device
	red	On	Overload, short circuit (pin 4 and pin 3)
	red	Flashing 1 Hz	Overload, sensor supply short circuit (pin 1 and pin 3)
1, 3, 5, ... IO-Link Port Channel A	Duo LED, yellow/red (yellow = simultaneously red and green)		
	yellow	On	Status of digital input/output channel B: 1

LED	Color	State	Description
(pin 2)	Off	Off	Status of digital input/output channel B: 0
	red	On	Overload, short circuit (pin 2 and pin 3)
	red	Flashing 1 Hz	Overload, sensor supply short circuit (pin 1 and pin 3)

11.2 Diagnostics via EtherCAT

11.2.1 Diagnostic History

Table 98: Diagnostic History (Index 0x10F3)

Subindex	Name	Explanation	Type	Flags	Default
0	Highest Supported Subindex	Highest subindex See 🔗 Subindex 0: Highest Supported Subindex [▶ 125] .	UINT8	RO	
1	Maximum Messages	Number of diagnostic messages that can be stored in the diagnostic history See 🔗 Subindex 1: Maximum Messages [▶ 125] .	UINT8	RO	64
2	Newest Message	Subindex of the most recent logged diagnostic message See 🔗 Subindex 2: Newest Message [▶ 126] .	UINT8	RO	0
3	Newest Acknowledged Message	Most recent acknowledged message See 🔗 Subindex 3: Newest Acknowledged Message [▶ 126] .	UINT8	RW	0
4	New Messages Available	New message available See 🔗 Subindex 4: New Messages Available [▶ 127] .	BOOL	RO	0
5	Flags	Flags for controlling the sending and saving of diagnostic messages See 🔗 Subindex 5: Flags [▶ 127] .	UINT16	RW	0x0001
6–69	Diagnosis Message	Buffer for diagnostic messages See 🔗 Subindexes 6–69: Diagnosis Message (Write-Protected) [▶ 128] .	OCTET_STRING	RO	

11.2.1.1 Subindex 0: Highest Supported Subindex

The diagnostic history can contain at most the number of diagnostic messages specified in subindex 1: Maximum Messages. These can be retrieved starting with subindex 6. Subindex 0 indicates the highest subindex under which a diagnostic message is stored.

11.2.1.2 Subindex 1: Maximum Messages

The diagnostic history can contain as many diagnostic messages as specified here. The maximum value is 64.

11.2.1.3 Subindex 2: Newest Message

Using the subindex 2, you can retrieve the subindex in the diagnostic history under which the latest diagnostic message is stored. The value should be between 6 and 69. If no diagnostic messages are currently stored, a value of 0 is returned.

11.2.1.4 Subindex 3: Newest Acknowledged Message

This subindex contains the subindex of the newest acknowledged diagnostic message. It can be both read and written. In both cases, the meaning of the values depends on the current mode. The modes are overwrite mode (subindex 5, bit 4 = 0) and acknowledge mode (subindex 5, bit 4 = 1).

Overwrite Mode

Read = 0:

If the queue for diagnostic messages is overwritten, the EtherCAT slave sets subindex 3 to 0.

Writing = 0:

If a value of 0 is written to subindex 3, the EtherCAT slave deletes subindex 2, subindex 3, subindex 4 and subindex 5 bit 5 or sets them to 0.

Diagnostic messages are deleted even if they have not been acknowledged or read yet.

Writing = 1...5:

The slave returns SDO abort with error code 0x06090032 (written parameter value too low).

Writing = 6...69:

Subindex 3 = value is overwritten (without check)

All diagnostic messages up to the age of the message located in the subindex that was just written to are acknowledged. The EtherCAT slave does not check whether these diagnostic messages have been read before. If the number of a subindex that does not contain a diagnostic message is written to subindex 3, the slave returns SDO Abort with error code 0x06090030 (parameter value range exceeded).

Writing > 69...255:

The slave returns SDO Abort with error code 0x06090031 (written parameter value too high).

Acknowledgment Mode

Read = 0:

No diagnostic messages have been acknowledged so far.

Read != 0:

Subindex of last acknowledged diagnostic message (6–69)

Writing = 0:

All acknowledged diagnostic messages are deleted.

Writing = 1...5:

The slave returns SDO Abort with error code 0x06090032 (written parameter value too low).

Writing = 6...69:

The diagnostic messages are acknowledged.

All diagnostic messages up to the age of the message located in the subindex that was just written to are acknowledged. The EtherCAT slave does not check whether these diagnostic messages have been read before. If the number of a subindex that does not contain a diagnostic message is written to subindex 3, the slave returns SDO Abort with error code 0x06090030 (parameter value range exceeded).

Writing > 69...255:

The slave returns SDO Abort with error code 0x06090031 (written parameter value too high).

11.2.1.5 Subindex 4: New Messages Available

This subindex contains the subindex of the newest acknowledged diagnostic message. It can be both read and written. In both cases, the meaning of the values depends on the current mode. The modes are overwrite mode (subindex 5, bit 4 = 0) and acknowledge mode (subindex 5, bit 4 = 1).

Overwrite Mode

0: The newest message has been read.

1: The newest message has not been read.

Acknowledgment Mode

0: No unacknowledged diagnostic message present

1: There are diagnostic messages that can be acknowledged.

11.2.1.6 Subindex 5: Flags

The subindex contains flags for controlling the sending and saving of diagnostic messages.

Table 99: Flags for Controlling the Sending and Saving of Diagnostic Messages

Bit 0: Enable emergency messages	
0	Default, if the device cannot send emergency messages
1	New diagnostic messages are sent as emergency messages.
Bit 1: Disable info messages	
0	Info messages are stored in the diagnostic message queue.
1	Info messages are not stored in the diagnostic message queue.
Bit 2: Disable warnings	
0	Warnings are stored in the diagnostic message queue.
1	Warnings are not stored in the diagnostic message queue.
Bit 3: Disable error messages	
0	Error messages are stored in the diagnostic message queue.
1	Error messages are not stored in the diagnostic message queue.
Bit 4: Mode selection for reaction to diagnostic history buffer overflow	
0	Overwrite mode: If the buffer is full, old diagnostic messages are overwritten by new ones.
1	Acknowledgment mode: New diagnostic messages only overwrite older messages if the latter have been previously acknowledged.

Bit 5: Overwrite and discard information (read only)	
In overwrite mode:	
1	Unacknowledged diagnostic messages have been overwritten (= buffer overflow). Subindex 3 was also set to 0.
In acknowledgment mode:	
1	The buffer for diagnostic messages is full of acknowledged messages, and a new diagnostic message is discarded.
Bits 6 ... 15: reserved	

11.2.1.7 Subindexes 6–69: Diagnosis Message (Write-Protected)

Depending on subindex 1, the EtherCAT slave can store up to 64 diagnostic messages. In the process, the first message is stored in subindex 6, the second in subindex 7 etc. When the buffer is full, the EtherCAT slave overwrites subindex 6 etc., so the last diagnostic messages are accessible to the EtherCAT master. The exact number of them is indicated by subindex 1.

