EN

Initial Start-Up of the IO-Link Master
in an EtherNet/IP™ Network

Operating Instructions

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1. Notes for the User

These instructions describe the integration of an IO-Link master into an EtherNet/IP™ network as an example. The example provided by these instructions is based on RSLogix 5000 Mini Edition control software (version V20.01).

2. Safety Precautions

NOTE!

- Read the operating instructions carefully before using the utilized products.
- Installation, initial start-up and maintenance of the described products may only be carried out by qualified personnel.
- The described products are not suitable for safety applications.
- The operating company must comply with local safety regulations.

3. General Notes

This document is intended to explain the incorporation of an IO-Link master with Ethernet/IP interface into a controller, as well as IO-Link device assignment, as an example. This description has been prepared on the basis of an Allen Bradley CompactLogix5323 controller. wenglor sensoric does not offer any guarantee that the contents of this description are correct and/or complete. The instructions are simply intended to visualize a customary procedure which can be applied as required to other controllers with EtherNet/IP interface. Device-specific adaptation of products from other manufacturers is not dealt with in this version. Please refer to instructions provided by the respective manufacturer in this regard.

4. Integration of the IO-Link Master into the Working Environment

The following steps offer a sample procedure for correctly integrating the IO-Link master with the help of the control software.
The IO-Link master requires supply power and a network connection to the controller before initial start-up can begin. If IO-Link components will be incorporated, they have to be connected via the existing IO-Link ports. Please refer to the connection information in the operating instructions for the IO-Link master to this end: www.wenglor.com → Product World →
Product search (product number) → Download → Operating Instructions.

5. Initial Start-Up

5.1 Downloading the EDS File

An EDS file (electronic data sheet) is required in order to configure the IO-Link master. The file can be downloaded from our website (www.wenglor.com → Product World → Product search (product number) → Download → Device Description File). Upon request, you can also obtain the EDS file from our support team.

Save the EDS file to a location at which you can access it with the configuration software, and unzip it.

5.2 Finding the MAC Addresses

Each IO-Link master has three unique, fixed MAC addresses which are assigned by the manufacturer and cannot be changed by the user. The initially assigned MAC address is printed on the IO-Link master.

5.3 Configuring the Network Parameters

The operating mode for receiving network parameters such as IP address, subnet mask and gateway address can be set using the three rotary selector switches on the front of the IO-Link master.
The IO-Link master reads in the settings selected at the rotary selector switches after it has been restarted. The settings read in during this operation overwrite previously stored settings.
The device supports the DHCP and BOOTP protocols for setting the required network parameters such as IP address and subnet mask.

The following static network settings are selected upon shipment from the factory:

IP address:	192.168.100.1
Subnet mask:	255.255.255.0
Gateway address:	0.0.0.0

The following settings can be made using the rotary selector switches:

Selector Switch Setting	Function
000 (default setting)	The DHCP and BOOTP functions are activated as default settings. The network parameters are first of all queried via DHCP. If this is unsuccessful, a BOOTP query is used. Received network parameters are not saved, but the integrated web server can be used for this purpose.
000 (network parameters already saved)	The last saved network parameters are used (IP address, subnet mask, gateway address, DHCP on/off, BOOTP on/off).
001 to 254	The last three places of the saved or preset IP address are overwritten by the settings selected at the rotary selector switch.
255 to 298	The network parameters are retrieved via DCHP and BOOTP, but they're not saved.
299	The default IP address is used, namely 192.168.100.1.
979	The device resets itself to its default settings. The network parameters are also returned to their default settings. Communication is not possible in this operating mode.

5.4 Configuring the IO-Link Master with RsLogix5000

The first step involves adding a new controller to the RSLogix5000 software. Select **New** from the → **File** menu and **“20”** under **Revision** because this is the only variant which permits the incorporation of EDS files. Enter a project description to the **Description** field (see figure1). Continue then with the Rockwell Automation EDS wizard (see figure 2). The wizard can be invoked by clicking “EDS Hardware Installation Tool” in the “Tools” menu.

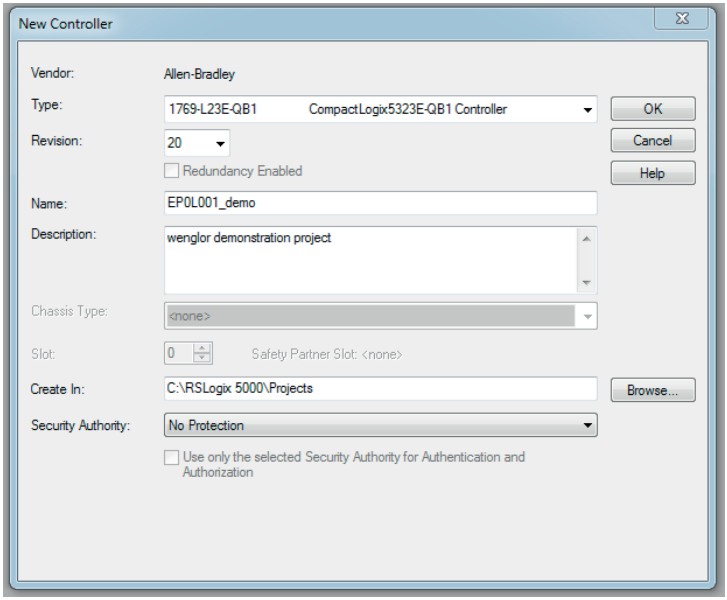
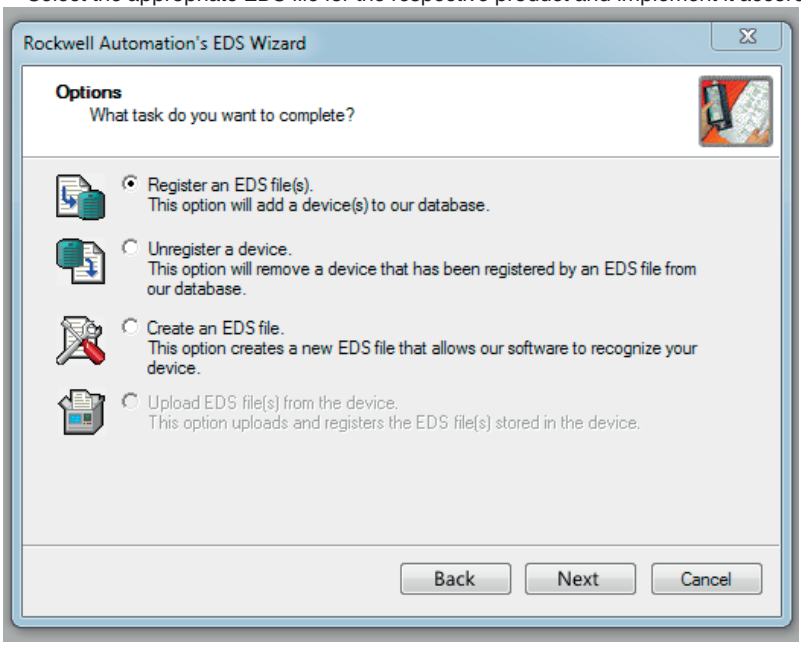
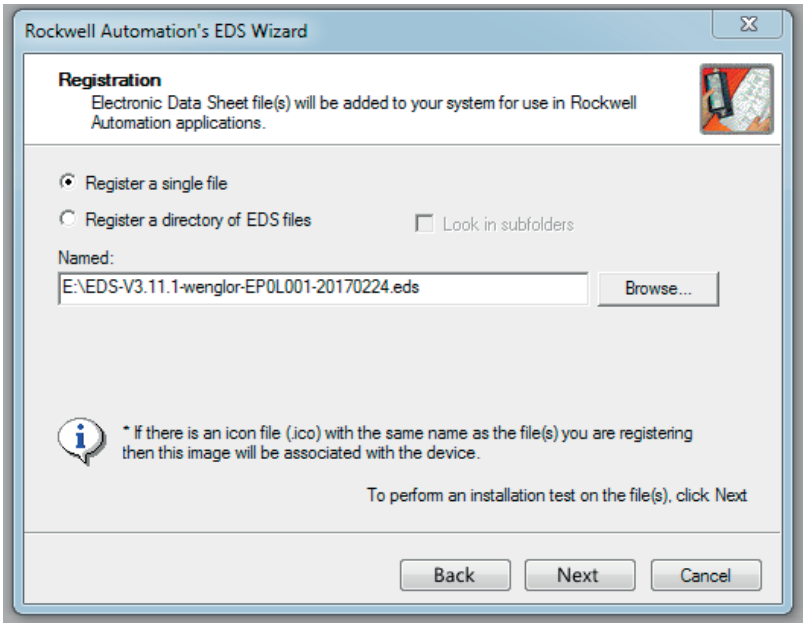


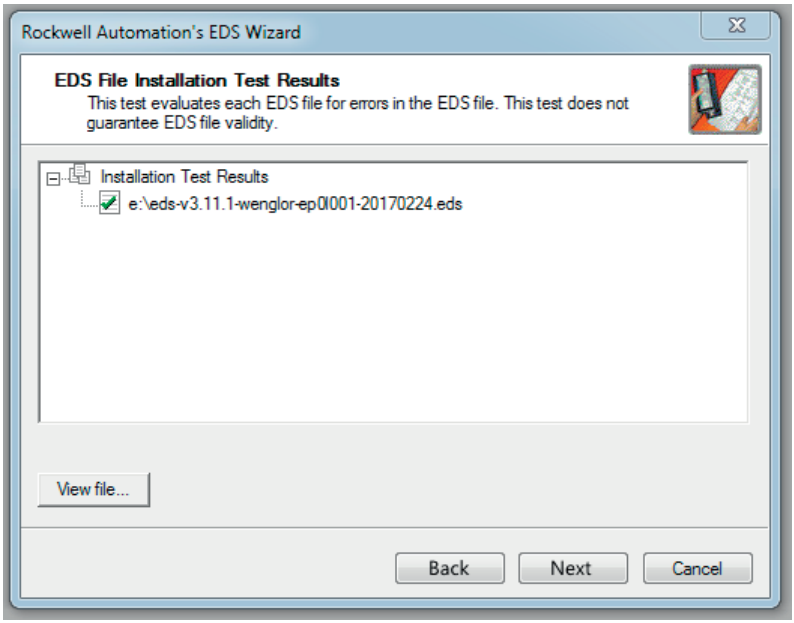
Figure 1: New Controller

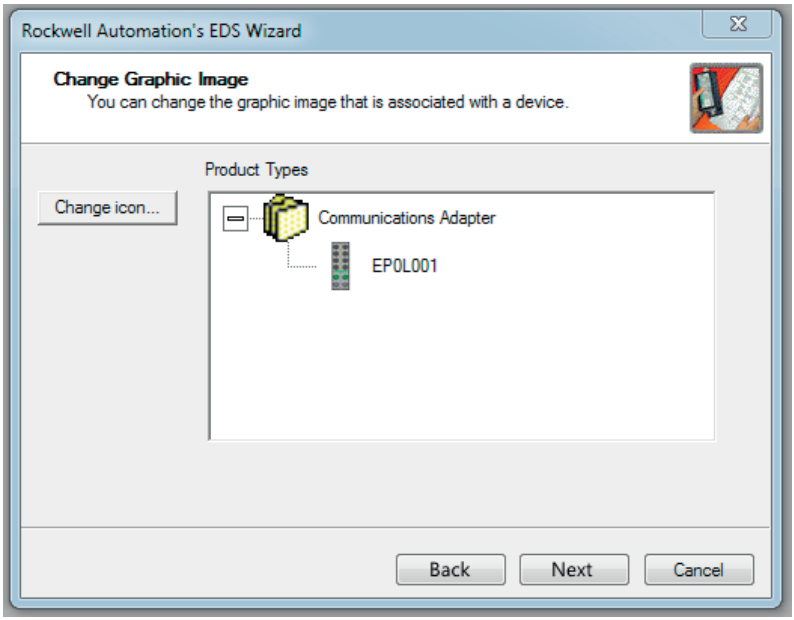
Figure 2

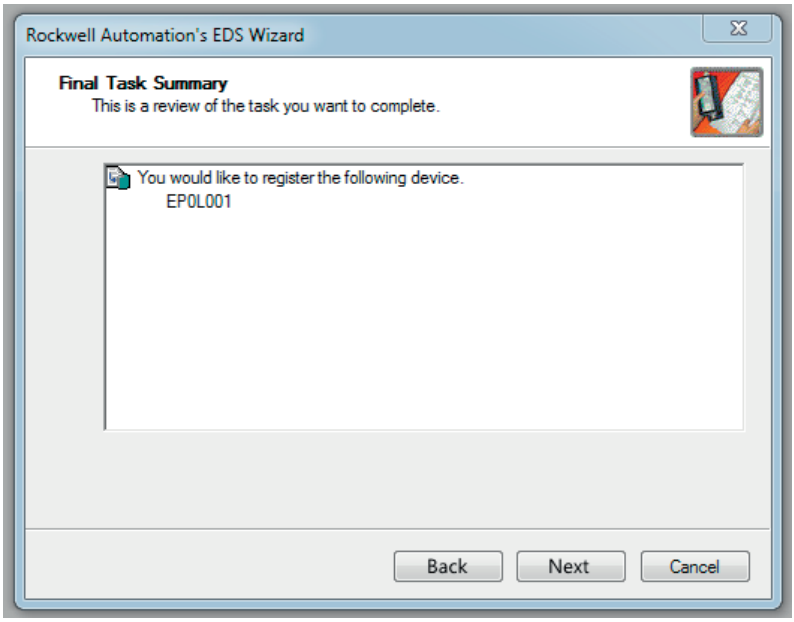
1. An EDS file must be imported during the next step. This can be done with the “Register EDS file(s)” option. Select the appropriate EDS file for the respective product and implement it accordingly.

