Original operating instructions

MD 798i-11-82/L5-2222

IO-Link Master Module

The Sensor People

We reserve the right to make technical changes
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1 About These Instructions

These operating instructions describe the structure, functions and the use of the product and will help you to operate the product as intended. Read these instructions carefully before using the product. This is to avoid possible damage to persons, property or the device. Retain the instructions for future use during the service life of the product. If the product is passed on, pass on these instructions as well.

1.1 Target groups

These instructions are aimed at qualified personal and must be carefully read by anyone mounting, commissioning, operating, maintaining, dismantling or disposing of the device.

1.2 Explanation of symbols used

The following symbols are used in these instructions:

Tab. 1.1: Warning symbols and signal words

	Symbol indicating dangers to persons
	Symbol indicating possible property damage
NOTE	Signal word for property damage Indicates dangers that may result in property damage if the measures for danger avoidance are not followed.
CAUTION	Signal word for minor injuries Indicates dangers that may result in minor injury if the measures for danger avoidance are not followed.
WARNING	Signal word for serious injury Indicates dangers that may result in severe or fatal injury if the measures for danger avoidance are not followed.
DANGER	Signal word for life-threatening danger Indicates dangers with which serious or fatal injury is imminent if the measures for danger avoidance are not followed.

Tab. 1.2: Other symbols

	Symbol for tips Text passages with this symbol provide you with further information.
↳	Symbol for action steps Text passages with this symbol instruct you to perform actions.
⇨	Symbol for action results Text passages with this symbol describe the result of the preceding action.

1.3 Additional documents

The following additional documents are available online at www.leuze.com:

- Data sheet
- EU Declaration of Conformity
- Commissioning manual IO-Link devices

2 Notes on the Product

2.1 Product identification

This instruction is valid for following devices:

- MD 798i-11-82/L5-2222

2.2 Scope of delivery

The scope of delivery includes:

- MD 798i-11-82/L5-2222
- Closure caps for M12 female connectors
- Label clips

2.3 Legal requirements

The device falls under the following EU directives:

- 2014/30/EU (electromagnetic compatibility)
- 2011/65/EU (RoHS Directive)

3 For Your Safety

The product is designed according to state-of-the-art technology. However, residual risks still exist. Observe the following warnings and safety notices to prevent damage to persons and property. Leuze electronic GmbH + Co. KG accepts no liability for damage caused by failure to observe these warning and safety notices.

3.1 Bestimmungsgemäße Verwendung

These devices are designed solely for use in industrial areas.

The multiprotocol I/O module MD 798i-11-82/L5-2222 is an IO-Link master according to IO-Link specification V1.1 and can be can be operated in the three Ethernet protocols PROFINET, Ethernet/IP and Modbus TCP. The module detects the bus protocol automatically during the start-up.

The IO-Link master module MD 798i-11-82/L5-2222 has eight IO-Link channels. Up to eight IO-Link sensors or IO hubs with IO-Link can be connected to the M12 sockets. In addition, up to 12 digital sensors can be connected directly it. When using I/O hubs, it is possible to connect up to 128 digital sensors per device.

⚠ CAUTION!
Observe intended use!!
↳ Only operate the device in accordance with its intended use. The protection of personnel and the device cannot be guaranteed if the device is operated in a manner not complying with its intended use.
Leuze electronic GmbH + Co. KG is not liable for damages caused by improper use.
↳ Read these operating instructions before commissioning the device. Knowledge of the operating instructions is an element of proper use.

NOTE
Comply with conditions and regulations!
↳ Observe the locally applicable legal regulations and the rules of the employer's liability insurance association.

3.2 General safety notes

- The device may only be assembled, installed, operated, parameterized and maintained by professionally-trained personnel.
- The device may only be used in accordance with applicable national and international regulations, standards and laws.
- The device only meets the EMC requirements for industrial areas and is not suitable for use in residential areas.
- Change the default password of the integrated web server after the first login. Leuze recommends using a secure password

NOTE
Do not modify or otherwise interfere with the device!
↳ Do not carry out modifications or otherwise interfere with the device. The device must not be tampered with and must not be changed in any way.
The device must not be opened. There are no user-serviceable parts inside.
Repairs must only be performed by Leuze electronic GmbH + Co. KG.

4 System Description IO-Link

IO-Link is a fieldbus independent communication interface for sensors and actuators. Signals and energy can be exchanged between any networks, fieldbuses and backplane buses via a digital, serial point-to-point connection.

Each IO-Link system consists of an IO-Link master and an IO-Link device (e.g. sensor, I/O hub, valve block). An IO-Link master is provided with at least one IO-Link port (channel). One IO-Link device can be connected to each port. The system components are interconnected according to the port specification via unshielded 3-wire or 5-wire standard cables.

The IO-Link technology is described in the "IO-Link Interface and System Specification" and IEC 61131-9. IO-Link capable devices comply either with specification V1.0 or specification V1.1.

The properties, functions and parameters of the IO-Link device are represented in an electronic device description (IODD). The IODDs for Leuze devices can be downloaded via the Leuze Software Manager and can also be obtained free of charge from www.leuze.com. The IODDs of all devices have the same structure and contain the following information for system integration

- Communication properties
- Device parameters with value range and default value
- Identification, process and diagnostic data
- Device data
- Text description
- Picture of the device
- Logo of the manufacturer

The structure of the IODD is defined by the IO-Link specification and is the same for all IO-Link devices. The IODD is based on indexes. The communication properties, device parameters, identification, process, diagnostic and device data are assigned to fixed indexes in the IODD, via which the parameters can be controlled. Some indexes are further divided by sub indexes.

4.1 Features

- Point-to-point connection (max. cable length: 20 m)
- Unshielded 3-wire or 5-wire standard cables
- Cyclical process data transmission
- Acyclical data transmission, e.g. device data and events
- Communication between IO-Link master and IO-Link device possible in three transmission rates
- Parallel exchange of device data without influencing the process data
- Communication via 24 V pulse modulation, standard UART protocol

4.2 System architecture

At least one IO-Link master and one IO-Link device (e.g. sensor or actuator) are required for IO-Link communication. IO-Link master and IO-Link device are interconnected via an unshielded 3-wire or 5-wire standard cable. The setting can be carried out with a configuration tool or via the fieldbus level.

The IO-Link master establishes the connection between IO-Link device and the higher-level control system. An IO-Link master can have several IO-Link ports. Only one IO-Link device can be connected to each port.

IO-Link hubs also make it possible to integrate devices without an IO-Link output in automation systems via IO-Link.

Standard tools and functions are provided for the integration, commissioning and configuration of the IO-Link communication.

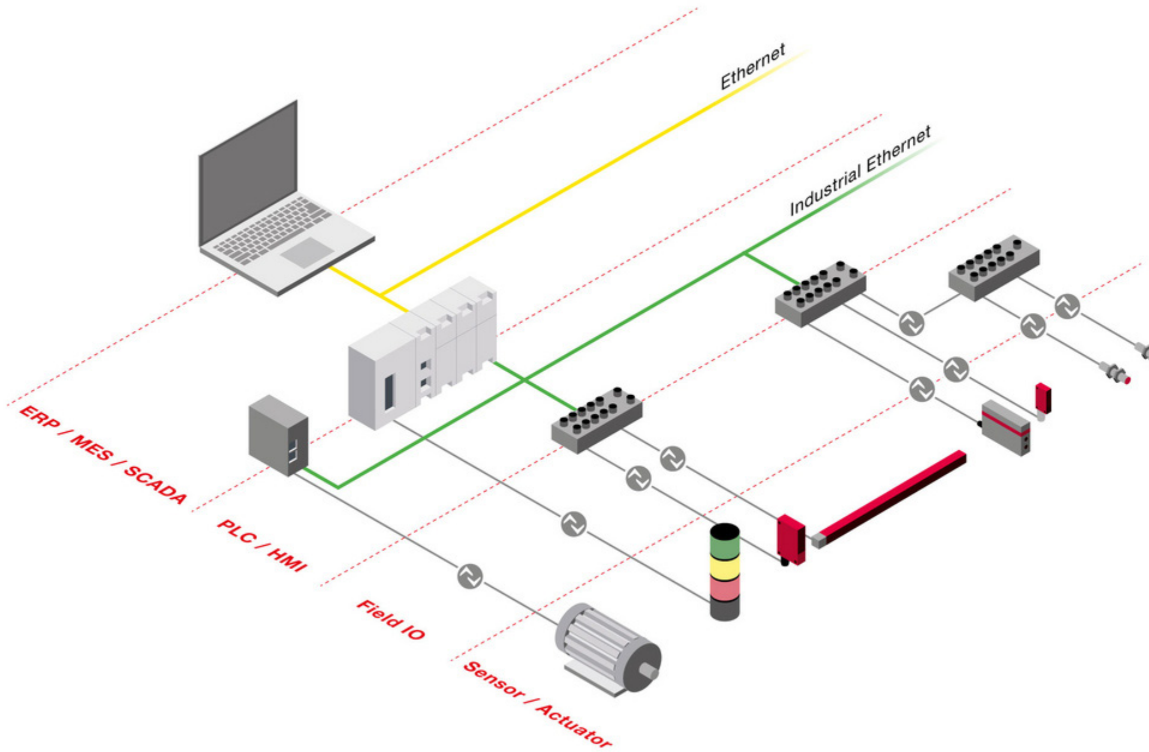

Fig. 4.1: IO-Link system overview

4.3 Operating principle

IO-Link is a digital point-to-point connection between an IO-Link master and an IO-Link device. Process data and other information such as parameters and diagnostic messages are transferred with a 24 V pulse modulation via a combined switching status and data channel (C/Q).

IO-Link communication is independent of the fieldbus used.

4.4 Operating modes

The operating mode can be set separately at any port of the IO-Link master.

Two operating modes are available for the IO-Link master:

- IO-Link mode: IO-Link communication possible
- Standard I/O mode (SIO): digital I/O communication

IO-Link communication is implemented via the switching and communication cable (C/Q).

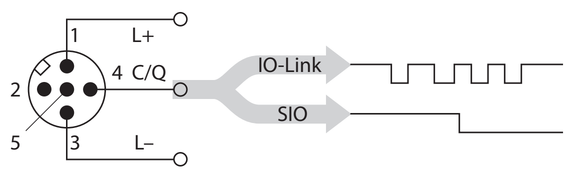

Fig. 4.2: IO-Link communication via C/Q

During initialization the ports of the IO-Link master behave like a normal digital input. The IO-Link devices are operated in IO-Link mode. A command of the higher-level IO-Link master establishes IO-Link communication in IO-Link mode. This command is called the "Wake-up request".

4.4.1 IO-Link mode

In IO-Link mode communication takes place between an IO-Link master and an IO-Link device. Communication always starts from the IO-Link master.

Transmission speed between IO-Link master and IO-Link device

Three transmission rates are defined in the IO-Link specification:

- 4.8 kBaud
- 38.4 kBaud
- 230.4 kBaud

Each device supports only one transmission rate, an IO-Link master supports all transmission rates. The transfer time of the cyclical process data is determined by the telegram length as well as the delay times in the device and the master. With a transmission rate of 38.4 kBaud and a telegram length of 2 byte the transmission time is typically 2.3 ms.

Response times

The response time of the IO-Link system provides information on the frequency and speed of the data transmission between IO-Link master and IO-Link device. This response time depends on the following factors:

- Minimum cycle time: Intervals defined in the IODD in which the IO-Link master addresses the IO-Link device. Different minimum cycle times can be defined for different devices.
- Internal processing time of the IO-Link master and the IO-Link device

Cyclical and Acyclical Communication

The data exchanged between IO-Link master and the IO-Link device can be divided into cyclical process data and acyclical data. Process data and value states are transferred cyclically. Acyclical data is transferred separately to cyclic process data. Acyclical data includes device data, parameter functions and events such as diagnostic information, which is only transferred on request. The two communication types are independent of each other and do not interact.

Cyclical communication	
Process data	Value status (port qualifier)
• 0…32 bytes of process data possible per device (each input and output) • Process data size determined by the device	• The Port Qualifier indicates whether the process data is valid or not.

Acylical communication	
Device data	Value status (port qualifier)
• Parameters, identification data or diagnostic information • Data exchange on request of the IO-Link master • Device data can be written to the device or read from the device.	• Device indicates event to master: Error messages and warnings • Master indicates event to device: e.g. cable break or communication abort

Combining IO-Link devices with different specifications

Only devices of specification V1.0 can be operated on IO-Link masters of specification V1.0. Devices of specification V1.0 and V1.1 can be operated on IO-Link masters of specification V1.1.

	IO-Link device V1.0	IO-Link device V1.1
IO-Link master V1.0	x	-
IO-Link master V1.1	x	x

Data storage mode

	NOTE
i	Data storage mode is only available for devices complying with the IO-Link specification V1.1.

Data storage mode makes it possible to replace IO-Link devices without the need for a reconfiguration.

The IO-Link master or the IO-Link device save the device parameters set in the previous configuration. In data storage mode the parameter data memories of IO-Link master and IO-Link device are synchronized. If data storage mode is activated in the IO-Link master, the master writes the stored device parameters to the new device after a device is replaced. The application can be restarted without having to perform a new configuration.

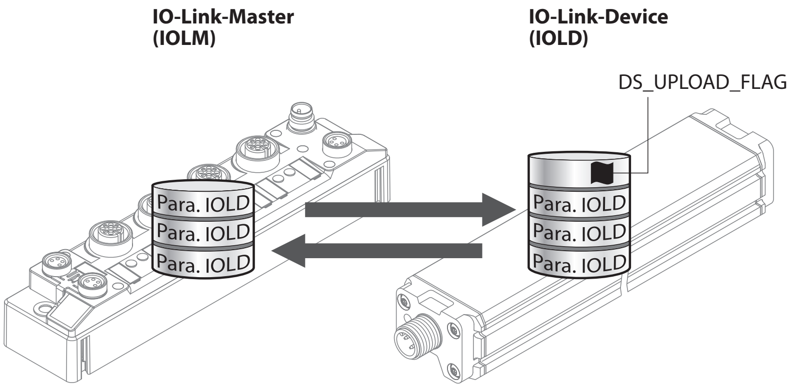

Fig. 4.3: Data storage mode - general principle, Para. IOLD = parameters of the IO-Link device

4.4.2 Standard I/O mode (SIO mode)

In standard I/O mode IO-Link devices behave like digital sensors or actuators. In this mode the devices only send input or output data to the higher-level instance. IO-Link access to the device is not possible.

