

WAGO I/O System Field

8-Channel Digital Output; EtherCAT; DC 24 V; 2.0 A;
4 × M12 Connection

765-1204/100-000



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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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Provisions

This document applies to the following product:

 **765-1204/100-000** (8 DIO EC PN 24 VDC 2.0 A) 8-Channel Digital Input/Output; EtherCAT; 24 V DC; 2.0 A; 4 × M12 Connection

Product detail page

 www.wago.com/765-1204/100-000

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 765-1204/100-000 is used to capture and output digital field signals, e.g., from sensors and actuators, which have been sent or received by a higher-level controller.

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

without any reference to patent rights. WAGO GmbH & Co. KG, or for third-party products, their manufacturer, retain all rights regarding patent, utility model or design registration.

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 [► 126]**.

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
- 4 ports with two channels each: 8 digital inputs / outputs
- Pin 2 and pin 4 can be configured as a digital input or output
- Port X01 ... X02 supplied by 1L
- Port X03 ... X04 supplied by 2L

Properties

4.1 View

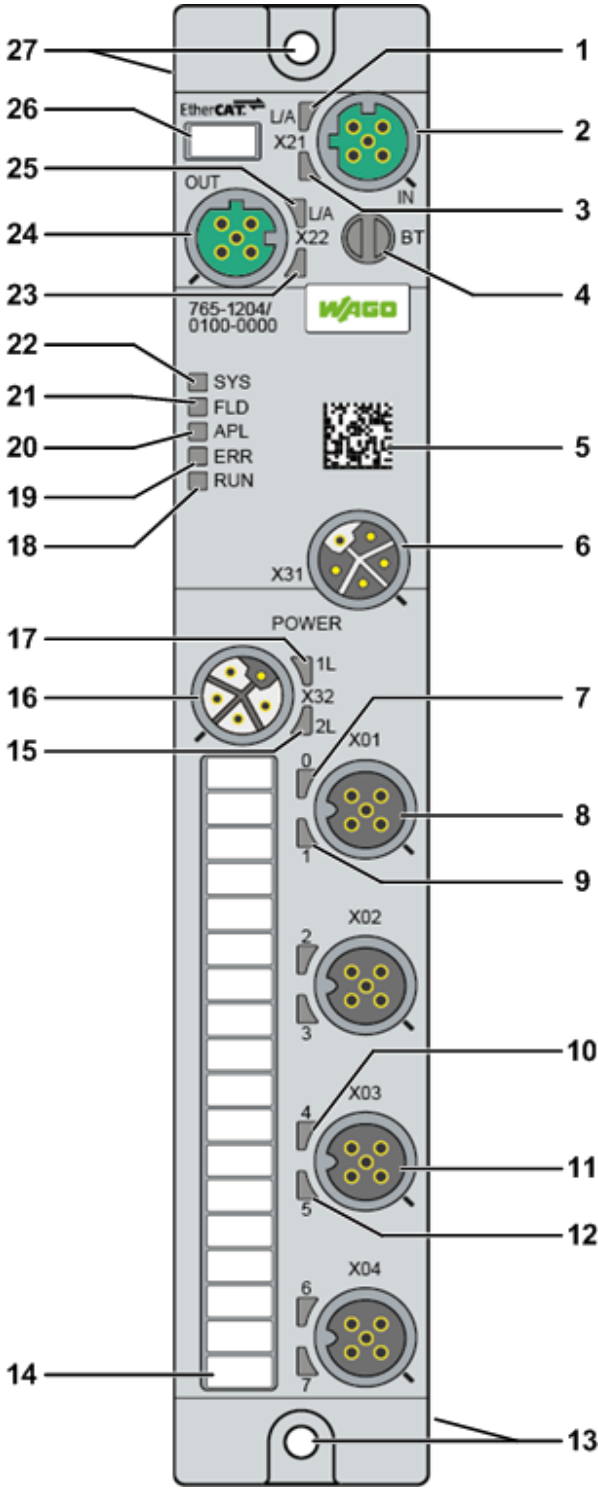


Figure 1: View

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
	24	X22	ETHERNET interface, M12, D-coded, EtherCAT® OUT port
	25	L/A (X22)	Link/activity LED for port X22
	23	-	LED with no function
Bluetooth®	4	BT	Bluetooth® antenna, including Bluetooth® LED
Indicators	22	SYS	System LED
	21	FLD	Field LED
	20	APL	Application LED
	19	ERR	EtherCAT® error status LED
	18	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)
	16	X32	Power supply output (Power Out)
	15	2L (X32)	2L power supply LED (24 VDC)
	17	1L (X32)	1L supply voltage LED (24 VDC)
Digital inputs/outputs (1L powered)	8	X01 ... X02	Digital inputs/outputs, ports X01 ... X02, 2-channel, M12, A-coded
	9	1, 3	Port LEDs for ports X01 ... X02, channel B (pin 2)
	7	0, 2	Port LEDs for ports X01 ... X02, channel A (pin 4)
Digital inputs/outputs (2L powered)	11	X03 ... X04	Digital inputs/outputs for ports X03 ... X04, 2-channel, M12, A-coded
	12	5, 7	Port LEDs for ports X03 ... X04, channel B (pin 2)
	10	4, 6	Port LEDs for ports X03 ... X04, channel A (pin 4)
Marking	14	-	Port marking (WMB Inline and marking strips)
	26	-	Module marking (WMB Inline)
Assembly	13	-	Mounting hole for front or side mounting
	27	-	Mounting hole for front or side mounting

4.2 Connections

4.2.1 Power supply

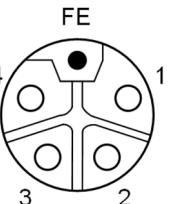
The product is powered through the X31 connection (Power in). Two supply cables can be connected to the plug:

- 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
		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
M12, L-coded, plug, 5-pin (4 + FE)	M12, L-coded, socket, 5-pin (4 + FE)			

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 \[p. 39\]](#). There you will find information on the maximum permitted current consumption.

4.2.2 Communication Interfaces

4.2.2.1 Digital inputs/outputs

Table 3: Digital input/output (2-channel, 1L powered)

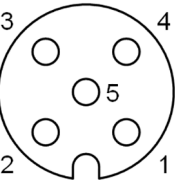
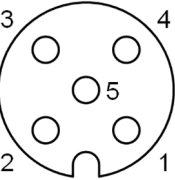
Digital Input/Output X01 - X02	Pin	Signal	Description
	1	1L+	Supply voltage, 1L powered
	2	DIO B (DI B/DQ B)	Digital input/output channel B
	3	1L–	Reference potential for 1L+
	4	DIO A (DI A/DQ A)	Digital input/output channel A
	5	-	Not connected
M12, A-coded, socket, 5-pin			

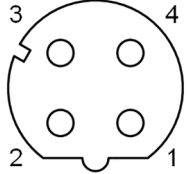
Table 4: Digital input/output (2-channel, 2L powered)

Digital Input/Output X03 - X04	Pin	Signal	Description
	1	2L+	Supply voltage, 2L powered
	2	DIO B (DI B/DQ B)	Digital input/output channel B
	3	2L–	Reference potential for 2L+
	4	DIO A (DI A/DQ A)	Digital input/output channel A
	5	-	Not connected
M12, A-coded, socket, 5-pin			

4.2.3 Network Connections

4.2.3.1 ETHERNET Interfaces

Table 5: 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.

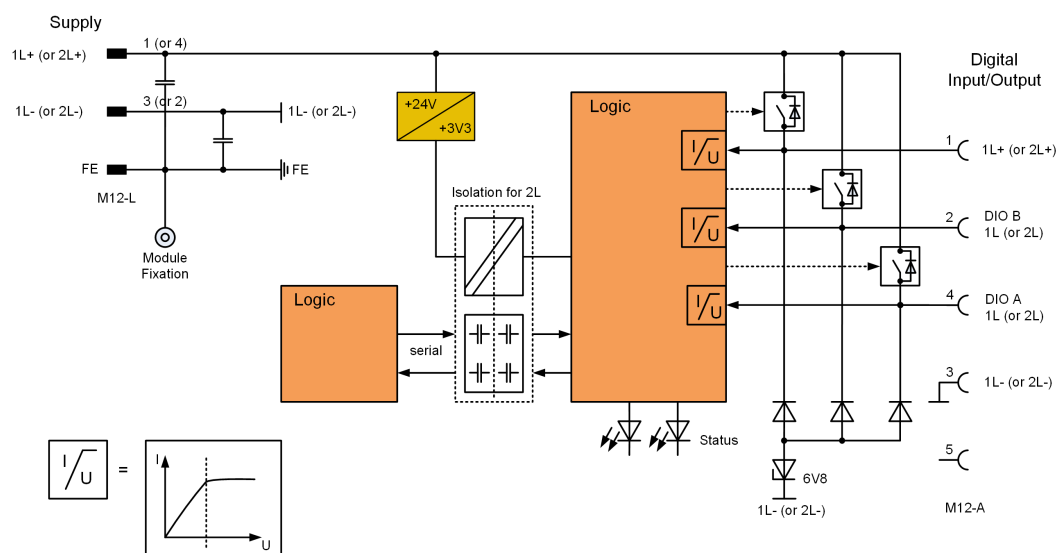


Figure 2: Circuit Diagram for Each Port

4.4 Technical data

4.4.1 Product

Table 6: Product

Property	Value
Item Number	765-1204/100-000
Product function	8-channel digital input/output
Product name (short)	8 DIO EC PN 24 VDC 2.0 A
Product name (long)	8-channel digital input/output; EtherCAT; 24 V DC; 2.0 A; 4 × M12 connector

4.4.2 Mechanical Data

Table 7: Mechanical Data

Property	Value
Width	35 mm
Height	30 mm
Length	210 mm
Weight	363.0 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 8: 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
Digital Inputs	4 × M12, A-coded, socket, 5-pin
Tightening Torque	M12: 1.0 Nm

Digital Input/Output, 1L or 2L Powered

Table 9: Digital Input/Output, 1L or 2L Powered

Property	Value	Value (per UL)
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, note that the transfer and processing of the process data (in the device and 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	
	Port X01 and X02: 1L powered	
	Port X03 and X04: 2L 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.	

Property	Value	Value (per UL)
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	
	Output current	
	Temperature	
	Line break	
Actuator/Sensor Supply		
Output voltage	24 VDC	
	Port X01 and X02: 1L powered	
	Port X03 and X04: 2L powered	
Current	Maximum: 4.0 A per supply cable per IEC 61131-2	
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+, 2L+)	Events: overcurrent, overload, overtemperature and overvoltage	

Table 10: Total Load

Parameters	Value	Value (per UL)
Maximum total load current (sum of all currents of connections X01–X04)	15.7 A	7.7 A

4.4.4 Power Supply

Table 11: 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, 2L	18.0 V ($\pm 5\%$ at 25 °C) message on	
	18.3 V ($\pm 5\%$ at 25 °C) message off	
Overvoltage warning, 1L, 2L	30.0 V ($\pm 5\%$ at 25 °C) message on	
	29.7 V ($\pm 5\%$ at 25 °C) message off	
Module current consumption	1L: 120 mA (at 24 VDC)	
	2L: 10 mA (at 24 VDC)	

Parameters	Value	Value (per UL)
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
	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 8 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 12: 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 13: 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 %	

Property	Value	Value (per UL)
Pollution degree	3 (EN 60664-1)	
Operating altitude	0 ... 2000 m	
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 14: Communication

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

Table 15: EtherCAT® Slave

Parameters	Value
Input data	4 bytes
Output data	3 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 16: OPC UA Server

Parameters	Value
OPC UA Server	Manufacturer-specific information models with diagnostic functions: http://www.wago.com/UA/DigitalConnector/ 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
Number of subscriptions per session	2
Number of "monitored items" per session	20
Data coding	UA binary

Table 17: 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).