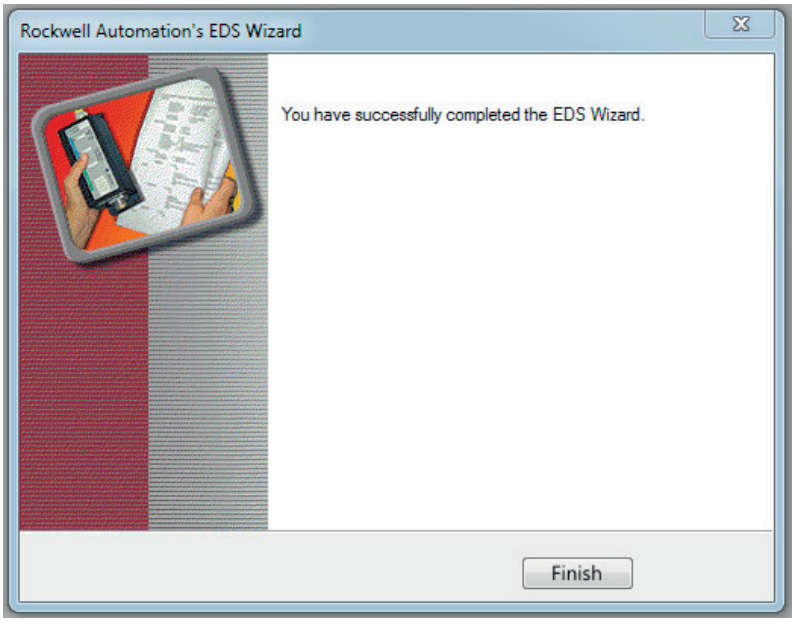





Rockwell Automation's EDS Wizard
EDS File Installation Test Results
This test evaluates each EDS file for errors in the EDS file. This test does not guarantee EDS file validity.
Installation Test Results
e:\eds-v3.11.1-wenglor-ep0l001-20170224.eds
View file...
Back
Next
Cancel

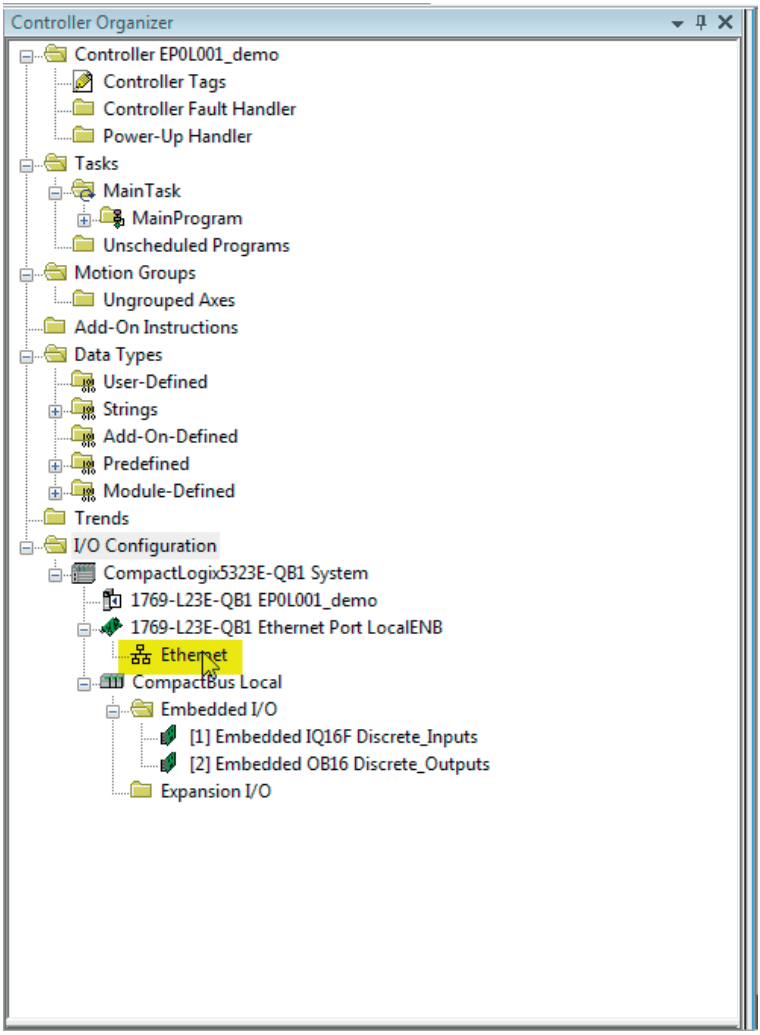

Rockwell Automation's EDS Wizard
Change Graphic Image
You can change the graphic image that is associated with a device.
Product Types
Change icon...
Communications Adapter
EP0L001
Back
Next
Cancel


Rockwell Automation's EDS Wizard
Final Task Summary
This is a review of the task you want to complete.
You would like to register the following device.
EP0L001
Back
Next
Cancel

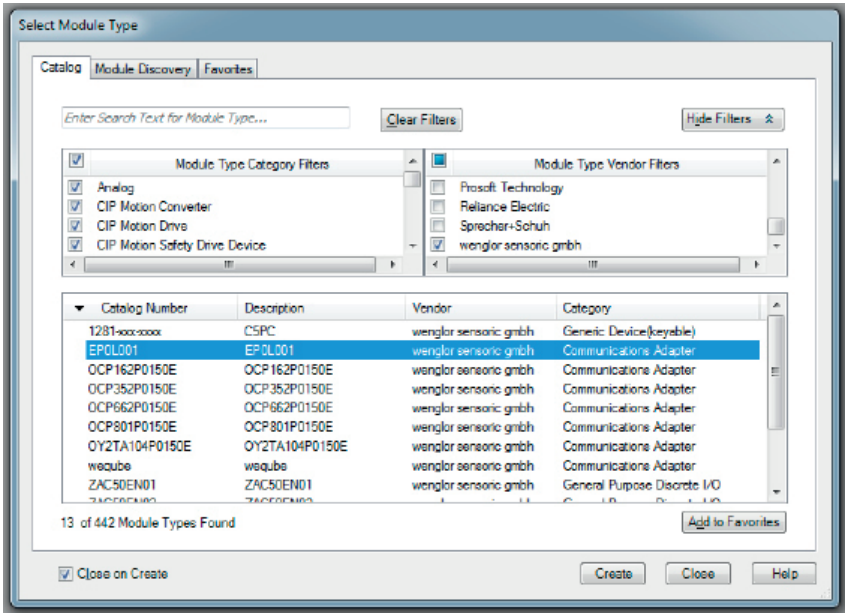

Rockwell Automation's EDS Wizard
You have successfully completed the EDS Wizard.
Finish

2. Select the correct controller during the next step.

3. Go to “I/O Configuration” in the “Controller Organizer” and right-click “Ethernet”.

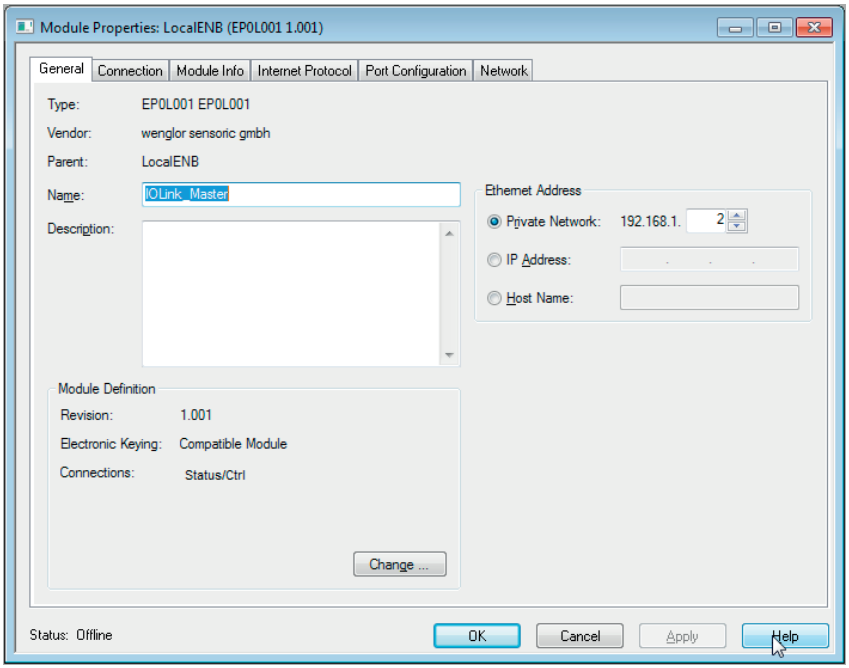


4. Select “New Module” from the menu – the following selection window appears:

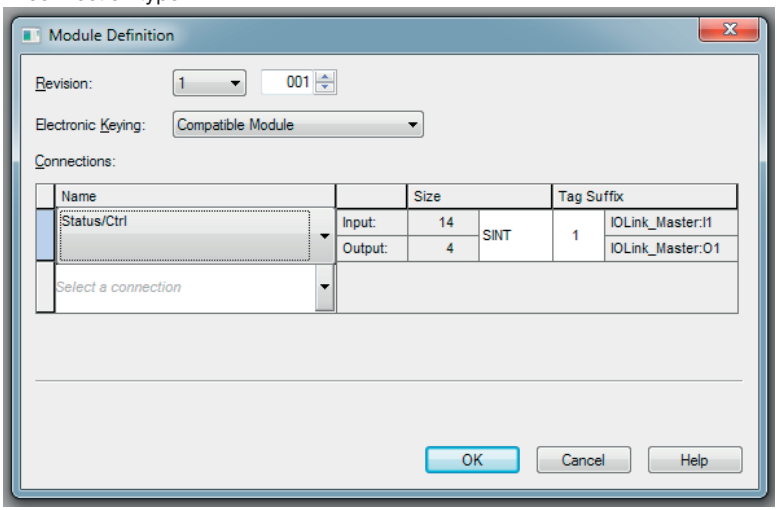


5. Select the EP0L001 module from the list and click the “Create” button.
6. Enter a name for the module and the correct IP address. In this example the name is “IOLink_Master” and the IP address is 192.168.1.2.

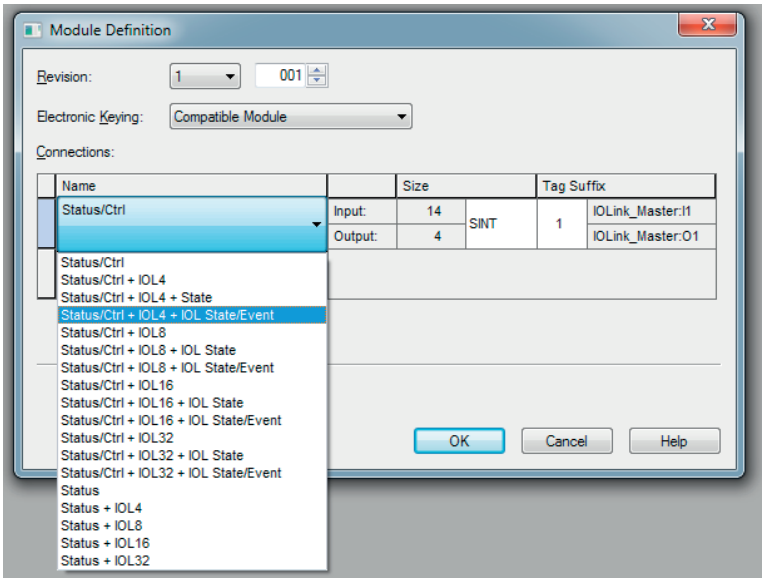
7. After double-clicking the newly added “IOLink_Master” module, you’re provided with a view of the module properties.



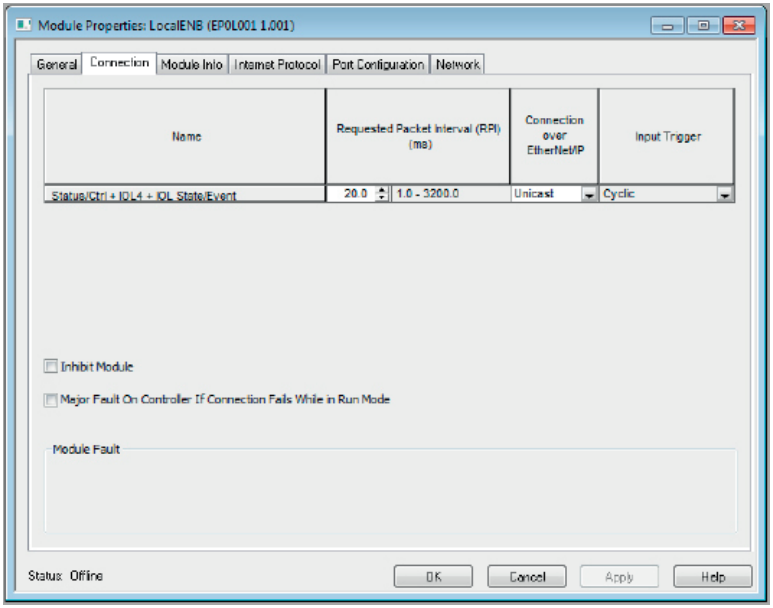
8. Click the “Change” button in order to change the settings for the module revision, electronic keying and connection type.



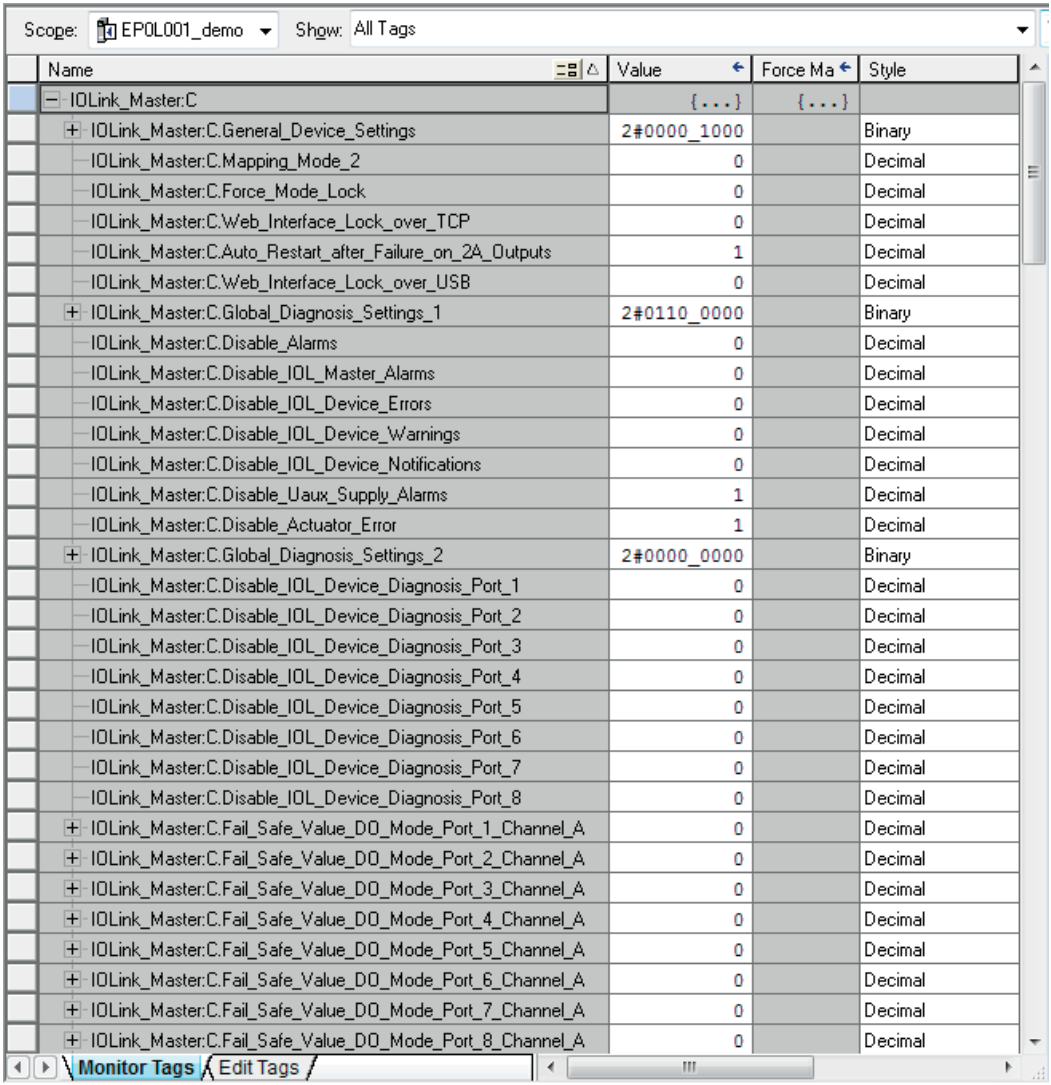
9. Select the type of connection. This selection determines which process data and diagnostics data will be made available by the IO-Link master.