11.2.1.8 Structure of a Diagnostic Message

A diagnostic message in subindexes 6 to 69 has the following structure:

Table 100: Structure of a Diagnostic Message in Subindexes 6 to 69:

Parameter	Data Type	Description	
Diag Code	UINT32	Diagnostic code for identifying the diagnostic message	
		Bits 0–15 = 0x0000-0xDFFF	Not used
		Bits 0–15 = 0xE000-0xE7FF	Bits 16–31: can be used according to the manufacturer's specifications
		Bits 0–15 = 0xE800	Bits 16–31: emergency error code
		Bits 0–15 = 0xE801-0xEDFF	Reserved
		Bits 0–15 = 0xEE00-0xEFFF	Bits 16–31: profile-specific
		Bits 0–15 = 0xF000-0xFFFF	Not used
Flags	UINT16	Bits 0–3	Diagnostic type 0: info message 1: warning 2: error message 3–15: reserved
		Bit 4	Local timestamp The global timestamp can be calculated from this value by reading the current timestamp (object 0x10F8) and calculating the age of the message
		Bits 5–7	Reserved
		Bits 8–15	Number of parameters in this diagnostic message
Text ID	UINT16	Text ID as a reference to the diagnostic text as described in the ESI file	
		0	No Text ID
		1–65535	Text ID reference to the ESI file
Time-stamp	UINT64	Local timestamp in nanoseconds (corresponds to 0x10F8)	
		0	No Timestamp
		!= 0	Timestamp

Parameter	Data Type	Description
Parameter 1 Flags	UINT16	Describes the type of parameter 1
		Bits 12–15 = 0 Bits 0–11 = data type index of the data type of parameter 1 0x0005: UINT8 The corresponding text parameters and formats are described in document ETG.2000.
Parameter 1	UINT8	Port number (1 ... 8)
Parameter 2 Flags	UINT16	Describes the type of parameter 2
		Bits 12–15 = 0 Bits 0–11 = data type index of the data type of parameter 2 0x0007: UINT32 The corresponding text parameters and formats are described in document ETG.2000.
Parameter 2	UINT8	Event Code
Parameter 3 Flags	UINT16	Describes the type of parameter 3
		Bits 12–15 = 0 Bits 0–11 = data type index of the data type of parameter 3 0x0005: UINT8 The corresponding text parameters and formats are described in document ETG.2000.
Parameter 3	UINT8	Event Qualifier

Table 101: Event Qualifier

Bit	Name	Description
Bits 6–7	Mode	0: reserved 1: single event 2: event disappears 3: event appears
Bits 4–5	Type	0: reserved 1: notification 2: warning 3: error
Bit 3	Source	0: device (remote) 1: master/port
Bits 0–2	Instance	0: unknown 1–3: reserved 4: application 5–7: reserved

11.2.1.9 Emergency Error Codes

The following emergency error codes are defined in the EtherCAT specification:

Table 102: Emergency Error Codes

Emergency Error Code (hex)	Description
00xx	Error Reset or No Error
10xx	Generic Error
20xx	Current

Emergency Error Code (hex)	Description
21xx	Current, device input side
22xx	Current inside the device
23xx	Current, device output side
30xx	Voltage
31xx	Mains Voltage
32xx	Voltage inside the device
33xx	Output Voltage
40xx	Temperature
41xx	Ambient Temperature
42xx	Device Temperature
50xx	Device Hardware
60xx	Device Software
61xx	Internal Software
62xx	User Softwares
63xx	Data Set
70xx	Additional Module
80xx	Monitoring
81xx	Communication
8110	CAN Overrun (Objects lost)
8120	CAN in Error Passive Mode
8130	Life Guard Error or Heartbeat Error
8140	recovered from bus off
8150	Transmit COB-ID
82xx	Protocol Error
8210	PDO not processed due to length error
8220	PDO length exceeded
90xx	External Error
F0xx	Additional Functions
FFxx	Device-specific

The following device-specific emergency error codes are used by the device (diagnostic type: warning):

Table 103: General Alarms

Emergency Error Code (hex)	Alarm	Description	Remedy
0xFF00	Undervoltage	Undervoltage in supply line 1L The supply line has fallen below the limiting value for the minimum voltage.	Check supply voltage
0xFF01	Overvoltage	Overvoltage in supply line 1L The supply line has exceeded the limiting value for the maximum voltage.	Check supply voltage
0xFF02	Overtemperature	Overtemperature The device temperature has exceeded the upper limiting value.	Eliminate external heat source or overload.
0xFF03	Overload	Overload in supply line 1L The total current in supply line 1L has exceeded the upper limiting value.	Eliminate overload.

Emergency Error Code (hex)	Alarm	Description	Remedy
0xFF04	Overload, 2L	Overload in supply line 2L The total current in supply line 1L has exceeded the upper limiting value.	Eliminate overload.
0xFF05	Undertemperature	Undertemperature The device temperature has fallen below the lower limiting value.	Thermally insulate the device
0xFF06	Undervoltage, 2L	Undervoltage in supply line 2L The power supply for supply line 2L has fallen below the limiting value for the minimum voltage.	Check supply voltage
0xFF07	Overvoltage, 2L	Overvoltage in supply line 2L The power supply for supply line 2L has exceeded the limiting value for the maximum voltage.	Check supply voltage
0xFF08	Forcing operating mode active	Forcing operating mode active (activated by Web client or OPC UA client)	The Web client or OPC UA client should exit the Forcing operating mode as soon as forcing is no longer needed.
0xFF09	Short circuit on pin 4	Short circuit detected on pin 4	Eliminate short circuit.
0xFF0A	Short circuit on pin 2	Short circuit detected on pin 2	Eliminate short circuit.
0xFF0B	Short circuit on pin 1	Short circuit detected on pin 1.	Eliminate short circuit.

11.2.1.10 Events Triggered by the IO-Link Master

Events on the IO-Link master or its ports are reported by the IO-Link master to the EtherCAT® slave, which forwards this to the EtherCAT® master in the form of diagnostics.

The following values are set in the event qualifier:

TYPE = 2 (Warning) or 3 (Error)

MODE = 2 (Event disappears) or 3 (Event appears)

SOURCE = 1 (Master/local)

The following table lists the IO-Link event codes associated with IO-Link master events and provides information on how to remedy faults.

Table 104: IO-Link Master Events

IO-Link Event Code	Description	Remedy
0x17FF	Process data error	Check submodule configuration
0x1800	No device access / loss of communication	Check IO-Link port
0x1801	Start parameter error	Check parameters
0x1802	Incorrect device identification	Check port configuration parameters
0x1803	Incorrect device identification	Check port configuration parameters
0x1804	Short circuit on C/Q	Check wiring
0x1805	PHY overtemperature	Check temperature and load
0x1806	Short circuit on L+	Check wiring
0x1807	Overcurrent on L+	Check power supply (e.g., 1L+)
0x1808	Device event overflow	Contact device manufacturer

IO-Link Event Code	Description	Remedy
0x1809	Backup inconsistency	Access outside the memory area (2048 octets)
0x180A	Backup inconsistency	Fix identity error
0x180B	Backup inconsistency	Unspecified error during data storage
0x180C	Backup inconsistency	Fix upload error
0x180D	Parameter inconsistency	Fix download error
0x180E	P24 (class B) missing or has under-voltage	Check power supply
0x180F	Short circuit on P24 (class B)	Check wiring (e.g., 2L+)
0x1810	Short circuit on I/Q	Check wiring
0x1811	Short circuit on C/Q	Check wiring
0x1812	Overcurrent on I/Q	Check load
0x6000	Invalid cycle time	Check port configuration parameters
0x6001	Revision error (incompatible protocol version)	Check port configuration parameters
0x6002	ISDU batch failed	Fix parameter inconsistency

11.2.1.11 Events Triggered by the IO-Link Device

Events can also be triggered by an IO-Link device connected to the IO-Link master via a port. An IO-Link device sends the “Event Code” and the “Event Qualifier” of the event to the IO-Link master.

The following values are set in the event qualifier:

TYPE = 1 (Notification)

MODE = 1 (Single shot)

SOURCE = 0 (Device/remote)

The IO-Link master sends this event to the EtherCAT slave, which can report it to the EtherCAT master as an emergency. The IODD of the IO-Link device contains manufacturer-specific events with message text.

The following table describes possible standard events of the IO-Link device that can trigger EtherCAT emergencies.