5 Product Description

The devices are designed in a fully encapsulated housing with degree of protection IP65/IP67/IP69K.

The IO-Link master module MD 798i-11-82/L5-2222 has eight IO-Link ports for connecting IO-Link devices. The IO-Link ports at the connectors X0…X3 are designed as Class A ports. The IO-Link ports at the connectors X4…X7 are designed as Class B ports. In addition to the eight IO-Link channels, four universal digital DXP channels (PNP) are available. The eight IO-Link channels can be parameterized independently of each other and operated either in IO-Link mode or in SIO mode (DI).

The 4 universal digital channels are designed as DXP-channels and can therefore be parameterized as in- or output.

For connecting the supply voltage, the device has 5-pin, L-coded M12 connectors.

The multiprotocol device can be operated with the three Ethernet protocols PROFINET, EthernNet/IP and Modbus TCP mentioned above by automatic protocol detection without user intervention.

5.1 Device overview

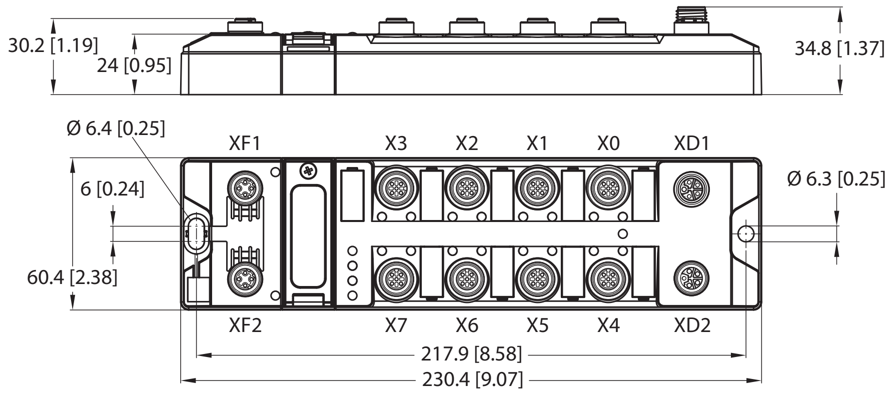

Fig. 5.1: Dimensions MD 798i-11-82/L5-2222

5.1.1 Block diagram

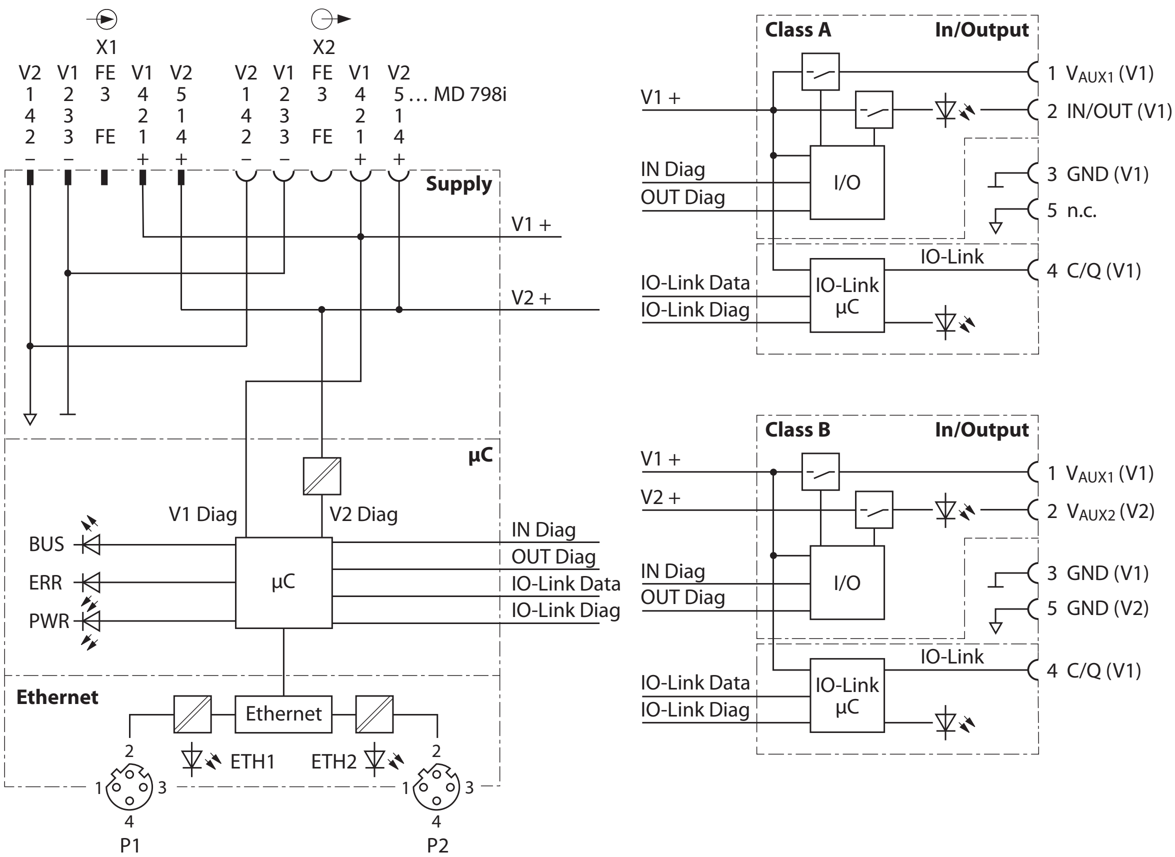

Fig. 5.2: Block diagram

5.2 Properties and features

- Fibre-glass reinforced housing
- Shock and vibration tested
- Fully potted module electronics
- Degree of protection IP67/IP69K
- UV-resistant according to DIN EN ISO 4892-2
- Metal connectors
- 4 IO-Link ports Class A and 4 IO-Link ports Class B
- Multiprotocol functionality: PROFINET Device, EtherNet/IP Device, Modbus TCP Slave
- 4 universal DXP channels
- PROFINET:
  - Conformance Class B PA
  - Conformance according to PROFINET specifikation V2.35
  - System redundancy S2
  - Network load class 3
- EtherNet/IP:
  - Support of the IO-Link Parameter Object for asynchronous services (IO-Link CALL)
  - Predefined in- and oputput assemblies

5.3 Operating principle

The IO-Link master module MD 798i-11-82/L5-2222 connects IO-Link sensors and actuators with the higher-level control system. The device has an Ethernet interface and fieldbus-independent I/O electronics with IO-Link master functionality (Class A and Class B ports). Via the Ethernet interface, the IO-Link master is connected to an (existing) Ethernet network as an EtherNet/IP device, Modbus TCP slave or PROFINET device. During operation, the process data is exchanged between Ethernet and IO-Link. In addition the devices can process signals from sensors and actuators via four configurable digital channels.

5.4 Functions and operating modes

5.4.1 Multiprotocol technology

The devices can be used in the following three Ethernet protocols:

- Modbus TCP
- EtherNet/IP
- PROFINET

The required Ethernet protocol can be detected automatically or determined manually.

Automatic protocol detection

A multi-protocol device can be operated without intervention of the user (which means, without changes in the parameterization) in all of the three Ethernet protocols mentioned.

During the system start-up phase (snooping phase), the module detects which Ethernet protocol requests a connection to be established and adjusts itself to the corresponding protocol. After this an access to the device from other protocols is read-only.

Manual Protocol Selection

The user can also define the protocol manually. In this case, the snooping phase is skipped and the device is fixed to the selected protocol. With the other protocols, the device can only be accessed read-only.

Protocol Dependent Functions

The device Supported the following Ethernet protocol specific functions:

PROFINET

- FSU - Fast Start-Up (prioritized startup)
- Topology discovery
- Address assignment via LLDP
- MRP (Media Redundancy Protocol)

EtherNet/IP

- QC - QuickConnect
- Device Level Ring (DLR)

5.4.2 IO-Link channels

The IO-Link master module MD 798i-11-82/L5-2222 has four Class A IO-Link ports (slots X0…X3) and four Class B IO-Link ports (slots X4…X7).

The eight IO-Link channels can be parameterized independently of each other and operated either in IO-Link mode or in SIO mode (DI).

5.4.3 Configurable digital channels - functions

The device is provided with four digital channels, which can be configured as inputs or outputs according to the application requirements. In all, up to four 3-wire PNP sensors or four PNP DC actuators with a maximum output current of 0.5 A can be connected per input or output.

6 Mounting

⚠ CAUTION!	
⚠	Mounting on uneven surfaces **Device damage due to stresses in the housing** ↳ Fix the device on a flat mounting surface. ↳ Use two M6 screws for mounting.

The device can be screwed onto a flat mounting plate.

↳ Attach the module to the mounting surface with two M6 screws. The maximum tightening torque for the screws is 1.5 Nm.

↳ Avoid mechanical stresses.

↳ Optional: Ground the device.

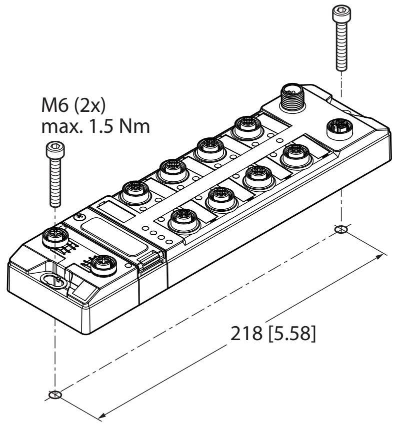

Fig. 6.1: Mounting the device on a mounting plate

6.1 Mounting the device outdoors

The device is UV-resistant according to DIN EN ISO 4892-2. Direct sunlight can cause material abrasion and color changes. The mechanical and electrical properties of the device are not affected.

↳ To avoid material abrasion and color changes: Protect the device from direct sunlight, e.g. by using protective shields.

6.2 Grounding the device

6.2.1 Equivalent wiring diagram and shielding concept

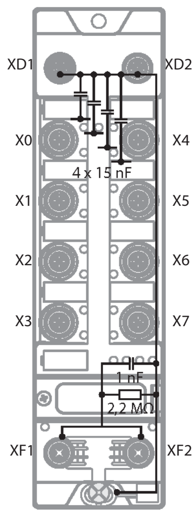

Fig. 6.2: MD 798i-11-82/L5-2222 - equivalent circuit diagram and shielding concept

6.2.2 Shielding of the fieldbus and I/O level

The fieldbus and the I/O level of the modules can be grounded separately.

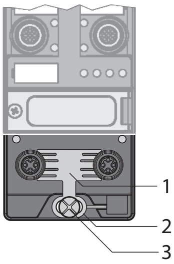

Fig. 6.3: Grounding clip (1), grounding ring (2) and metal screw (3)

The grounding ring (2) is the module grounding. The shielding of the I/O level is permanently connected to the module grounding. The module grounding is only connected to the reference potential of the installation when the module is mounted.

Shielding concept of the I/O modules (I/O level)

In the case of direct mounting on a mounting plate, the module grounding is connected to the reference potential of the system via the metal screw in the lower mounting hole (3). If module grounding is not desired, the electrical connection to the reference potential must be interrupted, e.g. by using a plastic screw.

Shielding concept of the fieldbus level

On delivery, a grounding clip is provided on the connectors for the fieldbus connection.

When mounted directly on a mounting plate, the shielding of the fieldbus cables is routed directly to the module ground via the grounding clip and the metal screw in the lower mounting hole.

If direct grounding of the fieldbus shield is not desired, the grounding clip must be removed. In this case, the fieldbus shield is connected to the module ground via an RC element.

6.2.3 Grounding the device - I/O level and fieldbus level

The grounding of the fieldbus level can either be connected directly via the grounding clip (1) or connected and routed indirectly via an RC element to the grounding of the I/O level. If the grounding is to be routed via an RC element, the grounding clip must be removed.

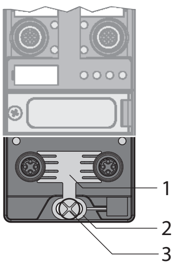

Fig. 6.4: Grounding clamp (1)

Removing the grounding clip: disconnect the direct grounding of the fieldbus level

↳ Use a flat screwdriver to slide the grounding clamp forward and remove it.

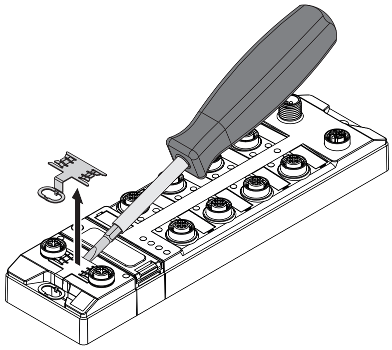

Fig. 6.5: Removing the grounding clamp

Mounting the grounding clip: grounding the fieldbus level directly

↳ Place the grounding clamp between the fieldbus connectors by using a screwdriver in such way that the clamp contacts the metal housing of the connectors.

↳ The shielding of the fieldbus cables is connected to the grounding clip.

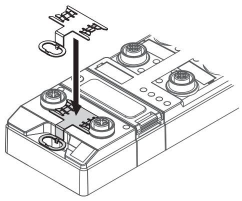

Fig. 6.6: Mounting the grounding clip

Grounding the device - mounting on a mounting plate

↳ For mounting onto a mounting plate: Fix the Device with an M6 metal screw through the lower mounting hole.

⇨ The shielding of the M12 flanges for the I/O level is connected to the reference potential of the installation via the M6 metal screw.

⇨ With mounted grounding clip: The shielding of the fieldbus is connected to the reference potential of the installation via the module grounding of the I/O level.