10. The selected connection type is displayed in the “Connection” tab of the “Module Properties” window. The settings for the “Requested Packet Interval (RPI)” and the “Input Trigger” can be changed here. 1 ms is the minimum value for the RPI parameter.



11. Switch to “Controller Tags” in the “Controller Organizer”. The controller tags include the setting parameters for the name of the module followed by :C. The setting parameters in the “Value” column are described in the following section.



6. IO-Link Master Parameters

The following section describes the parameters of the IO-Link master. The parameters have to be transferred to the IO-Link master after it's switched on. Amongst other entries, the parameters also include the IO-Link port mode. The IO-Link port data length is determined by various available connection types.
Default settings appear below in boldface.

6.1 General Settings

Para. No.	Function	Bits	Description
1	General device settings	0	**0 = mapping mode 1** 1 = mapping mode 2
		1	0 = force mode via web interface on **1 = force mode via web interface off**
		2	**0 = web interface via TCP on** 1 = web interface via TCP off
		3	**0 = automatic restart after error (port 5-8) on** 1 = automatic restart after error (port 5-8) off
		4	0 reserved
		5	0 reserved
		6	0 reserved
		7	0 reserved

Mapping Mode, Bit 0
The "digital I/O mapping mode" parameter can be used in order to define mapping of the input and output bits which are transferred as part of the module's cyclical and acyclical data.

- MM1: Default Mapping
  In mapping mode 1 (MM1), the first bits (C/Q, ch. A / pin 4) and the second bits (ch. B / pin 2) are transferred alternately in ascending order for all ports.
- MM2: E2C Compatible Mapping
  In mapping mode 2 (MM2), the first bits (C/Q, ch. A / pin 4) and the second bits (ch. B / pin 2) are transferred one after the other in ascending order for all ports.

The different formats are also described in detail under "Bit Assignments".

6.2 Global Diagnostics Parameters

Para. No.	Function	Bits	Description
2	Global diagnostics parameter	0	**0 = all diagnostics messages on** 1 = all diagnostics messages off
		1	**0 = IO-Link master diagnostics messages on** 1 = IO-Link master diagnostics messages off
		2	**0 = IO-Link device diagnostics, error type, on** 1 = IO-Link device diagnostics, error type, off
		3	**0 = IO-Link device diagnostics, warning type, on** 1 = IO-Link device diagnostics, warning type, off
		4	**0 = IO-Link device diagnostics, remarks type, on** 1 = IO-Link device diagnostics, remarks type, off
		5	0 = U_{AUX} auxiliary power supply diagnostics on **1 = U_{AUX} auxiliary power supply diagnostics off**
		6	**0 = actuator output diagnostics on** 1 = actuator output diagnostics off
		7	0 reserved, do not use

Para. No.	Function	Bits	Description
3	Global diagnostics parameter	0	**0 = IO-Link port 1 device diagnostics on** 1 = IO-Link port 1 device diagnostics off
		1	**0 = IO-Link port 2 device diagnostics on** 1 = IO-Link port 2 device diagnostics off
		2	**0 = IO-Link port 3 device diagnostics on** 1 = IO-Link port 3 device diagnostics off
		3	**0 = IO-Link port 4 device diagnostics on** 1 = IO-Link port 4 device diagnostics off
		4	**0 = IO-Link port 5 device diagnostics on** 1 = IO-Link port 5 device diagnostics off
		5	**0 = IO-Link port 6 device diagnostics on** 1 = IO-Link port 6 device diagnostics off
		6	**0 = IO-Link port 7 device diagnostics on** 1 = IO-Link port 7 device diagnostics off
		7	**0 = IO-Link port 8 device diagnostics on** 1 = IO-Link port 8 device diagnostics off

6.3 Performance in Case of Malfunction: Parameters for Digital Outputs

The IO-Link Master supports a failsafe function for the channels used as digital outputs (DO).
Performance of the outputs in the event that EtherNet/IP™ communication is interrupted or lost can be specified while the IO-Link master is being configured.
The following options can be selected:

- **Set low:** The output channel is off and/or the output bit is set to 0.
- **Set high:** The output channel is on and/or the output bit is set to 1.
- **Hold last:** The last output state is retained.

Para. No.	Function	Bits	Description
4	Failsafe value DO mode port 1 Channel A	0 - 1	**0 = set low** 1 = set high 2 = hold last
		2 - 7	0 = reserved, do not use
5	Failsafe value DO mode port 2 Channel A	0 - 1	**0 = set low** 1 = set high 2 = hold last
		2 - 7	0 = reserved, do not use
6	Failsafe value DO mode port 3 Channel A	0 - 1	**0 = set low** 1 = set high 2 = hold last
		2 - 7	0 = reserved, do not use
7	Failsafe value DO mode port 4 Channel A	0 - 1	**0 = set low** 1 = set high 2 = hold last
		2 - 7	0 = reserved, do not use
8	Failsafe value DO mode port 5 Channel A	0 - 1	**0 = set low** 1 = set high 2 = hold last
		2 - 7	0 = reserved, do not use
9	Failsafe value DO mode port 6 Channel A	0 - 1	**0 = set low** 1 = set high 2 = hold last
		2 - 7	0 = reserved, do not use
10	Failsafe value DO mode port 7 Channel A	0 - 1	**0 = set low** 1 = set high 2 = hold last
		2 - 7	0 = reserved, do not use
11	Failsafe value DO mode port 8 Channel A	0 - 1	**0 = set low** 1 = set high 2 = hold last
		2 - 7	0 = reserved, do not use

Para. No.	Function	Bits	Description
40	Failsafe value DO mode port 1 Channel B	0 - 1	0 = no digital output, do not use
		2 - 7	0 = reserved, do not use
41	Failsafe value DO mode port 2 Channel B	0 - 1	0 = no digital output, do not use
		2 - 7	0 = reserved, do not use
42	Failsafe value DO mode port 3 Channel B	0 - 1	0 = no digital output, do not use
		2 - 7	0 = reserved, do not use
43	Failsafe value DO mode port 4 Channel B	0 - 1	0 = no digital output, do not use
		2 - 7	0 = reserved, do not use
12	Failsafe value DO mode port 5 Channel B	0 - 1	**0 = set low** 1 = set high 2 = hold last
		2 - 7	0 = reserved, do not use
13	Failsafe value DO mode port 6 Channel B	0 - 1	**0 = set low** 1 = set high 2 = hold last
		2 - 7	0 = reserved, do not use
14	Failsafe value DO mode port Channel B	0 - 1	**0 = set low** 1 = set high 2 = hold last
		2 - 7	0 = reserved, do not use
15	Failsafe value DO mode port 6 Channel B	0 - 1	**0 = set low** 1 = set high 2 = hold last
		2 - 7	0 = reserved, do not use
16	Reserved 1	0 - 7	0 = reserved, do not use

6.4 Surveillance Timeout Parameter

Separate auxiliary supply power U_{AUX}, which is available at type B IO-Link ports (channel B / pin 2), ports 5 through 8, can also be configured as a separate digital output. This provides you with the opportunity of wiring the power supply like a digital output.
The firmware of the IO-Link master makes it possible to select a delay time prior to output current monitoring for this special case.
This delay time is designated “surveillance timeout” and can be configured for each output channel. Delay time begins after the status of the output channel has been changed, for example when it’s activated (after a rising edge) or deactivated (after a falling edge). As soon as delay time has elapsed, the output is monitored and error statuses are indicated by means of the diagnostics function.
The surveillance timeout parameter can be set to a value within a range of 0 to 255 ms. The default value for this parameter is 80 ms. If the output channel is in a static state, for example if it’s switched off permanently, the typical value amounts to 5 ms.

Para. No.	Function	Bits	Description
20	Surveillance timeout port 1 Channel B	0 - 16	0 = no digital output, do not use
21	Surveillance timeout port 2 Channel B	0 - 16	0 = no digital output, do not use
22	Surveillance timeout port 3 Channel B	0 - 16	0 = no digital output, do not use
23	Surveillance timeout port 4 Channel B	0 - 16	0 = no digital output, do not use
24	Surveillance timeout port 5 Channel B	0 - 16	0 ms = minimum value **80 ms = default value** 255 ms = maximum value
25	Surveillance timeout port 6 Channel B	0 - 16	0 ms = minimum value **80 ms = default value** 255 ms = maximum value
26	Surveillance timeout port 7 Channel B	0 - 16	0 ms = minimum value **80 ms = default value** 255 ms = maximum value
27	Surveillance timeout port 8 Channel B	0 - 16	0 ms = minimum value **80 ms = default value** 255 ms = maximum value

6.5 Digital Input Logic

Standard input logic, namely normally open (NO), can be inverted to normally closed (NC). When set up as normally closed, a high level at the EtherNet/IP™ sampler is transferred to a physical low-level at the digital input. Port LED logic is not changed when the input configuration is modified. The LED indicates the physical state of the input port.

Para. No.	Function	Bits	Description
28	Digital input logic Channel A	0	**0 = normally closed, port 1A** 1 = normally open, port 1A
		1	**0 = normally closed, port 2A** 1 = normally open, port 2A
		2	**0 = normally closed, port 3A** 1 = normally open, port 3A
		3	**0 = normally closed, port 4A** 1 = normally open, port 4A
		4	**0 = normally closed, port 5A** 1 = normally open, port 5A
		5	**0 = normally closed, port 6A** 1 = normally open, port 6A
		6	**0 = normally closed, port 7A** 1 = normally open, port 7A
		7	**0 = normally closed, port 8A** 1 = normally open, port 8A

Para. No.	Function	Bits	Description
29	Digital input logic Channel B	1	**0 = normally closed, port 1A** 1 = normally open, port 1A
		2	**0 = normally closed, port 2A** 1 = normally open, port 2A
		3	**0 = normally closed, port 3A** 1 = normally open, port 3A
		4	**0 = normally closed, port 4A** 1 = normally open, port 4A
		5	0 = input not available, do not use
		6	0 = input not available, do not use
		7	0 = input not available, do not use
		8	0 = input not available, do not use

6.6 Digital I/O Mode, Channel B

The function for ports 5 through 8 (IO-Link type B) at channel B can be selected with this parameter.

Para. No.	Function	Bits	Description
30	Digital I/O mode Port 1 Channel B	0 - 7	0 = digital input cannot be changed
31	Digital I/O mode Port 2 Channel B	0 - 7	0 = digital input cannot be changed
32	Digital I/O mode Port 3 Channel B	0 - 7	0 = digital input cannot be changed
33	Digital I/O mode Port 4 Channel B	0 - 7	0 = digital input cannot be changed
34	Digital I/O mode Port 5 Channel B	0 - 1	0 = reserved **1 = auxiliary power supply** 2 = digital output 3 = inactive
		2 - 7	0 = reserved, do not use
35	Digital I/O mode Port 6 Channel B	0 - 1	0 = reserved **1 = auxiliary power supply** 2 = digital output 3 = inactive
		2 - 7	0 = reserved, do not use
36	Digital I/O mode Port 7 Channel B	0 - 1	0 = reserved **1 = auxiliary power supply** 2 = digital output 3 = inactive
		2 - 7	0 = reserved, do not use
37	Digital I/O mode Port 8 Channel B	0 - 1	0 = reserved **1 = auxiliary power supply** 2 = digital output 3 = inactive

- Auxiliary Power Supply
  Pin 2 and pin 5 of the type B IO-Link ports (ports 5 - 8) are used for auxiliary power supply in this mode. Auxiliary power is supplied via the U_{AUX} auxiliary power input. The auxiliary power input cannot be controlled.
- Digital Output
  Channel B / pin 2 of the type B IO-Link ports (ports 5 - 8)can be used as a digital output in this mode. The control bits are transmitted to the device via digital output control bytes. A “surveillance timeout” can be configured for the outputs (see parameters 20 - 27).

6.7 IO-Link Port Mode, Channel A

The function of channel A of the IO-Link port can be specified with these parameters.
The following modes are available:

- Inactive
  This mode should be selected when the channel is not used. In this case, power supply L+ (pin 1) is deactivated at the port.
- Digital Input (DI)
  The channel functions as a digital input in this mode. The IO-Link master does not attempt to establish communication with an IO-Link device autonomously. The channel can be switched to the COM mode using the cyclical output bit in the status/control byte of the IO-Link master in order to start parameters configuration of the connected IO-Link device.

NOTE!
Please note that the status of the digital input signal is not updated when using the optional COM mode.

- Digital Output (DO)
  The channel functions as a digital output in this mode. At no time is it possible to communicate with the connected device.
- SIO Mode
  This mode is used to configure the parameters of the IO-Link devices. It's based on the fallback mechanism – from the COM mode to the SIO mode – without using the COM control bits in the status/control byte of the IO-Link master's COM control. The parameters of the IO-Link device are configured in this mode during the module's startup time, and the device switches back to the digital input mode via the fallback mechanism.
- IO-Link
  Process data can be exchanged to or from the device via the communication interface in this mode (COM mode). The IO-Link master automatically initiates communication with the connected IO-Link device in consideration of the baud rate. This mode also offers the option of configuring the parameters of the IO-Link device.
  Connections are available with data lengths of 4, 8, 16 and 32 input and output bytes. If no suitable connection for the respective IO-Link device is available, the next higher data length is tested.

