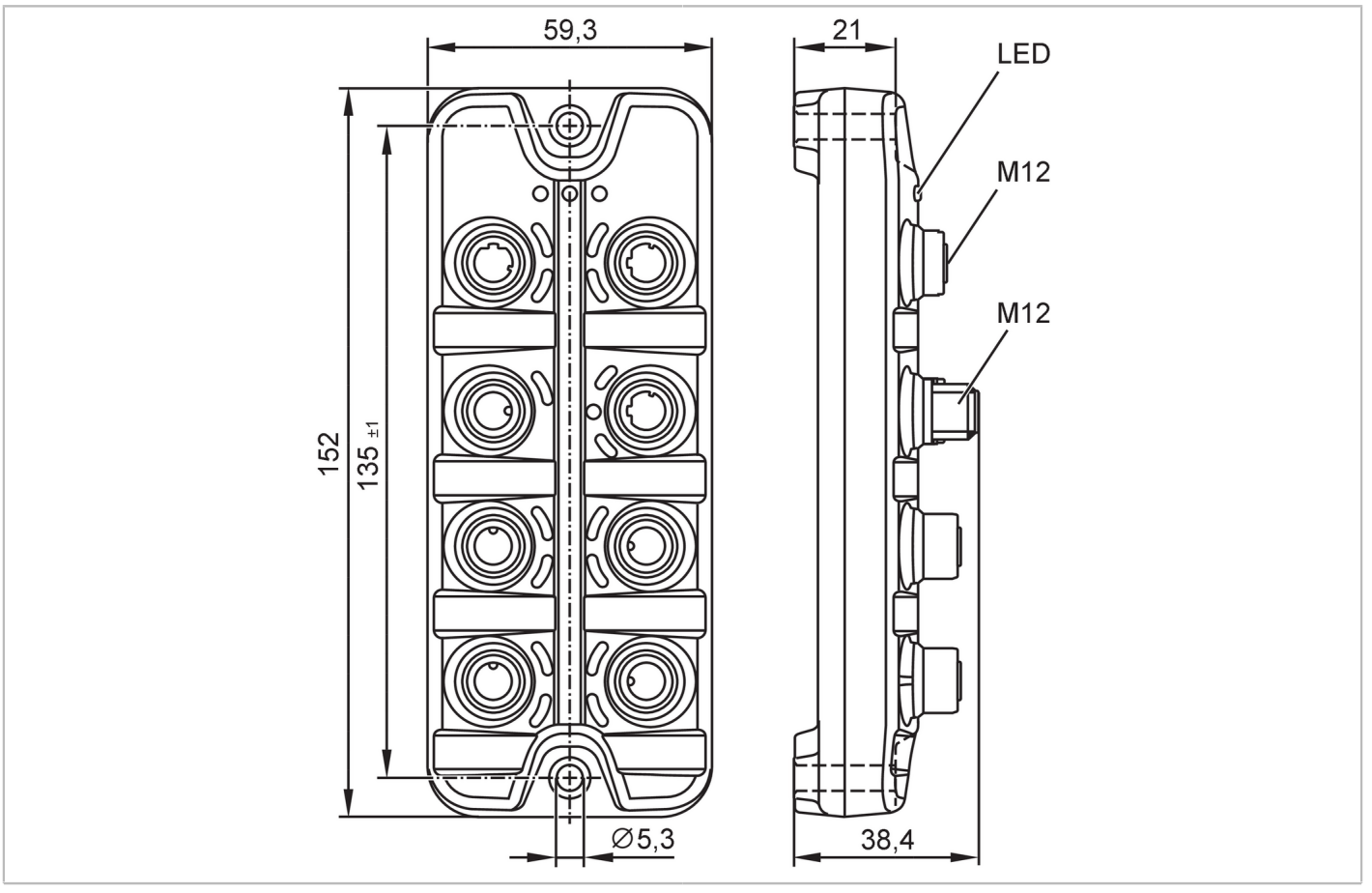
AL1324

IO-Link master with EtherNet/IP interface

IO-Link Master DL EIP 4P IP67



Application		
Application		I/O modules for field applications
Daisy-chain function		fieldbus interface
Electrical data		
Operating voltage	[V]	20...30 DC; (US ; to SELV/PELV)
Current consumption	[mA]	300...3900; (US)
Protection class		III
Sensor supply US		
Max. current load total	[A]	3.6
Inputs / outputs		
Total number of inputs and outputs		8; (configurable)
Number of inputs and outputs		Number of digital inputs: 8; Number of digital outputs: 4
Inputs		
Number of digital inputs		8; (IO-Link Port Class A: 4 x 2)
Switching level high	[V]	11...30
Switching level low	[V]	0...5
Digital inputs protected against short circuits		yes

AL1324

IO-Link master with EtherNet/IP interface

IO-Link Master DL EIP 4P IP67

Outputs			
Number of digital outputs		4; (IO-Link Port Class A: 4 x 1)	
Max. current load per output	[mA]	300	
Short-circuit proof		yes	
Interfaces			
Communication interface		Ethernet; IO-Link	
Ethernet - EtherNet/IP			
Transmission standard		10Base-T; 100Base-TX	
Transmission rate		10 MBit/s; 100 MBit/s	
Protocol		EtherNet/IP	
Factory settings		IP address: 192.168.1.250	
		subnet mask: 255.255.255.255	
		gateway IP address: 0.0.0.0	
		MAC address: see type label	
Note on interfaces		DHCP, BOOTP, static	
		DLR (Device Level Ring)	