7 Connecting

7.1 Connecting the device to Ethernet

For the connection to Ethernet the device has an integrated auto-crossing switch with two 4-pole, D-coded M12 x 1-Ethernet-connectors. The maximum tightening torque is 0.6 Nm.

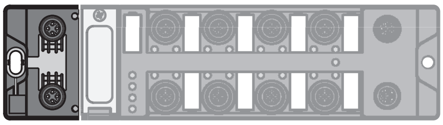

Fig. 7.1: M12 Ethernet connector

✎ Connect the device to Ethernet according to the pin assignment below.

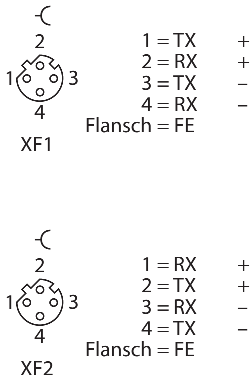

Fig. 7.2: Pin assignment Ethernet connectors

7.2 Connecting the power supply

For the connection to the power supply, the device has two 5-pin, L coded M12 connectors. V1 and V2 are galvanically isolated from each other. The maximum tightening torque is 0.8 Nm.

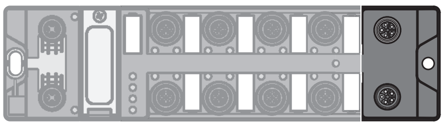

Fig. 7.3: M12 connector for connecting the supply voltage

✎ Connect the device to the power supply according to the pin assignment shown below.

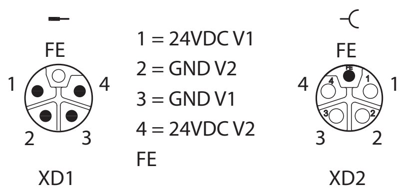

Fig. 7.4: Pin assignment power supply connectors

Connector	Function
XD1	Power feed
XD2	Continuation of the power to the next node
V1	System supply: power supply 1 (incl. supply of electronics)
V2	Load voltage: power supply 2

NOTE

The system voltage (V1) and the load voltage (V2) are supplied and monitored separately. If the voltage goes below the permissible lower limit, the sockets are disconnected according to the supply concept of the module type. If V2 goes below the permissible minimum voltage, the PWR LED changes from green to green flashing or red (depending on the configuration). If V1 goes below the permissible minimum, the PWR LED goes out.

7.2.1 Supply concept

The Device is supplied via two separate voltages V1 and V2.

The I/O-channels are therefore consequently separated into the different potential groups "detachable I/O" (supplied through V2) and "non-detachable" I/O (supplied through V1). This allows a safety shutdown of parts of an installation via emergency-off circuits.

V1 = supply of the module electronics and the respective slots

V2 = supply of module electronics and the respective connectors (separately detachable)

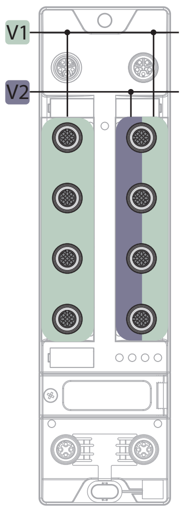

Fig. 7.5: Power supply of 798i-11-82/L5-2222

7.3 Connecting IO-Link devices and digital sensors

The device has eight M12 female connectors for connecting IO-Link devices and digital sensors and actuators. The maximum tightening torque is 0.8 Nm.

⚠ CAUTION!

Wrong supply of IO-Link devices

Damage to the device electronics

↳ Only supply IO-Link devices with the voltage provided at the M12 connectors.

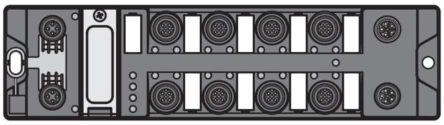

Fig. 7.6: M12 connectors, IO-Link master ports

↳ Connect the sensors and actuators to the device according to the pin assignment.

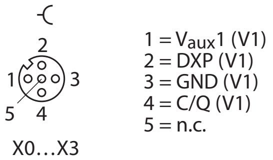

Fig. 7.7: Pin assignment of IO-Link master ports, Class A, X0…X3

Pin	Meaning
Pin 1	VAUX1, switchable via process data
Pin 2	Digital in- or output (DXP)
Pin 3	Ground (V1)
Pin 4	IO-Link or digital input
Pin 5	Not connected

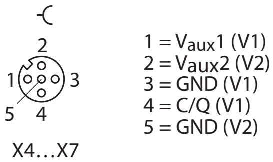

Fig. 7.8: Pin assignment of IO-Link master ports, Class B, X4…X7

↳ Connect the sensors and actuators to the device according to the pin assignment.

Pin	Meaning
Pin 1	VAUX1, switchable via process data
Pin 2	Switchable Class B supply (VAUX2)
Pin 3	Ground V1
Pin 4	IO-Link or digital input
Pin 5	Ground V2

⚠ CAUTION!

Connection of Class A devices to Class B ports

Loss of the galvanic isolation with Class A devices at pin 2 and 5

↳ Only use Class A devices with signals on pin 1, pin 3 and pin 4 at Class B ports.

8 Commissioning

8.1 Setting the IP address

The IP address can be set via three decimal rotary coding switches and DIP switches on the device, via the web server or via the Leuze Service Tool.

8.1.1 Setting the IP address via switches at the device

The IP address can be set via three decimal rotary coding switches on the device.
The switches are located under a cover together with the SET button.

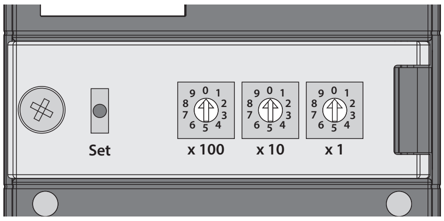

Fig. 8.1: Switches for setting the IP address

↳ Open the cover over the switches.

↳ Set the required rotary coding switches to the required position according to the table below.

↳ Carry out a voltage reset.

⚠ CAUTION!
↳ IP67 or IP69K protection is not guaranteed when the cover over the rotary coding switches is opened. Device damage through penetrating foreign objects or liquids is possible. Close the cover over the switches securely.

Addressing options

The IP address of the devices can be set in different ways. The following addressing options can be selected via the switches on the device. Setting changes are activated after a voltage reset.

Setting option	Rotary coding switch	Description
Default address	000	IP address: 192.168.60.254 Subnet mask: 255.255.255.0 Gateway: 192.168.60.1
Rotary mode	1…254	In Rotary mode, the last byte of the IP address can be set manually on the gateway. The other network settings can be stored retentively in the gateway memory and cannot be changed in Rotary mode. Addresses 1…254 can be set.
BootP mode	300	In BootP mode, the complete IP address is assigned automatically by a BootP server in the network. The sub-net mask assigned by the BootP server and the default gateway address are stored retentively in the gateway memory.

Setting option	Rotary coding switch	Description
DHCP mode	400	In DHCP mode, the complete IP address is assigned automatically by a DHCP server in the network. The sub-net mask assigned by the DHCP server and the default gateway address are stored retentively in the gateway memory. DHCP supports three types of IP address assignment: • Automatic address assignment: The DHCP server assigns a per-manent IP address to the client. • Dynamic address assignment: The IP address assigned by the server is always only reserved for a specific period. After this time has elapsed or after the explicit release by a client, the IP address is reassigned. • Manual address assignment: A network administra-tor assigns an IP address to the client. DHCP is only used in this case to transfer the assigned IP address to the client.
PGM mode	500	In PGM mode, the complete IP address is assigned man-ually via the Leuze Service tool, FDT/DTM or via a web server. In PGM mode, the set IP address and the subnet mask are stored in the gateway memory. All network set-tings (IP address, subnet mask, default gateway) are accepted by the internal EEPROM of the module.
PGM-DHCP mode	600	In PGM-DHCP mode, the gateway transmits DHCP requests until it is assigned a fixed IP address. The DHCP client is automatically deactivated if an IP address is assigned to the gateway via the DTM or a web server.
F_Reset	900	F_Reset mode resets all device settings to the default val-ues and clears all data in the internal flash memory of the device. The following values are reset or deleted: • IP address and subnet mask • PROFINET Device Name • Parameters

8.1.2 Setting the IP address with Leuze Service Tool

↳ Connect the device to a PC via the Ethernet interface.

↳ Open the Leuze Service Tool.

↳ Click **Search** or [F5].

The Leuze Service Tool shows the connected devices

↳ Click on the desired device.

↳ Click **Change** or press [F2].

	NOTE
ℹ	Clicking the IP address of the device opens the web server.

↳ Change the IP address and the network mask if necessary.

↳ Assume the changes by clicking Set in device.

8.1.3 Setting the IP address via the web server

NOTE
To set the IP address via the web server, the device must be in PGM mode.

↳ Opening the web server

↳ Log- in to the web server as administrator. The default password for the web server is "password".

↳ Click **Station → Network Configuration**.

↳ Change the IP address and if necessary also the subnet mask and default gateway.

↳ Write the new IP address, subnet mask and default gateway via **Submit** to the device.

8.2 Commissioning an IO-Link device with IO-Link V1.0

IO-Link devices in accordance with IO-Link specification V1.0 do not support data storage. If an IO-Link V1.0 device is used, data storage at the IO-Link port must be deactivated.

↳ **Set Data storage mode** at the port to **deactivated, clear**.

↳ Load the parameter changes into the device.

↳ Connect the IO-Link V1.0 device.

⇨ The LED IOL at the IO-Link port is green, IO-Link communication active.

8.3 Commissioning an IO-Link device with IO-Link V1.1

The data storage of the master should be cleared before a device with a different device type is connected to an IO-Link port which has already been used before.
The data storage memory of the master can be deleted in two ways:

- Reset the master to factory settings.
- Delete the data storage memory using the parameter **Data storage mode**.

↳ Connect the IO-Link V1.1 device.

⇨ The LED IOL at the IO-Link port is green, IO-Link communication active.

Delete the data storage memory via parameters

↳ Set Data storage mode to **deactivated, clear**.

↳ Load the parameter changes into the device.

↳ Re-activate the data storage, if necessary.

↳ Load the parameter changes into the device.

↳ Connect the IO-Link V1.1 device.

⇨ The LED IOL at the IO-Link port is green, IO-Link communication active

8.4 Commissioning the device in PROFINET

8.4.1 PROFINET IO device model

The technical properties of PROFINET IO devices are defined via their device description file, the GSDML file. A PROFINET IO device consists of 1…n slots, which can also contain 1…n sub slots. Sub slots are placeholders for sub modules and establish the interface to the process. Sub modules can contain parameters, data and diagnostics.
Slot 0 is always reserved as Device Access Point (DAP). The DAP contains the physical interface to the Ethernet network and represents the device. The other slots and sub slots rep-resent the other device functions. The structure is defined by the manufacturer of field devices. It is not necessary that every slot or respectively sub slot is related to physical functions. The allocation of the slots and sub slots and thus the assignment of functions (operation mode, diagnostics, etc.) is done in the configuration software of the PROFINET controller. This device model allows manufacturers to design modular and flexible decentral field devices. Users are flexible in configuring decentralized field devices.

8.4.2 Device model - MD 798i-11-82/L5-2222

The MD 798i-11-82/L5-2222 provide eight parameterizable I/O-Link-channels and four universal I/O-channels (DXP). In addition to that, four virtual slots are provided via GSDML in PROFINET. Those channels are used to map the different diagnostic and status (IO-Link and VAUX diagnostics, IO-Link Events, module status) data into the master's process image.

A	Basic slot for e. g. DXP-channels and Data Valid Signal
B	IO-Link ports for the configuration with specific IO-Link devices or for generic configuration
C	one slot each for diagnostics and status

8.4.3 Address setting in PROFINET

In IP-based communication, the field devices are addressed by means of an IP address. PROFINET uses the Discovery and Configuration Protocol (DCP) for IP assignment.

When delivered, each field device has, among other things, a MAC address. The MAC address is sufficient to give the respective field device a unique name.

The address is assigned in two steps:

- Assignment of a unique plant specific name to the respective field device.
- Assignment of the IP address from the IO-Controller before the system start-up based on the plant-specific (unique) name.

PROFINET naming convention

The names are assigned via DCP. The device name must meet the requirements of the Domain Name System (DNS) (see below). The device name is checked for correct spelling during input.

> **NOTE**
>
> The maximum length of the device name is 255 characters according to the specification. In a Step7 or TIA Portal environment, however, only names with a maximum length of 127 characters are accepted.

- All device names must be unique.
- Maximum name size: 255 or 127 characters (a...z, 0...9, "-" or "…")
- Do not use capital letters.
- The name must not begin or end with "-".
- Do not use special characters
- The name must not begin with 0....9 or "port-xyz" (xyz = 0....9).

8.4.4 FSU - Fast Start-Up (prioritized startup)

FSU - Fast Start-Up is not supported by device.

8.4.5 MRP (Media Redundancy Protocol)

8.4.6 MRP (Media Redundancy Protocol)

The device supports MRP.

MRP is a standardized protocol according to IEC 62439. It describes a mechanism for media redundancy in ring topologies. With MRP, a defective ring topology with up to 50 nodes is detected and reconfigured in the event of an error. With MRP a trouble-free switch-over is not possible.

A Media Redundancy Manager (MRM) checks the ring topology of a PROFINET network defined by the network configuration for functionality. All other network nodes are Media Redundancy Clients (MRC). In the error-free state, the MRM blocks normal network traffic on one of its ring ports, with the exception of the test telegrams. The physical ring structure thus becomes a line structure again at the logical level for normal network traffic. If a test telegram fails to appear, a network error has occurred. In this case, the MRM opens its blocked port and establishes a new functioning connection between all remaining devices in the form of a linear network topology.

The time between ring interruption and recovery of a redundant path is called reconfiguration time. For MRP, this is a maximum of 200 ms. Therefore, an application must be able to compensate for the 200 ms interruption. The reconfiguration time always depends on the Media Redundancy Manager (e.g. the PROFINET PLC) and the I/O cycle and watchdog times set here. For PROFINET, the response monitoring time must be selected accordingly > 200 ms.

It is not possible to use Fast Start-Up in an MRP network.