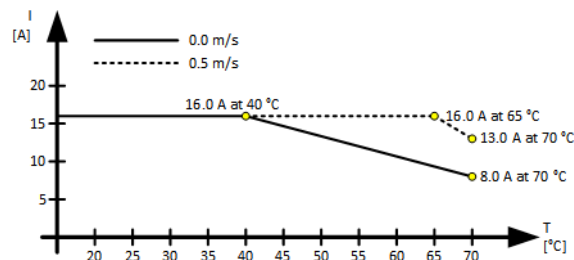


Figure 3: Derating, 765-1204/100-000

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).

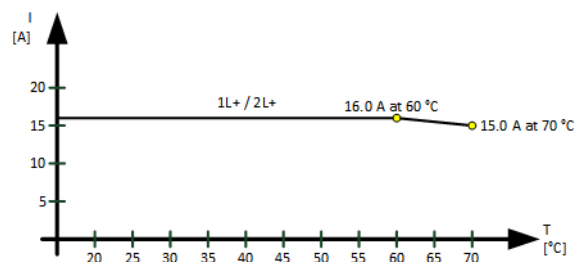


Figure 4: Derating of a Contact (Pin) of L-Coded Connections X31 and X32 (For Core Cross-Section = 0.25 mm²/AWG 14)

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).

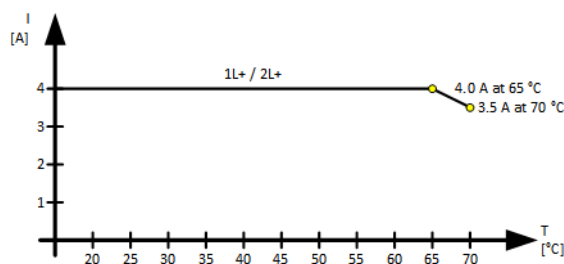


Figure 5: Derating of a Contact (Pin) of the A-Coded Connections Port X01, X02, ... (for Core Cross-Section = 0.34 mm²/AWG 22)

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 18: 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
---	--------------------

	UL	UL 61010-1 and UL 61010-2-201, "Ordinary Location"	In preparation.
---	----	--	-----------------

	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: R20-0936-01-TEC (Slimline)
-----	--

FCC	FCC ID: 2AKUE-SLIMLINE
-----	------------------------

ISED	Certificate number: 22322-SLIMLINE
------	------------------------------------

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

Objects 0x1A00 and 0x1A11 transfer input process data.

Table 19: Object 0x1A00: Assignment of the Digital Inputs

Index Subindex	Size	Name	Description
0x4000.01	2 bytes	Process data (pin 2 + 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.
0x1800.07	1 bit	Status bit	True: input data invalid False: input data valid
0x1800.09	1 bit	Toggle bit	The slave toggles this bit every time the Tx-PDO is updated.
-	6 bits	-	-

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 20: Process Data of the Digital Inputs (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 ... 7	0

Table 21: Process Data of the Digital Inputs (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
	2	Port X03, pin 4: DI A or DO A
	3	Port X04, pin 4: DI A or DO A
	4 ... 7	0
Byte 2	0	Port X01, pin 2: DI B or DO B
	1	Port X02, pin 2: DI B or DO B
	2	Port X03, pin 2: DI B or DO B
	3	Port X04, pin 2: DI B or DO B
	4 ... 7	0

Table 22: Object 0x1A11: Assignment of "New Message Available"

Index Subindex	Size	Name	Description
0x10F3.04	1 bit	New Message Available Flag	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	-	-

Output Process Data

Object 0x1600 transfers output process data.

Table 23: Object 0x1600: Assignment of the Digital Outputs

Index Subindex	Size	Name	Description
0x3000.01	2 bytes	Process data (pin 2 + 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.
0x1400.08	1 bit	Control Bit	True: Output data invalid. False: Output data valid.
0x1400.09	1 bit	Toggle bit	The master toggles this bit every time the RxPDO is updated.
-	6 bits	-	-

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 24: Process data of digital outputs (port-based assignment)

Byte Offset	Bit	Output Process Data
3	0	Port X01, pin 4: DO A
	1	Port X01, pin 2: DO B
	...	...
	6	Port X04, pin 4: DO A
	7	Port X04, pin 2: DO B
4	0 ... 7	0

Table 25: Process Data of Digital Outputs (Pin-Based Assignment)

Byte Offset	Bit	Output Process Data
3	0	Port X01, pin 4: DO A
	1	Port X02, pin 4: DO A
	2	Port X03, pin 4: DO A
	3	Port X04, pin 4: DO A
	4 ... 7	0
4	0	Port X01, pin 2: DO B
	1	Port X02, pin 2: DO B
	2	Port X03, pin 2: DO B
	3	Port X04, pin 2: DO B
	4 ... 7	0

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.

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.

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 \[► 41\]](#). 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.

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

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 \[► 34\]](#).

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 module's parameters. The following table provides an overview of the tools.

Table 26: 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 <code>WAGO_series765.xml</code> and <code>WAGO_series765_diag.xml</code> 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 one or more 765 Series modules. The user loads the configuration onto the EtherCAT® master. The EtherCAT® master configures and parameterizes the 765 modules via EtherCAT®.
WAGO I/O Field Webserver	The WAGO I/O Field Webserver is a Webserver that is integrated into the 765 Series module. With a Web browser, users can view the Web pages and display and modify parameters.
WAGO App I/O Field	The WAGO I/O Field app is an app for mobile devices that can communicate with a 765 Series module via Bluetooth®. With the app, the user can parameterize the 765 Series module, read and write process data and display diagnostics.
WAGO IO-Link Configurator	WAGO IO-Link Configurator is software for configuring the WAGO IO-Link masters and the IO-Link devices.

A distinction is made between two parts of the configuration and parameterization:

1. **EtherCAT configuration:** select EtherCAT® module

2. Port configuration: digital input or output

The following table shows which tool can influence which section.

Table 27: Parameterization Overview

Tool	EtherCAT® Module	Port 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 <i>WAGO_series765.xml</i> . These parameters configure each individual port and determine whether the port is used as a digital input or digital output (or is disabled).
WAGO I/O Field Webserver	–	Yes
WAGO App I/O Field	–	Yes
WAGO IO-Link Configurator	–	Yes

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 or the OPC UA client are overwritten.

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

5.5.2 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 of the digital inputs and outputs: temperature, voltage, current and status on pins 1, 2 and 4
- Display the status information for the entire port
- Configure ports, e.g. set operating mode
- 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 28: Function Overview for the WAGO I/O Field Webserver for Digital Input/Output Modules

Menu	Tab	Description	Section
Dashboard	-	Display product information	
Ports X01, X02 etc.	(All)	Port information and settings for ports X01, X02, ...	🔗 Configure Ports [▶ 63]
	Information	Display current measured values for port (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)	
	Process Data	Display the process data (input/output)	
Settings	(All)	Product Settings	
	Device Configuration	Configure parameters for IP connection	🔗 Configuring IP Parameters [▶ 64]
	Maintenance Information	Save maintenance information	🔗 Storing Maintenance Information [▶ 65]
	Firmware Upgrade	Update firmware	🔗 Updating Firmware [▶ 110]
	Factory Reset	Reset the product to factory settings	🔗 Resetting the Module to the Factory Settings [▶ 68]
	Bluetooth®	Access via Bluetooth®	🔗 Configure Bluetooth [▶ 69]
DIO Forcing	-	Forcing for digital inputs and outputs	🔗 Forcing Digital Inputs and Outputs [▶ 74]
User Administration	-	Set up and manage users	🔗 Logging Users on and off and Managing Them [▶ 71]
Sign in, Sign out	-	Log users on and off	

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

5.5.3 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 \[p. 33\]](#).

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 [► 28]**) 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  **Tech-nical 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  **Con-nect Sensors/Actuators** [▶ 52](#)].
- 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  **Con-nect Sensors/Actuators** [▶ 52](#)].

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 \[► 38\]](#).

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 \[► 38\]](#) (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 29: 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 765-1204/100-000 – 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 1L of the 765-1204/100-000 Digital Input/Output Module, the currents declared in the following table must be taken into account:

Table 30: Module 765-1204/100-000 – 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}	Total current for supply cable 1 at digital input/output X0i (i.e., port X01, X02); corresponds to current $I_{X0i_pin3_1L}$ at pin 3 (ground). This current is the sum of the currents at pins 1, 2 and 4 of digital input/output 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 $I_{module_1L} = I_{X01_pin3_1L} + I_{X02_pin3_1L}$

For supply cable 2L of the 765-1204/100-000 Digital Input/Output Module, the currents declared in the following table must be taken into account:

Table 31: Module 765-1204/100-000 – 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_{X03_2L}, I_{X04_2L}	Total current for supply cable 2 at digital input/output X0i (i.e., port X03, X04); corresponds to current $I_{X0i_pin3_2L}$ at pin 3 (ground). This current is the sum of the currents at pins 1, 2 and 4 of digital input/output X0i: $I_{X0i_2L} = I_{X0i_pin3_2L} = I_{X0i_pin1_2L} + I_{X0i_pin2_2L} + I_{X0i_pin4_2L}$
I_{module_2L}	Module current $I_{module_2L} = I_{X03_pin3_2L} + I_{X04_pin3_2L}$

During operation of the 765-1204/100-000 Module requires, the rules below for the currents in supply cables 1 and 2 must be followed at all times:

Table 32: Rules for Supply Cables 1 and 2

Current	Supply Cable 1	Supply Cable 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 Cable 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	Port X01, X02 (henceforth summarized as port X0i for $1 \leq i \leq 2$)	Port X03, X04 (henceforth summarized as port X0i for $3 \leq i \leq 4$)
Supply current on pin 1 (rule 3)	$I_{X0i_pin1_1L} \leq 4 \text{ A}$	$I_{X0i_pin1_2L} \leq 4 \text{ A}$
Signal current on pin 2/4 in normal operation (rule 3)	$I_{X0i_pin2_1L} \leq 2 \text{ A}$ $I_{X0i_pin4_1L} \leq 2 \text{ A}$	$I_{X0i_pin2_2L} \leq 2 \text{ A}$ $I_{X0i_pin4_2L} \leq 2 \text{ A}$
Signal current on pin 2/4 in overload operation (rule 3)	$I_{X0i_pin2_1L} \leq 2.4 \text{ A}$ $I_{X0i_pin4_1L} \leq 2.4 \text{ A}$	$I_{X0i_pin2_2L} \leq 2.4 \text{ A}$ $I_{X0i_pin4_2L} \leq 2.4 \text{ A}$
Reverse current on pin 3 (ground) (rule 3)	$I_{X0i_pin3_1L} \leq 4 \text{ A}$	$I_{X0i_pin3_2L} \leq 4 \text{ A}$

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 product for each option:

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

Example of Individual Power Supply

This example considers a single 765-1204/100-000 module where no additional devices are powered through its PWR OUT connection (X32).