Table 105: Standard Events of the IO-Link Device

IO-Link Event Code	Description of the Error Function on the Connected IO-Link Device	Corrective Action on the Connected IO-Link Device
0x1000	General malfunction	IO-Link device reports unknown error
0x4000	Temperature error	Eliminate overload
0x4210	Device overheating	Eliminate heat source
0x4220	Device undercooling	Insulate IO-Link device
0x5000	Hardware error in device	Replace IO-Link device
0x5010	Malfunction of a component	Repair for replacement
0x5011	Loss of data of non-volatile memory	Check batteries
0x5012	Batteries too weak	Replace batteries
0x5100	General error in the power supply	Check availability
0x5101	Fuse blown/open	Replace fuse
0x5110	Overvoltage in primary power supply	Check tolerance
0x5111	Undervoltage in primary power supply	Check tolerance
0x5112	Error in additional power supply	Check tolerance
0x6000	Error in device software	Check firmware version

IO-Link Event Code	Description of the Error Function on the Connected IO-Link Device	Corrective Action on the Connected IO-Link Device
0x6320	Parameter error	Check datasheet and values
0x6321	Missing parameter(s)	Check datasheet
0x6350	Parameter change	Check configuration
0x7700	Wire break on a lower-level device	Check installation
0x7701 – 0x770F	Wire break of lower-level device 1...15	Check installation
0x7710	Short circuit	Check installation (device)
0x7711	Grounding fault	Check installation
0x8C00	Technology-specific application error	Reset device
0x8C01	Simulation active	Check operating mode
0x8C10	Value range of a process variable exceeded	Process data insecure
0x8C20	Measurement overrange	Check application
0x8C30	Process variable value below value range	Process data insecure
0x8C40	Maintenance required	Cleaning
0x8C41	Maintenance required	Refill
0x8C42	Maintenance required	Replacement of wear parts

11.2.2 Diagnostic Data of the Modules

The diagnostic data of the individual IO-Link ports can be accessed in the object dictionary via the following indexes and subindexes:

The error register can be accessed in the object dictionary of the EtherCAT slave under index 0x1001.

Table 106: Diagnostic Data of the Modules

Index	Sub index	Name	Explanation	Type	Flags	Defaults
0xA000	-	Diagnostic Data	Diagnostic data of IO-Link port 1	RECORD	–	–
	0	Highest Supported Subindex	Highest supported subindex	UINT8	RO	–
	1	IO-Link State	IO-Link status; see below (optional)	UINT8	RO	–
	2	Lost Frames	Number of lost telegrams	UINT8	RO	0
0xA010	-	Diagnostic Data	Diagnostic data of IO-Link port 2	RECORD	–	–
	0	Highest Supported Subindex	Highest supported subindex	UINT8	RO	–
	1	IO-Link State	IO-Link status; see below (optional)	UINT8	RO	–
	2	Lost Frames	Number of lost telegrams	UINT8	RO	0
...						
0xA070	-	Diagnostic Data	Diagnostic data of IO-Link port 8	RECORD	–	–
	0	Highest Supported Subindex	Highest supported subindex	UINT8	RO	–
	1	IO-Link State	IO-Link status; see below (optional)	UINT8	RO	–
	2	Lost Frames	Number of lost telegrams	UINT8	RO	0

Table 107: Status of the IO-Link master

Value	Explanation
0x00	Port inactive
0x01	Digital input

Value	Explanation
0x02	Digital output
0x03	Start communication
0x04-0x07	Reserved
0x08	Communication OPERATE
0x09	Communication STOP

Service

12.1 Resetting to Factory Settings

The device can be reset to the factory settings. Use the WAGO I/O Field Webserver for this purpose.

You can find information on the procedure in  [Resetsetting the Module to the Factory Settings \[► 89\]](#).

12.2 Updating Firmware

The firmware of the module can be updated. Use the WAGO I/O Field Webserver for this purpose.

You need the firmware file corresponding to the module type. The name of the firmware file is always `FWUPDATE.zip`; you can store it in a folder with the name of the module (e.g., “765-4101”).

You can find information on performing firmware updates in  [Updating Firmware \[► 88\]](#).

Decommissioning

13.1 Disposal and Recycling

Table 108: WEEE Mark

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

Electrical and electronic equipment contain materials and substances that can be harmful to the environment and health. Electrical and electronic equipment must be disposed of properly after use. Environmentally friendly disposal benefits health, protects the environment from harmful substances in electrical and electronic equipment and enables sustainable and efficient use of resources.

- Observe the national and local regulations for the disposal of electrical and electronic equipment, lithium-ion batteries, lead–acid batteries and packaging.
- Clear any data stored on electrical and electronic equipment.
- Remove lithium-ion batteries, lead–acid batteries or memory cards that are added to the electrical and electronic equipment.
- Wear appropriate personal protective equipment when removing the lithium-ion batteries and lead–acid batteries.
- Dispose of all types of packaging to ensure a high level of recovery, reuse and recycling.
- Have electrical and electronic equipment sent to a local collection point.
- Throughout Europe, Directives 2006/66/EC, 94/62/EC and 2012/19/EU (WEEE) apply. National directives and laws may differ.

Appendix

14.1 ISDU Services via AoE

The IO-Link ISDU (Indexed Service Data Unit) service enables reading and writing from EtherCAT of the parameters of the IO-Link devices connected to the IO-Link master ports.

The AoE (ADS over EtherCAT) mailbox protocol is used for the connection to EtherCAT. A mailbox protocol is a protocol whose frames are transferred packaged in the mailbox of the EtherCAT packet (see [🔗 AoE – Transfer of ADS Data in the Mailbox of the EtherCATFrame \[► 138\]](#)).

The ISDU read and write commands are transferred to and from the IO-Link gateway in AoE frames via the ADS protocol (ADS = Automation Device Specification).

This approach maps EtherCAT services to IO-Link services and makes the IO-Link services available for EtherCAT.

ISDU Read Service

During reading, the user data from the IO-Link device is transferred to the EtherCAT master via the ISDU mechanism and the AoE protocol.

ISDU Write Service

During writing, the user data is transferred from the EtherCAT master to the IO-Link device via the AoE protocol and the ISDU mechanism.

Transferred IO-Link Data

The following IO-Link parameters (ISDU request) are transferred between EtherCAT and IO-Link via AoE frames:

- The **Port** parameter addresses the IO-Link port to which the IO-Link device is connected.
- The **Index** and **Subindex** parameters address the object of the IO-Link device. The documentation of the manufacturer of the IO-Link device used describes the objects and parameters.

14.1.1 Addressing and Device Identification in AoE

14.1.1.1 Device Identification

An AoE device is identified through two parameters:

- Port Number
- AoE NetId

Port Number

AoE devices are uniquely identified by a fixed port number.

AoE NetId

The EtherCAT master assigns an AoE NetId to each EtherCAT slave in its network, through which the EtherCAT slave can be identified as a sender or receiver of AoE packets.

The AoE NetId consists of six bytes. It can be freely chosen and must be unique within the AoE network. Example of an AoE NetId: 174.15.18.10.2.1.

The AoE NetId is a logical specification and not an IP address, but may include the IP address for easier identification.

Only the EtherCAT communication uses the AoE NetId of the EtherCAT slave.

For EtherCAT slaves with integrated IO-Link functionality like the EtherCAT IO-Link gateway, the EtherCAT master additionally assigns a **second AoE NetId** to the EtherCAT slave; **only the IO-Link communication** uses this.

14.1.1.2 Addressing the Objects in IO-Link Devices via AoE

In AoE, the following applies for addressing the objects of connected IO-Link devices:

- For addressing, AoE uses the parameters PortNumber, IndexGroup and IndexOffset (32 bits each).
- The assignment of the port number to the IO-Link port is shown in the following table:

Table 109: Assignment of AoE Port Numbers to IO-Link Ports

Port Number	IO-Link Port
0x1001	Port 1
0x1002	Port 2
0x1003	Port 3
...	...
0x1008	Port 8

- IndexGroup has the fixed value 0xF302.
- IndexOffset specifies the index and the subindex of the object of the IO-Link device connected to the IO-Link master port. The **IndexOffset** parameter contains the index and subindex.

Table 110: IndexOffset Parameter for Addressing the IO-Link Object

Bits	Contents
Bits 16 ... 31	Index (16 bit value)
Bits 8 ... 15	Fixed value 0
Bits 0 ... 7	Subindex (8 bit value)

14.1.2 AoE – Transfer of ADS Data in the Mailbox of the EtherCATFrame

EtherCAT offers the option of integrating other protocols via a mailbox. The data of these protocols is written into the mailbox area in the EtherCAT frame.

With AoE, protocol data of the ADS protocol is transmitted in the mailbox area. ADS is integrated into the EtherCAT frame in this way, as the following figure shows.