8.4.7 User data for acyclic services

The acyclic data exchange is by using via Record Data CRs (Communication Relation). Via these Record Data CRs the reading and writing of the following services is realized:

- Writing of AR data
- Writing of configuration data
- Reading and writing of device data
- Reading of diagnostic data
- Reading of I/O data
- Reading of Identification Data Objects (I&M functions)

Acyclic device user data

Index		Name	Data type	Access	Comment
Dec.	Hex.				
1	0x01	Module parameters	WORD	read/write	Parameter data of the module (slot 0)
2	0x02	Module designation	STRING	read	Designation assigned to the module (slot 0)
3	0x03	Module revision	STRING	read	Firmware revision of the module
4	0x04	Vendor ID	WORD	read	Ident no. Leuze
5	0x05	Module name	STRING	read	The device name assigned to the module
6	0x06	Module type	STRING	read	Device type of the module
7	0x07	Device ID	WORD	read	Ident no. of the module
8…23	0x08…0x17	reserved	-	-	-
24	0x18	Module diagnostics	WORD	read	Diagnostic data of the module (slot 0).
25…31	0x19…0x1F	reserved	-	-	-
32	0x20	Input list	ARRAY of BYTE	read	List of all module input channels
33	0x21	Output list	ARRAY of BYTE	read	List of all module output channels
34	0x22	Diag. list	ARRAY of BYTE	read	List of all I/O-channel diagnostics
35	0x23	Parameter list	ARRAY of BYTE	read	List of all I/O-channel parameters
36…28671	0x24…0x6FFF	reserved	-	-	-
28672	0x7000	Module parameters	WORD	read/write	Activate field bus protocol
28673…45039	0x7001…0xAFEF	reserved	-	-	-

Index		Name	Data type	Access	Comment
45040	0xAFF0	I&M0-functions		read	Identification & Maintaining
45041	0xAFF1	I&M0-functions	STRING[54]	read/write	I&M Tag function and location
45042	0xAFF2	I&M2-functions	STRING[16]	read/write	I&M Installation Date
45043	0xAFF3	I&M3-functions	STRING[54]	read/write	I&M Description Text
45044	0xAFF4	I&M4-functions	STRING[54]	read/write	I&M Signature
45045… 45055	0xAFF5…0xAFFF	I&M5 to I&M15-functions			not supported

Acyclic I/O channel user data

Index		Name	Data type	Access	Comment
Dec.	Hex.				
1	0x01	Module parameters	specific	read/write	Parameters of the module
2	0x02	Module type	ENUM UINT8	read	Contains the module type
3	0x03	Module version	UINT8	read	Firmware version of I/O channels
4	0x04	Module ID	DWORD	read	Ident number of the I/O
5…9	0x05 …0x09	reserved	-	-	-
10	0x0A	Slave controller version	UINT8 array [8]	read	Version number of the slave controller.
11…18	0x0B…0x12	reserved	-	-	-
19	0x13	Input data	specific	read	Input data of the respective I/O-channel
20…22	0x14 … 0x16	reserved	-	-	-
23	0x17	Output data	specific	read/write	Output data of the respective I/O-channel
…	…	reserved	-	-	-
247	0xF7	CAP 1	Record	read/write	Client access point for class 1 masters
248	0xF8	CAP 2	Record	read/write	
249	0xF9	CAP 3	Record	read/write	
250	0xFA	CAP 4	Record	read/write	
251	0xFB	CAP 5	Record	read/write	
252	0xFC	CAP 6	Record	read/write	
253	0xFD	CAP 7	Record	read/write	
254	0xFE	CAP 8	Record	read/write	
255	0xFF	CAP 9	Record	read/write	Client access point for class 2 masters

IM99 (IOL_M)

Name	Size	Data type	Default setting
IOL_LINK_VERSION	1 byte	UINT8	17 (0x11)
IO_LINK_PROFILE_VERSION	1 byte	UINT8	0 (0x00)
IO_LINK_FEATURE_SUPPORT	4 byte	UINT32	0 (0x00)
NUMBER_OF_PORTS	1 byte	UINT8	4 (0x04)
REF_PORT_CONFIG	1 byte	UINT8	0 (0x00)
REF_IO_MAPPING	1 byte	UINT8	0 (0x00)
REF_IOL_M	1 byte	UINT8	0 (0x00)
NUMBER_OF_CAP	1 byte	UINT8	5 (0x05)
INDEX_CAP1	1 byte	UINT8	247 (0xF7)
INDEX_CAP2	1 byte	UINT8	248 (0xF8)
INDEX_CAP3	1 byte	UINT8	249 (0xF9)
INDEX_CAP4	1 byte	UINT8	250 (0xFA)
INDEX_CAP5	1 byte	UINT8	251 (0xFB)
INDEX_CAP6	1 byte	UINT8	252 (0xFC)
INDEX_CAP7	1 byte	UINT8	253 (0xFD)
INDEX_CAP8	1 byte	UINT8	254 (0xFE)
INDEX_CAP9	1 byte	UINT8	255 (0xFF)

8.4.8 The IO-Link function block IOL_CALL

The IO-Link function block IOL_CALL is specified in the IO-Link specification "IO-Link Inte-gration Part 1- Technical Specification for PROFIBUS and PROFINET".
Depending on the PLC manufacturer, the IO-Link CALL function block can differ from the specification (for example in the representation or the use of variables).

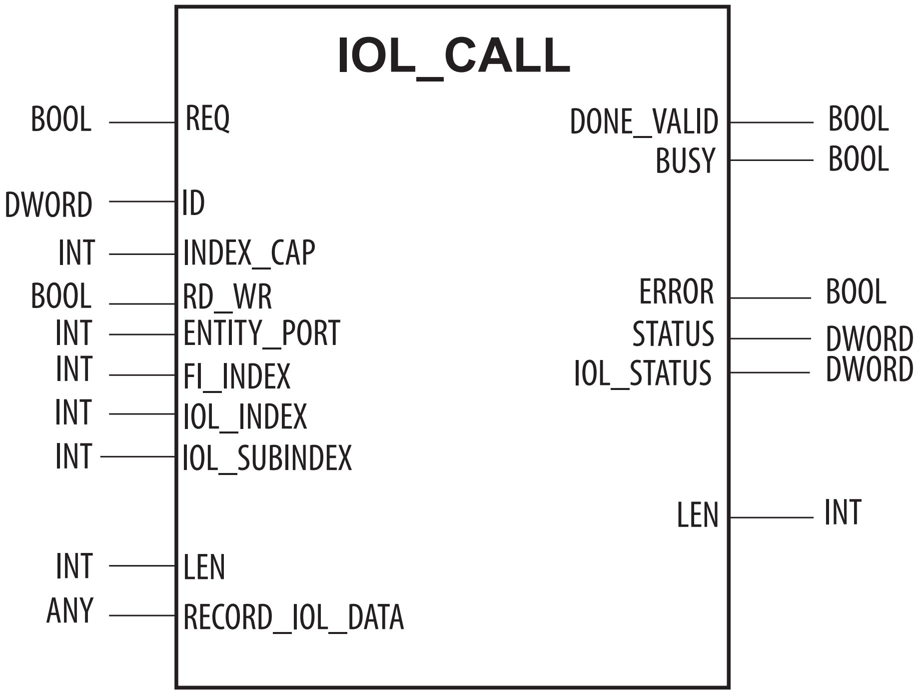

Fig. 8.2: IOL_CALL in accordance with IO-Link specification

IOL_CALL- input variables

Designation acc. IO-Link spec	Data type	Meaning
REQ	BOOL	A rising edge triggers the send command.
ID	DWORD	Address of the IO-Link master module **Step 7 Classic** • Start address of the input data of the IO-Link master module. **TIA Portal** • older Siemens CPUs (e.g. CPU 315): Start address of the input data of the IO-Link master module. • recent Siemens CPUs (e.g. CPU 1511): HW identifier of the device's "Basic" slot
INDEX_CAP	INT	Function block instance: 247 to 254, 255
RD_WR	BOOL	0 = read access 1 = write access
ENTITY_PORT	INT	Address of the IO-Link port to be accessed
FI_INDEX	INT	Fix value (65098): defines the access to be an IO-Link CALL
IOL_INDEX	INT	Number of the IO-Link index which has to be read
IOL_SUBINDEX	INT	Definition of a possible sub index.
LEN	INT	Length of the data to be read/written. This information is not necessary for the Siemens IOL_CALL.
RECORD_IOL_DATA	ANY	Source/destination for the data to be read/written.

IOL_CALL - output variables

Designation acc. IO-Link spec.	Data type	Meaning
DONE_VALID	BOOL	The read or write access has been executed.
BUSY	BOOL	The read or write access is actually in progress.
ERROR	BOOL	Error while reading or writing.
STATUS	DWORD	Communication error status of the acyclic communication [see page 29]
IOL_STATUS	DWORD	IO-Link error messages (in accordance with "IO-Link Integration Part 1- Technical Specification for PROFIBUS and PROFINET" and "IO-Link Interface and System"), which concern the communication between IO-Link master and connected devices [see page 30].
LEN	INT	Length of the read data

IOL_CALL - communication error status

The status of the acyclic communication contains 4 byte and is structured as follows:

Byte 3	Byte 2	Byte 1	Byte 0
Manufacturer specific identifier (not always applicable)	0x80 Specifies the error as an error of acyclic communication.	Error code/status code	Vendor specific identifier (not always applicable)

Status Code	Name	Meaning
0xFF000000	TIMEOUT	Internal error in the communication with the module
0x00FFF00	INVALID_HANDLE	
0x00FFFE00	HANDLE_OUT_OF_BUFFERS	
0x00FFFD00	HANDLE_DESTINATION_UNAVAILABLE	
0x00FFFC00	HANDLE_UNKNOWN	
0x00FFFB00	HANDLE_METHOD_INVALID	
0xXX80A0XX	MASTER_READ_ERROR	Error while reading
0xXX80A1XX	MASTER_WRITE_ERROR	Error while writing
0xXX80A2XX	MASTER_MODULE_FAILURE	Failure of the IO-Link master, bus failure possible
0xXX80A6XX	MASTER_NO_DATA	No data received
0xXX80A7XX	MASTER_BUSY	IO-Link master busy
0xXX80A9XX	MASTER_FEATURE_NOT_SUPPORTED	Function not supported by IO-Link master.
0xXX80AAXX	MASTER_RESOURCE_UNAVAILABLE	IO-Link master not available.
0xXX80B0XX	ACCESS_INVALID_INDEX	Index invalid, wrong INDEX_CAP used
0xXX80B1XX	ACCESS_WRITE_LENGTH_ERROR	Length of data to be written can not be handled from the module, wrong module accessed.

Status Code	Name	Meaning
0xXX80B2XX	ACCESS_INVALID_ DESTINATION	Wrong slot accessed
0xXX80B03XX	ACCESS_TYPE_CONFLICT	IOL_CALL ungültig
0xXX80B5XX	ACCESS_STATE_CONFLICT	Error in IOL_CALL sequence
0xXX80B6XX	ACCESS_DENIED	IOL-Link master module refuses the access.
0xXX80C2XX	RESOURCE_BUSY	The IO-Link master module is busy or is waiting for an answer of the connected IO-Link device.
0xXX80C3XX	RESOURCE_UNAVAILABLE	
0xXX8901XX	INPUT_LEN_TOO_SHORT	The index to be read contains more data than defined in the input variable "LEN".

IOL_CALL - IOL_STATUS

The IOL_STATUS consists of 2 byte Error Code (IOL_M Error_Codes, according to "IO-Link Integration Part 1- Technical Specification for PROFIBUS and PROFINET") and 2 byte Error Type (according to "IO-Link Interface and System").

Byte 3	Byte 2	Byte 1	Byte 0
IOL_M-Error-Code	IOL-Error-Type		

IOL_M-Error-Code	Designation acc. to IO-Link Spec.	Meaning
0x0000	No error	No error
0x7000	IOL_CALL Conflict	Unexpected write-request, read request expected
0x7001	Wrong IOL_CALL	Decoding error
0x7002	Port blocked	The accessed port is occupied by another task
…	reserved	
0x8000	Timeout	Timeout, IOL master or IOL device port busy
0x8001	Wrong index	Error: IOL index < 32767 or > 65535 selected
0x8002	Wrong port address	Port address not available
0x8003	Wrong port function	Port function not available
…	reserved	

IOL-Error-Type	Designation acc. to IO-Link Spec.	Meaning
0x1000	COM_ERR	Communication error Possible source: the ad-dressed port is parameterized as digital input DI and is not in IO-Link mode
0x1100	I_SERVICE_TIMEOUT	Timeout in communication, device does not respond in time
0x5600	M_ISDU_CHECKSUM	Master reports checksum error, access to device not possible
0x5700	M_ISDU_ILLEGAL	Device can not respond to master request
0x8000	APP_DEV	Application error in the device
0x8011	IDX_NOTAVAIL	Index not available

IOL-Error-Type	Designation acc. to IO-Link Spec.	Meaning
0x8012	SUBIDX_NOTAVAIL	Sub-Index not available
0x8020	SERV_NOTAVAIL	The service is temporarily not available.
0x8021	SERV_NOTAVAIL_LOCCTRL	Service temporarily not avail-able, device is busy (e. g. teaching or parameterization of the device via the master active)
0x8022	SERV_NOTAVAIL_DEVCTRL	Service temporarily not avail-able, device is busy (e. g. teaching or parameterization of the device via DTM/PLC etc. active)
0x8023	IDX_NOT_WRITEABLE	Access denied, Index cannot be written
0x8030	PAR_VALOUTOFRNG	Parameter value out of the valid range
0x8031	PAR_VALGTLIM	Parameter value above the upper limit
0x8032	PAR_VALLTLIM	Parameter value value below the lower limit
0x8033	VAL_LENOVRRUN	Length of data to be written does not match the length defined for this parameter
0x8034	VAL_LENUNDRUN	
0x8035	FUNC_NOTAVAIL	Function not available in the device
0x8036	FUNC_UNAVAILTEMP	Function temporarily unavailable in the device
0x8040	PARA_SETINVALID	Invalid parameter: Parameters not consistent with other parameters in the device.
0x8041	PARA_SETINCONSIST	Inconsistent parameters
0x8082	APP_DEVNOTRDY	Application not ready, device busy
0x8100	UNSPECIFIC	Vendor specific, according to device documentation
0x8101…0x8FF	VENDOR_SPECIFIC	

9 Parameterizing and Configuring

9.1 Parameters

The device has 4 bytes of module parameters, 16 bytes each of IO-Link port parameters and 16 bytes of parameters for VAUX1/VAUX2 monitoring.