Para. No.	Function	Bits	Description
53	Digital I/O mode Port 1 Channel A	0 - 2	0 = inactive **1 = digital input** 2 = digital output 3 = SIO 4 = IO-Link
		3 - 7	0 = reserved, do not use
54	Digital I/O mode Port 2 Channel A	0 - 2	0 = inactive **1 = digital input** 2 = digital output 3 = SIO 4 = IO-Link
		3 - 7	0 = reserved, do not use

Para. No.	Function	Bits	Description
55	Digital I/O mode Port 3 Channel A	0 - 2	0 = inactive **1 = digital input** 2 = digital output 3 = SIO 4 = IO-Link
		3 - 7	0 = reserved, do not use
56	Digital I/O mode Port 4 Channel A	0 - 2	0 = inactive **1 = digital input** 2 = digital output 3 = SIO 4 = IO-Link
		3 - 7	0 = reserved, do not use
57	Digital I/O mode Port 5 Channel A	0 - 2	0 = inactive **1 = digital input** 2 = digital output 3 = SIO 4 = IO-Link
		3 - 7	0 = reserved, do not use
58	Digital I/O mode Port 6 Channel A	0 - 2	0 = inactive **1 = digital input** 2 = digital output 3 = SIO 4 = IO-Link
		3 - 7	0 = reserved, do not use
59	Digital I/O mode Port 7 Channel A	0 - 2	0 = inactive **1 = digital input** 2 = digital output 3 = SIO 4 = IO-Link
		3 - 7	0 = reserved, do not use
60	Digital I/O mode Port 8 Channel A	0 - 2	0 = inactive **1 = digital input** 2 = digital output 3 = SIO 4 = IO-Link
		3 - 7	0 = reserved, do not use

6.8 IO-Link Port, Advanced Parameters

“Parameters memory” and the “validation mode” of the IO-Link master can be set for each IO-Link port (channel A). A parameters block consisting of 22 bytes is available for each IO-Link port.

Para. No.	Function	Bits	Description
62 … 70	IO-Link port 1 parameters		See table below
72 … 80	IO-Link port 2 parameters		See table below
82 … 90	IO-Link port 3 parameters		See table below
92 … 100	IO-Link port 4 parameters		See table below
102 … 110	IO-Link port 5 parameters		See table below
112 … 120	IO-Link port 6 parameters		See table below
122 … 130	IO-Link port 7 parameters		See table below
132 … 140	IO-Link port 8 parameters		See table below

Para. No.	Function	Bits	Description
62	Parameters Memory, port 1	0 - 3	**0 = deactivated** 1 = download (master to device) 2 = upload (device to master) 3 = download and upload 4 = deactivated and deleted
		4 - 7	0 = reserved, do not use
63	Device validation mode Port 1	0 - 3	**0 = no validation** 1 = compatible with entered values 2 = identical to entered values
		4 - 7	0 = reserved, do not use
64	Vendor ID (MSB) Port 1	0 - 7	0 … 255
65	Vendor ID (LSB) Port 1	0 - 7	0 … 255
66	Device ID (MSB) Port 1	0 - 7	0 … 255
67	Device ID Port 1	0 - 7	0 … 255
68	Device ID (LSB) Port 1	0 - 2	0 … 255

Para. No.	Function	Bits	Description
69	Serial number of the IO-Link device Port 1 (16 bytes)	0 - 7	Serial number, byte 1 (MSB)
		…	…
		0 - 7	Serial number, byte 16 (LSB)
70	Performance in case of fault IO-Link port 1	0 - 3	**0 = set low** 1 = set high 2 = retain last value 3 = replace value (transfer via class code 0x81) 4 = command
		4 - 7	0 = reserved, do not use

IO-Link Parameters Memory

The parameters server of the IO-Link master can be set up with the “parameters memory” parameters. The “parameters memory” function manages the IO-Link device parameters in order to permit simple device or master replacement. The following options can be configured:

- Deactivated
  The deactivated mode is the default setting upon shipment from the factory. The data maintenance function is deactivated. If a device’s parameters and data have been previously stored, these remain in memory without any change.
- Download Only (master to device)
  This function makes it possible to transfer parameters data from the IO-Link master to an IO-Link device. Parameters data can only be downloaded to the IO-Link device if compatible data are available on the parameters server. When an IO-Link device is connected, the master compares the stored data with the device data. If the function is not disabled at the IO-Link device (parameters memory disabled), the IO-Link master downloads the stored data to the device, insofar as they are different.
  IO-Link device data can be loaded with the “Upload Only” mode. if the IO-Link master hasn’t stored a set of device parameters, the mode has to be compared with “deactivated”.
  IO-Link devices can be replaced in this mode.
- Upload Only (device to master)
  This activates the parameters data upload function of the IO-Link master from the device view. Uploading takes place when an IO-Link device is connected and the IO-Link master doesn’t have any validated data. This is the case if the “deactivated and deleted” mode had been previously selected and/or if “deactivated” was selected, which is the case upon shipment from the factory.
  If the parameters data are changed during operation, the parameters data stored to the IO-Link master can be overwritten. The following command has to be used for this purpose: ParamDownloadStore (index 0x0002, sub-index 0x00, value 0x05).
  This command sets the DS_UPLOAD_REQ flag at the IO-Link device which then executes an upload. The IO-Link master can be replaced in this mode.

- Download and Upload
  This activates the function for downloading and uploading IO-Link parameters.
  Uploading takes place when an IO-Link device is connected and the IO-Link master doesn't have any validated data. This is the case if the "deactivated and deleted" mode had been previously selected and/or if "deactivated" was selected, which is the case upon shipment from the factory. Retrieved parameters data are permanently stored to the IO-Link master.
  If the parameters data at the IO-Link device are changed during operation, the data at the IO-Link master can be overwritten. The following command has to be used for this purpose: ParamDownloadStore (index 0x0002, sub-index 0x00, value 0x05).
  This command sets the DS_UPLOAD_REQ flag at the IO-Link device which then executes an upload. Each time connection is established with an IO-Link device, the IO-Link master compares stored parameters data with the IO-Link device data. If the function is not disabled at the device (parameters memory disabled), the IO-Link master writes the stored data to the IO-Link device, insofar as they are different.
  The IO-Link the device can be replaced in this mode.

Action	IO-Link Master Status	IO-Link Device Status
Upload	Invalid data (previously deleted)	Upload flag activated (valid data)
Upload	Invalid data (previously deleted)	Upload flag not activated and valid data
Upload	Valid data	Upload flag activated and valid data
Download	Valid data	Upload flag not activated (identical data)

- Deactivated and deleted
  The data storage function is deactivated. All stored data will be deleted.

NOTE!
The IO-Link device automatically sets the "upload flag" as soon as the parameters are written in the block mode.

IO-Link Device Validation
The values of the connected devices can be compared with the values which are stored to the control program by means of IO-Link device validation (IO-Link device identification). This function can be used to determine the types of the connected devices before working with their data.

- Validation mode
  - No Validation
    This option is the default setting. In this case neither the vendor ID, the device ID nor the serial number is synchronized after powering up, before communication is initiated between the IO-Link master and the IO-Link device.
  - Compatible with Entered Values
    The vendor ID and the device ID are synchronized between the IO-Link master and the IO-Link device with this option. Process data communication is not started until the configured values coincide with the values read-out from the device.
    Replacement with an IO-Link device of the same type is possible without making any changes in the engineering tool.

– Identical to Entered Values
  If the vendor ID, the device ID and the serial number were synchronized when the device was started, process data communication is only initiated if the received data correspond to the stored data. Replacement with an IO-Link device of the same type is only possible if the serial number in the engineering tool is replaced with the serial number of the new device.
– Vendor ID
  The vendor ID of the utilized IO-Link device can be entered as a decimal value to the “VendorID (MSB)” value (most significant byte) and the “VendorID (LSB)” value (least significant byte).
– Device ID
  The device ID of the utilized IO-Link device can be entered as a decimal value to the “DeviceID (MSB)” value (most significant byte) and the “DeviceID (LSB)” value (least significant byte).
– Serial Number
  The serial number of an IO-Link device can be entered as a string to the “Serial Number” field as an input. The input is limited to 16 characters.

Performance in the Event of Error (for outputs only)
This option only applies to IO-Link channels which are in the COM mode and whose output data are used. In the COM mode, I/O data are exchanged between the IO-Link master and the IO-Link device via serial communication.

• Value Options in Case of Error
  The following values can be selected:
  – Set Low
    All of the output data’s bits are transferred to the IO-Link device with a value of 0.
    This option is selected as a default setting.
  – Set High
    All of the output data’s bits are transferred to the IO-Link device with a value of 1.
    This option is selected as a default setting.
  – Hold Last
    The last valid output value received by the controller is transferred to the IO-Link device continuously and cyclically.
  – Replace Value
    If this option is selected, the values transferred via the “IO-Link failsafe parameter object” (class code 0x81) are transferred to the IO-Link device continuously and cyclically.
  – IO-Link Master Command
    The “IO-Link master command” option makes it possible for IO-Link to use specific mechanisms for valid/invalid output process data. The device automatically determines performance itself.

7. Connections

The IO-Link master supports various fixed I/O data connections.

7.1 Exclusive Owner Connection

The exclusive owner connection can be configured as a multicast or a point-to-point connection in the direction of the target origin.

- Input Data Size
  Provider data volume (input data) is variable and depends on the selected connection number.
  The first block of input data is always the status data block. This block contains the status of the I/O port's digital input, the status of the IO-Link port and the diagnostics data.
  The number of input data depends on the configured size of the IO-Link input/output data.
- Configured Size of the IO-Link Input/Output Data
  Various data lengths can be selected for IO-Link input/output data. The following data lengths can be selected: 4, 8, 16 or 32 bytes for all IO-Link channels. The length must be selected for the maximum data length of all utilized IO-Link devices at a given IO-Link master. The selected data length applies to the input/output data size of all utilized IO-Link master ports. This provides for simple and constant data offset in the input data stream with reduced input/output data volume.
- Configured, Extended IO-Link Status Data
  This block contains the IO-Link communication status, the parameters memory status and the IDs of the connected IO-Link devices.
- Configured IO-Link Event Data
  This block contains up to three IO-Link event data records.

The following EtherNet/IP™ instances are available for configuring the input/output data:
(connection = CONN, assembly = ASSY)

CONN No.	Input Instance ID	Input Data	Output Instance ID
1	101	Status data of the IO-Link master (without IO-Link device or optional data)	100 (0 bytes IO-Link)
2	103	Status data of the IO-Link master + 4 bytes IO-Link device per port	102 (4 bytes IO-Link)
5	105	Status data of the IO-Link master + 8 bytes IO-Link device per port	104 (8 bytes IO-Link)
8	107	Status data of the IO-Link master + 16 bytes IO-Link device per port	106 (16 bytes IO-Link)
11	109	Status data of the IO-Link master + 32 bytes IO-Link device per port	108 (32 bytes IO-Link)
3	111	Status data of the IO-Link master + 4 bytes IO-Link device per port + extended IO-Link status	102 (4 bytes IO-Link)
6	113	Status data of the IO-Link master + 8 bytes IO-Link device per port + extended IO-Link status	104 (8 bytes IO-Link)
9	115	Status data of the IO-Link master + 16 bytes IO-Link device per port + extended IO-Link status	106 (16 bytes IO-Link)
12	117	Status data of the IO-Link master + 32 bytes IO-Link device per port + extended IO-Link status	108 (32 bytes IO-Link)

CONN No.	Input Instance ID	Input Data	Output Instance ID
4	119	Status data of the IO-Link master + 4 bytes IO-Link device per port + extended IO-Link status + IO-Link events	102 (4 bytes IO-Link)
7	121	Status data of the IO-Link master + 8 bytes IO-Link device per port + extended IO-Link status + IO-Link events	104 (8 bytes IO-Link)
10	123	Status data of the IO-Link master + 16 bytes IO-Link device per port + extended IO-Link status + IO-Link events	106 (16 bytes IO-Link)
13	125	Status data of the IO-Link master + 32 bytes IO-Link device per port + extended IO-Link status + IO-Link events	108 (32 bytes IO-Link)

Output Data Size
The size of the consumption data (output data) is variable.
The first block of output data is always the control data block of the IO-Link master. This block contains the digital output control bits of the IO-Link port.

The variable number of output data depends on the
- Configured size of the IO-Link input/output data
  IO-Link output data can be selected in a length of 4, 8, 16 or 32 bytes, identical for all IO-Link channels. The length must be selected for the maximum data length of all utilized IO-Link devices at a given IO-Link master. The selected data length applies to the input/output data size of all utilized IO-Link master ports. This provides for simple and constant data offset in the input data stream with reduced input/output data volume.

The following EtherNet/IP™ instances are available for configuring the input/output data:
(connection = CONN, assembly = ASSY)

CONN No.	Input Instance ID	Input Data	Output Instance ID
1	100	Status data of the IO-Link master (without IO-Link device or optional data)	100 (0 bytes IO-Link)
2	102	4 bytes IO-Link master control data + 4 bytes IO-Link device per port	103 (4 bytes IO-Link)
3	102	4 bytes IO-Link master control data + 4 bytes IO-Link device per port	111 (4 bytes IO-Link + status)
4	102	4 bytes IO-Link master control data + 4 bytes IO-Link device per port	106 (4 bytes IO-Link + status + event)
5	104	4 bytes IO-Link master control data + 8 bytes IO-Link device per port	105 (8 bytes IO-Link)
6	104	4 bytes IO-Link master control data + 8 bytes IO-Link device per port	113 (8 bytes IO-Link + status)
7	104	4 bytes IO-Link master control data + 8 bytes IO-Link device per port	121 (8 bytes IO-Link + status + event)

CONN No.	Input Instance ID	Input Data	Output Instance ID
8	106	4 bytes IO-Link master control data + 16 bytes IO-Link device per port	107 (16 bytes IO-Link)
9	106	4 bytes IO-Link master control data + 16 bytes IO-Link device per port	115 (16 bytes IO-Link + status)
10	106	4 bytes IO-Link master control data + 16 bytes IO-Link device per port	123 (16 bytes IO-Link + status + event)
11	108	4 bytes IO-Link master control data + 32 bytes IO-Link device per port	109 (32 bytes IO-Link)
12	108	4 bytes IO-Link master control data + 32 bytes IO-Link device per port	117 (32 bytes IO-Link + status)
13	108	4 bytes IO-Link master control data + 32 bytes IO-Link device per port	125 (32 bytes IO-Link + status + event)

7.2 Listen Only Connection

Listen only connections are available in both communication directions.
The following EtherNet/IP™ instances are available for configuring the input data as a listen only connection: (connection = CONN, assembly = ASSY)

CONN No.	Input Instance ID	Input Data	Output Instance ID
14	100	Status data of the IO-Link master (without IO-Link devices or optional data)	-
15	101	Status data of the IO-Link master + 4 bytes IO-Link device per port	-
16	102	Status data of the IO-Link master + 8 bytes IO-Link device per port	-
17	103	Status data of the IO-Link master + 16 bytes IO-Link device per port	-
18	104	Status data of the IO-Link master + 32 bytes IO-Link device per port	-

8. Bit Assignments

8.1 Status Data of the IO-Link Master (inputs)

Status Data	Description
Byte 0	Status of digital inputs, ports 1 - 4 (mapping mode 1, standard)
Byte 1	Status of digital inputs, ports 5 - 8 (mapping mode 1, standard)
Byte 2	Status of IO-Link communication
Byte 3	Status of IO-Link process data validity
Byte 4	Status of module diagnostics (byte 0)
Byte 5	Status of module diagnostics (byte 1)
Byte 6	Status of sensor supply power diagnostics, ports 1 - 8
Byte 7	Reserved
Byte 8	Status of digital output diagnostics for channel A, ports 1 - 8
Byte 9	Status of digital output diagnostics for channel B, ports 5 - 8
Byte 10	Status of IO-Link device diagnostics, error type, ports 1 - 8
Byte 11	Status of IO-Link device diagnostics, warning type, ports 1 - 8
Byte 12	Status of IO-Link device diagnostics, remarks type, ports 1 - 8
Byte 13	Reserved

Detailed information regarding input status is included in the following section.