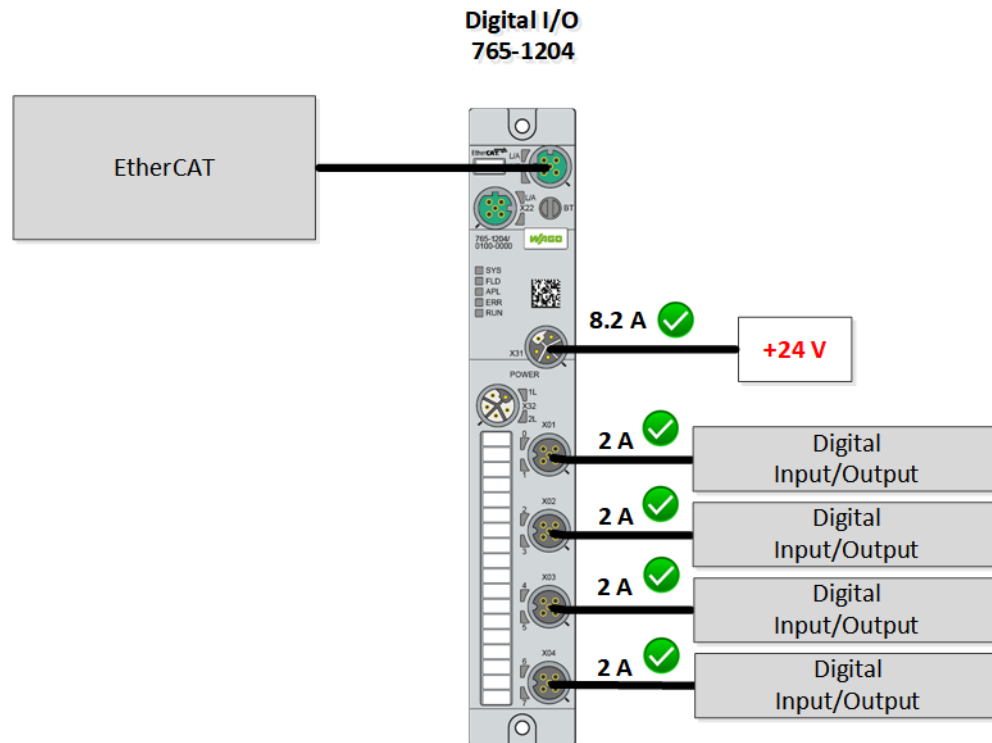


Figure 6: Connection Example with Individual Power Supply (Module Image May Vary)

One digital input/output with a current consumption of max. 2 A is connected to ports X01 through X04 of the module. The module's current consumption is 0.2 A.

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) und $16 \text{ A} - 4.0 \text{ A} = 12 \text{ A}$ for supply cable 2 (2L).

6.3 Settings Options

6.3.1 Module Parameters

Indexes 0x2000 to 0x2003

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

Table 33: Module Parameters

Index Subindex	Parametername	Value Range	Default	Description
0x2000.0 0	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.
0x2001.0 0	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 = 0, bit 2 = port X02 pin 4, bit 3 = 0, ...
		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 = 0, bit 9 = 0, ...
0x2002.0 1	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
0x2002.0 2	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.
0x2003.0 1	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.
0x2003.0 2	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 0x2130

Parameters with index 0x2100 configure port X01.

Parameters with index 0x2110 configure port X02.

Parameters with index 0x2120 configure port X03.

Parameters with index 0x2130 configure port X04.

Table 34: Port Parameters

Index Subindex	Parametername	Value Range	Default	Description
0x2100.0 1, 0x2110.0 1, ...	Digital logic port X01/ X02/... pin 4	0: Normally open	0	Pin 4 is a digital input. The input signal is not inverted.
		1: Normally closed		Pin 4 is a digital input. The input signal is inverted.
		2: Output		Pin 4 is a digital output.
		3: Static On		Pin 4 is a digital output and switched on (+24 VDC).
0x2100.0 2, 0x2110.0 2, ...	Input filter time X01/ X02/... pin 4	0: deactivated	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		

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** [▶ 18](#).

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 [► 39]**.

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.

Power supply 2L is provided to power actuators at specific ports. It can also be passed on to additional devices.

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

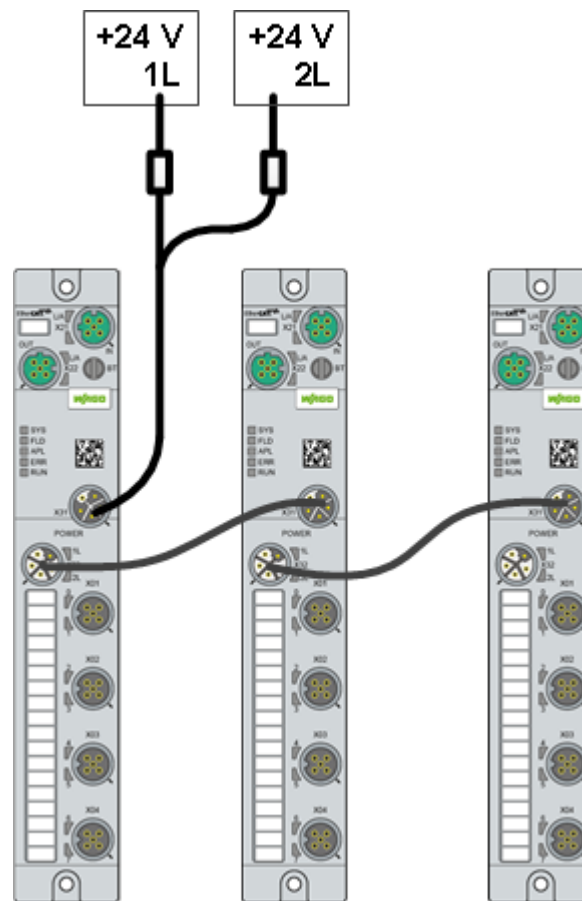


Figure 7: Example of Feeding in and Passing on the Supply Voltages

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 \[► 34\]](#).

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 [► 39]**.

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** [▶ 17].

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):

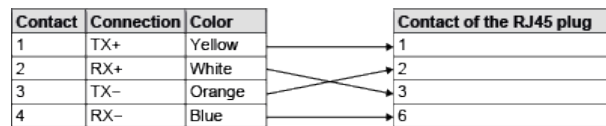


Figure 8: RJ45 Pin Assignment

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:

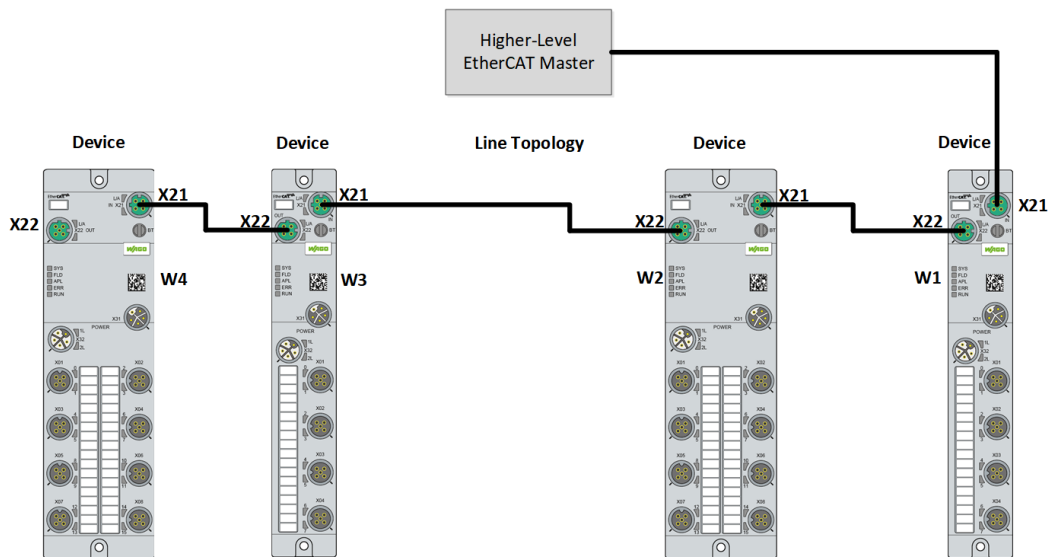


Figure 9: Line Topology for EtherCAT® Networks (Module Image May Differ)

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 \[► 34\]](#).

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

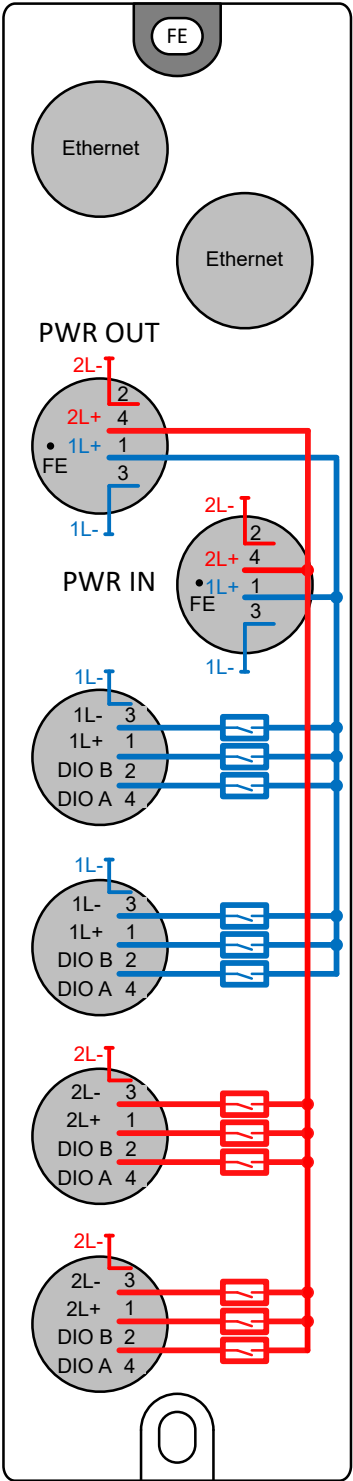
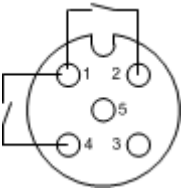
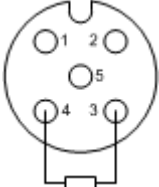
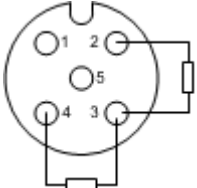
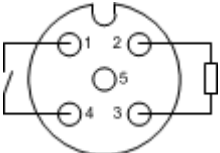
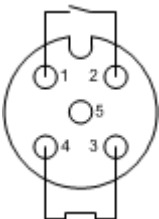


Figure 10: Schematic Circuit Diagram of the Power Supply

The following table shows the connection options for digital inputs and outputs.

Table 35: Connecting Digital Inputs/Outputs

Connection Option	Description
	Connection of a digital input at channel A. Required port configuration: pin 4 as digital input and pin 2 disabled.

Connection Option	Description
	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 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 \[► 56\]](#).

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).