		Supported network topologies: line	
		ring	
Ethernet - Internet of Things			
Transmission standard		10Base-T; 100Base-TX	
Transmission rate		10 MBit/s; 100 MBit/s	
Protocol		MQTT JSON	
Factory settings		IP address: 169.254.x.x	
		subnet mask: 255.255.0.0	
		gateway IP address: 0.0.0.0	
		MAC address: see type label	
Note on interfaces		Safety protocol: HTTPS	
IO-Link Master			
Transmission type		COM1 (4,8 kBaud); COM2 (38,4 kBaud); COM3 (230,4 kBaud)	
IO-Link revision		1.1	
Number of ports class A		4	
Operating conditions			
Ambient temperature	[°C]	-25...60	
Storage temperature	[°C]	-25...85	
Max. relative air humidity	[%]	90	
Protection		IP 65; IP 66; IP 67	
Protection rating (NEMA 250)		6P	
Pollution degree		2	
Chemical media		ISO 16750-5	AA, BA, BD, HLP, CC, DB, DC, DD, CA
		NEMA 250 5.13.1	AA
Tests / approvals			
EMC		EN 61000-6-2	
		EN 61000-6-4	
Shock resistance		DIN EN 60068-2-27	

AL1324

IO-Link master with EtherNet/IP interface

IO-Link Master DL EIP 4P IP67

Vibration resistance		DIN EN 60068-2-64 2009-04	
		DIN EN 60068-2-6 2008-10	
MTTF	[years]	97	

Mechanical data

Weight	[g]	311.8
Housing		rectangular
Type of mounting		Backplane mounting
Dimensions	[mm]	152 x 59.3 x 38.4
Material		housing: PA orange; Socket: brass nickel-plated
Sealing material		FKM

Remarks

Remarks	Further information is available in the manual.
Pack quantity	1 pcs.