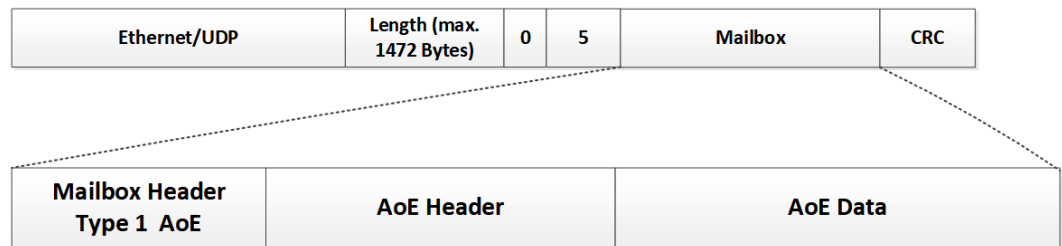


Figure 47: Structure of the Ethernet Frame for AoE

The upper part shows the structure of an EtherCAT frame with mailbox area. The size of the mailbox area is limited to a maximum of 1472 bytes. The actual length of the mailbox is entered in the “Length” field.

The lower part shows only the mailbox area as an excerpt from the EtherCAT frame. It contains the protocol data structure of the integrated protocol. With AoE, this contains the protocol data structure of the ADS protocol:

- AoE uses mailbox header type 1 and includes 6 bytes.
- The AoE header contains 32 bytes.
- A maximum of 1434 bytes (= 1472 bytes – 6 bytes – 32 bytes) are thus available for the AoE data area (AoE data).

14.1.3 Overview of the Structure of the AoE Frame

The basic structure of the AoE frame is described in the following table:

Table 111: Structure of the AoE Frame

Offset	Name	Type	Description
0 ... 1	Length	Word	Length of the mailbox data
2 ... 3	Address	Word	If the EtherCAT master is the client: station address of the source. If the EtherCAT slave is the client: station address of the target.
4	Channel	Unsigned6	Value 0 (fixed)
	Priority	Unsigned2	Value 0 (fixed)
5	Type	Unsigned4	Value 1 (fixed) Label for an AoE mailbox frame
	Cnt	Unsigned3	Counter for mailbox services (value range: 1 ... 7; is reset to 1 after 7; 0 is reserved)
	Reserved	Unsigned1	Value 0 (fixed)
6 ... 37	AoE Header	Unsigned8[32]	AoE header; see the following table “Structure of the AoE Header.”
38 ... 38 + (n-1)	AoE Data	Unsigned8[n]	AoE Data Area

The AoE header (offset 6 to 37) contains the addresses of the transmitter and receiver, plus the error code, the command ID and other information.

The AoE data area (from offset 38) contains the parameters of the individual ADS commands. The structure of the data field depends on the specific ADS command. Some commands do not require additional data. In this case, the AoE data area is omitted.

The structure of the AoE header within the AoEMailbox frame is described in the following table.

Table 112: Structure of the AoE Header

Offset in the AoE Frame	Name	Description
6 ... 11	Target NetId	AoE NetId of the target If the module is the target, use the AoE NetId assigned by the EtherCAT master for IO-Link communication for ISDU.
12 ... 13	Target Port	Port number of the target
14 ... 19	Source NetId	AoE NetId of the source If the module is the source, use the AoE NetId assigned by the EtherCAT master for IO-Link communication for ISDU.
20 ... 21	Source Port	Port number of the source
22 ... 23	Command ID	Command number for selecting the AoE service The command numbers of the AoE services relevant to ISDU are: For reading (AoE Read command): 0x0002 For writing (AoE Write command): 0x0003
24 ... 25	State Flags	Status flags (see below)
26 ... 29	Data Size	Size of the data area in bytes.
30 ... 33	Error code	Error code (only for response packet) For the possible error codes, see Error Handling [► 145] .
34 ... 37	Invoke ID	Free 32 bit field. You can use the <i>Invoke ID</i> to establish a link between the request packet and response packet. This is necessary, for example, if AoE is to be accessed multiple times simultaneously.

Parameter State Flags (Offset 24 ... 25):

Table 113: Parameter status flags

Bit	Description
0x01	1: for response packet (Response) 0: for request packet (Request)
0x04	1: if the packet contains an AoE command 0: otherwise

The AoE data area starts at offset 38 of the AoE mailbox frame, directly following the AoE header. The data area contains one or more AoE commands of length Data Size (offset 26 ... 29).

Note

Additional information

A description of AoE and the underlying ADS protocol can be found in ETG specification 1020. The “Mailbox” section of ETG specification 5001.6220 describes how IO-Link services are mapped to EtherCAT services.

14.1.4 ISDU Read Service

Parameter data is read from an object of an IO-Link device using the AoE mailbox protocol and IO-Link ISDU services.

The procedure is as follows:

- The EtherCAT master uses the AoE Read command and writes the ISDU read request into the AoE mailbox header, indicating the index and subindex. This information addresses the port and the object of the IO-Link device.
- After the IO-Link device has sent the IO-Link master the response to the ISDU read request, the EtherCAT slave sends the AoE response to the EtherCAT master.

The following figure shows the process of reading to an IO-Link device with the AoE Read command:

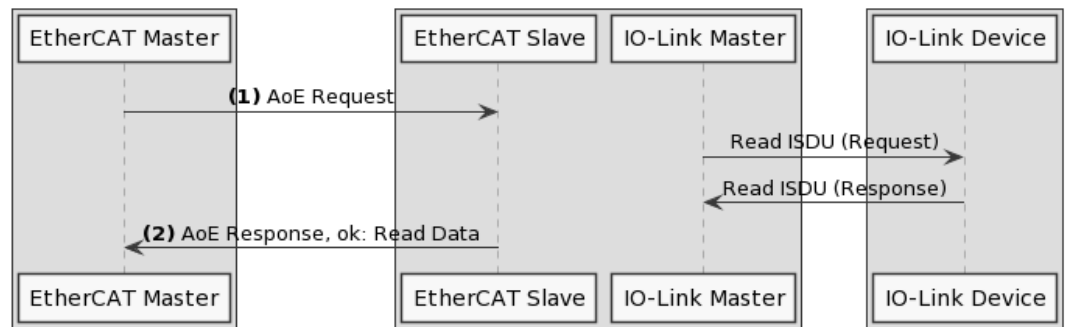


Figure 48: ISDU Read Process (EtherCAT)

(1) AoE Read Request: Packet Structure for an ISDU Read Request

Addressing is done in AoE via:

- AoE port number (in AoE header)
- IndexGroup (in the AoE data area)
- IndexOffset (in the AoE data area)

The structure of the AoE mailbox frame for transferring the ISDU read request (number (1) in figure “ISDU Read Process (EtherCAT)”) is as follows:

1. The structure of the AoE mailbox frame corresponds to the description in [🔗 Overview of the Structure of the AoE Frame \[▶ 139\]](#).
2. The AoE header corresponds to the description in [🔗 Overview of the Structure of the AoE Frame \[▶ 139\]](#).
3. The AoE data area has the following structure for an ISDU read request:

Table 114: Structure of the AoE Data Area for an ISDU Read Request (AoE Read Request)

Offset	Parametername	Type	Value	Description
0	IndexGroup	Unsigned32	0xF302	IndexGroup of the data to be read (fixed value).
4	IndexOffset	Unsigned32	see below	IndexOffset of the data to be read. Contains index and subindex of the IO-Link object. Structured according to the following table.
8	Length	Unsigned32	–	Length of the data to be read (in bytes)

The data is stored in Index Offset as follows:

Table 115: Structure of the IndexOffset in the AoE Data Area for an ISDU Read Request (AoE Read Request)

Offset	Parametername	Type	Value	Description
4	(IO-Link index)	Unsigned16	0x0000 ... 0x7FFF	Object index of the IO-Link device to be read from.
6	–	Unsigned8	0x00	Fixed value
7	(IO-Link subindex)	Unsigned8	[0x00...0xFF]	Object subindex of the IO-Link device to be read from.

The following figure shows the structure of the AoE header area and AoE data area of the ISDU read service.