8.1.1 Status of Digital Inputs (mapping mode 1, standard)

If mapping mode 1 has been selected in the device settings, the module's digital input data are transferred as follows:

Byte 0	Digital Input Status of Ports 1 - 4							
Bits	7	6	5	4	3	2	1	0
Port	X4	X4	X3	X3	X2	X2	X1	X1
Pin	2	4	2	4	2	4	2	4
Channel	4B	4A	3B	3A	2B	2A	1B	1A

Byte 1	Digital Input Status of Ports 5 - 8							
Bits	7	6	5	4	3	2	1	0
Port	X8	X8	X7	X7	X6	X6	X5	X5
Pin	2	4	2	4	2	4	2	4
Channel	8B	8A	7B	7A	6B	6A	5B	5A

8.1.2 Status of Digital Inputs (mapping mode 2)

If mapping mode 2 has been selected in the device settings, the module's digital input data are transferred as follows:

Byte 0	Digital Input Status of Ports 1 - 4							
Bits	7	6	5	4	3	2	1	0
Port	X8	X7	X6	X5	X4	X3	X2	X1
Pin	4	4	4	4	4	4	4	4
Channel	8A	7A	6A	5A	4A	3A	2A	1A

Byte 1	Digital Input Status of Ports 5 - 8							
Bits	7	6	5	4	3	2	1	0
Port	X8	X7	X6	X5	X4	X3	X2	X1
Pin	2	2	2	2	2	2	2	2
Channel	8B	7B	6B	5B	4B	3B	2B	1B

8.1.3 Status of IO-Link Communication Direction

The "IOL-COM" status indicates which port has established communication with an IO-Link device.

Byte 2	IOL-COM Status							
Bits	7	7	5	4	3	2	1	0
Port	X8	X8	X6	X5	X4	X3	X2	X1
Pin	4	4	4	4	4	4	4	4
Channel	8A	8A	6A	5A	4A	3A	2A	1A

8.1.4 Status of IO-Link Process Data Validity

The "IOL-PD valid" status indicates whether or not the IO-Link process data at the corresponding port are valid.

Byte 3	IOL-PD valid							
Bits	7	6	5	4	3	2	1	0
Port	X8	X7	X6	X5	X4	X3	X2	X1
Pin	4	4	4	4	4	4	4	4
Channel	8A	7A	6A	5A	4A	3A	2A	1A

8.1.5 Status of the Diagnostics Module

This data delivers collected information concerning available module diagnostics.

Input	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 4	0	MI-FMA	MI-VAL	MI-SCB	MI-SCA	MI-SCS	MI-LVA	MI-LVS
Byte 5	0	0	0	0	0	IOL_DN	IOL-DW	IOL-DE

- MI-LVS: Module information – system/sensor power supply low
- MI-LVA: Module information – auxiliary power supply too low
- MI-SCS: Module information – sensor short-circuit
- MI-SCA: Module information – actuator short-circuit, channel A
- MI-SCB: Module information – actuator short-circuit, channel B
- MI-VAL: Module information – IO-Link validation error
- MI-FMA: Module information – force mode activated
- MI-DE: Module information – IO-Link device error
- MI-DW: Module information – IO-Link device warning
- MI-DN: Module information – IO-Link device message

8.1.6 Sensor Power Supply Status, Diagnostics Processing

These data provide status information concerning sensor power supply per port (pin 1 of X1 - X8).

Input	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 6	SCS-X8	SCS-X7	SCS-X6	SCS-X5	SCS-X4	SCS-X3	SCS-X2	SCS-X1

- SCS-X1 ... SCS-X8: Sensor short-circuit at ports X1 to X8

8.1.7 Status of Digital Output Diagnostics

These data transfer digital output diagnostics information for channel A and Channel B of each port. Channel B information is also available if the port has been configured as an auxiliary power supply.

Input	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 8	CE-X8A	CE-X7A	CE-X6A	CE-X5A	CE-X4A	CE-X3A	CE-X2A	CE-X1A
Byte 9	CE-X8B	CE-X7B	CE-X6B	CE-X5B	0	0	0	0

- CE-X1A … CE-X8A:
  Channel error, channel A (contact pin 4) of ports X1 to X8
- CE-X5B … CEX8B:
  Channel error, channel B (contact pin 2) of ports X1 to X8

8.1.8 Diagnostics Module Status (error warning)

This data provides information for each port as to whether an IO-Link device has transmitted an error, a warning or a message.

Input	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 10	DE-X8A	DE-X7A	DE-X6A	DE-X5A	DE-X4A	DE-X3A	DE-X2A	DE-X1A
Byte 11	DW-X8A	DW-X7A	DW-X6A	DW-X5A	DW-X4A	DW-X3A	DW-X2A	DW-X1A
Byte 12	DN-X8A	DN-X7A	DN-X6A	DN-X5A	DN-X4A	DN-X3A	DN-X2A	DN-X1A
Byte 13	VAL-X8A	VAL-X7A	VAL-X6A	VAL-X5A	VAL-X4A	VAL-X3A	VAL-X2A	VAL-X1A

- DE-X1A … DE-X8A: IO-Link device error message, channel A (contact pin 4, C/Q) at port X1-X8
- DW-X1A … DW-X8A: IO-Link device warning, channel A (contact pin 4, C/Q) at port X1-X8
- DN-X1A … DN-N8A: IO-Link device message, channel A (contact pin 4, C/Q) at port X1-X8
- VAL-X1A … VAL-X8A: IO-Link device validation error, channel A (contact pin 4, C/Q) at port X1-X8

8.2 Input Data, IO-Link Devices

Depends on selected input instances

- 103: 4 bytes IO-Link input
- 105: 8 bytes IO-Link input
- 107: 16 bytes IO-Link input
- 109: 32 bytes IO-Link input
- 111: 4 bytes IO-Link input + 8 bytes extended IO-Link status
- 113: 4 bytes IO-Link input + 8 bytes extended IO-Link status
- 115: 4 bytes IO-Link input + 8 bytes extended IO-Link status
- 117: 4 bytes IO-Link input + 8 bytes extended IO-Link status

8.2.1 IO-Link Data for 4 Bytes Input, Instance 103

Instance 103 provides 4 bytes IO-Link input data for each IO-Link port with the following mapping:

Input	Port	Description
Bytes 14 - 17	X1	Byte 0 to byte 3 of the IO-Link input data
Bytes 18 - 21	X2	Byte 0 to byte 3 of the IO-Link input data
Bytes 22 - 25	X3	Byte 0 to byte 3 of the IO-Link input data
Bytes 26 - 29	X4	Byte 0 to byte 3 of the IO-Link input data
Bytes 30 - 33	X5	Byte 0 to byte 3 of the IO-Link input data
Bytes 34 - 37	X6	Byte 0 to byte 3 of the IO-Link input data
Bytes 38 - 41	X7	Byte 0 to byte 3 of the IO-Link input data
Bytes 42 - 45	X8	Byte 0 to byte 3 of the IO-Link input data

The 4 bytes of input data per port are zero if no IO-Link device is connected to the corresponding port.

8.2.2 IO-Link Data for 8 Bytes Input, Instance 105

Instance 105 provides 8 bytes IO-Link input data for each IO-Link port with the following mapping:

Input	Port	Description
Bytes 14 - 21	X1	Byte 0 to byte 7 of the IO-Link input data
Bytes 22 - 29	X2	Byte 0 to byte 7 of the IO-Link input data
Bytes 30 - 37	X3	Byte 0 to byte 7 of the IO-Link input data
Bytes 38 - 45	X4	Byte 0 to byte 7 of the IO-Link input data
Bytes 46 - 53	X5	Byte 0 to byte 7 of the IO-Link input data
Bytes 54 - 61	X6	Byte 0 to byte 7 of the IO-Link input data
Bytes 62 - 69	X7	Byte 0 to byte 7 of the IO-Link input data
Bytes 70 - 78	X8	Byte 0 to byte 7 of the IO-Link input data

The 8 bytes of input data per port are zero if no IO-Link device is connected to the corresponding port.

8.2.3 IO-Link Data for 16 Bytes Input, Instance 107

Instance 107 provides 16 bytes IO-Link input data for each IO-Link port with the following mapping:

Input	Port	Description
Bytes 14 - 29	X1	Byte 0 to byte 15 of the IO-Link input data
Bytes 29 - 45	X2	Byte 0 to byte 15 of the IO-Link input data
Bytes 46 - 61	X3	Byte 0 to byte 15 of the IO-Link input data
Bytes 62 - 77	X4	Byte 0 to byte 15 of the IO-Link input data
Bytes 78 - 93	X5	Byte 0 to byte 15 of the IO-Link input data
Bytes 94 - 109	X6	Byte 0 to byte 15 of the IO-Link input data
Bytes 110 - 125	X7	Byte 0 to byte 15 of the IO-Link input data
Bytes 126 - 141	X8	Byte 0 to byte 15 of the IO-Link input data

The 16 bytes of input data per port are zero if no IO-Link device is connected to the corresponding port.

8.2.4 IO-Link Data for 32 Bytes Input, Instance 109

Instance 109 provides 32 bytes IO-Link input data for each IO-Link port with the following mapping:

Input	Port	Description
Bytes 14 - 45	X1	Byte 0 to byte 31 of the IO-Link input data
Bytes 46 - 77	X2	Byte 0 to byte 31 of the IO-Link input data
Bytes 78 - 109	X3	Byte 0 to byte 31 of the IO-Link input data
Bytes 110 - 141	X4	Byte 0 to byte 31 of the IO-Link input data
Bytes 142 - 173	X5	Byte 0 to byte 31 of the IO-Link input data
Bytes 174 - 205	X6	Byte 0 to byte 31 of the IO-Link input data
Bytes 206 - 237	X7	Byte 0 to byte 31 of the IO-Link input data
Bytes 238 - 269	X8	Byte 0 of the IO-Link input data to byte 7 of the IO-Link input data

The 32 bytes of input data per port are zero if no IO-Link device is connected to the corresponding port.

8.3 IO-Link Data & Extended IO-Link Status Data

Depending on the selected input instance

- 111: 4 bytes IO-Link input + 8 bytes extended IO-Link status data
- 113: 8 bytes IO-Link input + 8 bytes extended IO-Link status data
- 115: 16 bytes IO-Link input + 8 bytes extended IO-Link status data
- 117: 32 bytes IO-Link input + 8 bytes extended IO-Link status data

data for each IO-Link port are added to received process data in the case of address offset 14. Received IO-Link device input data are forwarded to the EtherNet/IP™ controller without byte mapping.

The extended IO-Link status data are defined as follows:

Byte	Bits	Description
0	7	Reserved
	6	Reserved
	5	Reserved
	4	Reserved
	3	Reserved
	2	Reserved
	1	1 = communication with IO-Link device available
	0	1 = port configured in IO-Link mode
1	7	Reserved
	6	Reserved
	5	Reserved
	4	Reserved
	3	1 = IO-Link device detected and serial number identified
	2	1 = IO-Link device detected with incompatible (vendor ID or device ID)
	1	1 = parameters memory error
	0	1 = direct parameters page implausible
2		Vendor ID (LSB)
3		Vendor ID (MSB)
4		Device ID (LSB)
5		Device ID
6		Device ID (MSB)
7		Reserved

8.3.1 IO-Link 4 Bytes Input & Extended Status, Instance 111

Instance 111 provides 4 bytes IO-Link input data and 8 bytes extended IO-Link status data for each IO-Link port with the following mapping:

Input	Port	Description
Bytes 14 - 17	X1	Byte 0 to byte 3 of the IO-Link input data
Bytes 18 - 25	X1	Byte 0 to byte 7 of the extended IO-Link status data
Bytes 26 - 29	X2	Byte 0 to byte 3 of the IO-Link input data
Bytes 30 - 37	X2	Byte 0 to byte 7 of the extended IO-Link status data
Bytes 38 - 41	X3	Byte 0 to byte 3 of the IO-Link input data
Bytes 42 - 49	X3	Byte 0 to byte 7 of the extended IO-Link status data
Bytes 50 - 53	X4	Byte 0 to byte 3 of the IO-Link input data
Bytes 54 - 61	X4	Byte 0 to byte 7 of the extended IO-Link status data
Bytes 62 - 65	X5	Byte 0 to byte 3 of the IO-Link input data
Bytes 66 - 73	X5	Byte 0 to byte 7 of the extended IO-Link status data
Bytes 74 - 77	X6	Byte 0 to byte 3 of the IO-Link input data
Bytes 78 - 85	X6	Byte 0 to byte 7 of the extended IO-Link status data
Bytes 86 - 89	X7	Byte 0 to byte 3 of the IO-Link input data
Bytes 90 - 97	X7	Byte 0 to byte 7 of the extended IO-Link status data
Bytes 98 - 101	X8	Byte 0 to byte 3 of the IO-Link input data
Bytes 102 - 109	X8	Byte 0 to byte 7 of the extended IO-Link status data

The 4 bytes of input data and extended IO-Link status data per port are zero if no IO-Link device is connected to the corresponding port.

8.3.2 IO-Link 8 Bytes Input & Extended Status, Instance 113

Instance 113 provides 8 bytes IO-Link input data and 8 bytes extended IO-Link status data for each IO-Link port with the following mapping:

Input	Port	Description
Bytes 14 - 21	X1	Byte 0 to byte 7 of the IO-Link input data
Bytes 22 - 29	X1	Byte 0 to byte 7 of the extended IO-Link status data
Bytes 30 - 37	X2	Byte 0 to byte 7 of the IO-Link input data
Bytes 38 - 45	X2	Byte 0 to byte 7 of the extended IO-Link status data
Bytes 46 - 53	X3	Byte 0 to byte 7 of the IO-Link input data
Bytes 54 - 61	X3	Byte 0 to byte 7 of the extended IO-Link status data
Bytes 62 - 69	X4	Byte 0 to byte 7 of the IO-Link input data
Bytes 70 - 77	X4	Byte 0 to byte 7 of the extended IO-Link status data
Bytes 78 - 85	X5	Byte 0 to byte 7 of the IO-Link input data
Bytes 86 - 96	X5	Byte 0 to byte 7 of the extended IO-Link status data
Bytes 97 - 104	X6	Byte 0 to byte 7 of the IO-Link input data
Bytes 105 - 112	X6	Byte 0 to byte 7 of the extended IO-Link status data
Bytes 113 - 120	X7	Byte 0 to byte 7 of the IO-Link input data
Bytes 121 - 128	X7	Byte 0 to byte 7 of the extended IO-Link status data
Bytes 135 - 142	X8	Byte 0 to byte 7 of the IO-Link input data
Bytes 143 - 150	X8	Byte 0 to byte 7 of the extended IO-Link status data

The 8 bytes of input data and extended IO-Link status data per port are zero if no IO-Link device is connected to the corresponding port.