Electrical connection - Ethernet

Connector: 2 x M12; coding: D; Contacts: 4; sealing: FKM



EtherNet/IP X21, X22

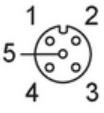
1	TX +
2	RX +
3	TX -
4	RX -
5	not used

IoT X23

1	TX +
2	RX +
3	TX -
4	RX -
5	not used

Electrical connection - IO-Link

Connector: 4 x M12; coding: A; Contacts: 4; sealing: FKM



IO-Link Port Class A X01...X04

1	Sensor supply (US) L+
2	Digital input
3	Sensor supply (US) L-
4	C/Q IO-Link
5	not used

Electrical connection - voltage supply

Connector: 1 x M12; coding: A; Contacts: 4



AL1324

IO-Link master with EtherNet/IP interface

IO-Link Master DL EIP 4P IP67

X31	
1	+ 24 V DC (US)
2	not used
3	GND (US)
4	not used

GB

Operating instructions

IO-Link master with EtherNet/IP interface DataLine

AL1324

11501193 / 02 07 / 2024

Contents

1 Preliminary note . . . 6
1.1 Legal and copyright information . . . 6
1.2 Symbols used . . . 6
1.3 Warnings . . . 6
1.4 Change history . . . 6

2 Safety instructions . . . 8
2.1 Cyber security . . . 8
2.2 Safety symbol on the device . . . 8

3 Intended use . . . 9

4 Function . . . 10
4.1 IO-Link . . . 10
4.1.1 IO-Link supply . . . 10
4.2 Parameter setting . . . 10
4.3 Visual indication . . . 10
4.4 EtherNet/IP . . . 10
4.5 ifm IoT Core . . . 11
4.6 Digital inputs . . . 11

5 Installation . . . 12
5.1 Overview . . . 12

6 Electrical connection . . . 13
6.1 General wiring information . . . 13
6.1.1 Connection technology . . . 13
6.2 Ethernet ports . . . 13
6.3 IO-Link ports (class A) . . . 14
6.3.1 Connecting IO-Link devices (class A) . . . 14
6.3.2 Connecting IO-Link devices (Class B) . . . 14
6.4 Ground connection . . . 15

7 Operating and display elements . . . 16
7.1 LEDs . . . 16
7.1.1 Status . . . 16
7.1.2 Ethernet . . . 16
7.1.3 IoT . . . 16
7.1.4 IO-Link ports (Class A) . . . 17
7.1.5 Voltage supply . . . 17

8 Set-up . . . 18

9 Settings . . . 19
9.1 Parameter setting software . . . 19
9.1.1 Supported parameter setting software . . . 19
9.1.2 Getting started . . . 19
9.1.2.1 Online parameter setting . . . 20
9.1.2.2 Offline parameter setting . . . 20
9.1.3 Configuring IP settings . . . 20
9.1.4 IoT interface . . . 20
9.1.4.1 Configuring access rights . . . 21
9.1.4.2 Configuring IP settings . . . 21
9.1.4.3 Configuring the interface to the monitoring software . . . 22
9.1.5 Fieldbus interface . . . 23
9.1.5.1 Configuring the EtherNet/IP interface . . . 23
9.1.5.2 Setting the EtherNet/IP configuration mode . . . 24
9.1.6 IO-Link ports . . . 24
9.1.6.1 Setting data transmission to the monitoring software . . . 24
9.1.6.2 Setting the operating mode Pin 4 (US) . . . 25
9.1.6.3 Setting the cycle time . . . 25
9.1.6.4 Setting the device validation and data storage . . . 26
9.1.6.5 Setting fail-safe values . . . 27
9.1.7 Device information . . . 28