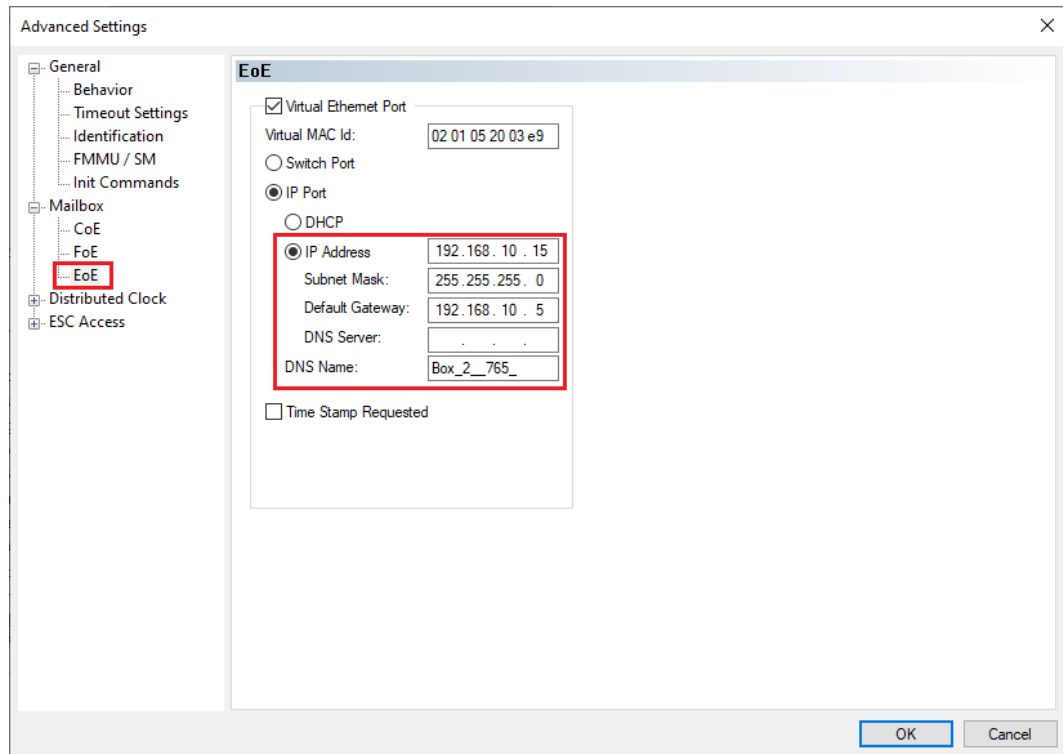


Figure 11: Setting the IP Address

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.
- Set the parameters.

10.2.1.1 Selecting the Module

Select the module used from the device catalog.

Module: 765-1204/100-000

Designation: 8 DIO EC PN 24 VDC 2.0 A

10.2.1.2 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** [\[▶ 41\]](#).

10.3 Parameterization

The following tools are described below:

-  **WAGO Webserver I/O Field** [\[▶ 57\]](#)
-  **WAGO I/O Field app** [\[▶ 76\]](#)
-  **OPC UA Server** [\[▶ 76\]](#)

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

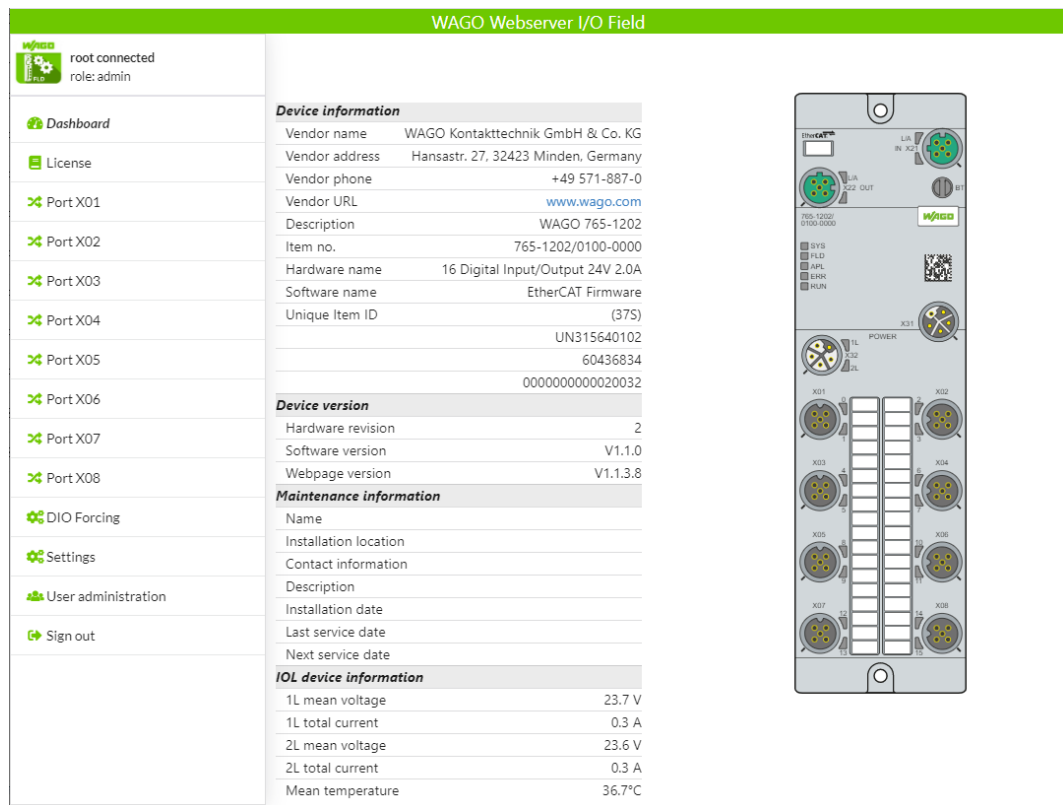


Figure 12: **Dashboard** Menu Item, Main Page (Example View)

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 36: 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 Display Port Information

For each of the digital inputs/outputs of the module (port X01, port X02, etc.), individual port information can be found on the **Information**, **Status**, **Configuration** 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.

The following four tabs are available for each digital input/output:

Table 37: Tab for port information (digital inputs/outputs X01, X02, etc.)

Tab	Description
Information	Displays the current measured values for temperature, voltage and current, as well as the port state, individually for pin 1, pin 2 and pin 4. If an IO-Link device is connected to the digital input/output, its product data is also shown. This tab is pre-configured.
Status	Displays status information for the digital input/output.
Configuration	For displaying and setting port parameters.
Process data	Displays the process data.

10.3.1.3.2 Displaying Measured Values and Information on Connected Sensors/Actuators

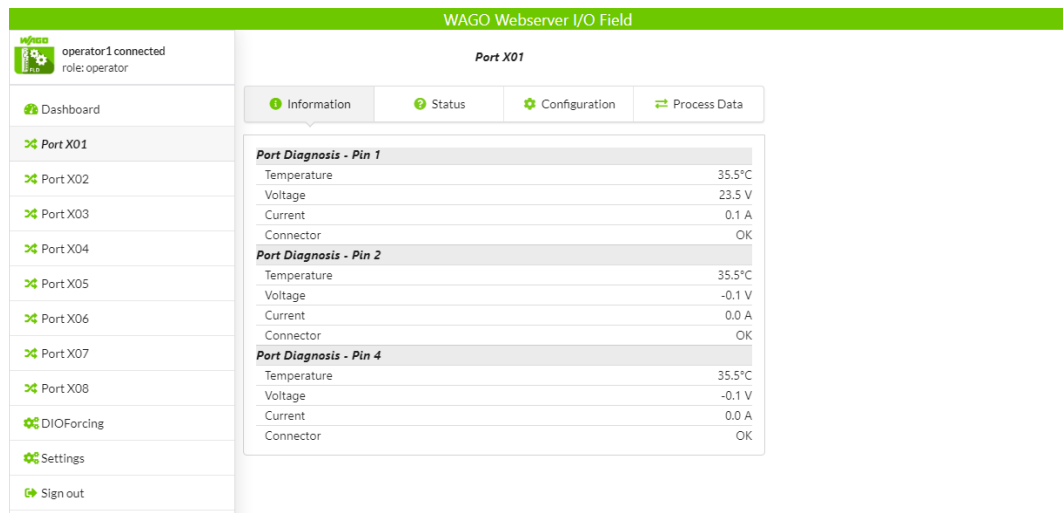


Figure 13: **Information** Tab, **Port X0i** Menu Item (Example View)

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

- The measured values and states of the port diagnostics
- The information on connected sensors/actuators

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

10.3.1.3.3 Display Port Status Information

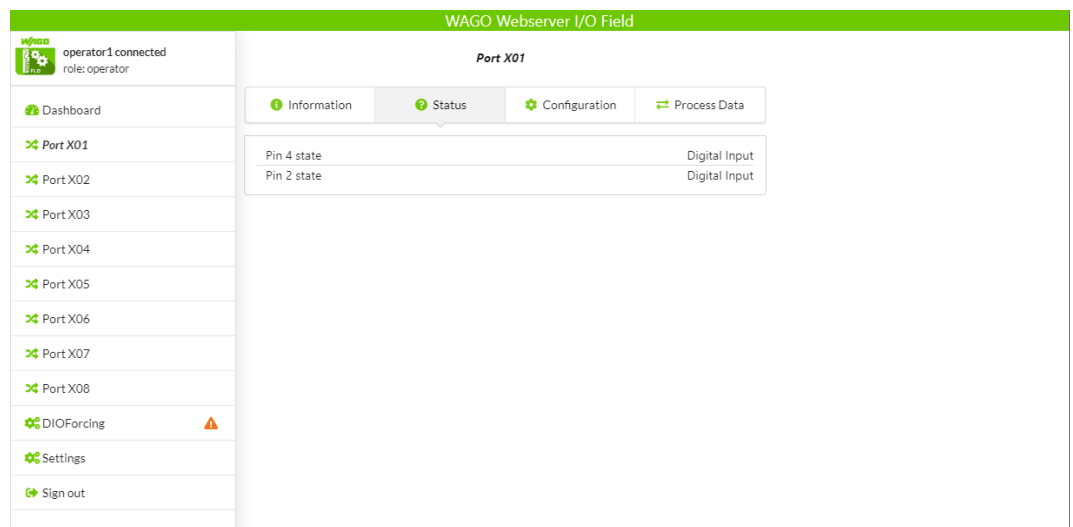


Figure 14: **Port XX** Menu Item, **Status** Tab (Example View)

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

The current port information of the digital input/output is displayed. Possible values are:

- Digital Input: The port is in digital input mode.
- Digital Output: The port is in digital output mode.