8.3.3 IO-Link 16 Bytes Input & Extended Status, Instance 115

Instance 115 provides 16 bytes IO-Link input data and 8 bytes extended IO-Link status data for each IO-Link port with the following mapping:

Input	Port	Description
Bytes 14 - 29	X1	Byte 0 to byte 15 of the IO-Link input data
Bytes 30 - 37	X1	Byte 0 to byte 7 of the extended IO-Link status data
Bytes 38 - 53	X2	Byte 0 to byte 15 of the IO-Link input data
Bytes 54 - 61	X2	Byte 0 to byte 7 of the extended IO-Link status data
Bytes 62 - 77	X3	Byte 0 to byte 15 of the IO-Link input data
Bytes 78 - 85	X3	Byte 0 to byte 7 of the extended IO-Link status data
Bytes 86 - 101	X4	Byte 0 to byte 15 of the IO-Link input data
Bytes 102 - 109	X4	Byte 0 to byte 7 of the extended IO-Link status data
Bytes 110 - 125	X5	Byte 0 to byte 15 of the IO-Link input data
Bytes 126 - 133	X5	Byte 0 to byte 7 of the extended IO-Link status data
Bytes 134 - 149	X6	Byte 0 to byte 15 of the IO-Link input data
Bytes 150 - 157	X6	Byte 0 to byte 7 of the extended IO-Link status data
Bytes 158 - 173	X7	Byte 0 to byte 15 of the IO-Link input data

Bytes 174 - 181	X7	Byte 0 to byte 7 of the extended IO-Link status data
Bytes 182 - 189	X8	Byte 0 to byte 15 of the IO-Link input data
Bytes 190 - 197	X8	Byte 0 to byte 7 of the extended IO-Link status data

The 16 bytes of input data and extended IO-Link status data per port are zero if no IO-Link device is connected to the corresponding port.

8.3.4 IO-Link 32 Bytes Input & Extended Status, Instance 117

Instance 117 provides 32 bytes IO-Link input data and 8 bytes extended IO-Link status data for each IO-Link port with the following mapping:

Input	Port	Description
Bytes 14 - 45	X1	Byte 0 to byte 31 of the IO-Link input data
Bytes 46 - 53	X1	Byte 0 to byte 7 of the extended IO-Link status data
Bytes 54 - 85	X2	Byte 0 to byte 31 of the IO-Link input data
Bytes 86 - 93	X2	Byte 0 to byte 7 of the extended IO-Link status data
Bytes 94 - 125	X3	Byte 0 to byte 31 of the IO-Link input data
Bytes 126 - 133	X3	Byte 0 to byte 7 of the extended IO-Link status data
Bytes 134 - 165	X4	Byte 0 to byte 31 of the IO-Link input data
Bytes 166 - 173	X4	Byte 0 to byte 7 of the extended IO-Link status data
Bytes 174 - 205	X5	Byte 0 to byte 31 of the IO-Link input data
Bytes 206 - 213	X5	Byte 0 to byte 7 of the extended IO-Link status data
Bytes 214 - 245	X6	Byte 0 to byte 31 of the IO-Link input data
Bytes 246 - 253	X6	Byte 0 to byte 7 of the extended IO-Link status data
Bytes 254 - 285	X7	Byte 0 to byte 31 of the IO-Link input data
Bytes 286 - 293	X7	Byte 0 to byte 7 of the extended IO-Link status data
Bytes 294 - 325	X8	Byte 0 to byte 31 of the IO-Link input data
Bytes 326 - 332	X8	Byte 0 to byte 7 of the extended IO-Link status data

The 32 bytes of input data and extended IO-Link status data per port are zero if no IO-Link device is connected to the corresponding port.

8.4 IO-Link Input data & Extended IO-Link Status Data & IO-Link Event

Depending on the selected input instance

- 119: 4 bytes IO-Link input + 8 bytes extended IO-Link status data + IO-Link event data
- 121: 8 bytes IO-Link input + 8 bytes extended IO-Link status data + IO-Link event data
- 123: 16 bytes IO-Link input + 8 bytes extended IO-Link status data + IO-Link event data
- 125: 32 bytes IO-Link input + 8 bytes extended IO-Link status data + IO-Link event data

data for each IO-Link port are added to received process data in the case of address offset 14. Received IO-Link device input data are forwarded to the EtherNet/IP™ controller without byte mapping.

The extended IO-Link status data are defined as follows:

Byte	Bits	Description
0	1	Event qualifier
1	1	Event code 1 (LSB)
2	1	Event code 2 (MSB)
3	1	Reserved
4	2	Event qualifier
5	2	Event code 1 (LSB)
6	2	Event code 2 (MSB)
7	3	Reserved
8	3	Event qualifier
9	3	Event code 1 (LSB)
10	3	Event code 2 (MSB)
11	3	Reserved

This data block can contain up to three event messages from the connected IO-Link device. Event 1 always shows the last event message, and older event messages are shifted into data block 2 or 3.
The event data are deleted after the IO-Link master has run through a deenergized cycle.

- Event qualifier

	Mode		Type		Res.	Instance		
Bits	7	6	5	4	3	2	1	0

  – Event qualifier instances:

Value	Description
0	Unknown
1	Phy.
2	DL
3	AL
4	Use
5 … 7	Reserved

– Event qualifier res.
  This bit is reserved and must be set to 0.

– Event qualifier type:

Value	Description
0	Reserved
1	Information
2	Warning
3	Error

– Event qualifier mode:

Value	Description
0	Reserved
1	Individual event recording
2	Event disappears
3	Event appears

- Event code 1 and code 2
  The IO-Link device sends the diagnostics code. Refer to the IO-Link device documentation in order to interpret the error message.

8.4.1 IO-Link 4 Bytes Input Data & Status & Event Data 119

Instance 119 provides 4 bytes IO-Link input data, 8 bytes extended IO-Link status data and 8 bytes IO-Link event data for each IO-Link port with the following mapping:

Input	Port	Description
Bytes 14 - 17	X1	Byte 0 to byte 3 of the IO-Link input data
Bytes 18 - 25	X1	Byte 0 to byte 7 of the extended IO-Link status data
Bytes 26 - 33	X1	Byte 0 to byte 7 of the IO-Link event data
Bytes 35 - 37	X2	Byte 0 to byte 3 of the IO-Link input data
Bytes 38 - 45	X2	Byte 0 to byte 7 of the extended IO-Link status data
Bytes 46 - 53	X2	Byte 0 to byte 7 of the IO-Link event data
Bytes 54 - 57	X3	Byte 0 to byte 3 of the IO-Link input data
Bytes 58 - 65	X3	Byte 0 to byte 7 of the extended IO-Link status data
Bytes 66 - 73	X3	Byte 0 to byte 7 of the IO-Link event data
Bytes 74 - 77	X4	Byte 0 to byte 3 of the IO-Link input data
Bytes 78 - 85	X4	Byte 0 to byte 7 of the extended IO-Link status data
Bytes 86 - 93	X4	Byte 0 to byte 7 of the IO-Link event data
Bytes 94 - 97	X5	Byte 0 to byte 3 of the IO-Link input data
Bytes 98 - 105	X5	Byte 0 to byte 7 of the extended IO-Link status data
Bytes 106 - 113	X5	Byte 0 to byte 7 of the IO-Link event data
Byte 114 - 117	X6	Byte 0 to byte 3 of the IO-Link input data
Bytes 118 - 125	X6	Byte 0 to byte 7 of the extended IO-Link status data
Bytes 126 - 133	X6	Byte 0 to byte 7 of the IO-Link event data
Bytes 134 - 137	X7	Byte 0 to byte 3 of the IO-Link input data
Bytes 138 - 145	X7	Byte 0 to byte 7 of the extended IO-Link status data
Byte 146 - 153	X7	Byte 0 to byte 7 of the IO-Link event data
Bytes 154 - 157	X8	Byte 0 to byte 3 of the IO-Link input data
Bytes 158 - 165	X8	Byte 0 to byte 7 of the extended IO-Link status data
Bytes 166 - 173	X8	Byte 0 to byte 7 of the IO-Link event data

The 4 bytes of input data, extended IO-Link status data and IO-Link event data per port are zero if no IO-Link device is connected to the corresponding port.

8.4.2 IO-Link 8 Bytes Input Data & Status & Event Data 121

Instance 121 provides 8 bytes IO-Link input data, 8 bytes extended IO-Link status data and 8 bytes IO-Link event data for each IO-Link port with the following mapping:

Input	Port	Description
Bytes 14 - 21	X1	Byte 0 to byte 7 of the IO-Link input data
Bytes 22 - 29	X1	Byte 0 to byte 7 of the extended IO-Link status data
Bytes 30 - 37	X1	Byte 0 to byte 7 of the IO-Link event data
Bytes 38 - 45	X2	Byte 0 to byte 7 of the IO-Link input data
Bytes 46 - 53	X2	Byte 0 to byte 7 of the extended IO-Link status data
Bytes 54 - 61	X2	Byte 0 to byte 7 of the IO-Link event data
Bytes 62 - 69	X3	Byte 0 to byte 7 of the IO-Link input data
Bytes 70 - 77	X3	Byte 0 to byte 7 of the extended IO-Link status data
Bytes 78 - 85	X3	Byte 0 to byte 7 of the IO-Link event data
Bytes 86 - 93	X4	Byte 0 to byte 7 of the IO-Link input data
Bytes 94 - 101	X4	Byte 0 to byte 7 of the extended IO-Link status data
Bytes 102 - 109	X4	Byte 0 to byte 7 of the IO-Link event data
Byte 110 - 117	X5	Byte 0 to byte 7 of the IO-Link input data
Bytes 118 - 125	X5	Byte 0 to byte 7 of the extended IO-Link status data
Bytes 126 - 133	X5	Byte 0 to byte 7 of the IO-Link event data
Bytes 134 - 141	X6	Byte 0 to byte 7 of the IO-Link input data
Bytes 142 - 149	X6	Byte 0 to byte 7 of the extended IO-Link status data
Bytes 150 - 157	X6	Byte 0 to byte 7 of the IO-Link event data
Bytes 158 - 165	X7	Byte 0 to byte 7 of the IO-Link input data
Bytes 166 - 173	X7	Byte 0 to byte 7 of the extended IO-Link status data
Bytes 174 - 181	X7	Byte 0 to byte 7 of the IO-Link event data
Bytes 182 - 189	X8	Byte 0 to byte 7 of the IO-Link input data
Bytes 190 - 197	X8	Byte 0 to byte 7 of the extended IO-Link status data
Bytes 198 - 205	X8	Byte 0 to byte 7 of the IO-Link event data

The 8 bytes of input data, extended IO-Link status data and IO-Link event data per port are zero if no IO-Link device is connected to the corresponding port.

8.4.3 IO-Link 16 Bytes Input Data & Status & Event Data 123

Instance 123 provides 16 bytes IO-Link input data, 8 bytes extended IO-Link status data and 8 bytes IO-Link event data for each IO-Link port with the following mapping:

Input	Port	Description
Bytes 14 - 29	X1	Byte 0 to byte 15 of the IO-Link input data
Bytes 30 - 37	X1	Byte 0 to byte 7 of the extended IO-Link status data
Byte 37 - 44	X1	Byte 0 to byte 7 of the IO-Link event data
Bytes 45 - 60	X2	Byte 0 to byte 15 of the IO-Link input data
Bytes 61 - 68	X2	Byte 0 to byte 7 of the extended IO-Link status data
Byte 69 - 76	X2	Byte 0 to byte 7 of the IO-Link event data
Bytes 77 - 92	X3	Byte 0 to byte 15 of the IO-Link input data
Bytes 93 - 100	X3	Byte 0 to byte 7 of the extended IO-Link status data
Byte 101 - 108	X3	Byte 0 to byte 7 of the IO-Link event data
Bytes 109 - 134	X4	Byte 0 to byte 15 of the IO-Link input data
Bytes 135 - 142	X4	Byte 0 to byte 7 of the extended IO-Link status data
Bytes 149 - 156	X4	Byte 0 to byte 7 of the IO-Link event data
Byte 157 - 172	X5	Byte 0 to byte 15 of the IO-Link input data
Bytes 173 - 180	X5	Byte 0 to byte 7 of the extended IO-Link status data
Bytes 187 - 193	X5	Byte 0 to byte 7 of the IO-Link event data
Byte 194 - 209	X6	Byte 0 to byte 15 of the IO-Link input data
Bytes 210 - 217	X6	Byte 0 to byte 7 of the extended IO-Link status data
Bytes 218 - 225	X6	Byte 0 to byte 7 of the IO-Link event data
Byte 226 - 241	X7	Byte 0 to byte 15 of the IO-Link input data
Bytes 242 - 249	X7	Byte 0 to byte 7 of the extended IO-Link status data
Bytes 250 - 257	X7	Byte 0 to byte 7 of the IO-Link event data
Byte 258 - 273	X8	Byte 0 to byte 15 of the IO-Link input data
Bytes 274 - 281	X8	Byte 0 to byte 7 of the extended IO-Link status data
Bytes 282 - 299	X8	Byte 0 to byte 7 of the IO-Link event data

The 16 bytes of input data, extended IO-Link status data and IO-Link event data per port are zero if no IO-Link device is connected to the corresponding port.

8.4.4 IO-Link 32 Bytes Input Data & Status & Event Data 125

Instance 125 provides 32 bytes IO-Link input data, 8 bytes extended IO-Link status data and 8 bytes IO-Link event data for each IO-Link port with the following mapping:

Input	Port	Description
Bytes 14 - 45	X1	Byte 0 to byte 31 of the IO-Link input data
Bytes 46 - 53	X1	Byte 0 to byte 7 of the extended IO-Link status data
Bytes 54 - 61	X1	Byte 0 to byte 7 of the IO-Link event data
Bytes 62 - 93	X2	Byte 0 to byte 31 of the IO-Link input data
Bytes 94 - 101	X2	Byte 0 to byte 7 of the extended IO-Link status data
Bytes 102 - 109	X2	Byte 0 to byte 7 of the IO-Link event data
Bytes 110 - 41	X3	Byte 0 to byte 31 of the IO-Link input data
Bytes 142 - 149	X3	Byte 0 to byte 7 of the extended IO-Link status data
Bytes 150 - 157	X3	Byte 0 to byte 7 of the IO-Link event data
Bytes 158 - 189	X4	Byte 0 to byte 31 of the IO-Link input data
Bytes 190 - 197	X4	Byte 0 to byte 7 of the extended IO-Link status data
Bytes 198 - 205	X4	Byte 0 to byte 7 of the IO-Link event data
Bytes 206 - 237	X5	Byte 0 to byte 31 of the IO-Link input data
Bytes 238 - 245	X5	Byte 0 to byte 7 of the extended IO-Link status data
Bytes 246 - 253	X5	Byte 0 to byte 7 of the IO-Link event data
Bytes 254 - 285	X6	Byte 0 to byte 31 of the IO-Link input data
Bytes 286 - 293	X6	Byte 0 to byte 7 of the extended IO-Link status data
Bytes 294 - 301	X6	Byte 0 to byte 7 of the IO-Link event data
Bytes 302 - 333	X7	Byte 0 to byte 31 of the IO-Link input data
Bytes 334 - 341	X7	Byte 0 to byte 7 of the extended IO-Link status data
Bytes 342 - 349	X7	Byte 0 to byte 7 of the IO-Link event data
Bytes 350 - 381	X8	Byte 0 to byte 31 of the IO-Link input data
Bytes 382 - 389	X8	Byte 0 to byte 7 of the extended IO-Link status data
Bytes 390 - 397	X8	Byte 0 to byte 7 of the IO-Link event data

The 32 bytes of input data, extended IO-Link status data and IO-Link event data per port are zero if no IO-Link device is connected to the corresponding port.