Word no.	Bit no.															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Basic																
0x00	-	-	-	-	-	-	-	-	DXP7 _SRO	-	DXP5 _SRO	-	DXP3 _SRO	-	DXP1 _SRO	-
0x01	-	-	-	-	-	-	-	-	DXP7 _EN DO	-	DXP5 _EN DO	-	DXP3 _EN DO	-	DXP1 _EN DO	-
IO-Link port 1																
0x02	Cycle time								GSD	Acti-vate quick start-up	Data storage mode		Operation mode			
0x03	-								Mapping PCDO		Mapping PDIN		Deactivate diag.		PDIN inva-lid	Rev.
0x04…0x05	-								-	-	-	-	-	-	-	-
0x06	Vendor ID (MSB)								Vendor ID (LSB)							
0x07	Device ID								Device ID (LSB)							
0x08	Device ID (MSB)								Device ID							
0x09	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
IO-Link port 2																
0x0A…0x11	Assignment similar to IO-Link port 1 (word 0x02…0x09)															
IO-Link port 3																
0x12…0x19	Assignment similar to IO-Link port 1 (word 0x02…0x09)															
IO-Link port 4																
0x1A…0x21	Assignment similar to IO-Link port 1 (word 0x02…0x09)															
IO-Link port 5																
0x22…0x29	Assignment similar to IO-Link port 1 (word 0x02…0x09)															
IO-Link port 6																
0x2A…0x31	Assignment similar to IO-Link port 1 (word 0x02…0x09)															
IO-Link port 7																
0x32…0x39	Assignment similar to IO-Link port 1 (word 0x02…0x09)															
IO-Link port 8																
0x3A…0x41	Assignment similar to IO-Link port 1 (word 0x02…0x09)															

Word no.	Bit no.															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
VAUX monitoring																
0x42	-	-	-	-	-	-	VAUX1 pin1 X1 (ch2/3)		-	-	-	-	-	-	VAUX1 pin1 X0 (ch0/1)	
0x43	-	-	-	-	-	-	VAUX1 pin1 X3 (ch6/7)		-	-	-	-	-	-	VAUX1 pin1 X2 (ch4/5)	
0x44	-	-	-	-	-	-	VAUX1 pin1 X5 (ch10)		-	-	-	-	-	-	VAUX1 pin1 X4 (ch8)	
0x45	-	-	-	-	-	-	VAUX1 pin1 X7 (ch14)		-	-	-	-	-	-	VAUX1 pin1 X6 (ch12)	
0x46…0x47	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
0x48	-	-	-	-	-	-	VAUX2 pin2 X5 (ch11)		-	-	-	-	-	-	VAUX2 pin2 X4 (ch9)	
0x49	-	-	-	-	-	-	VAUX2 pin2 X7 (ch15)		-	-	-	-	-	-	VAUX2 pin2 X6 (ch13)	

The default values are shown in **bold** type.

Parameter name	Value		Meaning	Description
	Dec.	Hex.		
Manual output reset after over-current (DXPx_SRO)	0	0x00	Yes	The output switches on automatically after an over-load.
	1	0x01	No	The output is manually switched-off after an over-load until a new set-command is given (rise and fall).
Activate output Chx (DXPx_ENDO)	0	0x00	Yes	The output at pin 2 is deactivated.
	1	0x01	No	The output at pin 2 is activated.

Parameter name	Value		Meaning	Description
	Dec.	Hex.		
Operation mode	0	0x00	IO-Link without validation	Pin 4 is operated in IO-Link mode. The master does not check if the connected device matches the configured one.
	1	0x01	IO-Link with family compatible device	Pin 4 is operated in IO-Link mode. The master checks if the Vendor ID and the MSB of the Device ID (this byte defines the product family) of the connected device match those of the configured one. If the master detects a mismatch, the IO-Link communication is established, but there is no process data exchange. The device remains in the safe state (Pre-Operate). Parameters and diagnostic information can be read and respectively written.
	2	0x02	IO-Link with compat-ible device	Pin 4 is operated in IO-Link mode. The master checks if the Vendor ID and the Device ID of the connected device match those of the configured one. If the Vendor ID matches, but the Device ID not, then the master tries to write the Device ID to the device. If the writing is successful, then the device is a compatible one, process data exchange is possible. If writing the Device ID is not successful, then process data exchange is not possible. The device remains in the safe state (Pre-Operate). Parameters and diagnostic information can be read and respectively written.
	3	0x03	IO-Link with identical device	Pin 4 is operated in IO-Link mode. The master checks if the device type (Ven-dor ID and Device ID) and the serial number of the connected device match the data of the configured one. If the master detects a mismatch, the IO-Link communication is established, but there is no pro-cess data exchange. The device remains in the safe state (Pre-Operate). Parameters and diagnostic information can be read and respectively written.
	4	0x04	DI (with parameter access)	Pin 4 is generally operated as simple digital input. However, an acyclic parameter access from the PLC or the DTM is possible. The IO-Link master starts the port in IO-link mode, parameterizes the device and sets the port back into SIO mode (SI). The port remains in SIO mode (DI) until a new IO-Link re-quest is sent from the higher-level control. Data storage is not supported. Connected devices have to support the SIO mode (DI). In case of a parameter access, the IO-Link communication at the port is started. Switch-ing signals are interrupted.
	8	0x08	DI	Pin 4 is operated as simple digital input. Data storage is not supported.

Parameter name	Value		Meaning	Description
	Dec.	Hex.		
Data storage mode	Synchronization of parameter data of IO-Link devices (storing the parameter of the con-nected device in the master). If the synchronization is not possible, a diagnostic message is displayed (DS_ERR). In this case the data memory of the master must be deleted: ↳ "Select option "11 = deactivated, delete" to delete the data memory of the master IO-Link devices in accordance with IO-Link specification V1.0 do not support data storage. When using IO-Link devices with IO-Link V1.0: ↳ "Select option "11 = deactivated, delete" to deactivate data storage.			
	0	0x00	Activated	Synchronization of parameter data acti-vated. The actual data (master or device) serve as the reference data.
	1	0x01	overwrite	Synchronization of parameter data acti-vated, the data in the master serve as reference data.
	2	0x02	read in	Synchronization of parameter data acti-vated. The data in the connected IO-Link device serve as reference data.
	3	0x03	Deactivated, clear	Synchronization of parameter data deacti-vated. The data set in the master is deleted.
Activate Quick Start-Up	For fast applications (e.g. tool changing applications) the start-up time of IO-Link devices can be shortened. The start-up time defined in the IO-Link specification (TSD = Device Detection Time) is reduced.			
	0	0x00	No	The start-up time is within the specified range (0.5 s). All IO-Link devices in accord-ance with the specification can be operated.
	1	0x01	Yes	The start-up time is reduced to approx. 100 ms. It is not supported by every IO-Link device. It can thus be necessary to check if the used IO-Link de-vice starts in this mode.
Device parameter-ization via GSD (GSD)	0	0x00	inactive	The port is generic or is not parameterized.
	1	0x01	Active	In PROFINET the port is parameterized with a specific device type from the GSDML-file.
Cycle time	0	0x00	Automatic	The lowest cycle time supported by the device is taken from the table.
	16…191	0x10…0xBF	1.6 = 132,8 ms	Settable in steps of 0.8 or 1.6 ms.
	255	0xFF	Automatic, compatible	Compatibility mode The mode solves possi-ble communication problems with sensors of the SGB family from IFM.
Revision	0	0x00	Automatic	The Master defines the IO-Link revision automatically.
	1	0x01	V1.0	IO-Link Revision V 1.0 is used.
Process input data invalid (PDIN inva-lid)	0	0x00	Diagnostic generated	If the process data are invalid, a respective diagnostic message is generated.
	1	0x01	No diagnostic generated	Invalid process data do not cause a diag-nostic message.

Parameter name	Value		Meaning	Description
	Dec.	Hex.		
Deactivate diagnostics	Influences the sending of IO-Link-Events from the master to the fieldbus. Depending on the parameterization, the master transmits Events based on their priority to the fieldbus or not.			
	0	0x00	No	The master transmits all IO-Link Events to the fieldbus.
	1	0x01	Notifications	The master transmits all IO-Link Events to the fieldbus except for IO-Link notifications.
	2	0x02	Notifications and warnings	The master transmits all IO-Link Events to the fieldbus except for IO-Link notifications and warnings.
	3	0x03	Yes	The master doesn't transmit any IO-Link Event to the fieldbus.
Process inpput data mapping (Mapping PDIN)	Optimization of the process data mapping for the used fieldbus: The I/O-Link-data can be swapped depending on the used fieldbus in order to achieve an optimized data mapping on the fieldbus side. PROFINET: With PROFINET, the parameter is permanently set to 0x00 = direct and cannot be changed.			
	0	0x00	direct	The process data are not swapped. z. B.: 0x0123 4567 89AB CDEF
	1	0x01	Swap 16 bit	The bytes are swapped per word. z. B.: 0x2301 6745 AB89 EFCD
	2	0x02	Swap 32 bit	The bytes are swapped per double word. z. B.: 0x6745 2301 EFCD AB89
	3	0x03	swap all	All bytes are swapped. z. B.: 0xEFCD AB89 6745 2301
Process output data mapping (Mapping PDOUT)	see above Process input data mapping			
Vendor ID	0…65535 0x0000… 0xFFFF			Vendor ID for the port configuration check
Device ID	0…16777215 0…0x00FFFFFF			Device ID for the port configuration check 24 bit value
VAUX1 pin 1 Xx (chy/chz)	0	0x00	24 VDC	The 24 VDC sensor/actuator supply at pin 1 of the connector is switched on.
	1	0x01	switchable	The 24 VDC sensor/actuator supply at pin 1 of the respective connector is switchable via the process data.
	2	0x02	off	The 24 VDC sensor/actuator supply at pin 1 of the connector is switched off.
VAUX2 pin 2 Xx (chy)	0	0x00	24 VDC	The Class B supply at Pin2 of the respective connector is switched on.
	1	0x01	switchable	The Class B supply at pin 2 of the respective connector is switchable via the process data.
	2	0x02	off	The Class B supply at Pin2 of the respective connector is switched off.

Values for the parameter "cycle time" [ms]

Time	Value	Time	Value	Time	Value	Time	Value	Time	Value	Time	Value
auto	0x00	16	0x58	31.2	0x7E	60.8	0x92	91.2	0xA5	121.6	0xB8
1.6	0x10	16.8	0x5A	32	0x80	62.4	0x93	92.8	0xA6	123.2	0xB9
2.4	0x18	17.6	0x5C	33.6	0x81	64	0x94	94.4	0xA7	124.8	0xBA
3.2	0x20	18.4	0x5E	35.2	0x82	65.6	0x95	96	0xA8	126.4	0xBB
4	0x28	19.2	0x60	36.8	0x83	67.1	0x96	97.6	0xA9	128	0xBC
4.8	0x30	20	0x62	38.4	0x84	68.8	0x97	99.2	0xAA	129.6	0xBD
5.6	0x38	20.8	0x67	40	0x85	70.4	0x98	100.8	0xAB	131.2	0xBE
6.4	0x40	21.6	0x66	41.6	0x86	72	0x99	102.4	0xAC	132.8	0xBF
7.2	0x42	22.4	0x68	43.2	0x87	73.6	0x9A	104	0xAD	reserved	
8	0x44	23.2	0x6A	44.8	0x88	75.2	0x9B	105.6	0xAE		
8.8	0x46	24.0	0x6C	46.4	0x89	76.8	0x9C	107.2	0xAF		
9.6	0x48	24.8	0x6E	48	0x8A	78.4	0x9D	108.8	0xB0		
10.4	0x4A	25.6	0x70	49.6	0x8B	80	0x9E	110.4	0xB1		
11.2	0x4C	26.4	0x72	51.2	0x8C	81.6	0x9F	112	0xB2		
12.0	0x4E	27.2	0x74	52.8	0x8D	83.2	0xA0	113.6	0xB3		
12.8	0x50	28	0x76	54.4	0x8E	84.8	0xA1	115.2	0xB4		
13.6	0x52	28.8	0x78	56	0x8F	86.4	0xA2	116.8	0xB5		
14.4	0x54	29.6	0x7A	57.6	0x90	88	0xA3	118.4	0xB6		
15.2	1x56	30.4	0x7C	59.2	0x91	89.6	0xA4	120	0xB7	auto., comp	0xFF

9.1.1 Adapting process data mapping

The mapping of process data can be adapted application-specifically via the IO-Link master's parameterization.

Depending on the used fieldbus, it can be necessary to swap process data word-wise, double word-wise or completely in order to align them to the data structure in the PLC. The process data mapping is determined channel by channel through the parameters pro-cess input data mapping and process output data mapping.

Example mapping for field buses with Little Endian-format:

Mapping through the IO-Link master→ field bus → PLC						
Byte	Device at IO-Link port	Device process data in IO-Link master		Parameter Pro-cess data mapping	Device process data to field bus	
Byte 0		Status			Status	
Byte 1		Control			Control	
IO-Link port 1						
Byte 2	Temperature sensor TS…	Temperature	Low byte	swap 16 bit	Temperature	High byte
Byte 3			High byte			Low byte
IO-Link port 2						
Byte 4	Linearity sensor Li…	Position	Low byte	swap 16 bit	position	High byte
Byte 5			High byte			Low byte

Mapping through the IO-Link master→ field bus → PLC						
Byte	Device at IO-Link port	Device process data in IO-Link master		Parameter Process data mapping	Device process data to field bus	
IO-Link port 3						
Byte 6	I/O hub MD 742-…	Digital signal	0…7	Direct	Digital signal	0…7
Byte 7		Digital signal	8…15		Digital signal	8…15
IO-Link port 4						
Byte 8		Diagnostics		swap all	Counter/position value	Most Significant Byte
Byte 9	Rotary encoder RI…	Counter/position value	Low byte			High byte
Byte 10			High byte			Low byte
Byte 11			Most Significant Byte		Diagnostics	

9.1.2 PROFINET parameters

For PROFINET, a distinction must be made in the parameters between the PROFINET device parameters and the parameters of the I/O channels.