10.3.1.3.5 Display 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.

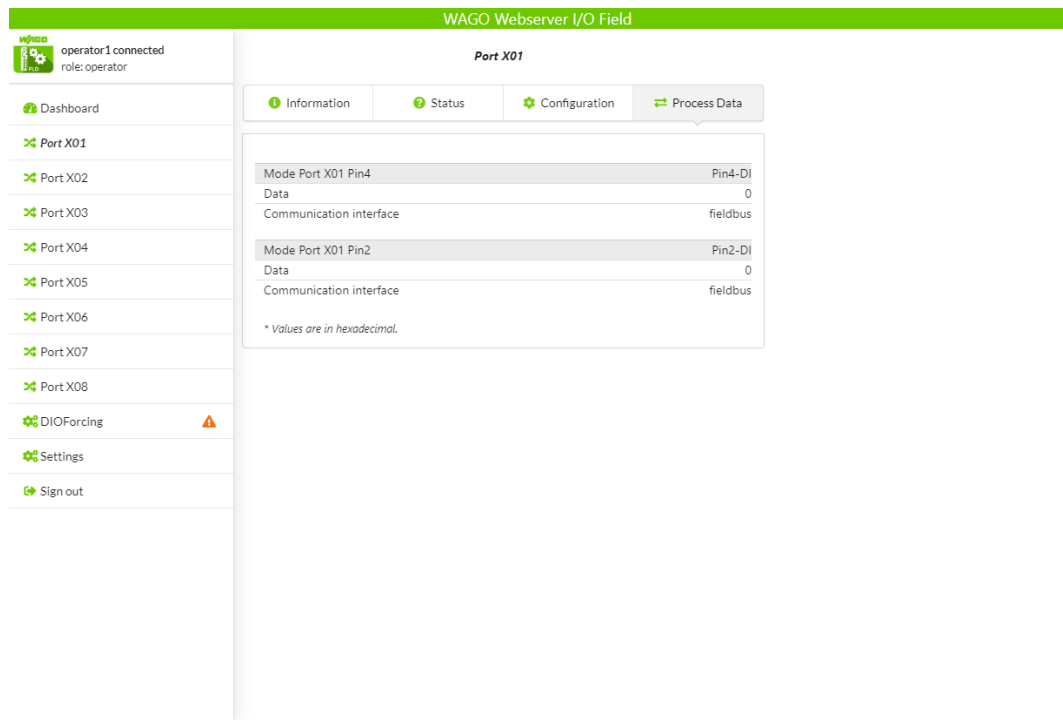


Figure 15: **Port X0i** Menu Item, **Process Data** Tab (Example View)

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:

-  **Configure Ports [► 63]**
-  **Configuring IP Parameters [► 64]**
-  **Storing Maintenance Information [► 65]**
-  **Update Firmware [► 66]**
-  **Resetsetting the Module to the Factory Settings [► 68]**
-  **Configure Bluetooth [► 69]**
-  **Logging Users on and off and Managing Them [► 71]**
-  **Forcing Digital Inputs and Outputs [► 74]**

10.3.1.4.1 Configure Ports

Figure 16: Port XX Menu Item, Configuration Tab

Table 38: Port Configuration Settings

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)
Port mode (pin 2)	Drop-down menu	Port operating mode (configuration of pin 2)
Digital input signal filter (pin 2)	Drop-down menu	Filter time for digital input signals on pin 4 (only for "Port mode (pin 2)" on digital input)

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 the controller and module are exchanging process data, configuration is not 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. Configure pin 2 by setting the port operating mode.
5. Configure the filter time for the digital input signals for pin 4 and pin 2.
6. Click the **Apply** button.

⇒ Your changes now take effect.

Configuring the Operating Mode for Pin 2 and Pin 4 of the Port

You can select the port operating mode for pin 2 and pin 4 of the selected port from the **Port mode** drop-down menu. The following operating modes are available:

Table 39: "Port Mode" Drop-Down Menu: Selecting the Operating Mode for Pin 2 and Pin 4 of the Selected IO-Link Port

Selection Option	Description
Deactivated	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 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 to the port are inverted. All elements of the port configuration are ignored except for the input and output data length.
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 2 and pin 4 is permanently set to logic 1.

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.

10.3.1.4.2 Configuring IP Parameters

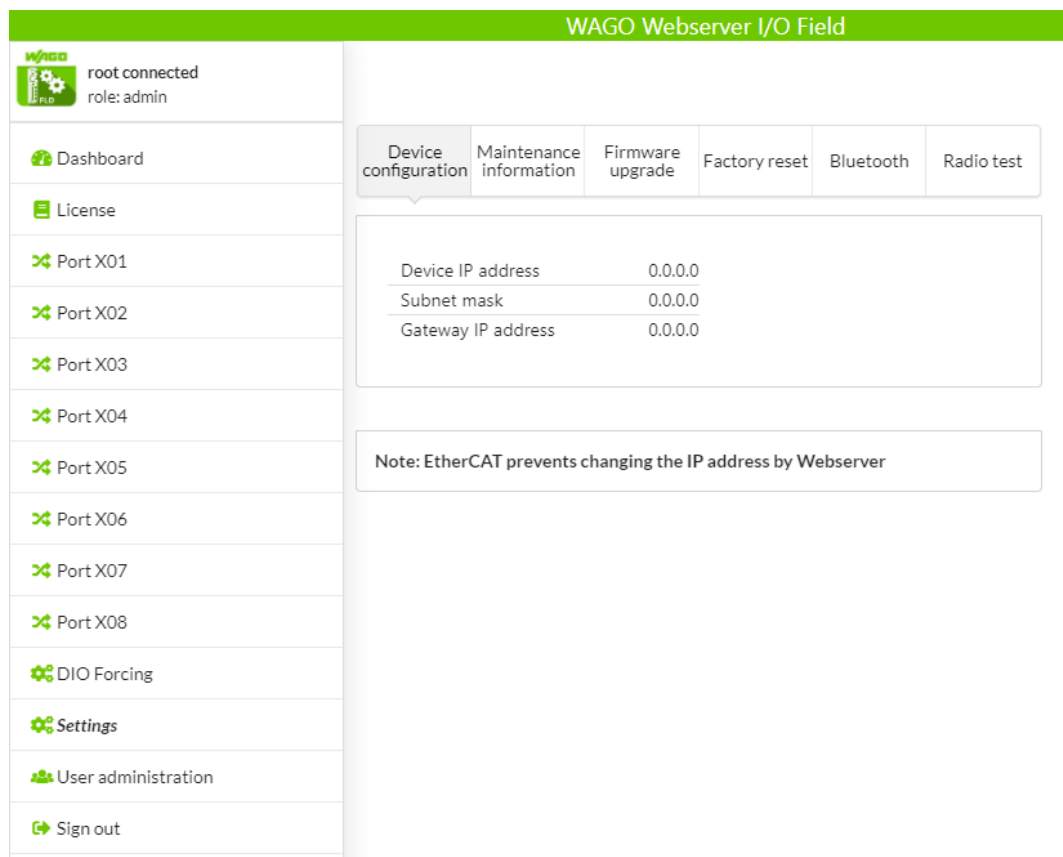


Figure 17: Settings Menu Item, Device Configuration Tab (Example View)

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.

10.3.1.4.3 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 18: **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 40: 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

Name	Data Format and Length	Description	Corresponding I&M Field
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
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.

10.3.1.4.4 Update Firmware

With the **Firmware upgrade** tab, WAGO Webserver I/O Field provides the option to update the product firmware.

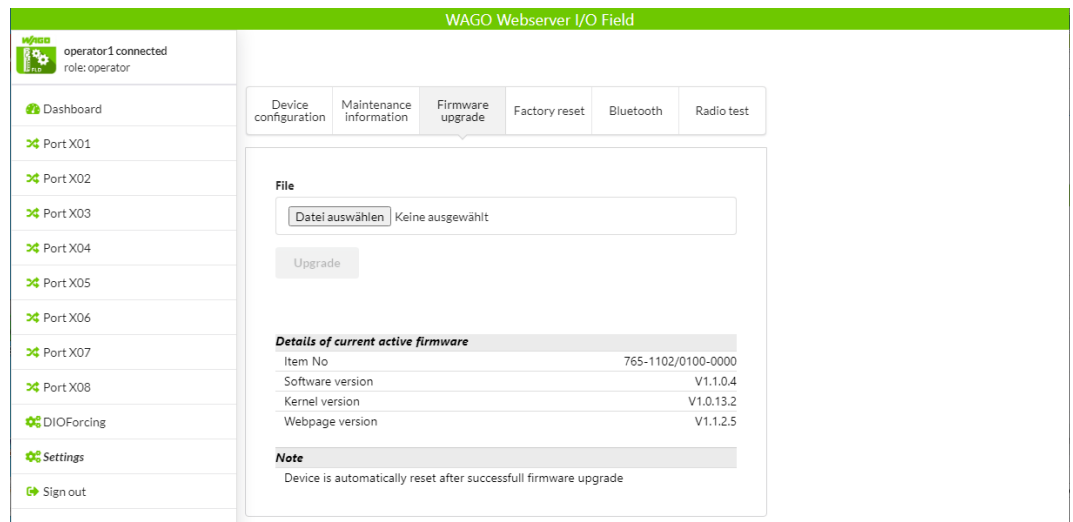


Figure 19: Settings Menu Item, Firmware Upgrade Tab (Example View)

! 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.

i 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.

10.3.1.4.5 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.

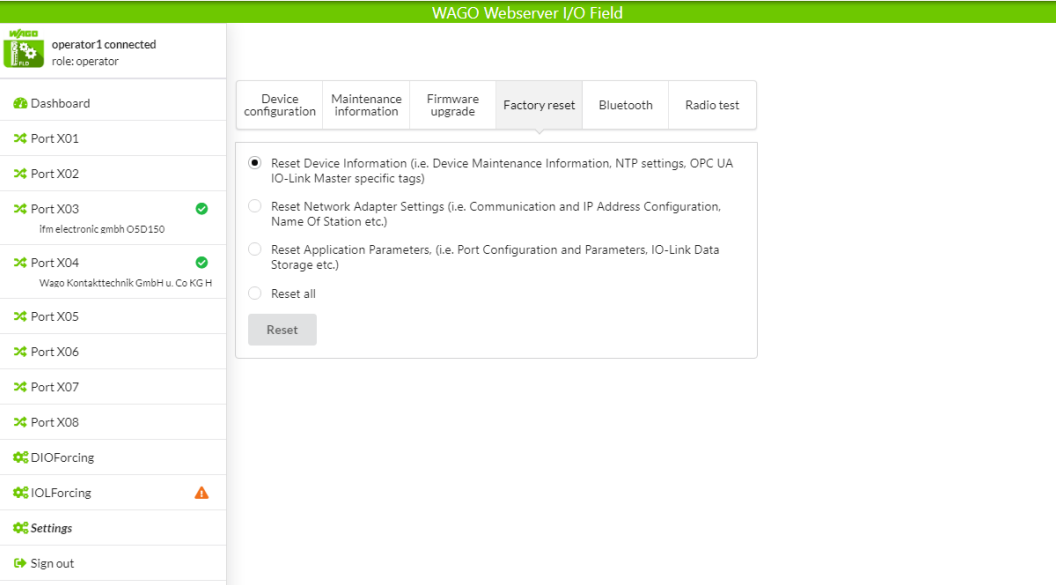


Figure 20: **Settings** Menu Item, **Factory Reset** Tab (Example View)

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 41: 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.

10.3.1.4.6 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.

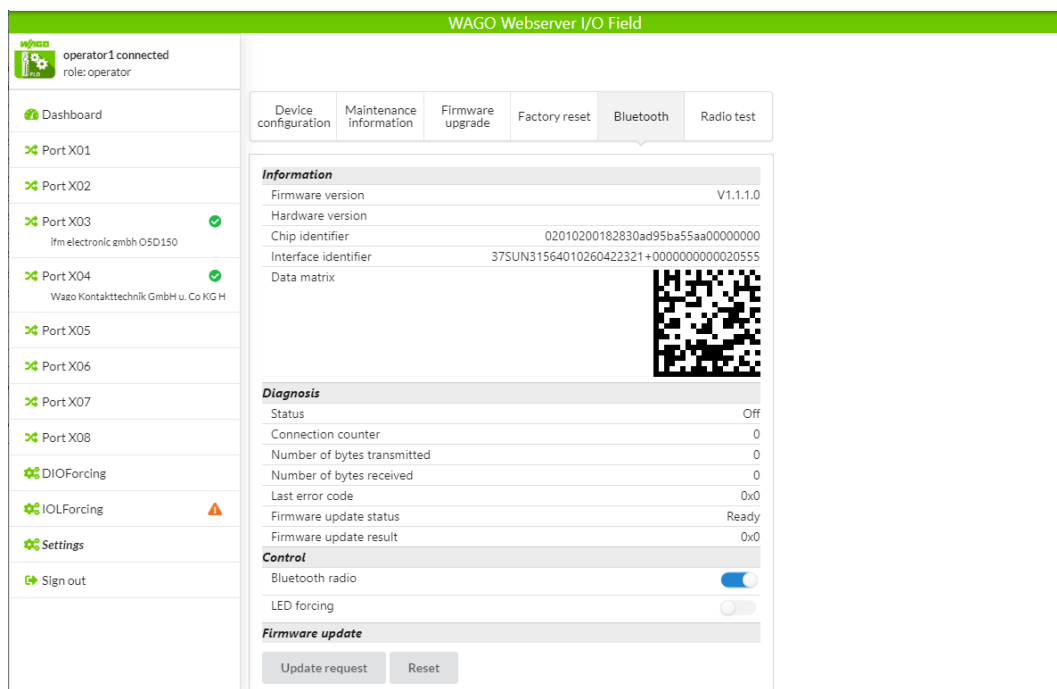


Figure 21: **Settings** Menu Item, **Bluetooth®** Tab (Example View)

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 42: 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

i 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.

i 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.