8.5 Control Data of the IO-Link Master (outputs)

The following EtherNet/IP™ consuming assemblies are available for configuring the output data:

Instance	Output Data Description
100	4 bytes IO-Link master control data (without IO-Link device output data)
102	4 bytes IO-Link master control data + 4 bytes IO-Link device per port
104	4 bytes IO-Link master control data + 8 bytes IO-Link device per port
106	4 bytes IO-Link master control data + 16 bytes IO-Link device per port
108	4 bytes IO-Link master control data + 32 bytes IO-Link device per port

The digital output at the corresponding port can be controlled with the control data of the IO-Link master. The IO-Link port must be configured as a digital output in the engineering tool.
The IO-Link master requires the following control data from the IO-Link master digital outputs for each utilized instance.

8.5.1 Controlling the Digital Outputs (mapping 1, default setting)

If mapping mode 1 has been configured in the IO-Link master, all digital outputs are transmitted as follows.

Byte 0	Control Data for the Digital Outputs of Ports 1 - 4							
Bits	7	6	5	4	3	2	1	0
Port	X4	X4	X3	X3	X2	X2	X1	X1
Pin	-	4	-	4	-	4	-	4
Channel	-	4A	-	3A	-	2A	-	1A

Byte 1	Control Data for the Digital Outputs of Ports 1 - 4							
Bits	7	6	5	4	3	2	1	0
Port	X4	X4	X3	X3	X2	X2	X1	X1
Pin	2	4	2	4	2	4	2	4
Channel	4B	4A	3B	3A	2B	2A	1B	1A

8.5.2 Controlling the Digital Outputs (mapping 2, default setting)

If mapping mode 2 has been configured in the IO-Link master, all digital outputs are transmitted as follows.

Byte 0	Control Data for the Digital Outputs of Ports 1 - 8							
Bits	7	6	5	4	3	2	1	0
Port	X8	X7	X6	X5	X4	X3	X2	X1
Pin	4	4	4	4	4	4	4	4
Channel	8A	7A	6A	5A	3A	3A	2A	1A

Byte 1	Control Data for the Digital Outputs of Ports 1 - 8							
Bits	7	6	5	4	3	2	1	0
Port	X8	X7	X6	X5	X4	X3	X2	X1
Pin	2	2	2	2	-	-	-	-
Channel	8B	7B	6B	5B	-	-	-	-

8.5.3 Controlling the IO-Link COM Mode

This mode can be used as long as the corresponding COM control bit has been set. This mode switches one or more IO-Link ports, which have been previously configured as digital inputs, to the IO-Link operating mode. In this way, IO-Link communication can be established in order to configure the IO-Link device. No process data are exchanged during operation in this mode.

Byte 2	Control Data for the Digital Outputs of Ports 1 - 4							
Bits	7	6	5	4	3	2	1	0
Port	X8	X7	X6	X5	X4	X3	X2	X1
Pin	4	4	4	4	4	4	4	4
Channel	8A	7A	6A	5A	3A	3A	2A	1A

8.5.4 Reserved

Byte 3	Reserved, do not use							
Bits	7	6	5	4	3	2	1	0
Port	X8	X7	X6	X5	X4	X3	X2	X1
Pin	-	-	-	-	-	-	-	-
Channel	-	-	-	-	-	-	-	-

8.6 Control Data of the IO-Link Devices (outputs)

8.6.1 IO-Link Data, 4 Bytes Output, Instance 102

Instance 102 provides 4 bytes IO-Link output data (master to device) for each IO-Link port with the following mapping:

Input	Port	Description
Bytes 4 - 7	X1	Bytes 0 - 3, IO-Link output data
Bytes 8 - 11	X2	Bytes 0 - 3, IO-Link output data
Bytes 12 - 15	X3	Bytes 0 - 3, IO-Link output data
Bytes 16 - 19	X4	Bytes 0 - 3, IO-Link output data
Bytes 20 - 23	X5	Bytes 0 - 3, IO-Link output data
Bytes 24 - 27	X6	Bytes 0 - 3, IO-Link output data
Bytes 28 - 31	X7	Bytes 0 - 3, IO-Link output data
Bytes 32 - 35	X8	Bytes 0 - 3, IO-Link output data

8.6.2 IO-Link Data, 8 Bytes Output, Instance 104

Instance 104 provides 8 bytes IO-Link output data (master to device) for each IO-Link port with the following mapping:

Input	Port	Description
Bytes 4 - 11	X1	Bytes 0 - 7, IO-Link output data
Bytes 12 - 19	X2	Bytes 0 - 7, IO-Link output data
Bytes 20 - 27	X3	Bytes 0 - 7, IO-Link output data
Bytes 28 - 35	X4	Bytes 0 - 7, IO-Link output data
Bytes 36 - 43	X5	Bytes 0 - 7, IO-Link output data
Bytes 44 - 51	X6	Bytes 0 - 7, IO-Link output data
Bytes 52 - 59	X7	Bytes 0 - 7, IO-Link output data
Bytes 60 - 67	X8	Bytes 0 - 7, IO-Link output data

8.6.3 IO-Link Data, 16 Bytes Output, Instance 106

Instance 106 provides 16 bytes IO-Link output data (master to device) for each IO-Link port with the following mapping:

Input	Port	Description
Bytes 4 - 19	X1	Bytes 0 - 15, IO-Link output data
Bytes 20 - 35	X2	Bytes 0 - 15, IO-Link output data
Bytes 36 - 51	X3	Bytes 0 - 15, IO-Link output data
Bytes 52 - 67	X4	Bytes 0 - 15, IO-Link output data
Bytes 68 - 83	X5	Bytes 0 - 15, IO-Link output data
Bytes 84 - 99	X6	Bytes 0 - 15, IO-Link output data
Bytes 100 - 115	X7	Bytes 0 - 15, IO-Link output data
Bytes 116 - 131	X8	Bytes 0 - 15, IO-Link output data

8.6.4 IO-Link Data, 32 Bytes Output, Instance 108

Instance 108 provides 32 bytes IO-Link output data (master to device) for each IO-Link port with the following mapping:

Input	Port	Description
Bytes 4 - 35	X1	Bytes 0 - 31, IO-Link output data
Bytes 36 - 67	X2	Bytes 0 - 31, IO-Link output data
Bytes 68 - 99	X3	Bytes 0 - 31, IO-Link output data
Bytes 100 - 131	X4	Bytes 0 - 31, IO-Link output data
Bytes 132 - 163	X5	Bytes 0 - 31, IO-Link output data
Bytes 164 - 195	X6	Bytes 0 - 31, IO-Link output data
Bytes 196 - 227	X7	Bytes 0 - 31, IO-Link output data
Bytes 228 - 259	X8	Bytes 0 - 31, IO-Link output data

9. Diagnostics Processing

9.1 System/Sensor Supply Power Error

The voltage value of incoming system/sensor supply power is monitored globally. If voltage drops to below approximately 18.6 V or exceeds a value of approximately 30 V, an error message is generated. The green power supply indicator goes off. The error message has no effect on the outputs.

ATTENTION!
In any event, it must be assured that supply voltage – measured at the most distant user – is no less than 18 V DC from a system power supply standpoint.

The following table shows the diagnostics bits in the status data of the IO-Link master:

Input	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 4	0	MI-FMA	MI-VAL	MI-SCB	MI-SCA	MI-SCS	MI-LVA	MI-LVS
Byte 5	0	0	0	0	0	IOL-DN	IOL-DW	IOL-DE
Byte 6	SCS-X8	SCS-X7	SCS-X6	SCS-X5	SCS-X4	SCS-X3	SCS-X2	SCS-X1
Byte 7	0	0	0	0	0	0	0	0
Byte 8	CE-X8A	CE-X7A	CE-X6A	CE-X5A	CE-X4A	CE-X3A	CE-X2A	CE-X1A
Byte 9	CE-X8B	CE-X7B	CE-X6B	CE-X5B	0	0	0	0
Byte 10	DE-X8A	DE-X7A	DE-X6A	DE-X5A	DE-X4A	DE-X3A	DE-X2A	DE-X1A
Byte 11	DW-X8A	DW-X7A	DW-X6A	DW-X5A	DW-X4A	DW-X3A	DW-X2A	DW-X1A
Byte 12	DN-X8A	DN-X7A	DN-X6A	DN-X5A	DN-X4A	DN-X3A	DN-X2A	DN-X1A
Byte 13	VAL-X8	VAL-X7	VAL-X6	VAL-X5	VAL-X4	VAL-X3	VAL-X2	VAL-X1

9.2 Auxiliary/Actuator Power Supply Error

The voltage value of incoming auxiliary/actuator supply power is monitored globally. If the U_{AUX} diagnostics message has been activated, an error message is generated if voltage drops to below approximately 18.6 V or exceeds a value of approximately 30 V. The U_{AUX} indicator lights up red. If output channels are activated, any additional error messages due to the voltage error are generated at the I/O ports. The U_{AUX} diagnostics message is deactivated as a default setting and must be activated by means of parameters configuration. The following group diagnosis is generated:

Input	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 4	0	MI-FMA	MI-VAL	MI-SCB	MI-SCA	MI-SCS	MI-LVA	MI-LVS
Byte 5	0	0	0	0	0	IOL-DN	IOL-DW	IOL-DE
Byte 6	SCS-X8	SCS-X7	SCS-X6	SCS-X5	SCS-X4	SCS-X3	SCS-X2	SCS-X1
Byte 7	0	0	0	0	0	0	0	0
Byte 8	CE-X8A	CE-X7A	CE-X6A	CE-X5A	CE-X4A	CE-X3A	CE-X2A	CE-X1A
Byte 9	CE-X8B	CE-X7B	CE-X6B	CE-X5B	0	0	0	0
Byte 10	DE-X8A	DE-X7A	DE-X6A	DE-X5A	DE-X4A	DE-X3A	DE-X2A	DE-X1A
Byte 11	DW-X8A	DW-X7A	DW-X6A	DW-X5A	DW-X4A	DW-X3A	DW-X2A	DW-X1A
Byte 12	DN-X8A	DN-X7A	DN-X6A	DN-X5A	DN-X4A	DN-X3A	DN-X2A	DN-X1A
Byte 13	VAL-X8	VAL-X7	VAL-X6	VAL-X5	VAL-X4	VAL-X3	VAL-X2	VAL-X1

9.3 Overload/Short-Circuit of the I/O Port Sensor Power Supply Outputs

In the event of overloading or short-circuiting between pins 1 and 3 of the ports (X1 - X8), the following channel-specific diagnostics messages are generated:

Input	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 4	0	MI-FMA	MI-VAL	MI-SCB	MI-SCA	MI-SCS	MI-LVA	MI-LVS
Byte 5	0	0	0	0	0	IOL-DN	IOL-DW	IOL-DE
Byte 6	SCS-X8	SCS-X7	SCS-X6	SCS-X5	SCS-X4	SCS-X3	SCS-X2	SCS-X1
Byte 7	0	0	0	0	0	0	0	0
Byte 8	CE-X8A	CE-X7A	CE-X6A	CE-X5A	CE-X4A	CE-X3A	CE-X2A	CE-X1A
Byte 9	CE-X8B	CE-X7B	CE-X6B	CE-X5B	0	0	0	0
Byte 10	DE-X8A	DE-X7A	DE-X6A	DE-X5A	DE-X4A	DE-X3A	DE-X2A	DE-X1A
Byte 11	DW-X8A	DW-X7A	DW-X6A	DW-X5A	DW-X4A	DW-X3A	DW-X2A	DW-X1A
Byte 12	DN-X8A	DN-X7A	DN-X6A	DN-X5A	DN-X4A	DN-X3A	DN-X2A	DN-X1A
Byte 13	VAL-X8	VAL-X7	VAL-X6	VAL-X5	VAL-X4	VAL-X3	VAL-X2	VAL-X1

9.4 Overload/Short-Circuiting of the 500 mA Digital Outputs

The digital outputs at the C/Q pin are short-circuit and overload-proof. In the event of an error, the output is automatically switched off and automatically switched back on cyclically.
The device reads out the following diagnostics message in the event of an error:

Input	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 4	0	MI-FMA	MI-VAL	MI-SCB	MI-SCA	MI-SCS	MI-LVA	MI-LVS
Byte 5	0	0	0	0	0	IOL-DN	IOL-DW	IOL-DE
Byte 6	SCS-X8	SCS-X7	SCS-X6	SCS-X5	SCS-X4	SCS-X3	SCS-X2	SCS-X1
Byte 7	0	0	0	0	0	0	0	0
Byte 8	CE-X8A	CE-X7A	CE-X6A	CE-X5A	CE-X4A	CE-X3A	CE-X2A	CE-X1A
Byte 9	CE-X8B	CE-X7B	CE-X6B	CE-X5B	0	0	0	0
Byte 10	DE-X8A	DE-X7A	DE-X6A	DE-X5A	DE-X4A	DE-X3A	DE-X2A	DE-X1A
Byte 11	DW-X8A	DW-X7A	DW-X6A	DW-X5A	DW-X4A	DW-X3A	DW-X2A	DW-X1A
Byte 12	DN-X8A	DN-X7A	DN-X6A	DN-X5A	DN-X4A	DN-X3A	DN-X2A	DN-X1A
Byte 13	VAL-X8	VAL-X7	VAL-X6	VAL-X5	VAL-X4	VAL-X3	VAL-X2	VAL-X1

9.5 Overload/Short-Circuiting of the 2.0 A Digital Outputs

Four 2.0 A outputs are available at the class B ports of the IO-Link master module. Channels errors are ascertained by comparing the actual value of an output channel to the setpoint set by a controller.

Target Value	Active Value	Comment
Active	Active	OK, no diagnosis
Off	Off	OK, no diagnosis
Active	Off	Short-circuit Channel indicator is red Channel error bit is set in the diagnosis The channel is disabled after the error has been eliminated.