9.1.7.1 Reading identification information . . . 28
9.1.8 Device control . . . 28
9.1.8.1 Resetting the device . . . 28
9.1.8.2 Restarting the device . . . 28
9.1.9 Updating the firmware . . . 29
9.1.10 Setting the parameters of IO-Link devices . . . 29
9.2 ifm IoT Core REST API . . . 31
9.2.1 ifm IoT Core: General information . . . 31
9.2.1.1 Accessing the ifm IoT Core . . . 31
9.2.2 Getting started . . . 31
9.2.3 General functions . . . 31
9.2.3.1 Example: Reading properties of an element . . . 31
9.2.3.2 Example: Outputting the subtree . . . 33
9.2.3.3 Example: Changing a parameter value . . . 35
9.2.3.4 Example: Read multiple elements sequentially . . . 36
9.2.3.5 Example: Browsing device description . . . 37
9.2.4 IoT: Configuring access rights . . . 37
9.2.5 IoT: Configuring IP settings . . . 37
9.2.6 IoT: Configuring security mode . . . 38
9.2.6.1 Example: Activating security mode . . . 39
9.2.6.2 Example: Request with authentication . . . 39
9.2.6.3 Example: Resetting the password . . . 40
9.2.7 IoT: Configuring the interface to the monitoring software . . . 40
9.2.8 Fieldbus: Configuring the EtherNet/IP interface . . . 41
9.2.9 Fieldbus: Setting the EtherNet/IP configuration mode . . . 41
9.2.10 Fieldbus: Setting fail-safe values of the outputs . . . 42
9.2.11 Ports: Setting the operating mode Pin 4 (US) . . . 42
9.2.12 Ports: Configuring device validation and data storage . . . 43
9.2.12.1 Example: Cloning the data memory of an IO-Link port . . . 44
9.2.13 Ports: Setting data transmission to the monitoring software . . . 46
9.2.14 Ports: Reading / writing process data . . . 46
9.2.14.1 Example: Reading an IO-Link process value (operating mode "IO-Link") . . . 46
9.2.14.2 Example: Reading an IO-Link process value (operating mode "IO-Link") . . . 47
9.2.14.3 Example: Reading the digital input value (operating mode "DI") . . . 48
9.2.14.4 Example: Writing the digital output value (operating mode "DO") . . . 48
9.2.15 Ports: Reading port events . . . 49
9.2.16 Timer: Configuring the timers . . . 49
9.2.16.1 Set the counting interval . . . 49
9.2.17 IO-Link devices: Accessing parameters . . . 50
9.2.17.1 Example: Reading a parameter value of an IO-Link device . . . 50
9.2.17.2 Example: Writing a parameter value of an IO-Link device . . . 51
9.2.18 IO-Link devices: Reading and writing device information . . . 51
9.2.19 IO-Link devices: Reading IO-Link events . . . 52
9.2.20 Gateway: Set the application tag . . . 53
9.2.21 Gateway: Update firmware . . . 53
9.2.22 Gateway: Reading status and diagnostic information . . . 53
9.2.23 Gateway: Reading device information . . . 53
9.2.24 Gateway: Resetting, rebooting and localising the device . . . 54
9.2.25 Notifications . . . 54
9.2.25.1 Event-controlled notifications . . . 54
9.2.25.2 Time-controlled notifications . . . 55
9.2.25.3 Example: Subscribing to notifications . . . 55
9.2.25.4 Example: Changing a notification . . . 56
9.2.25.5 Example: Subscribing to a notification in CSV format . . . 56
9.2.25.6 Example: Unsubscribing from a notification . . . 57
9.2.25.7 Example: checking a notification . . . 58
9.2.25.8 MQTT support . . . 58
9.2.25.9 WebSocket support . . . 62
9.3 IoT Core Visualizer . . . 64
9.3.1 Starting the IoT-Core Visualizer . . . 64
9.3.2 Managing notifications . . . 65
9.3.2.1 Creating a new notification . . . 65

9.3.2.2 Deleting a notification . . . 65
9.3.3 Searching for elements of the IoT Core . . . 66
9.3.4 Configuring the IO-Link master . . . 67
9.3.5 Accessing process data . . . 68
9.3.6 Update firmware . . . 69
9.4 EtherNet/IP . . . 70
9.4.1 Note: Startup package . . . 70