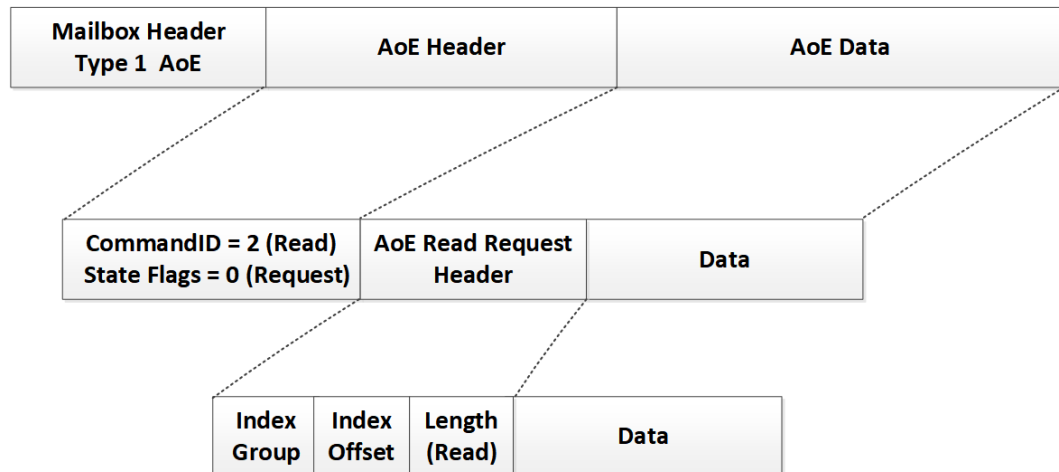


Figure 49: Structure of the AoE Header Area and AoE Data Area in the ISDU Read Service

(2) AoE Read Response: Response of the ISDU Read Service

The EtherCAT master receives the AoE read response (number (2) in figure “ISDU Read Process (EtherCAT)”).

- If the **Result** parameter in the AoE data area of the response packet is equal to 0, then the response of the ISDU read service has been read.
- If the **Result** parameter in the AoE data area of the response packet is not equal to 0, then an error has occurred, and the operation was unsuccessful.

AoE Read Response: Structure of the AoE Data Area (in Case of Success: ADS Return Code Equals 0)

If the **Result** parameter (offset 0) in the AoE data area of the response packet has the value 0, then the ISDU read request has been executed, and the user data is located in the **Data** parameter (starting at offset 8).

The response has the following structure:

Table 116: Structure of the AoE Data Area (AoE Read Response in Case of Success)

Offset	Parametername	Type	Value	Description
0	Result	Unsigned32	0 (corresponds to ERR_NOERROR)	Contains the ADS error number
4	Length	Unsigned32	(Corresponds to the request)	Length of the data that has been read (in bytes)
8	Data	Unsigned32 [Length]	(Data-dependent)	The data that has been read

AoE Read Response: Structure of the AoE Data Area (in Case of Error: ADS Return Code Not Equal to 0)

If the Result parameter (offset 0) in the AoE data area of the response packet has a value not equal to 0 (ERR_NOERROR), then the ISDU read request could not be executed.

The **Result** parameter contains the error number.

The response has the following structure:

Table 117: Structure of the AoE Data Area (AoE Read Response in Case of Error)

Offset	Parametername	Type	Value	Description
0	Result	Unsigned32	Value not equal to 0	Contains the ADS error number
4	Length	Unsigned32	0	Length of the data that has been read (0 bytes)

14.1.5 ISDU Write Service

Parameter data is written to an object of an IO-Link device via the AoE mailbox protocol and IO-Link ISDU services.

The procedure is as follows:

- The EtherCAT master uses the AoE write command and writes the ISDU write request into the AoE mailbox header, indicating the index and subindex. This information addresses the port and the object of the IO-Link device.
- After the IO-Link device has sent the IO-Link master the response to the ISDU write request, the EtherCAT slave sends the AoE response to the EtherCAT master.

The following figure shows the process of writing to an IO-Link device using the AoE Write command:

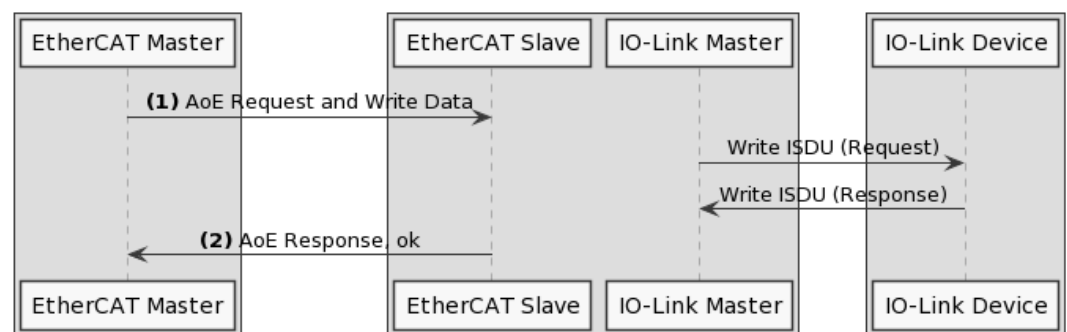


Figure 50: ISDU Write Process (EtherCAT)

(1) AoE Write Request: Packet Structure for an ISDU Write Request

Addressing is done in AoE via:

- AoE port number (in AoE header)
- IndexGroup (in the AoE data area)
- IndexOffset (in the AoE data area)

The structure of the AoE mailbox frame for the transmission of the ISDU write request (number (1) in figure “ISDU Write Process(EtherCAT)”) is as follows:

- The structure of the AoE mailbox frame corresponds to the description in [🔗 Overview of the Structure of the AoE Frame \[p. 139\]](#).
- The AoE header corresponds to the description in [🔗 Overview of the Structure of the AoE Frame \[p. 139\]](#).
- The AoE data area has the following structure for an ISDU write request:

Table 118: Structure of the AoE Data Area for an ISDU Write Request (AoE Write Request)

Offset	Parametername	Type	Value	Description
0	IndexGroup	Unsigned32	0xF302	IndexGroup of the data to be written (fixed value).

Offset	Parametername	Type	Value	Description
4	IndexOffset	Unsigned32	see below	IndexOffset of the data to be written. Contains index and subindex of the IO-Link object. Structured according to the following table.
8	Length	Unsigned32		Length of the data to be written (in bytes).
12	Data			Data for the ISDU write request (n bytes).

The data is stored in IndexOffset as follows:

Table 119: Structure of the IndexOffset in the AoE Data Area for an ISDU Write Request (AoE Write Request)

Offset	Parametername	Type	Value	Description
4	(IO-Link index)	Unsigned16	0x0000 ... 0x7FFF	Object index of the IO-Link device to be written to
6	–	Unsigned8	0x00	Fixed value
7	(IO-Link subindex)	Unsigned8	0x00 ... 0xFF	Object subindex of the IO-Link device to be written to.

The following figure shows the structure of the AoE header and AoE data area of the ISDU write service.

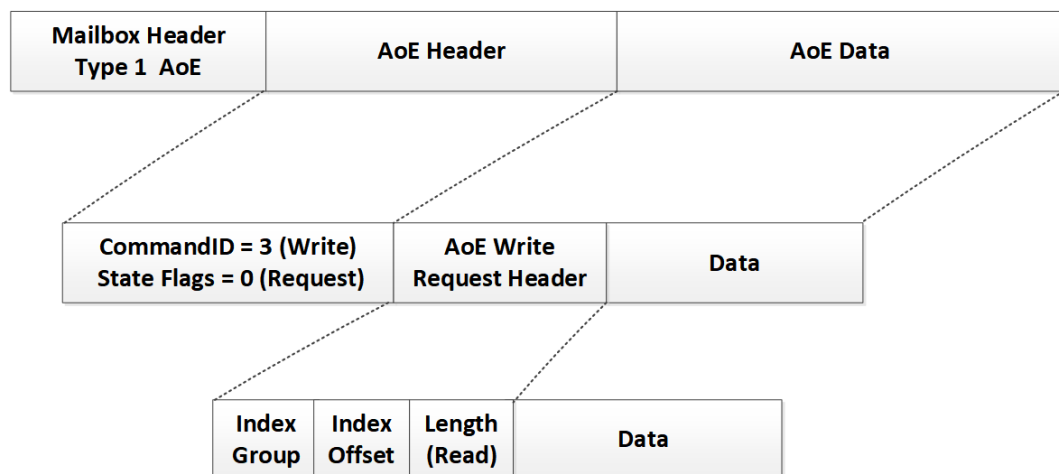


Figure 51: Structure of the AoE Header and AoE Data Area for the ISDU Write Service

(2) AoE Write Response: Response from the ISDU Write Service

The EtherCAT master receives the AoE write response (number (2) in figure “ISDU Write Process (EtherCAT)”).