When an output channel is activated (rising channel state edge) or deactivated (falling edge), the channel error is filtered for as long as was specified via the “surveillance timeout” parameter when the module was configured. A value within a range of 0 to 255 ms can be assigned to this parameter, and the default value is 80 ms.
The filter prevents premature error messages when capacitive loads are switched on or inductive loads are switched off, as well as in the case of other voltage peaks which occur during status changes.
When the output channel is in the static state, i.e. when it’s permanently switched on or off, filtering time between error detection and the diagnostics message typically amounts to between 5 and 10 ms.

The device reads outs the following diagnostics message in this case:

Input	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 4	0	MI-FMA	MI-VAL	MI-SCB	MI-SCA	MI-SCS	MI-LVA	MI-LVS
Byte 5	0	0	0	0	0	IOL-DN	IOL-DW	IOL-DE
Byte 6	SCS-X8	SCS-X7	SCS-X6	SCS-X5	SCS-X4	SCS-X3	SCS-X2	SCS-X1
Byte 7	0	0	0	0	0	0	0	0
Byte 8	CE-X8A	CE-X7A	CE-X6A	CE-X5A	CE-X4A	CE-X3A	CE-X2A	CE-X1A
Byte 9	CE-X8B	CE-X7B	CE-X6B	CE-X5B	0	0	0	0
Byte 10	DE-X8A	DE-X7A	DE-X6A	DE-X5A	DE-X4A	DE-X3A	DE-X2A	DE-X1A
Byte 11	DW-X8A	DW-X7A	DW-X6A	DW-X5A	DW-X4A	DW-X3A	DW-X2A	DW-X1A
Byte 12	DN-X8A	DN-X7A	DN-X6A	DN-X5A	DN-X4A	DN-X3A	DN-X2A	DN-X1A
Byte 13	VAL-X8	VAL-X7	VAL-X6	VAL-X5	VAL-X4	VAL-X3	VAL-X2	VAL-X1

9.6 Overloading/Short-Circuiting of Auxiliary Power Supply (U_{AUX}) at Class B Ports

In the event of overloading or short-circuiting between pins 2 and 5 of these ports (X1 - X8), the following channel-specific diagnostics message is generated:

Input	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 4	0	MI-FMA	MI-VAL	MI-SCB	MI-SCA	MI-SCS	MI-LVA	MI-LVS
Byte 5	0	0	0	0	0	IOL-DN	IOL-DW	IOL-DE
Byte 6	SCS-X8	SCS-X7	SCS-X6	SCS-X5	SCS-X4	SCS-X3	SCS-X2	SCS-X1
Byte 7	0	0	0	0	0	0	0	0
Byte 8	CE-X8A	CE-X7A	CE-X6A	CE-X5A	CE-X4A	CE-X3A	CE-X2A	CE-X1A
Byte 9	CE-X8B	CE-X7B	CE-X6B	CE-X5B	0	0	0	0
Byte 10	DE-X8A	DE-X7A	DE-X6A	DE-X5A	DE-X4A	DE-X3A	DE-X2A	DE-X1A
Byte 11	DW-X8A	DW-X7A	DW-X6A	DW-X5A	DW-X4A	DW-X3A	DW-X2A	DW-X1A
Byte 12	DN-X8A	DN-X7A	DN-X6A	DN-X5A	DN-X4A	DN-X3A	DN-X2A	DN-X1A
Byte 13	VAL-X8	VAL-X7	VAL-X6	VAL-X5	VAL-X4	VAL-X3	VAL-X2	VAL-X1

9.7 IO-Link Master Error

9.7.1 IO-Link C/Q Error

If an IO-Link device in the COM mode is disconnected, if an incorrect IO-Link device is plugged in or if an error occurs at the C/Q line (pin 4), e.g. due to a short circuit, the following error message is generated:

Input	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 4	0	MI-FMA	MI-VAL	MI-SCB	MI-SCA	MI-SCS	MI-LVA	MI-LVS
Byte 5	0	0	0	0	0	IOL-DN	IOL-DW	IOL-DE
Byte 6	SCS-X8	SCS-X7	SCS-X6	SCS-X5	SCS-X4	SCS-X3	SCS-X2	SCS-X1
Byte 7	0	0	0	0	0	0	0	0
Byte 8	CE-X8A	CE-X7A	CE-X6A	CE-X5A	CE-X4A	CE-X3A	CE-X2A	CE-X1A
Byte 9	CE-X8B	CE-X7B	CE-X6B	CE-X5B	0	0	0	0
Byte 10	DE-X8A	DE-X7A	DE-X6A	DE-X5A	DE-X4A	DE-X3A	DE-X2A	DE-X1A
Byte 11	DW-X8A	DW-X7A	DW-X6A	DW-X5A	DW-X4A	DW-X3A	DW-X2A	DW-X1A
Byte 12	DN-X8A	DN-X7A	DN-X6A	DN-X5A	DN-X4A	DN-X3A	DN-X2A	DN-X1A
Byte 13	VAL-X8	VAL-X7	VAL-X6	VAL-X5	VAL-X4	VAL-X3	VAL-X2	VAL-X1

9.7.2 IO-Link Validation Error

If an IO-Link device in the COM mode is disconnected (assuming the validation function has been configured), if an incorrect IO-Link device is plugged in or if an error occurs at the C/Q line (pin 4), e.g. due to a short circuit, the following error message is generated:

Input	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 4	0	MI-FMA	MI-VAL	MI-SCB	MI-SCA	MI-SCS	MI-LVA	MI-LVS
Byte 5	0	0	0	0	0	IOL-DN	IOL-DW	IOL-DE
Byte 6	SCS-X8	SCS-X7	SCS-X6	SCS-X5	SCS-X4	SCS-X3	SCS-X2	SCS-X1
Byte 7	0	0	0	0	0	0	0	0
Byte 8	CE-X8A	CE-X7A	CE-X6A	CE-X5A	CE-X4A	CE-X3A	CE-X2A	CE-X1A
Byte 9	CE-X8B	CE-X7B	CE-X6B	CE-X5B	0	0	0	0
Byte 10	DE-X8A	DE-X7A	DE-X6A	DE-X5A	DE-X4A	DE-X3A	DE-X2A	DE-X1A
Byte 11	DW-X8A	DW-X7A	DW-X6A	DW-X5A	DW-X4A	DW-X3A	DW-X2A	DW-X1A
Byte 12	DN-X8A	DN-X7A	DN-X6A	DN-X5A	DN-X4A	DN-X3A	DN-X2A	DN-X1A
Byte 13	VAL-X8	VAL-X7	VAL-X6	VAL-X5	VAL-X4	VAL-X3	VAL-X2	VAL-X1

9.8 IO-Link Device Diagnostics

Diagnoses of IO-Link devices may include level errors, warnings and messages.

9.8.1 IO-Link Device Errors

In the event of a device error, the IO-Link device transmits a diagnosis status. This status can include the following status data:

Input	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 4	0	MI-FMA	MI-VAL	MI-SCB	MI-SCA	MI-SCS	MI-LVA	MI-LVS
Byte 5	0	0	0	0	0	IOL-DN	IOL-DW	IOL-DE
Byte 6	SCS-X8	SCS-X7	SCS-X6	SCS-X5	SCS-X4	SCS-X3	SCS-X2	SCS-X1
Byte 7	0	0	0	0	0	0	0	0
Byte 8	CE-X8A	CE-X7A	CE-X6A	CE-X5A	CE-X4A	CE-X3A	CE-X2A	CE-X1A
Byte 9	CE-X8B	CE-X7B	CE-X6B	CE-X5B	0	0	0	0
Byte 10	DE-X8A	DE-X7A	DE-X6A	DE-X5A	DE-X4A	DE-X3A	DE-X2A	DE-X1A
Byte 11	DW-X8A	DW-X7A	DW-X6A	DW-X5A	DW-X4A	DW-X3A	DW-X2A	DW-X1A
Byte 12	DN-X8A	DN-X7A	DN-X6A	DN-X5A	DN-X4A	DN-X3A	DN-X2A	DN-X1A
Byte 13	VAL-X8	VAL-X7	VAL-X6	VAL-X5	VAL-X4	VAL-X3	VAL-X2	VAL-X1

9.8.2 IO-Link Device Warning

In the event of a device warning, the IO-Link device transmits a diagnosis status. This status can include the following status data:

Input	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 4	0	MI-FMA	MI-VAL	MI-SCB	MI-SCA	MI-SCS	MI-LVA	MI-LVS
Byte 5	0	0	0	0	0	IOL-DN	IOL-DW	IOL-DE
Byte 6	SCS-X8	SCS-X7	SCS-X6	SCS-X5	SCS-X4	SCS-X3	SCS-X2	SCS-X1
Byte 7	0	0	0	0	0	0	0	0
Byte 8	CE-X8A	CE-X7A	CE-X6A	CE-X5A	CE-X4A	CE-X3A	CE-X2A	CE-X1A
Byte 9	CE-X8B	CE-X7B	CE-X6B	CE-X5B	0	0	0	0
Byte 10	DE-X8A	DE-X7A	DE-X6A	DE-X5A	DE-X4A	DE-X3A	DE-X2A	DE-X1A
Byte 11	DW-X8A	DW-X7A	DW-X6A	DW-X5A	DW-X4A	DW-X3A	DW-X2A	DW-X1A
Byte 12	DN-X8A	DN-X7A	DN-X6A	DN-X5A	DN-X4A	DN-X3A	DN-X2A	DN-X1A
Byte 13	VAL-X8	VAL-X7	VAL-X6	VAL-X5	VAL-X4	VAL-X3	VAL-X2	VAL-X1

9.8.3 IO-Link Device Message

In the event of a device message, the IO-Link device transmits a diagnosis status. This status can include the following status data:

Input	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 4	0	MI-FMA	MI-VAL	MI-SCB	MI-SCA	MI-SCS	MI-LVA	MI-LVS
Byte 5	0	0	0	0	0	IOL-DN	IOL-DW	IOL-DE
Byte 6	SCS-X8	SCS-X7	SCS-X6	SCS-X5	SCS-X4	SCS-X3	SCS-X2	SCS-X1
Byte 7	0	0	0	0	0	0	0	0
Byte 8	CE-X8A	CE-X7A	CE-X6A	CE-X5A	CE-X4A	CE-X3A	CE-X2A	CE-X1A
Byte 9	CE-X8B	CE-X7B	CE-X6B	CE-X5B	0	0	0	0
Byte 10	DE-X8A	DE-X7A	DE-X6A	DE-X5A	DE-X4A	DE-X3A	DE-X2A	DE-X1A
Byte 11	DW-X8A	DW-X7A	DW-X6A	DW-X5A	DW-X4A	DW-X3A	DW-X2A	DW-X1A
Byte 12	DN-X8A	DN-X7A	DN-X6A	DN-X5A	DN-X4A	DN-X3A	DN-X2A	DN-X1A
Byte 13	VAL-X8	VAL-X7	VAL-X6	VAL-X5	VAL-X4	VAL-X3	VAL-X2	VAL-X1

10. EtherNet/IP™ Objects

The following EtherNet/IP™ objects are supported by the IO-Link master:

- Identity object (class code 0x01)
- Assembly object (class code 0x04)
- Connection manager object (class code 0x06)
- EtherNet/IP™ link object (class code 0xF6)
- TCP/IP object (class code 0xF5)
- Quality of service object (class code 0x48)
- DLR object (class code 0x47)
- IO-Link device parameters object (class code 0x80), manufacturer-specific
- IO-Link failsafe parameters object (class code 0x81), manufacturer-specific

10.1 IO-Link Device Parameters Object (class code 0x80)

This manufacturer-specific object contains IO-Link device parameters which can be read and written.

10.1.1 Read ISDU Service (class code 0x80)

The reading ISDU service query parameter is defined as follows:

Name	Value	Type	Description
Class	0x80		IO-Link device parameters object
Instance	1		IO-Link master
Instance attribute	1 - 8		IO-Link port number
Service code	0x4B		Read ISDU code
Index	1)	UINT	IO-Link ISDU object index
Sub-index	1)	USINT	IO-Link ISDU object sub-index

1) Detailed information can be found in the IO-Link device documentation depending on the connected IO-Link device.

If the read query was successful (general status of the CIP query is equal to 0), the response is available in the following format.

Name	Type	Description
ISDU	Byte array	Max. 232 bytes

If the read query was not successful (general status of the CIP query is not equal to 0), the response is available in the following format.

Name	Type	Error Code Description	Error Code
Class	UNIT	Service not available	1
		Port blocked	2
		Timeout	3
		Invalid index	4
		Invalid sub-index	5
		Incorrect port	6
		Incorrect port function	7
		Invalid length	8
		ISDU not supported	9
I/O-Link device error	USINT	See IO-Link specification	-
I/O-Link device additional error	USINT	See IO-Link specification	-

10.1.2 Write ISDU Service (class code 0x80)

The writing ISDU service query parameter is defined as follows:

Name	Value	Type	Description
Class	0x80		IO-Link device parameters object
Instance	1		IO-Link master
Instance attribute	1 - 8		IO-Link port number
Service code	0x4C		Write ISDU code
Index	1)	UINT	IO-Link ISDU object index
Sub-index	1)	USINT	IO-Link ISDU object sub-index
Data	1)	Byte array	IO-Link ISDU data, max. 232 bytes

1) Detailed information can be found in the IO-Link device documentation depending on the connected IO-Link device.

If the write command was successful, the general status of the CIP is equal to 0. If it wasn't possible to successfully execute the write command, the general status of the CIP is not equal to 0. The response is made available in the following format.

Name	Type	Error Code Description	Error Code
IO-Link master	UNIT	Service not available	1
		Port blocked	2
		Timeout	3
		Invalid index	4
		Invalid sub-index	5
		Incorrect port	6
		Incorrect port function	7
		Invalid length	8
		ISDU not supported	9
I/O-Link device error	USINT	See IO-Link specification	-
I/O-Link device additional error	USINT	See IO-Link specification	-

10.2 IO-Link Failsafe Parameters Object (class code 0x81)

If EtherNet/IP™ communication is interrupted, values can be specified which are used as a substitute for the IO-Link device output data in this case.

If the “substitute value” option has been selected in the IO-Link port parameters, the substitute value is transmitted via class code 0x81 instead of the output data of the IO-Link device. The value has to be transferred to the IO-Link master each time it’s switched on.
The value has to be entered in MSB-to-LSB direction, depending on the selected data length and the utilized IO-Link device.

10.2.1 Setting the Failsafe Parameter (class code 0x81)

The failsafe service query parameter is defined as follows:

Name	Value	Type	Description
Class	0x81		IO-Link device parameters object
Instance	1		IO-Link master failsafe
Instance attribute	1 - 8		IO-Link port number
Service code	0x0E		Get individual attribute
Data	1)	Byte array	Failsafe values of the IO-Link port

1) Detailed information can be found in the IO-Link device documentation depending on the connected IO-Link device.

If the write command was successful, the general status of the CIP response is equal to 0.