10 Maintenance, repair and disposal . . . 71
10.1 Cleaning the housing surface . . . 71
10.2 Update firmware . . . 71

11 Appendix . . . 72
11.1 ifm IoT Core . . . 72
11.1.1 Profiles . . . 72
11.1.2 Types . . . 72
11.1.3 Services . . . 73
11.1.3.1 Service: factoryreset . . . 73
11.1.3.2 Service: getblobdata . . . 73
11.1.3.3 Service: getdata . . . 73
11.1.3.4 Service: getdatamulti . . . 73
11.1.3.5 Service: getelementinfo . . . 74
11.1.3.6 Service: getidentity . . . 74
11.1.3.7 Service: getsubscriberlist . . . 75
11.1.3.8 Service: getsubscriptioninfo . . . 75
11.1.3.9 Service: gettree . . . 75
11.1.3.10 Service: install . . . 76
11.1.3.11 Service: iolreadacyclic . . . 76
11.1.3.12 Service: iolwriteacyclic . . . 76
11.1.3.13 Service: querytree . . . 77
11.1.3.14 Service: reboot . . . 77
11.1.3.15 Service: reset . . . 77
11.1.3.16 Service: setblock . . . 77
11.1.3.17 Service: setdata . . . 78
11.1.3.18 Service: signal . . . 78
11.1.3.19 Service: start . . . 78
11.1.3.20 Service: start_stream_set . . . 78
11.1.3.21 Service: stop . . . 78
11.1.3.22 Service: stream_set . . . 79
11.1.3.23 Service: validation_useconnecteddevice . . . 79
11.2 EtherNet/IP . . . 80
11.2.1 Parameters . . . 80
11.2.1.1 Configuration Assembly (Instance 199) . . . 80
11.2.2 Cyclic data . . . 83
11.2.2.1 Input Assembly (Instance 100) . . . 83
11.2.2.2 Input Assembly (Instance 101) . . . 84
11.2.2.3 Input Assembly (Instance 102) . . . 85
11.2.2.4 Output Assembly (Instance 150) . . . 90
11.2.2.5 Output Assembly (Instance 151) . . . 90
11.2.3 Acyclical data . . . 92
11.2.3.1 Acyclic command channel . . . 92
11.2.3.2 Acyclic commands . . . 96
11.2.4 Object directory . . . 101
11.2.4.1 CIP object classes . . . 101
11.2.4.2 CIP class and instance services . . . 101
11.2.4.3 Identity Object (Class Code: 0x01) . . . 102
11.2.4.4 Message Router Object (Class Code: 0x02) . . . 103
11.2.4.5 Assembly Object (Class Code: 0x04) . . . 104
11.2.4.6 Connection Manager Object (Class Code: 0x06) . . . 105
11.2.4.7 Device Level Ring Object (Class Code: 0x47) . . . 106
11.2.4.8 Quality Of Service Object (Class Code: 0x48) . . . 107
11.2.4.9 IO-Link Request Object (Class Code: 0x80) . . . 108
11.2.4.10 TCP/IP Object (Class Code: 0xF5) . . . 112

11.2.4.11 Ethernet Link Object (Class Code: 0xF6) 115

1 Preliminary note

You will find instructions, technical data, approvals and further information using the QR code on the unit / packaging or at documentation.ifm.com.

1.1 Legal and copyright information

© All rights reserved by ifm electronic gmbh. No part of these instructions may be reproduced and used without the consent of ifm electronic gmbh.

All product names, pictures, companies or other brands used are the property of the respective rights owners.

1.2 Symbols used

✓	Requirement
▶	Instructions
▷	Reaction, result
[...]	Designation of keys, buttons or indications
→	Cross-reference
	Important note Non-compliance may result in malfunction or interference.
	Information Supplementary note

1.3 Warnings

Warnings indicate the possibility of personal injury and damage to property. This enables safe product handling. Warnings are graded as follows:

WARNING

Warning of serious personal injury

▷ If the warning is not observed, fatal and serious injuries are possible.

CAUTION

Warning of minor to moderate personal injury

▷ If the warning is not observed, minor to moderate injuries are possible.

ATTENTION

Warning of damage to property

▷ If the warning is not observed, damage to property is possible.