PROFINET device parameters

Default values are shown in **bold**.

Parameter name	Value	Meaning	Description
Output behavior at communication loss	0	set to 0	The device switches the outputs to "0". No error information sent.
	1	Hold current value	The device maintains the actual output data.
Deactivate all diagnostics	0	No	Diagnostic and alarm messages are generated.
	1	yes	Diagnostic and alarm messages are suppressed.
Deactivate load voltage diagnostics	0	No	The monitoring of voltage V2 is activated.
	1	yes	If V2 is undershot, this is not displayed.
Deactivate Force Mode	0	No	Explicit deactivation of the Ethernet protocols or web server
	1	yes	
Deactivate EtherNet/IP	0	No	
	1	yes	
Deactivate Modbus TCP	0	No	
	1	yes	
Deactivate WEB server	0	No	
	1	yes	

9.2 IO-Link functions for acyclic communication

The acyclic access to the data of IO-Link devices is realized via IO-Link CALLs. A distinction must be made between data of the IO-Link master (IOLM) and data of connected IO-Link devices (IOLD).

The addressing of the IO-Link CALL defines which device is addressed via the CALL.

The addressing is defined by the so called Entitiy_Port:

- Entity_Port 0 = IO-Link-Mastermodul (IOLM)
- Entity_Port 1 = IO-Link-Device an IO-Link-Port 1
- …
- Entity_Port 8 = IO-Link-Device an IO-Link-Port 8

9.2.1 Port functions for Port 0 (IO-Link Master)

IO-Link Index (port function invocation)

The access to the IO-Link master functionalities (port 0) is done via index 65535:

Subindex 64: Master Port Validation Configuration

The object writes a specific configuration of the Devices to be connected to the IO-Link port to the Master. The master stores the data for the The IO-Link device expected at the port and then accepts only one device at the port with exactly matching data (vendor ID, device ID and serial number).

The Master Port Validation Configuration is only useful in combination with an operation mode with validation (IO-Link with family compatible device, IO-Link with compatible device, IO-Link with identical device.

Entity_Port	IO-Link sub index	Read/write	Length
0	64	Write	Max. 192 byte

Structure of the command IOL_Port_Config:

	Content	Size	Format	Comment
IOL1	VENDOR_ID	2 byte	Unsigned 16	
	DEVICE_ID	4 byte	Unsigned 32	
	FUNCTION_ID	2 byte	Unsigned 16	Value: 0
	SERIAL_NUMBER	16 byte	String	
IOL2	VENDOR_ID	2 byte	Unsigned 16	
	DEVICE_ID	4 byte	Unsigned 32	
	FUNCTION_ID	2 byte	Unsigned 16	Value: 0
	SERIAL_NUMBER	16 byte	String	
IOL3	VENDOR_ID	2 byte	Unsigned 16	
	DEVICE_ID	4 byte	Unsigned 32	
	FUNCTION_ID	2 byte	Unsigned 16	Value: 0
	SERIAL_NUMBER	16 byte	String	
IOL4	VENDOR_ID	2 byte	Unsigned 16	
	DEVICE_ID	4 byte	Unsigned 32	
	FUNCTION_ID	2 byte	Unsigned 16	Value: 0
	SERIAL_NUMBER	16 byte	String	
IOL5	VENDOR_ID	2 byte	Unsigned 16	
	DEVICE_ID	4 byte	Unsigned 32	
	FUNCTION_ID	2 byte	Unsigned 16	Value: 0
	SERIAL_NUMBER	16 byte	String	
IOL6	VENDOR_ID	2 byte	Unsigned 16	
	DEVICE_ID	4 byte	Unsigned 32	
	FUNCTION_ID	2 byte	Unsigned 16	Value: 0

	Content	Size	Format	Comment
	SERIAL_NUMBER	16 byte	String	
IOL7	VENDOR_ID	2 byte	Unsigned 16	
	DEVICE_ID	4 byte	Unsigned 32	
	FUNCTION_ID	2 byte	Unsigned 16	Value: 0
	SERIAL_NUMBER	16 byte	String	
IOL7	VENDOR_ID	2 byte	Unsigned 16	
	DEVICE_ID	4 byte	Unsigned 32	
	FUNCTION_ID	2 byte	Unsigned 16	Value: 0
	SERIAL_NUMBER	16 byte	String	

Subindex 65: IO-Link Events

The object reads IO-Link Event diagnostics.

Entity_Port	IO-Link sub index	Read/write	Length
0	65	Read	255 byte

NOTE

Only "appears" (coming diagnostics) and "Single Shot Events" are shown, as long as they are pending.

Structure of the read data:

- Byte 0 contains 2 bit per IO-Link port which show, if the process data of the connected device are valid or not.
- Byte 0 is followed by 4 byte per Diagnostic Event which clearly assign and specify the diagnostic message. A maximum of 14 Events per IO-Link port are shown.

Byte no.	Bit no.								Description
	7	6	5	4	3	2	1	0	
0								x	PD_Valid Input Port 1
							x		PD_Valid Output Port 1
						x			PD_Valid Input Port 2
					x				PD_Valid Output Port 2
				x					PD_Valid Input Port 3
			x						PD_Valid Output Port 3
		x							PD_Valid Input Port 4
	x								PD_Valid Output Port 4
1								x	PD_Valid Input Port 5
							x		PD_Valid Output Port 5
						x			PD_Valid Input Port 6
					x				PD_Valid Output Port 6
				x					PD_Valid Input Port 7
			x						PD_Valid Output Port 7
		x							PD_Valid Input Port 8
	x								PD_Valid Output Port 8

Byte no.	Bit no.								Description
	7	6	5	4	3	2	1	0	
2	Qualifier								Defines the type of the event (Warning, Notification, Single Shot Event, etc.) in accordance with IO-Link specification "IO-Link Interface and System".
3	Port								IO-Link port which sends an event
4	Event Code high byte								High or- low byte of the error code sent
5	Event Code low byte								
…									…
223	Qualifier								see byte 2 - 5
224	Port								
225	Event Code high byte								
226	Event Code low byte								

Subindex 66: Set Default Parameterization

Writing this object sets the IO-Link master back to factory settings. Any parameter setting and configuration is overwritten. The data storage buffer is deleted as well.

Entity_Port	IO-Link sub index	Read/write	Length
0	66	Write	4 byte

Structure of the reset command:

Byte 3	Byte 2	Byte 1	Byte 0
0xEF	0xBE	0xAD	0xDE

Subindex 67: Teach Mode

The master reads all data (device-Id, vendor-ID, serial number, etc.) from the connected device and saves them. All all previously saved device data are overwritten.

Entity_Port	IO-Link sub index	Read/write	Length
0	67	Write	1 byte

Structure of the Teach command:

Byte 0	
0x00	Teach all ports
0x01	Teach port 1
0x02	Teach port 2
0x03	Teach port 3
0x04	Teach port 4
0x05	Teach port 5
0x06	Teach port 6
0x07	Teach port 7
0x08	Teach port 8
0x09…0xFF	reserved

Subindex 68: Master Port Scan Configuration

The object reads the configuration of the IO-Link devices connected to the IO-Link master.
28 byte are returned per IO-Link port.

Entity_Port	IO-Link sub index	Read/write	Length
0	68	Read	Max. 120 byte

Structure of the response telegram:

IO-Link port	Inhalt	Länge	Format	Description
Port 1	Vendor ID	2 byte	UINT16	Vendor ID of the connected device
	Device ID	4 byte	UINT32	Device ID of the connected device
	Function ID	2 byte	UINT16	reserved
	Serial Number	16 byte	UINT8	Serial number of the connected device
	COM_Revision	1 byte	UINT8	IO-Link version
	Proc_In_Length	1 byte	UINT8	Process input data length of the connected device
	Proc_Out_Length	1 byte	UINT8	Process output data length of the connected device
	Cycle time	1 byte	UINT8	Cycle time of the connected device
Port 2…port 8	Structure similar to port 1			

Subindex 69: Extended Port Diagnostics

The object reads the Extended Port Diagnostics.

Entity_Port	IO-Link sub index	Read/write	Length
0	68	Read	Max. 120 byte

Structure of the Extended Port Diagnostics:

Byte-Nr.	Bit no.							
	7	6	5	4	3	2	1	0
0	NO_SIO	TCYC	-	-	DS_F	NO_DS	-	-
1	-	WD	MD	PDI_H	-	-	NO_PD	
2	-	-	-	-	-	-	-	-
3	Device status according to IO-Link specification							

Diagnostic bit	Meaning
NO_DS	The parameterized port mode does not support data storage. Remedy • Change the parameterization of the port.
DS_F	Error in the data storage, synchronization not possible Possible causes: • Connected device does not support data storage • Overflow of the data storage buffer Remedy: ↳ Connect a device that supports data storage. ↳ Clear the data storage buffer. ↳ Deactivate the data storage.
TCYC	The device does not support the cycle time parameterized in the master. Remedy: ↳ Increase the cycle time set in the master.
NO_SIO	The device does not support the standard DI (SIO) mode. Remedy: ↳ Select the IO-Link mode for this port.
NO_PD	No process data available The connected device is not ready for operation. Remedy: ↳ Check the configuration.
PDI_E	The connected device reports invalid process data in accordance with IO-Link specification V1.0.
PDI_H	The connected device reports invalid process data in accordance with IO-Link specification V1.1.
MD	Missing device, no IO-Link device detected. Remedy: • Check the IO-Link cable. • Change the device.
WD	Wrong device detected: one or more parameters of the connected device (Vendor ID, Device ID, serial number) does not/do not match the data which are stored in the master for this device. Remedy: • Change the device. • Adapt the master parameterization

Device status

Value	Meaning
0	Device works correctly
1	Maintenance event
2	Out-of-specification event
3	Functional check
4	Error
5…255	reserved

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10 Operating

> ⚠ **CAUTION!**
>
> Hot surface at full load and high ambient temperatures
>
> Burn risk
>
> ↳ Avoid touching the device without additional protection.

10.1 Process input data

Word no.	Bit no.															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Basic																
0x00	-	DI14 (SIO)	-	DI12 (SIO)	-	DI10 (SIO)	-	DI8 (SIO)	DXP 7	DI6 (SIO)	DXP 5	DI4 (SIO)	DXP 3	DI2 (SIO)	DXP 1	DI0 (SIO)
0x01	-	DVS 14	-	DVS 12	-	DVS 10	-	DVS 8	-	DVS 6	-	DVS 4	-	DVS 2	-	DVS 0
IO-Link process input data																
0x02…0x11	IO-Link port 1, structure depends on the channel parameterization (0…32 byte per channel)															
0x12…0x21	IO-Link port 2, structure depends on the channel parameterization (0…32 byte per channel)															
0x22…0x31	IO-Link port 3, structure depends on the channel parameterization (0…32 byte per channel)															
0x32…0x41	IO-Link port 4, structure depends on the channel parameterization (0…32 byte per channel)															
0x42…0x51	IO-Link port 5, structure depends on the channel parameterization (0…32 byte per channel)															
0x52…0x61	IO-Link port 6, structure depends on the channel parameterization (0…32 byte per channel)															
0x62…0x71	IO-Link port 7, structure depends on the channel parameterization (0…32 byte per channel)															
0x72…0x81	IO-Link port 8, structure depends on the channel parameterization (0…32 byte per channel)															
Diagnostics																
	VAUX1/VAUX2															
0x82	VERR V2 X7 K15	VERR V2 X6 K13	VERR V2 X5 K11	VERR V2 X4 K9	-	-	-	-	VERR V1 X7 K14	VERR V1 X6 K12	VERR V1 X5 K10	VERR V1 X4 K8	VERR V1 X3 K6K7	VERR V1 X2 K4K5	VERR V1 X1 K2K3	VERR V1 X0 K0K1
	DXP channels															
0x83	-	-	-	-	-	-	-	-	ERR DXP 7	-	ERR DXP 5	-	ERR DXP 3	-	ERR DXP 1	-
	IO-Link port 1															
0x84	GEN-ERR	OVL	VHIGH	VLOW	ULVE	LLVU	OTMP	PRMERR	EVT1	EVT2	PDINV	HWERR	DSERR	CFGERR	PPE	-
0x85	IO-Link port 2, assignment similar to port 1															
0x86	IO-Link port 3, assignment similar to port 1															
0x87	IO-Link port 4, assignment similar to port 1															

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Word no.	Bit no.															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0x88	IO-Link port 5, assignment similar to port 1															
0x89	IO-Link port 6, assignment similar to port 1															
0x8A	IO-Link port 7, assignment similar to port 1															
0x8B	IO-Link port 8, assignment similar to port 1															
IO-Link Events																
0x8C	Port (1st Event)								Qualifier (1st Event)							
0x8D	Event Code low byte (1st Event)								Event Code high byte (1st Event)							
…																
0xAA	Port 16th Event)								Qualifier (16th Event)							
0xAB	Event Code low byte (16th Event)								Event Code high byte (16th Event)							
Module status (status word)																
0xAC	-	FCE	-	-	-	COM	V1	-	V2	-	-	-	-	-	-	DIAG