10.3.1.4.7 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:

Figure 22: **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.

i 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:

Account list			Actions
User name	Role		
root	Admin		

New account			Actions
user1	*****	Maintenance	

Figure 23: **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.

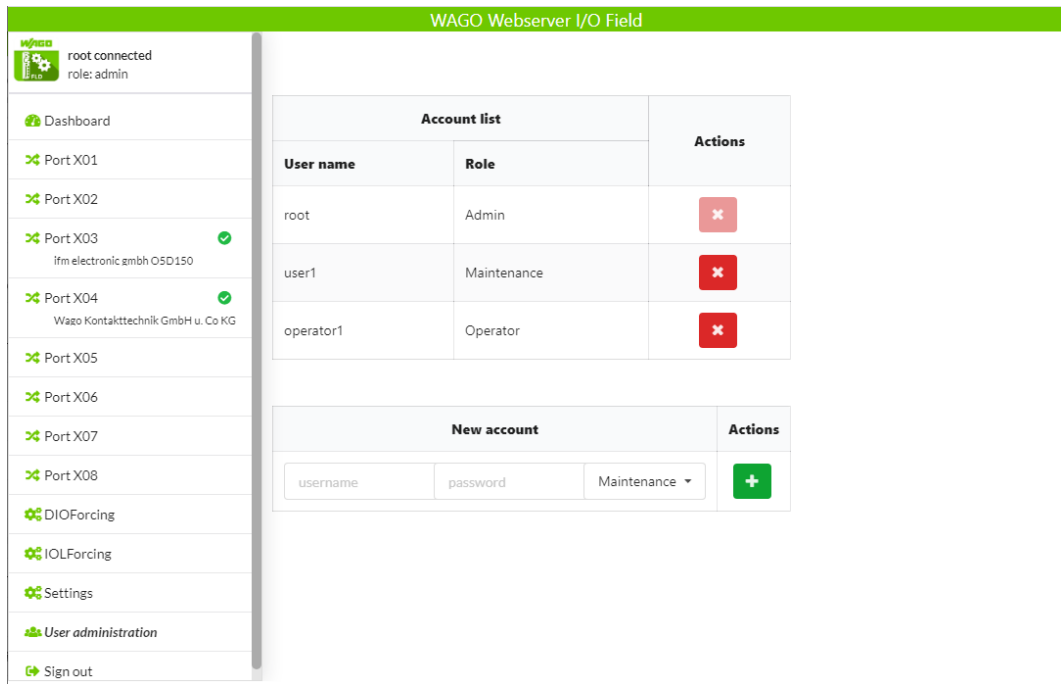


Figure 24: User Administration Menu Item (Example View)

⇒ 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.

10.3.1.4.8 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:

Port	Output process data				Input process data			
	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 25: DIO Forcing Menu Item, “DIO Forcing” Screen (Example View)

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

Table 43: 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 \[► 27\]](#).

There is a separate table row for each of the 4 ports (X01...X04).

- For pin 4, there is always the option of forcing. Whether forcing is also possible for pin 2 depends on the current configuration of pin 2. Pin 2 must be configured as a digital input to force the input process data and as a digital output to force the output process data.

This determines whether or not the pin 2 checkboxes are editable, and **Pin 2** or **No pin 2** is used as the column title in the screen form.

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 I/O Field app

10.3.2.1 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.

10.3.3 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.

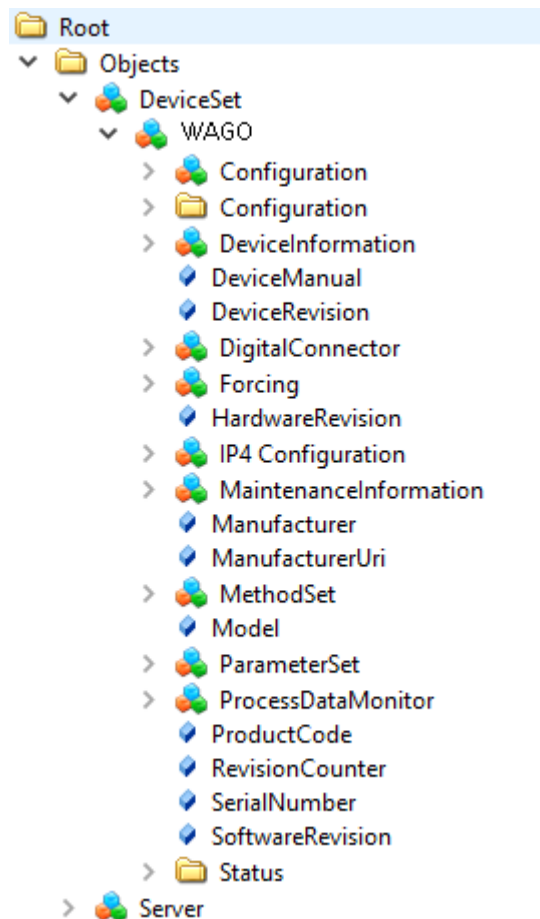


Figure 26: OPC UA: Device Information Model

10.3.3.1 Parameterizing the Product via OPC UA

10.3.3.1.1 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 44: 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

10.3.3.1.2 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] > DigitalConnector > Diagnostics > Configuration
```

The following table lists device-specific configuration parameters.

Table 45: 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.

10.3.3.1.3 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] > DigitalConnector > Diagnostics > PortXX > Configuration
```

The following table lists port-specific configuration parameters.

Table 46: 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

10.3.3.1.4 Reading Port Process Values

The OPC UA server provides nodes with process data. For example, the OPC UA client can read out the value on pin 4 of a port in the `Pin4ProcessData` node.

Process Data of the Digital Inputs and Outputs

The path to this node is:

```
Root > Object > DeviceSet > [device name] > DigitalConnector >
PortXX > SIOProcessData
```

Note

OPC UA client can only read process output data

The process output data is written by the EtherCAT controller. The OPC UA client can only read process output data.

The following table lists port-specific process data of the digital inputs and outputs.

Table 47: Port-Specific Process Data of the Digital Inputs and Outputs

Node Name	Node Class	Access	Description
Pin2ProcessData	Variable	Read	Process data on pin 2
Pin4ProcessData	Variable	Read	Process data on pin 4

10.3.3.1.5 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] > DigitalConnector > Diagnostics > Current

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

Table 48: 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] > DigitalConnector > Diagnostics > Temperature

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

Table 49: 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] > DigitalConnector > Diagnostics > Voltage

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

Table 50: 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

10.3.3.1.6 Read 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] > DigitalConnector > PortXX > Diagnostics > Flags

The following table lists port-specific diagnostic information.

Table 51: 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

10.3.3.1.7 Read Statistics

The OPC UA server provides nodes with statistical information. For example, the OPC UA client can read out the maximum measured current on pin 1 of a port in the `MaxCurrentPin1` node.

The path to this node is:

```
Root > Object > DeviceSet > [device name] > DigitalConnector >
PortXX > Statistics > Current / Temperature / Voltage
```

The following table lists port-specific statistical information:

Table 52: Port Specific Statistical Information

Measurement	Node Name	Node Class	Access	Description
Current	MaxCurrentPin1	Variable	Read	Maximum current on pin 1 since the value was reset; unit: mA
	MaxCurrentPin2	Variable	Read	Maximum current on pin 2 since the value was reset; unit: mA
	MaxCurrentPin4	Variable	Read	Maximum current on pin 4 since the value was reset; unit: mA
	MinCurrentPin1	Variable	Read	Minimum current on pin 1
	MinCurrentPin2	Variable	Read	Minimum current on pin 2
	MinCurrentPin4	Variable	Read	Minimum current on pin 4
Temperature	MaxTemperature-Pin1	Variable	Read	Maximum temperature on pin 1 since the value was reset; unit: °C

Measurement	Node Name	Node Class	Access	Description
	MaxTemperature-Pin2	Variable	Read	Maximum temperature on pin 2 since the value was reset; unit: °C
	MaxTemperature-Pin4	Variable	Read	Maximum temperature on pin 4 since the value was reset; unit: °C
	MinTemperaturePin1	Variable	Read	Minimum temperature on pin 1 since the value was reset; unit: °C
	MinTemperaturePin2	Variable	Read	Minimum temperature on pin 2 since the value was reset; unit: °C
	MinTemperaturePin4	Variable	Read	Minimum temperature on pin 4 since the value was reset; unit: °C
Voltage	MaxVoltagePin1	Variable	Read	Maximum voltage on pin 1 since the value was reset; unit: mV
	MaxVoltagePin2	Variable	Read	Maximum voltage on pin 2 since the value was reset; unit: mV
	MaxVoltagePin4	Variable	Read	Maximum voltage on pin 4 since the value was reset; unit: mV
	MinVoltagePin1	Variable	Read	Minimum voltage on pin 1 since the value was reset; unit: mV
	MinVoltagePin2	Variable	Read	Minimum voltage on pin 2 since the value was reset; unit: mV
	MinVoltagePin4	Variable	Read	Minimum voltage on pin 4 since the value was reset; unit: mV

10.3.3.1.8 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 53: 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:

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

10.3.3.1.9 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

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 reen-able the Force function.

10.3.3.1.10 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.

10.3.3.1.10.1 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.