AoE Write Response: Structure of the AoE Data Area (in Case of Success: ADS Return Code Equals 0)

If the **Result** parameter (offset 0) in the AoE data area of the response packet has the value 0 (ERR_NOERROR), then the ISDU write request has been executed successfully, and the user data has been written to the addressed object of the IO-Link device.

The response has the following structure:

Table 120: Structure of the AoE Data Area (AoE Write Response in Case of Success)

Offset	Parametername	Type	Value	Description
0	Result	Unsigned32	0 (corresponds to ERR_NOERROR)	Contains the error number.

AoE Write Response: Structure of the AoE Data Area (In Case of Error: ADS Return Code Does Not Equal 0)

If the **Result** parameter (offset 0) in the AoE data area of the response packet has a value not equal to 0 (ERR_NOERROR), then the ISDU write request could not be executed. The addressed object of the IO-Link device remains unchanged. The **Result** parameter contains the error number.

The response has the following structure:

Table 121: Structure of the AoE Data Area (AoE Write Response in Case of Error)

Offset	Parametername	Type	Value	Description
0	Result	Unsigned32	Value not equal to 0	Contains the error number.

14.1.6 Error Handling

In the event of an error, the 32 bit value “ADS Return Code” contains information on the error and cause according to the following tables:

Table 122: Coding of the ADS Return Code

Offset	Parameters	Contents	Data Type
0	ADS Return Code	ADS return code. These error codes come from ADS.	Unsigned16
2	Error Code	IO-Link error codes	Unsigned8
3	Additional Code	Additional IO-Link error codes (Additional Code)	Unsigned8

In most cases, the error “ADS device error” (numeric value 0x0700) is returned at offset 0.

Error Code and Additional Code: Application-Specific Errors

The following table explains the possible combinations of error codes and additional codes for application-specific errors:

Table 123: Application-Specific Errors

Error Code	Additional Code	Event	Error Name Description
0x80	0x00	Error in the device application – no details	APP_DEV This error type is used if the device application refused to execute the requested service and no detailed information about the event is available.
0x80	0x11	Index not available	IDX_NOTAVAIL This error type is used whenever an attempt is made to read from or write to a non-existent index.
0x80	0x12	Subindex not available	SUBIDX_NOTAVAIL This error type is used whenever an attempt is made to read from or write to a non-existent subindex.

Error Code	Additional Code	Event	Error Name Description
0x80	0x20	Service temporarily unavailable	SERV_NOTAVAIL This error type is used if a parameter for a read or write service cannot be accessed due to the current state of the device application.
0x80	0x21	Service temporarily unavailable – local control	SERV_NOTAVAIL_LOCCTRL This error type is used if a parameter cannot be accessed for a read or write service due to an ongoing local operation on the device (e.g., operation or parameterization via on-board device control panel).
0x80	0x22	Service temporarily unavailable – device control	SERV_NOTAVAIL_DEVCTRL This error type is used if a read or write service cannot be accessed due to a state of the device application due to an external cause (e.g., parameterization during a teach-in operation or calibration due to an external cause).
0x80	0x23	Access denied	IDX_NOT_WRITEABLE This error type is used if a service accesses a read-only parameter in order to write to it.
0x80	0x30	Parameter outside value range	PAR_VALOUTOFRNG This error type is used if a service receives a parameter outside its allowed range of values.
0x80	0x31	Parameter value exceeds limiting value	PAR_VALGTLM This error type is used if a write service receives a parameter above its specified value range.
0x80	0x32	Parameter value falls below limiting value	PAR_VALLTLM This error type is used if a write service receives a parameter below its specified value range.
0x80	0x33	Parameter length too large	VAL_LENVERRUN This error type is used if, in a write service to a parameter, the content is greater than the specified parameter length. This error type is also used if a data object is too large to be processed by the device application (e.g., due to a ISDU buffer size limit).
0x80	0x34	Parameter length too small	VAL_LENUNDRUN This error type is used if, for a write service to a parameter, the content is smaller than the specified parameter length (e.g., write access by an Unsigned16 value to an Unsigned32 parameter).
0x80	0x35	Function not available	FUNC_NOTAVAIL This error type is used for a write service if its command code is not supported by the device application (e.g., a system command with an unimplemented value).
0x80	0x36	Function temporarily unavailable	FUNC_UNAVAILTEMP This error type is used for a write service if its command code calls a device function that is not available due to the current state of the device application (e.g., a system command).
0x80	0x40	Invalid parameter set	PAR_SETINVALID This error type is used if values sent by an individual parameter transfer are not compatible with other current parameter settings.
0x80	0x41	Inconsistent parameter set	PAR_SETINCONSIST This error type is used if a block parameter transfer ends with with ParamDownloadEnd or ParamDownloadStore and the plausibility check identifies inconsistencies.

Error Code	Additional Code	Event	Error Name Description
0x80	0x82	Application not ready	APP_DEVNOTRDY This error type is used if a read or write service is refused due to temporary unavailability of an application (e.g., a peripheral controller during startup).
0x81	0x00	Vendor-specific	UNSPECIFIC This error type is forwarded directly by the IO-Link master as an error (no warning) for processing at a higher level.
0x81	0x01 ... 0xFF	Vendor-specific	VENDOR_SPECIFIC This error type is forwarded directly by the IO-Link master as an error (no warning) for processing at a higher level.

Error Codes and Additional Codes: “Derived” Errors

The following table lists the possible combinations of error codes and additional codes for the “derived” errors:

Table 124: “Derived” Errors

Error Code	Additional Code	Event	Error Name Description
0x10	0x00	IO-Link master – communication error	COM_ERR With an error of this type, the IO-Link master generates a negative response for the service if a communication error occurs during the read or write service, e.g., an interruption of the SDCI connection.
0x11	0x00	IO-Link master – ISDU timeout	I-SERVICE_TIMEOUT For an error of this type, the IO-Link master generates a negative response for the service if a read or write service waits longer than the specified I-Service timeout in the master.
0x11	0x00	Device event – ISDU error (DL)	I-SERVICE_TIMEOUT If the IO-Link master receives an event with event qualifier DL, error, event single shot and event code 0x5600, then a negative response is generated and returned indicating a timeout of the service.
0x11	0x00	Device event – ISDU illegal service primitives (AL)	I-SERVICE_TIMEOUT If the IO-Link master receives an event with event qualifier AL, error, event single shot and event code 0x5800, then a negative response is generated and returned indicating a timeout of the service.
0x56	0x00	IO-Link master – ISDU checksum error	M_ISDU_CHECKSUM For an error of this type, the IO-Link master generates a negative response for the service when its data link layer (DLL) detects an ISDU checksum error.
0x57	0x00	IO-Link master – ISDU illegal service primitives	M_ISDU_ILLEGAL For an error of this type, the IO-Link master generates a negative response for the service if its data link layer (DLL) detects an illegal ISDU service primitive.
0x80	0x33	Device event – ISDU buffer overflow (DL)	VAL_LENVERRUN If the IO-Link master receives an event with event qualifier DL, error, event single shot and event code 0x5200, then a negative response is generated and returned indicating that the permissible parameter length of the service has been exceeded.

14.2 Installation Regulations Specified by Approvals

Because the following information refers to language-specific regulations, standards or certifications applicable to the specific installation and operation location, it is presented in the respective original language.