Meaning of process data bits

Name	Value	Meaning
I/O data		
DIx	Digital input x	
	0	No signal at DI (pin 4, SIO)
	1	Signal at DI (pin 4, SIO)
DXPx	configurable digital channel (DXP channel)	
	0	No input signal at DXP-channel (pin 2)
	1	Input signal at DXP-channel (pin 2)
DVSx	Input value valid (Data Valid Signal)	
	0	The IO-Link data are invalid. Possible causes: • Sensor supply is below the admissible range. • IO-Link port is parameterized as simple digital input. • No device connected to the master. • No input data received from the connected device (only valid for devices with an input data length > 0). • No reaction from the connected device to the sending of output data (only valid for devices with an output data length > 0). • The connected device sends an **process input data invalid** error.
	1	The IO-Link data are valid.
IO-Link process input data	Process input data of the connected device The order of the IO-Link process input data can be changed via the parameter **Process input data mapping**.	
Diagnostics	(see page 48)	
IO-Link Events	(see page 40)	
Module status	(see page 48)	

10.2 Process output data

Word no.	Bit no.															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Basic																
0x00	-	-	-	-	-	-	-	-	DXP7	-	DXP5	-	DXP3	-	DXP1	-
IO-Link process output data																
0x01…0x10	IO-Link port 1, structure depends on the channel parameterization (0…32 byte per channel)															
0x11…0x20	IO-Link port 2, structure depends on the channel parameterization (0…32 byte per channel)															
0x21…0x30	IO-Link port 3, structure depends on the channel parameterization (0…32 byte per channel)															
0x31…0x40	IO-Link port 4, structure depends on the channel parameterization (0…32 byte per channel)															
0x41…0x50	IO-Link port 5, structure depends on the channel parameterization (0…32 byte per channel)															
0x51…0x60	IO-Link port 6, structure depends on the channel parameterization (0…32 byte per channel)															
0x61…0x70	IO-Link port 7, structure depends on the channel parameterization (0…32 byte per channel)															
0x71…0x80	IO-Link port 8, structure depends on the channel parameterization (0…32 byte per channel)															
	VAUX1/VAUX2															
0x81	VAUX2 Pin2 X7 (K15)	VAUX2 Pin2 X6 (K13)	VAUX2 Pin2 X5 (K11)	VAUX2 Pin2 X4 (K9)	-	-	-	-	VAUX1 Pin1 X7 (K14)	VAUX1 Pin1 X6 (K12)	VAUX1 Pin1 X5 (K10)	VAUX1 Pin1 X4 (K8)	VAUX1 Pin1 X3 (K6/7)	VAUX1 Pin1 X2 (K4/5)	VAUX1 Pin1 X1 (K2/3)	VAUX1 Pin1 X0 (K0/1)

Name	Value	Meaning
I/O data		
DXPx	DXP output	
	0	Output inactive
	1	Output active, max. output current 2 A
VAUX1 Pin1 Xx (chy/chz)	0	The 24 VDC sensor/actuator supply at Pin1 of the connector is switched off.
	1	The 24 VDC sensor/actuator supply at Pin1 of the connector is switched on.
VAUX2 Pin2 Xx (chy/chz)	0	The Class B supply at Pin2 of the connector is switched off.
	1	The Class B supply at Pin2 of the connector is switched on.

10.3 LED displays

The device has the following LED indicators:

- Power supply
- Group and bus errors
- Status
- Diagnostics

<table>
<tr><th>PWR LED</th><th>Meaning</th></tr>
<tr><td>Off</td><td>No voltage or undervoltage at V1</td></tr>
<tr><td>Green</td><td>Voltage at V1 and V2 ok</td></tr>
<tr><td>Green flashing</td><td rowspan="2">No voltage or undervoltage at V2 (depending on configuration of the “LED behavior (PWR) on V2 undervoltage” parameter)</td></tr>
<tr><td>Red</td></tr>
</table>

LED BUS	Meaning
Off	No voltage connected
Green	Active connection to a master
Green flashing (1 Hz)	Device is ready for operation
Red	IP address conflict, Restore mode active, F_Reset active or Modbus connection timeout
Red flashing	Wink command active
Red/green (1 Hz)	Autonegotiation and/or waiting for DHCP-/BootP-address assignment

LED ERR	Meaning
Off	No voltage connected
Green	No diagnostics
Red	Diagnostic message pending

NOTE

The Ethernet ports XF1 and XF2 each have an LED L/A.

LED L/A	Meaning
Off	No Ethernet connection
Green	Ethernet connection established, 100 Mbps
Yellow	Ethernet connection established, 10 Mbps
Green flashing	Ethernet traffic, 100 Mbps
Yellow blinking	Ethernet traffic, 10 Mbps

LED IOL 0, 2, 4, 6, 8, 10, 12, 14 (IO-Link-Port 1…8)	Meaning (Channel in IO-Link-mode)
Off	Port inactive, no IO-Link communication, diagnostics deactivated
Green flashing	IO-Link communication, process data valid
Red flashing	IO-Link communication active and module error, invalid process data
Red	IO-Link supply error free, no IO-Link communication and/ or module error, process data invalid

LED IOL 0, 2, 4, 6, 8, 10, 12, 14 (IO-Link port1…8)	Meaning (channel in SIO mode (DI))
Off	No input signal
Green	Digital input signal active

LED IOL 9, 11, 13, 15 (IO-Link Class B ports 4…8)	Meaning
Off	VAUX2 at Pin 2 inactive
Green	VAUX2 at Pin 2 active
Red	VAUX2 at Pin 2 active, overload/short-circuit at VAUX2
Red flashing	Overcurrent supply VAUX1

LED DXP 1, 3, 5, 7	Meaning (input)	Meaning (output)
Off	Input not active	Output not active
Green	Input active	Output active (max. 2 A)
Red	-	Output active with overload/short circuit

LED WINK (without designation on the device)	Meaning
White flashing	Wink command active

10.4 Software diagnostic messages

The device provides the following software diagnostic messages:

- V1/V2 overcurrent diagnostics
  Overcurrent diagnostics for the sensor-/ actuator supply VAUX1 and the Class B supply VAUX2
- IO-Link master diagnostics
  The IO-Link-master reports problems within the IO-Link communication.
- IO-Link device diagnostics
  The device diagnostics map the IO-Link Event Codes (according to the IO-Link specification) sent from the IO-Link devices to the diagnostic telegram of the master.
  Event Codes can be read from the connected devices by using appropriate device tools (e.g. IODD-Interpreter).
  Further information concerning the IO-Link Event Codes and their meaning can be found in the IO-Link specification or in the documentation of the connected devices.

10.4.1 Status- and control word

Status word

EtherNet/IP/ Modbus	PROFINET	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 0
Byte 0	Byte 1	V2	-	-	-	-	-	DIAG
Byte 1	Byte 0	-	FCE	-	-	-	COM	-

Bit	Description
COM	Internal error The device-internal communication is disturbed.
DIAG	Diagnostic messages at the device
V1	V1 or V2 too low (< 18 V DC).
V2	

The status word is mapped into the module's process data.

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In EtherNet/IP the mapping can be deactivated via the Gateway Class (VSC 100).

NOTE
Activating or deactivating the status and control word modifies the process data mapping.

Control word

The control word has no function.

10.4.2 Diagnostic telegram

Channel	Byte no.	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
V1/V2	V1/V2 overcurrent diagnostics								
	0	VERR V1 X7 K14	VERR V1 X6 K12	VERR V1 X5 K10	VERR V1 X4 K8	VERR V1 X3 K6K7	VERR V1 X2 K4K5	VERR V1 X1 K2K3	VERR V1 X0 K0K1
	1	VERR V 2 X7 K15	VERR V2 X6 K13	VERR V2 X5 K11	VERR V2 X4 K9	-	-	-	-
DXP	DXP diagnostics								
	0	ERR DXP7	-	ERR DXP5	-	ERR DXP3	-	ERR DXP1	-
	1	-	-	-	-	-	-	-	-
IO-Link		Device diagnostic messages				Master diagnostics			
IO-Link port 1	0	EVT1	EVT2	PD INV	HW ERR	DS ERR	CFG ERR	PPE	-
	1	GEN ERR	OLV	V HIGH	V LOW	ULVE	LLVU	OTEMP	PRM ERR
IO-Link port 2	2…3	Assignment similar to IO-Link port 1							
…	…								
IO-Link port 8	14…15								

NOTE
The "process data" invalid diagnostic (PDINV) can be sent from both devices, IO-Link master or IO-Link device.

Bedeutung der Diagnose-Bits

Bit	Meaning
V1/V2 overcurrent diagnostics	
VErrV1 Xx chy/chz	Overcurrent VAUX1 (pin1) at connector/channel group
VErrV1 Xxchy	Overcurrent VAUX1 (pin 1) at connector/channel
VErrV2 Xxchy	Overcurrent VAUX2 (pin 2) at connector/channel
IO-Link master diagnostics	
CFGER	Wrong or missing device The connected device does not match the channel configuration or there is no device connected to the channel. This diagnostic message depends on the parameterization of the channel.
DSER	Data storage error Possible causes: • Data storage mismatch: IO-Link device in accordance with IO-Link V1.0 connected. The data storage buffer contains data of another device. • Overflow of the data storage buffer • The connected device may be locked for parameter changes or for data storage.
PPE	Port parameterization The port parameters are inconsistent. The device parameterization via GSD is active, but not working. Possible causes: • The IO-Link-master did not receive GSDML-parameters for a connected device. The connected device was not parameterized by a PROFINET PLC via GSDML. • The port is in operation mode "IO-Link without validation" or "DI". These modes do not allow parameterization via GSDL file. • Data storage mode is active. The parameter is not set to "deactivated, clear". A device parameterization via GSDML is not possible with activated data storage. • Vendor or Device ID are "0". The connected device can not be identified and is thus not parameterizable.
IO-Link master/device diagnostics	
PDINV	Evaluating Process Input Data The IO-Link master or the IO-Link device report invalid process input data. The connected device is not in status "operate", which means, it is not ready for operation. Possible sources: • The connected device does not match the configured one, additional diagnostic message Wrong or missing device. • Diagnostic message Process input data invalid because the process value can not be measured (depends on the IO-Link device).
IO-Link device diagnostics	
	The IO-Link device diagnostics depend on the IO-Link device used. For more detailed information on the diagnoses, please refer to the documentation for the IO-Link device.
EVT1	Maintenance events A Maintenance Event in accordance with the IO-Link specification occurred, maintenance necessary.
EVT2	Out-of-specification events An Out-of-Specification Event in accordance with the IO-Link specification occurred.
GENERR	Common error The device sends an error (device status 4, in accordance with IO-Link specification), which is not clearly specified. Read out the device Event Codes in order to be able to specify the error more precisely.

Bit	Meaning
HWER	Hardware error General hardware error or device malfunction of the connected device
LLVU	Lower limit value underrun The process value lies under the parameterized measurement range or the chosen measurement range has been chosen too high.
OLV	Overload The connected device detected an overload.
OTMP	Overtemperature A temperature diagnosis is available on the connected device.
PRMERR	Parameterization error The connected device reports a parameterization error (loss of parameters, no parameter initialization, etc.).
ULVE	Upper limit value exceeded The process value exceeds the parameterized measurement range or the chosen measurement range has been chosen too low.
VLOW	Undervoltage One of the voltages at the connected device is below the defined range.
VHIGH	Overvoltage One of the voltages at the connected device is below the defined range.

10.4.3 PROFINET diagnostics

Modul-Diagnose (Steckplatz 0, gemäß Konfigurationstool)		PROFINET-Diagnose	
	Connector	Error code	Channel
Undervoltage V1	-	0x0002	0
Undervoltage V2	-	0x0002	1

DXP diagnostics (slot 1 according to configuration tool)			PROFINET Diagnostics	
	Channel	Connector	Error code	Channel
Overcurrent output	DXP1	X0	0x0001	1
	DXP3	X1	0x0001	3
	DXP5	X2	0x0001	5
	DXP7	X3	0x0001	7

VAUX1/VAUX2 diagnostics (slot 1, according ot configuration tool)	PROFINET Diagnostics	
	Error code	Channel

VAUX1/VAUX2 diagnostics (slot 1, according ot configuration tool)	PROFINET Diagnostics	
Overcurrent VAUX1 (pin 1) at X0, channel 0/1	0x01D0	0
Overcurrent VAUX1 (pin 1) at X1, channel 2/3	0x01D1	
Overcurrent VAUX1 (pin 1) at X2, channel 4/5	0x01D2	
Overcurrent VAUX1 (pin 1) at X3, channel 6/7	0x01D3	
Overcurrent VAUX1 (pin 1) at X4, channel 8	0x01E8	
Overcurrent VAUX1 (pin 1) at X5, channel 10	0x01EA	
Overcurrent VAUX1 (pin 1) at X6, channel 12	0x01EC	
Overcurrent VAUX1 (pin 1) at X7, channel 14	0x01EE	
Overcurrent VAUX2 (pin 2) at X4, channel 9	0x01F9	
Overcurrent VAUX2 (pin 2) at X5, channel 12	0x01FB	
Overcurrent VAUX2 (pin 2) at X6, channel 14	0x01FD	
Overcurrent VAUX2 (pin 2) at X7, channel 9	0x01FF	

IO-Link port diagnostics		PROFINET Diagnostics	
IO-Link port 1 (Slot 2, according to configuration tool)	Connector	Error code	Channel
Undervoltage (VLOW)	X0	0x0002	0
Overcurrent (VHIGH)		0x0003	
Overload (OVL)		0x0004	
Over temperature (OTMP)		0x0005	
Wrong or missing device (CFGER)		0x0006	
Upper limit value exceeded (ULVE)		0x0007	
Lower limit value underrun (LLVU)		0x0008	
Data storage error (DSER)		0x0009	
Process input data invalid (PDINV)			
Maintenance events (EVT1)			
Out of specification error (EVT2)			
Port parameterization error (PPE)			
Parameterization error (PRMER)		0x0010	
Hardware error (HWER)		0x0015	
IO-Link port 2 (Slot 3, according to configuration tool)			
Similar to port 1	X1		2
IO-Link port 3 (Slot 4, according to configuration tool)			
Similar to port 1	X2		4
IO-Link port 4 (Slot 5, according to configuration tool)			
Similar to port 1	X3		6

IO-Link port diagnostics		PROFINET Diagnostics	
IO-Link port 5 (Slot 6, according to configuration tool)			
Similar to port 1	X4		8
IO-Link port 6 (Slot 7, according to configuration tool)			
Similar to port 1	X5		10
IO-Link port 7 (Slot 8, according to configuration tool)			
Similar to port 1	X6		12
IO-Link port 8 (Slot 9, according to configuration tool)			
Similar to port 1	X7		14

10.5 Using the data storage mode

Data storage mode

NOTE
Data storage mode is only available for devices complying with the IO-Link specification V1.1.