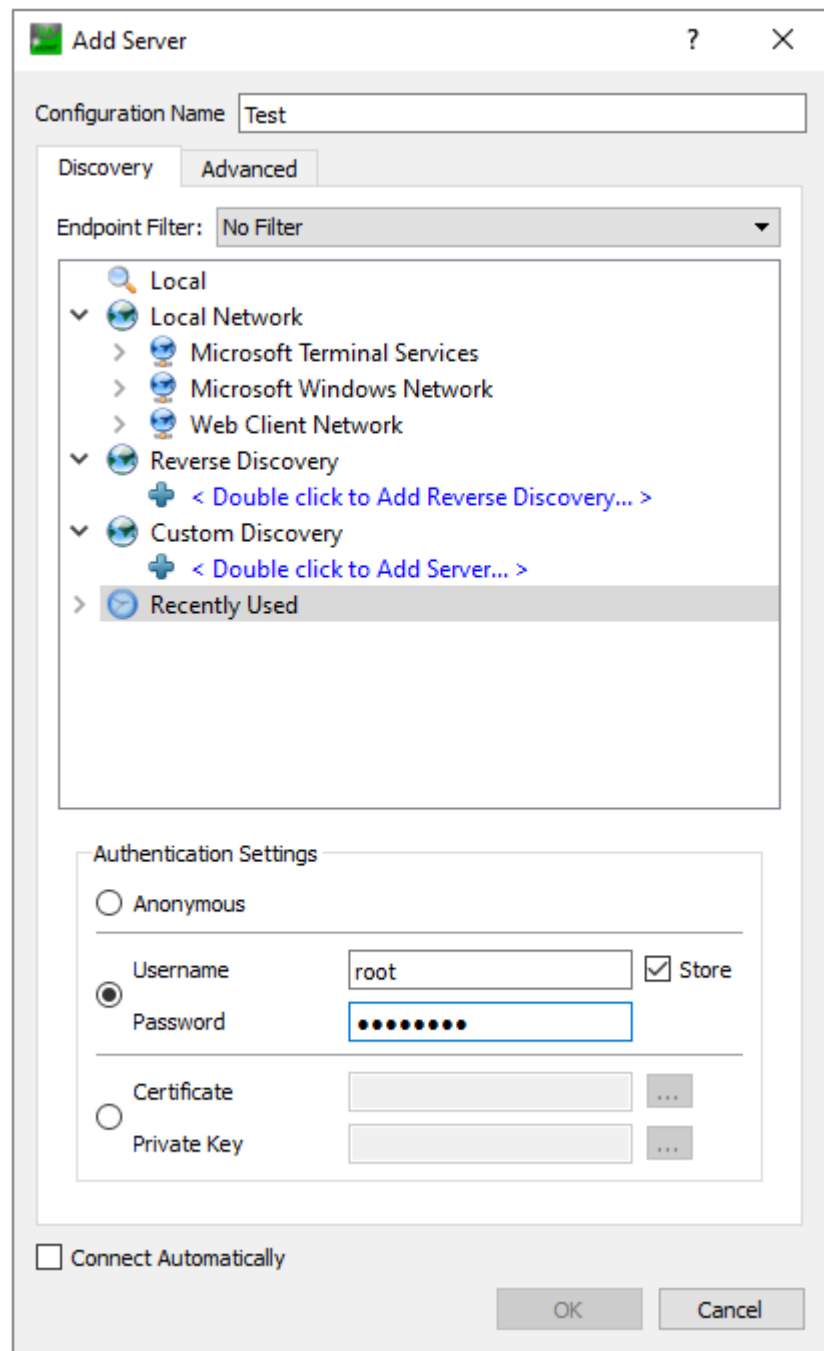


Figure 27: Add Server Dialog – Discovery Tab (Default)

Add Server

Configuration Name:

Discovery **Advanced**

Server Information

Endpoint Url:

Reverse Connect: ☐

Security Settings

Security Policy:

Message Security Mode:

Authentication Settings

☐ Anonymous

☒ Username: ☐ Store

Password:

☐ Certificate: ...

Private Key: ...

Session Settings

Session Name:

☐ Connect Automatically

OK **Cancel**

Figure 28: 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.

10.3.3.1.10.2 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.

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

Output Arguments			
Name	Value	DataType	Description
Status		Int32	

Result

Call Close

Figure 31: 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.

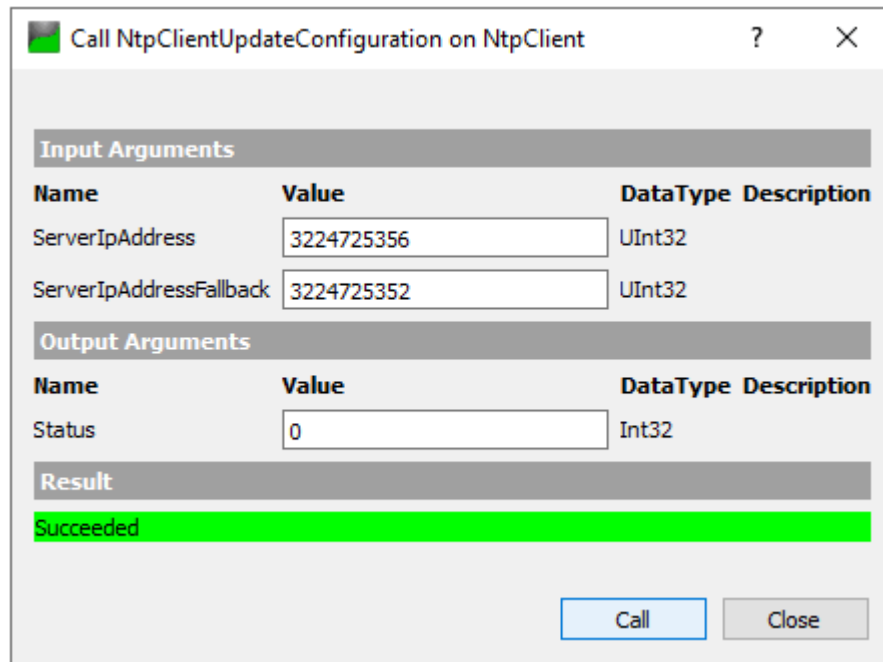


Figure 32: NTP Client Configuration Dialog (Succeeded)

10.3.3.1.10.3 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	... Save as...	String	
Status		Int32	

Result

Figure 33: 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 ... Save as...	String	
Status	0	Int32	

Result

Succeeded

Figure 34: 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.

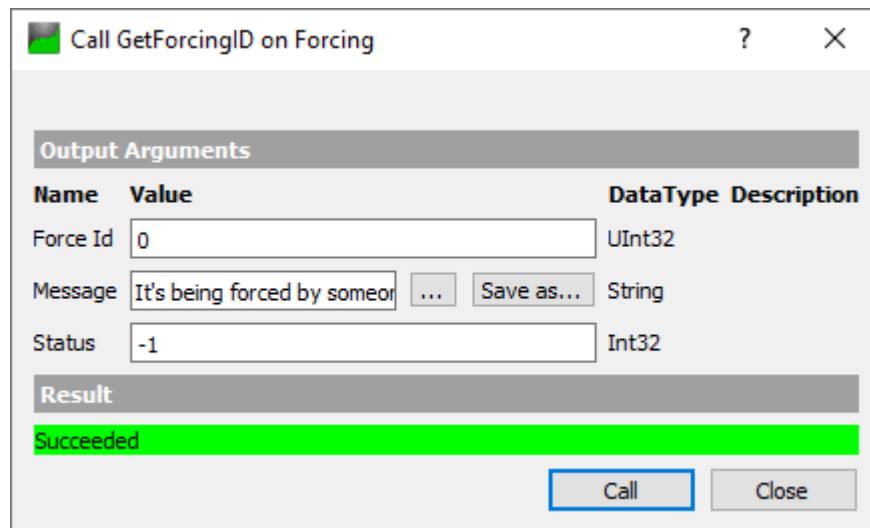


Figure 35: GetForcingID Method: Unsuccessful

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.

10.3.3.1.10.4 Simulating Digital Inputs

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.

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.

Call InputSimulationPin4 on Forcing

Input Arguments

Name	Value	DataType	Description
Force Id		UInt32	
Force Mask		Byte	
Force Data		Byte	

Output Arguments

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

Result

Figure 36: InputSimulationPin4 Method

- Enter the **Force ID**, the **Force Mask** and the **Force Data** (the input arguments are described below, including an example).
- 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 54: 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 55: Output Arguments of the InputSimulationPin Method

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

10.3.3.1.10.5 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).

Call OutputPin4 on Forcing

Input Arguments

Name	Value	DataType	Description
Force Id		UInt32	
Force Mask		Byte	
Force Data		Byte	

Output Arguments

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

Result

Figure 37: 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 56: 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 57: Output Arguments of the OutputPin Method

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

10.3.3.1.10.6 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.

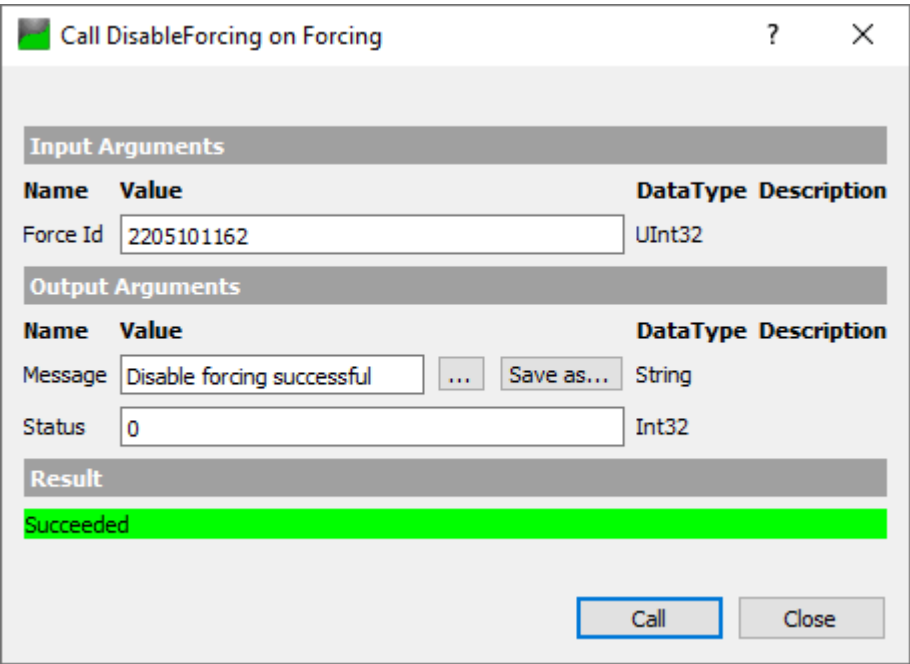


Figure 38: DisableForcing Method

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

Description of the Input Arguments

Table 58: 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 59: Output Arguments of the DisableForcing Method

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

10.3.3.2 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 ▶ 82](#).

Diagnostics

11.1 Diagnostics via Indicators

Power Supply Status

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

Table 60: 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
	Red	On	2L undervoltage (voltage between 11 V and 18 V)
	Red	Flashing	2L overvoltage (voltage above 30 V)
	Off	Off	No 2L supply voltage

System Status

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

Table 61: 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 62: 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 63: 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 64: EtherCAT® Slave Status

LED	Color	State	Description
RUN	Duo LED, red/green		
	Off	Off	INIT: 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 65: 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 66: 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 67: 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 68: LED States®

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

Port Status

LEDs 0 (port X01), 2 (port X02), 4 (port X03), 6 (port X04) indicate the status of the digital input/output channel A.

LEDs 1 (port X01), 3 (port X02), 5 (port X03), 7 (port X04) indicate the status of the digital input/output channel B.