EU Declaration of Conformity

Hereby, WAGO GmbH & Co. KG declares that the radio equipment type 765-4201/100-000 is in compliance with Directive 2014/53/EU. The full text of the EU declaration of conformity is available at the following internet address:

 [www.wago.com /765-4201/100-000](http://www.wago.com/765-4201/100-000).

FCC/ISED

Legal information:

Radiofrequency radiation exposure Information: This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance of 20 cm between the radiator and your body. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

NOTICE: This device complies with Part 15 of the FCC Rules and contains license-exempt transmitter(s)/receiver(s) that comply with Innovation, Science and Economic Development Canada's licence-exempt RSS standard(s). Operation is subject to the following two conditions:

1. this device may not cause harmful interference, and
2. this device must accept any interference received, including interference that may cause undesired operation.

L'émetteur/récepteur exempt de licence contenu dans le présent appareil est conforme aux CNR d'Innovation, Sciences et Développement économique Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes:

1. l'appareil ne doit pas produire de brouillage, et
2. l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Changes or modifications made to this equipment not expressly approved by WAGO GmbH & Co. KG may void the FCC authorization to operate this equipment.

14.3 Operational Description

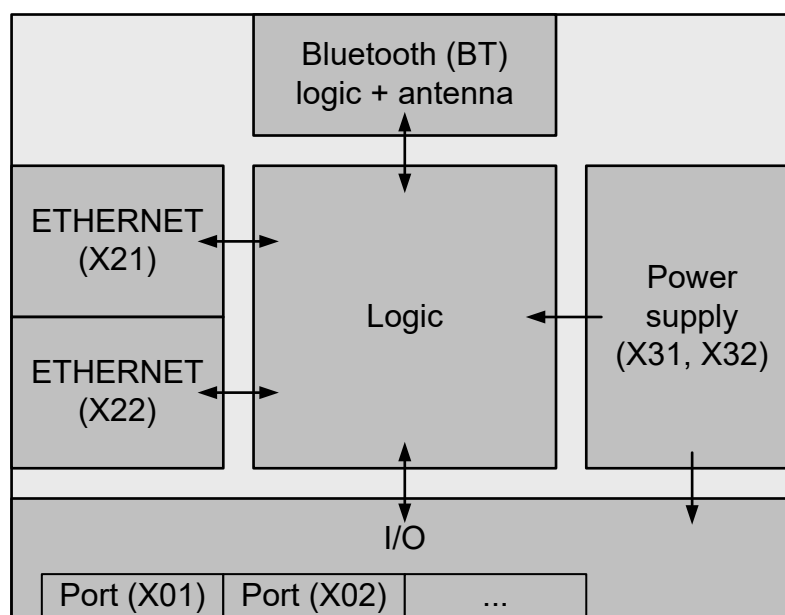
Product Description

The product 765-4201/100-000 is used to capture field signals on sensors, actuators and hubs which have been sent or received by a higher-level controller and output them via IO-Link.

Description of operation (FCC)

The product, a fieldbus module in the IP67 housing, serves the acquisition and output of data via sensors and actuators for the industrial control technology. The integrated Bluetooth® interface of the product allows the parameterization, operation, diagnosis, and monitoring using a mobile device and the WAGO App I/O Field.

The following figure shows the block diagram of the module.



Bluetooth® Transmitter

Table 125: Bluetooth® Transmitter

Technology used	Bluetooth® Low Energy
Modulation	GFSK
Data rate	1 Mbit/s
Work frequency	2402 ... 2480 MHz
Maximum power including tune up tolerance	Output power: +8 dBm Tolerance: +2 dBm / -3 dBm
Antenna type	PCB monopole
Maximum antenna gain	1.25 dBi

We declare that we meet the EN 62479 standard with respect to the limiting value for low powers less than 20 mW. Therefore, the product fundamentally corresponds to the European limiting values for high-frequency radiation.

Product Designs

SlimLine (W × H × D)	35 × 30 × 210 mm
WideLine (W × H × D)	60 × 30 × 210 mm

Temperature Ranges

Table 126: Temperature Ranges

Ambient temperature (operation)	–25 °C ... +70 °C
Ambient temperature (storage)	–40 °C ... +80 °C
Maximum temperature change	3 K/min

Voltage Ranges

Table 127: Voltage Ranges

Power source	24 VDC PELV (Protective Extra Low Voltage) or SELV (Safety Extra Low Voltage)
Voltage 1L	24 VDC, –25 %/+30 % (18 VDC ... 31.2 VDC)
Voltage 2L	
Digital output	Output voltage: 24 VDC, 1L powered
Actuator/sensor power supply	Output voltage: 24 VDC, 1L powered and 2L powered
Overvoltage category	II (EN 60664-1)

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List of Tables

Table 1	Legend for “View” Figure	14
Table 2	Supply Voltage.....	16
Table 3	IO-Link (class A)	16
Table 4	ETHERNET Interfaces.....	16
Table 5	Product.....	17
Table 6	Mechanical Data	17
Table 7	Connection technology	18
Table 8	IO-Link Port (Class A).....	18
Table 9	Total Load	19
Table 10	Power Supply.....	19
Table 11	Electrical Safety	20
Table 12	Environmental Requirements.....	20
Table 13	Communication	21
Table 14	EtherCAT® Slave.....	21
Table 15	OPC UA Server.....	21
Table 16	Communication – Bluetooth® transmitter	22
Table 17	Standards and Regulations.....	23
Table 18	Objects 0x1A0x: Assignment of the IO-Link input data.....	25
Table 19	Objects 0x1A0x: Assignment of the Digital Input	26
Table 20	Object 0x1A10: Assignment of the Digital Inputs.....	27
Table 21	Input Process Data (port-based assignment)	27
Table 22	Input Process Data (pin-based assignment).....	27
Table 23	Object 0x1A11: Assignment of “New Message Available”	27
Table 24	Object 0x1A80: assignment of the IO-Link port status.....	28
Table 25	Object 0x160x: Assignment of the IO-Link Output Data	28
Table 26	Objects 0x160x: Assignment of the Digital Output.....	29
Table 27	Object 0x1610: Assignment of the Digital Outputs	29
Table 28	Output Process Data (Port-Based Assignment)	30
Table 29	Output Process Data (Pin-Based Assignment).....	30
Table 30	Objects 0x1A0x: Assignment of the IO-Link input data.....	30
Table 31	Objects 0x1A0x: Assignment of the Digital Input	31
Table 32	Object 0x1A10: Assignment of the Digital Inputs.....	32
Table 33	Input Process Data (port-based assignment)	32
Table 34	Input Process Data (pin-based assignment).....	32
Table 35	Object 0x1A11: Assignment of “New Message Available”	32
Table 36	Object 0x1A80: assignment of the IO-Link port status.....	33

Table 37	Object 0x160x: Assignment of the IO-Link Output Data	33
Table 38	Objects 0x160x: Assignment of the Digital Output.....	34
Table 39	Object 0x1610: Assignment of the Digital Outputs	34
Table 40	Output Process Data (Port-Based Assignment)	35
Table 41	Output Process Data (Pin-Based Assignment).....	35
Table 42	Overview of Parameterization Tools	37
Table 43	Parameterization Overview	38
Table 44	Function Overview for WAGO I/O Field Webserver and WAGO IO-Link Modules	40
Table 45	Upper Limits for Current on the Individual Pins of the Connections	46
Table 46	Module 765-4201/100-000 – Currents in Supply Cable 1	47
Table 47	Module 765-4201/100-000 – Currents in Supply Cable 2.....	47
Table 48	Rules for Supply Cables 1 and 2	47
Table 49	Module Parameters.....	52
Table 50	Port Parameters	53
Table 51	“Port Cycle Time”	54
Table 52	Connecting an IO-Link Device or Digital Input or Output	66
Table 53	Configuration of the IO-Link Port	70
Table 54	Data on the “Dashboard” Page	72
Table 55	Tabs for Port Information and Settings (IO-Link Ports X01, X02 etc.)	73
Table 56	Additional Information on the Products Connected to the Selected Port.....	74
Table 57	Possible Values of “State” (Port Status Information)	76
Table 58	Meaning of the Individual Bits	76
Table 59	Cycle Time of the Master – Bits 6 ... 7	77
Table 60	Port Configuration Settings for IO-Link Devices	82
Table 61	“Port Mode” Drop-Down Menu: Selecting the Operating Mode for Pin 4 of the Selected IO-Link Port.....	83
Table 62	IQ Behavior Drop-Down Menu – Configuration of Pin 2 (I/Q) for IO-Link Class A Devices.....	84
Table 63	Possible Values of the Inspection Level Parameter	84
Table 64	Possible Values of the Backup Level Parameter	85
Table 65	Setting the Inspection Levels and Backup Levels for Device Check during Validation and Backup	85
Table 66	Maintenance Information	87
Table 67	Options for Resetting the Module to the Factory Settings	90
Table 68	Status of the Last Bluetooth® Firmware Update.....	92
Table 69	Input Options for Forcing for Each Pin of a Port	96
Table 70	Identify Devices.....	100
Table 71	Device-Specific Configuration Parameters	101
Table 72	Port-Specific Configuration Parameters.....	102