In the IO-Link master, the data storage mode can be set using the parameter "data stor-age mode".

- 00 = activated
- 01 = overwrite
- 10 = read in
- 11 = deactivated, clear

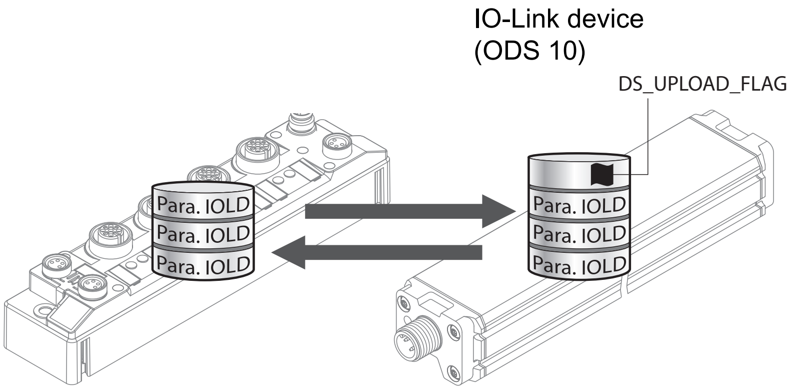

Fig. 10.1: Data storage mode - general principle, Para. IOLD = parameters of the IO-Link device

A change of parameters in the device is indicated by the status of the DS_UPLOAD_FLAG bit:

- 0 = no changes in the device's parameter set
- 1 = changes in the device's parameter set (e. g. via DTM, at the device, etc.)

10.5.1 Parameter "data storage mode" = activated

The synchronization of the parameter sets is bidirectional.
The actual data set (master or device) is valid:
The following applies:

- The data set in the device is actual, if DS_UPLOAD_FLAG = 1.
- The data set in the Master is actual, if DS_UPLOAD_FLAG = 0.

Use case 1: replace a defective device with a device in the delivery state.

The new IO-Link device has not been connected to the master before.

↳ The parameters of the new device remain unchanged, DS_UPLOAD_FLAG = 0.

↳ The parameter data of the defective device are transferred from the IO-Link master to the new IO-Link device.

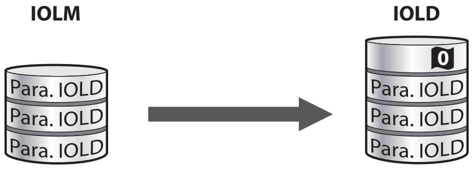

Fig. 10.2: Data storage mode activated - parameter set in the device unchanged

Use case 2: replace a defective device with a device with unknown (changed) parameters

The new IO-Link device has not been connected to the master before.

↳ The parameters of the new device remain unchanged, DS_UPLOAD_FLAG = 1.

⇨ The parameter data are transferred from the new IO-Link device to the IO-Link master.

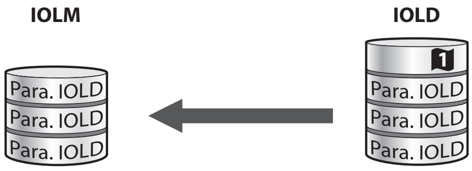

Fig. 10.3: Data storage mode activated - parameter set in the device changed

NOTE
If device replacement is necessary when data storage is activated, an IO-Link replacement device with unknown parameter data should be reset to its factory settings before connection to the IO-Link master.

10.5.2 Parameter "data storage mode" = read in

- The data set in the device is always the reference data set.
- The synchronization of the parameter sets is unidirectional towards to the master.
- The status of the DS_UPLOAD_FLAG is ignored.

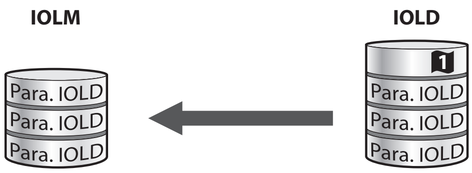

Fig. 10.4: Data storage mode = read in - parameter set in the device changed

10.5.3 Parameter "data storage mode" = overwrite

- The data set in the master is always the reference data set.
- The synchronization of the parameter sets is unidirectional towards to the device.
- The status of the DS_UPLOAD_FLAG is ignored.

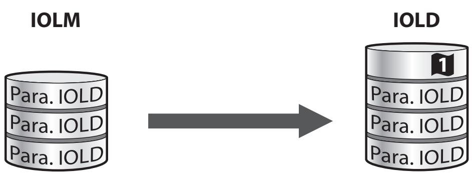

Fig. 10.5: Data storage mode = overwrite - parameter set in the master changed

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10.5.4 Parameter "data storage mode" = deactivated, clear

- The data set in the master is deleted.
- The synchronization of parameter sets is deactivated.

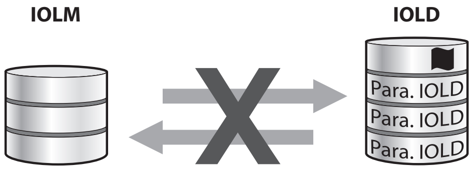

Fig. 10.6: Data storage mode deactivated - no synchronization

11 Troubleshooting

If the device does not work as expected, proceed as follows:

- Exclude environmental disturbances.
- Check the connections of the device for errors.
- Check device for parameterization errors.

If the malfunction persists, the device is faulty. In this case, decommission the device and replace it with a new device of the same type.

11.1 Parametrierfehler beheben

DXP-Kanäle

Error	Possible causes:	Remedy
DXP output does not switch	The output is deactivated per default.	↳ Switch on the output via parameter Activate output (DXP_EN_DO =1).

IO-Link channels

LED behavior	Diagnostics	Possible causes:	Remedy
DIA and IOL flash red	Data storage error	IO-Link device according to IO-Link V1.0 connected IO-Link devices in accordance with IO-Link specification V1.0 do not support data storage.	↳ Set parameter Data storage mode to deactivated, clear. ⇨ Data storage remain deactivated.
		The data storage buffer contains data of another device.	↳ Set parameter Data storage mode to deactivated, clear. ↳ Reactivate the data storage if necessary.
	Wrong or missing device	The connected device does not match the configured one (wrong vendor-ID, device-ID etc.)	↳ Adapt the parameterization of the IO-Link port (Vendor ID, Device ID, etc.) at the master. ↳ The parameterization can be done manually via the web server or similar or by teaching the master using the IO-Link-Call (port 0 function, sub index 67: Teach mode).
	Process input data invalid	Certain IO-Link devices send a **process input data invalid** diagnosis if the process value cannot be measured.	↳ Deactivate the sending of the diagnosis for the IO-Link port with the parameter Process input data invalid → No diagnostic generated.

12 Care, maintenance and disposal

12.1 Cleaning

Ensure that the plug connections and cables are always in good condition.

The devices are maintenance-free, clean dry if required.

12.2 Servicing

The device does not normally require any maintenance by the operator.

Repairs to the device must only be carried out by the manufacturer.

↳ For repairs, contact your responsible Leuze electronic subsidiary or Leuze electronic customer service (see chapter 13 „Service and support“).

12.3 Disposing

↳ For disposal observe the applicable national regulations regarding electronic components.

13 Service and support

Service hotline

You can find the contact information for the hotline in your country on our website www.leuze.com under **Contact & Support**.

Repair service and returns

Defective devices are repaired in our service centers competently and quickly. We offer you an extensive service packet to keep any system downtimes to a minimum.

Our service center requires the following information:

- Your customer number
- Product description or part description
- Serial number and batch number
- Reason for requesting support together with a description

Please register the merchandise concerned. Simply register return of the merchandise on our website www.leuze.com under **Contact & Support > Repair Service & Returns**.

To ensure quick and easy processing of your request, we will send you a returns order with the returns address in digital form.

What to do should servicing be required?

	NOTE
!	**Please use this chapter as a master copy should servicing be required!** ↳ Enter the contact information and fax this form together with your service order to the fax number given below.

Customer data (please complete)

Device type:	
Serial number:	
Firmware:	
Display messages	
Status of LEDs:	
Error description:	
Company:	
Contact person/department:	
Phone (direct dial):	
Fax:	
Street/No:	
ZIP code/City:	
Country:	

Leuze Service fax number:

+49 7021 573 - 199

14 Technical data

Technical data	
Power supply	
Supply voltage	24 VDC
Permissible range	18…30 VDC
• IO-Link	• 20.4 ... 28.8 VDC
Total current	max. 9 A per voltage group V1 + V2: max. 11 A
Power consumption	
Operating current (at 24 VDC nominal voltage)	< 120 mA (outputs inactive)
Operating current (at 28.8…18.0 VDC)	• V1: 120…180 mA • V2: 90…40 mA Operating conditions: • All outputs active without load • Ethernet communication active
Sensor/actuator supply VAUX1	Supply from V1 short-circuit proof, max. 4 A per connector X0 und X4, max. 2 A per connector X1…X3, X5…X7
Sensor/actuator supply VAUX2	Class B supply from V2 short-circuit proof, max. 4 A per connector X4…X5 max. 2 A per connector X6…X7
Potential isolation	Galvanic isolation from V1 and V2 voltage group, voltages up to 500 VDC
Connectors	
Ethernet	2 x M12, 4-pin, D coded
Power supply	2 x M12, 5-pin, L coded
Digital in-/outputs	
Admissible tightening torques • Ethernet • I/O channels/supply • Mounting (M6 screws)	 0.6 Nm 0.8 Nm 1.5 Nm
Isolation voltages	
V1 to V2	≥ 500 V AC
V1/V2 to field bus	≥ 500 V AC
System data	
Transmission rate	10 Mbps/100 Mbps
Fieldbus connection technology	2 x M12, 4-pole, D coded
Protocol detection	Automatic
Web server	Integrated, 192.168.60.254
Service interface	Ethernet via P1 or P2
Field Logic Controller (FLC)	
Supported from firmware version	3.0.6.0
Modbus TCP	
Address assignment	Static IP, DHCP
Supported Function Codes	FC1, FC2, FC3, FC4, FC5, FC6, FC15, FC16, FC23
Number of TCP connections	8

Technical data	
Register start address	0 (0x0000)
Register start address	2048 (0x0800)
Local port	Port 502, fix setting
EtherNet/IP	
Address assignment	According to EtherNet/ IP standard
Device Level Ring (DLR)	Supported
Quick Connect (QC)	< 150 ms
Number of Class 3 (TCP) connections	3
Number of Class 1 (CIP) connections	10
Input Assembly Instances	103, 120, 121, 122, 123,124, 125
Output Assembly Instances	104, 150, 151, 152
Configuration Assembly Instance	106
PROFINET	
PROFINET specification	V 2.35
Conformance Class	B (RT)
Address assignment	DCP
MinCycle Time	1 ms
Fast Start-Up (FSU)	< 150 ms
Diagnostics	According to PROFINET Alarm Handling
Topology detection	Supported
Automatic address setting	Supported
Media Redundancy Protocol (MRP)	Supported
System redundancy	S2
Network load class	3
Digital inputs	
Number of channels	4 DXP and 8 SIO
Input type	PNP
Type of input diagnostics	Channel diagnosis
Switching threshold	EN 61131-2 type 3, PNP
Signal voltage, low level	< 5 V
Signal voltage, high level	> 11 V
Low level signal current	< 1.5 mA
High-level signal current	> 2 mA
Input delay	0.05 ms
Potential isolation	Galvanic isolation to P1/P2, voltage proof up to 500 V AC
Digital outputs	
Number of channels	4 DXP
Output type	PNP
Type of output diagnostics	Channel diagnosis

Technical data	
Output voltage	24 VDC from potential group
Output current per channel	2 A, short-circuit-proof
Potential isolation	Galvanic isolation to P1/P2, voltage proof up to 500 V AC
IO-Link	
Number of channels	8
IO-Link	Pin 4 operated in IO-Link mode
IO-Link specification	Version 1.1
IO-Link port type	Class A at X0…X3 Class B at X4…X7
Frame type	Supports all specified frame types
Supported devices	Max. 32 byte input/32 byte output
• Input data	• max. 32 Byte per channel
• Output data	• max. 32 Byte per channel
Transmission rate	4.8 kbps (COM 1) 38.4 kbps (COM 2) 230.4 kbps (COM 3)
Transmission cable	Length: max. 20 m standard lines, 3- or 4-wire (depending on the application), unshielded
Mounting	
Type of mounting	Via 2 mounting holes, Ø 6.3 mm
Mounting distance (device to device)	≥ 50 mm Valid for operation in the ambient temperatures mentioned below, with sufficient ventilation as well as maximum load (horizontal mounting). At ambient temperatures of < 30 °C, the devices can also be mounted directly next to each other.
Standard/Directive conformity	
Vibration test	According to EN 60068-2-6
Acceleration	Up to 20 g
Shock test	According to EN 60068-2-27
Drop and topple	According to IEC 60068-2-31/IEC 60068-2-32
Electromagnetic compatibility	According to EN 61131-2
Approvals and certificates	CE
UL cond.	UL Listed
General information	
Dimensions (B × L × H)	60.4 × 230.4 × 39 mm
Operating temperature	-40…+70 °C
Storage temperature	-40…+85 °C

Technical data	
Operating height	Max. 5000 m
Protection class	IP65/IP67/IP69K
MTTF	160 years acc. to SN 29500 (Ed. 99) 20 °C
Housing material	PA6-GF30
Housing color	Black
Material window	Lexan
Material label	Polycarbonate
Halogen-free	Yes

15 EC Declaration of Conformity

The IO-Link devices of the MD 798 series have been developed and manufactured in accordance with the applicable European standards and directives.

The manufacturer of the product, Leuze electronic GmbH + Co. KG in D-73277 Owen, possesses a certified quality assurance system in accordance with ISO 9001.

CE

The EC Declaration of Conformity is available in the product download area at www.leuze.com.