Table 69: Port Status

LED	Color	State	Description
0, 2, 4, ... Port status channel A (pin 4)	Duo LED, yellow/red (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
	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, ... Port status channel B (pin 2)	Duo LED, yellow/red (yellow = simultaneously red and green)		
	yellow	On	Status of digital input/output channel B: 1
	Off	Off	Status of digital input/output channel B: 0
	red	On	Overload, short circuit (pin 2 and pin 3)

LED	Color	State	Description
	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 70: Diagnostic History (Index 0x10F3)

Subindex	Name	Explanation	Type	Flags	Default
0	Highest Supported Subindex	Highest subindex See 🔗 Subindex 0: Highest Supported Subindex [▶ 101] .	UINT8	RO	
1	Maximum Messages	Number of diagnostic messages that can be stored in the diagnostic history See 🔗 Subindex 1: Maximum Messages [▶ 101] .	UINT8	RO	64
2	Newest Message	Subindex of the most recent logged diagnostic message See 🔗 Subindex 2: Newest Message [▶ 101] .	UINT8	RO	0
3	Newest Acknowledged Message	Most recent acknowledged message See 🔗 Subindex 3: Newest Acknowledged Message [▶ 102] .	UINT8	RW	0
4	New Messages Available	New message available See 🔗 Subindex 4: New Messages Available [▶ 103] .	BOOL	RO	0
5	Flags	Flags for controlling the sending and saving of diagnostic messages See 🔗 Subindex 5: Flags [▶ 103] .	UINT16	RW	0x0001
6–69	Diagnosis Message	Buffer for diagnostic messages See 🔗 Subindexes 6–69: Diagnosis Message (Write-Protected) [▶ 104] .	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 71: 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 72: 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 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	Data Type	Description
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 73: 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 74: Emergency Error Codes

Emergency Error Code (hex)	Description
00xx	Error Reset or No Error
10xx	Generic Error
20xx	Current
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

Emergency Error Code (hex)	Description
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 75: 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.
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

Emergency Error Code (hex)	Alarm	Description	Remedy
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 76: 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
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

IO-Link Event Code	Description	Remedy
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 77: 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
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

IO-Link Event Code	Description of the Error Function on the Connected IO-Link Device	Corrective Action on the Connected IO-Link Device
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 Error Register

The error register can be accessed in the object dictionary of the EtherCAT® slave under index 0x1001.

Table 78: Error Register (Index 0x1001)

Index	Name	Explanation	Type	Flag	Default
0x1001	Error Register	Error Register Object Bit 0 = 1: Generic error Bit 1 = 1: Current error (SSC or ASC) Bit 2 = 1: Voltage error (LVS or LVA) Bits 3–6: reserved Bit 7 = 1: Internal module error (IME)	UINT32	RO	0x00000000

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 \[► 68\]](#).

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., “765-1101”).

You can find information on performing firmware updates in [🔗 Update Firmware \[► 66\]](#).

Decommissioning

13.1 Disposal and Recycling

Table 79: 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 \[► 113\]](#)).

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 80: 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 81: 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.

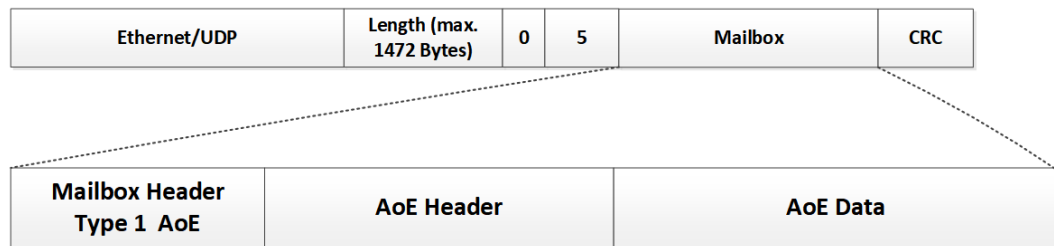


Figure 39: Structure of the Ethernet Frame for AoE

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 82: 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 83: 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 [▶ 120] .
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 84: 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:

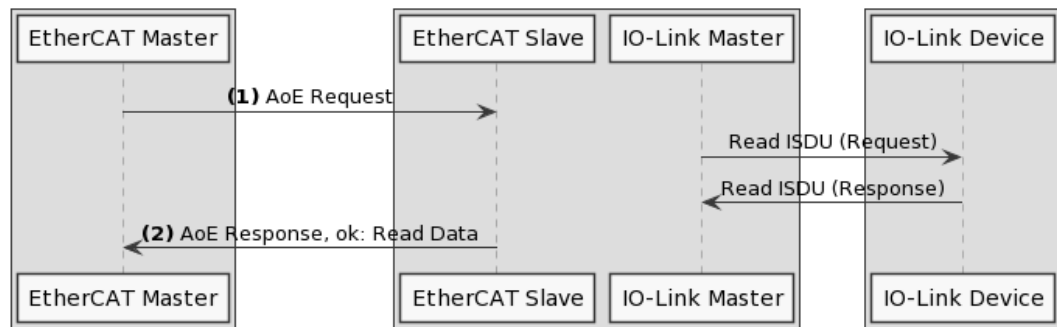


Figure 40: ISDU Read Process (EtherCAT)

(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](#) [▶ 114].
2. The AoE header corresponds to the description in [Overview of the Structure of the AoE Frame](#) [▶ 114].
3. The AoE data area has the following structure for an ISDU read request:

Table 85: 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 86: 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.

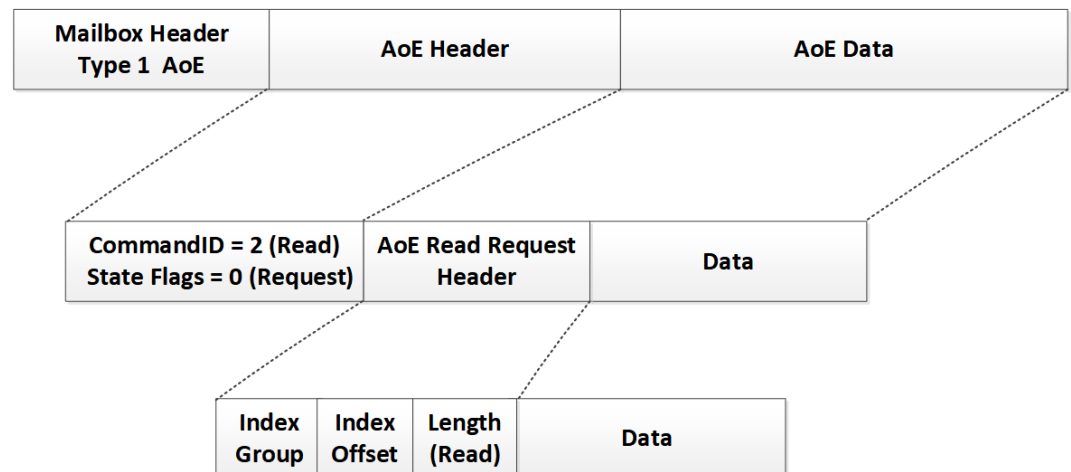


Figure 41: Structure of the AoE Header Area and AoE Data Area in the ISDU Read Service

(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 87: 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 88: 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:

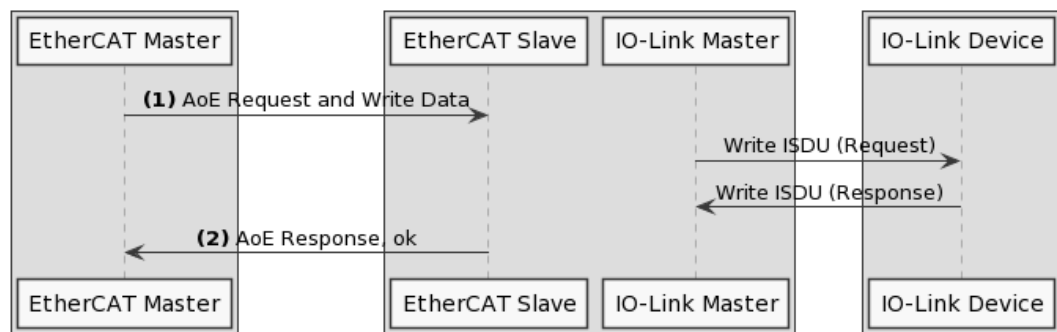


Figure 42: ISDU Write Process (EtherCAT)

(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 \[p 114\]](#).
- The AoE header corresponds to the description in [🔗 Overview of the Structure of the AoE Frame \[p 114\]](#).
- The AoE data area has the following structure for an ISDU write request:

Table 89: 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 90: 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.

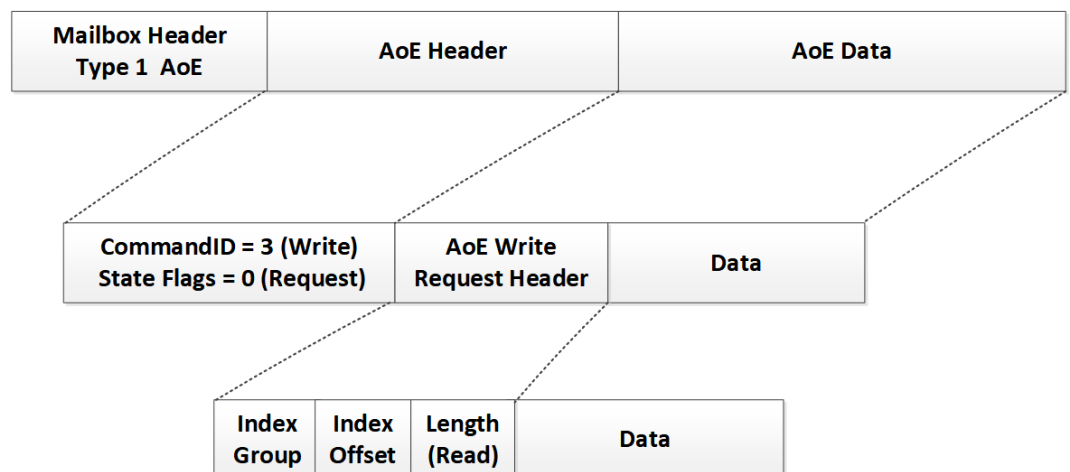


Figure 43: Structure of the AoE Header and AoE Data Area for the ISDU Write Service

(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 91: 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 92: 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 93: 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 94: 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 95: “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 765-1204/100-000 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 /765-1204/100-000](http://www.wago.com/765-1204/100-000).

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

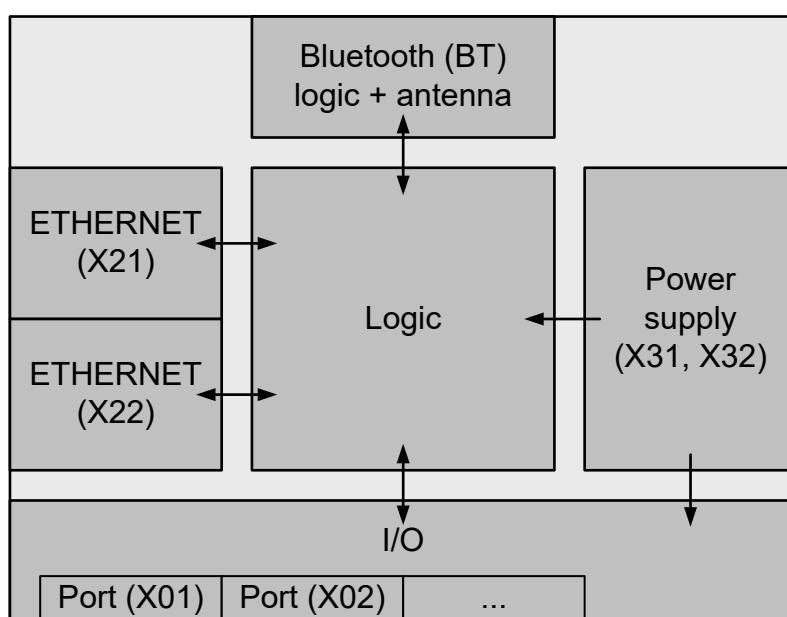
Product Description

The product 765-1204/100-000 is used to capture and output digital field signals, e.g., from sensors and actuators, which have been sent or received by a higher-level controller.

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 96: 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 97: 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 98: 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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