Table 73	Device-Specific (Calculated) Measured Current Values	102
Table 74	Device-Specific (Calculated) Measured Temperature Values	103
Table 75	Device-Specific (Calculated) Measured Voltage Values	103
Table 76	Port-Specific Diagnostics	103
Table 77	NTP Client Configuration	104
Table 78	Input Arguments of the InputSimulationPin Method	114
Table 79	Output Arguments of the InputSimulationPin Method	115
Table 80	Input Arguments of the OutputPin Method	116
Table 81	Output Arguments of the OutputPin Method	117
Table 82	Input Arguments of the IoLinkInputSimulation Method	118
Table 83	Output Arguments of the IoLinkInputSimulation Method	118
Table 84	Input Arguments of the IoLinkOutput Method	120
Table 85	Output Arguments of the IoLinkOutput Method	120
Table 86	Input Arguments of the DisableForcing Method	121
Table 87	Output Arguments of the DisableForcing Method	121
Table 88	Supply Voltage Status, 1L and 2L	122
Table 89	System Status	122
Table 90	Field LED	122
Table 91	APL LED	123
Table 92	EtherCAT® Slave Status	123
Table 93	LED States of EtherCAT® slave	123
Table 94	ETHERNET Status	124
Table 95	LED States ETHERNET Status	124
Table 96	LED States ®	124
Table 97	IO-Link Port Status (Class A)	124
Table 98	Diagnostic History (Index 0x10F3)	125
Table 99	Flags for Controlling the Sending and Saving of Diagnostic Messages	127
Table 100	Structure of a Diagnostic Message in Subindexes 6 to 69:	128
Table 101	Event Qualifier	129
Table 102	Emergency Error Codes	129
Table 103	General Alarms	130
Table 104	IO-Link Master Events	131
Table 105	Standard Events of the IO-Link Device	132
Table 106	Diagnostic Data of the Modules	133
Table 107	Status of the IO-Link master	133
Table 108	WEEE Mark	136
Table 109	Assignment of AoE Port Numbers to IO-Link Ports	138
Table 110	IndexOffset Parameter for Addressing the IO-Link Object	138

Table 111	Structure of the AoE Frame	139
Table 112	Structure of the AoE Header	140
Table 113	Parameter status flags	140
Table 114	Structure of the AoE Data Area for an ISDU Read Request (AoE Read Request)	141
Table 115	Structure of the IndexOffset in the AoE Data Area for an ISDU Read Request (AoE Read Request)	141
Table 116	Structure of the AoE Data Area (AoE Read Response in Case of Success)	142
Table 117	Structure of the AoE Data Area (AoE Read Response in Case of Error)	143
Table 118	Structure of the AoE Data Area for an ISDU Write Request (AoE Write Request)	143
Table 119	Structure of the IndexOffset in the AoE Data Area for an ISDU Write Request (AoE Write Request)	144
Table 120	Structure of the AoE Data Area (AoE Write Response in Case of Success)	145
Table 121	Structure of the AoE Data Area (AoE Write Response in Case of Error)	145
Table 122	Coding of the ADS Return Code	145
Table 123	Application-Specific Errors	145
Table 124	“Derived” Errors	147
Table 125	Bluetooth® Transmitter	149
Table 126	Temperature Ranges	150
Table 127	Voltage Ranges	150

List of Figures

Figure 1	View	14
Figure 2	Circuit Diagram for Each Port	17
Figure 3	Derating, 765-4201/100-000	22
Figure 4	Derating of a Contact (Pin) of L-Coded Connections X31 and X32 (For Core Cross-Section = 0.25 mm ² /AWG 14)	23
Figure 5	Derating of a Contact (Pin) of the A-Coded Connections Port X01, X02, ... (for Core Cross-Section = 0.34 mm ² /AWG 22)	23
Figure 6	Connection Example for 765-4201/100-000 Module with Individual Power Supply	50
Figure 7	Power Supply Group with 765-4201/100-000 – Connection Example 1	50
Figure 8	Power Supply Group with 765-4201/100-000 – Connection Example 2	51
Figure 9	Example of Feeding in and Passing on the Supply Voltages	61
Figure 10	RJ45 Pin Assignment	63
Figure 11	Line Topology for EtherCAT® Networks (Module Image May Differ)	64
Figure 12	Schematic Circuit Diagram of the Power Supply	65
Figure 13	Setting the IP Address	69
Figure 14	Dashboard Menu Item, Main Page (Example View)	71
Figure 15	Information Tab, Port X0i Menu Item (Example View)	73
Figure 16	Information Tab, Port X0i Menu Item (Example View)	74
Figure 17	Port X0i Menu Item, Status Tab (Example View)	75
Figure 18	Port X0i Menu Item, Process Data Tab (Example View)	78
Figure 19	Ports X0i – Read Access to IO-Link Device (Example View)	80
Figure 20	Ports X0i – Read Access to IO-Link at Index 43 and Subindex 0 Unsuccessful (Read Failed, Example View)	81
Figure 21	Port X0i Menu Item, Configuration Tab (Example View)	82
Figure 22	Settings Menu Item, Device Configuration Tab (Example View)	86
Figure 23	Settings Menu Item, Maintenance Information Tab (Example View)	87
Figure 24	Settings Menu Item, Firmware Upgrade Tab (Example View)	88
Figure 25	Settings Menu Item, Factory Reset Tab (Example View)	90
Figure 26	Settings Menu Item, Bluetooth® Tab (Example View)	91
Figure 27	Sign in Menu Item – Input Screen for Username and Password (Example View)	93
Figure 28	User Administration Menu Item (Initial State) (Example View)	95
Figure 29	User Administration Menu Item (Example View)	95
Figure 30	DIO Forcing Menu Item, “DIO Forcing” Screen (Example View)	96
Figure 31	IOL Forcing Menu Item, “IOL Forcing” Screen (Example View)	98
Figure 32	OPC UA: Device Information Model	100
Figure 33	Add Server Dialog – Discovery Tab (Default)	106
Figure 34	Add Server Dialog – Advanced Tab	107

Figure 35	NtpClientUpdateConfiguration Node.....	109
Figure 36	NtpClientUpdateConfiguration Node – Context Menu	109
Figure 37	NTP Client Configuration Dialog	110
Figure 38	NTP Client Configuration Dialog (Succeeded).....	111
Figure 39	GetForcingID Method.....	112
Figure 40	GetForcingID Method: Successful	112
Figure 41	GetForcingID Method: Unsuccessful	113
Figure 42	InputSimulationPin4 Method	114
Figure 43	OutputPin4 Method	116
Figure 44	IoLinkInputSimulation Method.....	118
Figure 45	IoLinkOutput Method.....	119
Figure 46	DisableForcing Method	121
Figure 47	Structure of the Ethernet Frame for AoE	139
Figure 48	ISDU Read Process (EtherCAT).....	141
Figure 49	Structure of the AoE Header Area and AoE Data Area in the ISDU Read Service	142
Figure 50	ISDU Write Process (EtherCAT).....	143
Figure 51	Structure of the AoE Header and AoE Data Area for the ISDU Write Service.....	144

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