1.4 Change history

Issue	Subject	Date
00	New creation of the document	02 / 2023

Issue	Subject	Date
01	• Changed: Identity Object (Class Code: 0x01) (→ 🗋 102) • Removed: REST API – DNS support • Added: WebSocket support (→ 🗋 62)	07 / 2023
02	• Changed: Chapter “Ground connection”, Ground connection (→ 🗋 15) • Changed: Description and example MQTT command channel, MQTT support (→ 🗋 58) • Added: Note regarding UL applications, Connection technology (→ 🗋 13)	07 / 2024

2 Safety instructions

- The unit described is a subcomponent for integration into a system.
  - The system architect is responsible for the safety of the system.
  - The system architect undertakes to perform a risk assessment and to create documentation in accordance with legal and normative requirements to be provided to the operator and user of the system. This documentation must contain all necessary information and safety instructions for the operator, the user and, if applicable, for any service personnel authorised by the architect of the system.
- Read this document before setting up the product and keep it during the entire service life.
- The product must be suitable for the corresponding applications and environmental conditions without any restrictions.
- Only use the product for its intended purpose (→ Intended use).
- If the operating instructions or the technical data are not adhered to, personal injury and/or damage to property may occur.
- The manufacturer assumes no liability or warranty for any consequences caused by tampering with the product or incorrect use by the operator.
- Installation, electrical connection, set-up, operation and maintenance of the product must be carried out by qualified personnel authorised by the machine operator.
- Protect units and cables against damage.

2.1 Cyber security

ATTENTION

Device operation in an unprotected network environment.

▷ Unauthorised read or write access to data is possible.

▷ Unauthorised manipulation of the device function is possible.

▶ Restrict access to authorised users (e.g. password-protected access).

▶ Choose a safe method to connect with the device (e. g. VPN).

▶ Use encrypted data transmission (e. g. https / TLS).

2.2 Safety symbol on the device



Safety symbol on the device:

▶ Adhere to the operating instructions for the safe operation of the device.

3 Intended use

The device may only be used for the following purposes:

- IO-Link master for configuration, management and operation of IO-Link devices
- Gateway between IO-Link devices and a higher-level EtherNet/IP control system

The device is designed for use outside of a control cabinet.

4 Function

4.1 IO-Link

The device offers the following IO-Link functions:

- IO-Link master (IO-Link revision 1.0 and 1.1)

4.1.1 IO-Link supply

The device offers supplies for 4 IO-Link devices (sensors, actuators).

Ports X01...X04 are class A ports.

The device ensures fire protection for connected IO-Link devices by providing an energy-limited circuit at the ports (according to IEC61010-1 and class 2 to UL1310).

4.2 Parameter setting

The device can be configured with the following options:

- Parameter setting software
  - ifm moneo OS + ifm moneo|configure
  - ifm moneo|configure free
- ifm IoT Core
  - ifm IoT Core Visualizer
- EtherNet/IP
  - Projection software

4.3 Visual indication

The device displays the following indications:

- Status and activity indication of the Ethernet connections

4.4 EtherNet/IP

The device supports supports the following EtherNet/IP functions:

- Device profile: EtherNet/IP device
- 2-port switch for access to the fieldbus interface
- Min. cycle time: 1 ms (RPI)
- Supported connection classes: 1, 3
- Supported connection types:
  - Exclusive Owner
  - Input Only
  - Listen Only
- UCMM support
- Predefined fieldbus objects
  - Identity Object (0x01)

  - Message Router Object (0x02)
  - Assembly Object (0x04)
  - Connection Manager (0x06)
  - DLR Object (0x47)
  - QoS Object (0x48)
  - IO-Link Request Object (0x80)
  - TCP/IP Interface Object (0xF5)
  - Ethernet Link Object (0xF6)
- Supported protocols: DHCP, BOOTP, ACD, DLR
- Device description: EDS file

4.5 ifm IoT Core

- Mapping of the data, events and services of the device to an object model (ifm IoT Core)
- Integration of the device in IIoT applications
- Access to the ifm IoT Core:
  - Browser-based interface (IoT Core Visualizer)

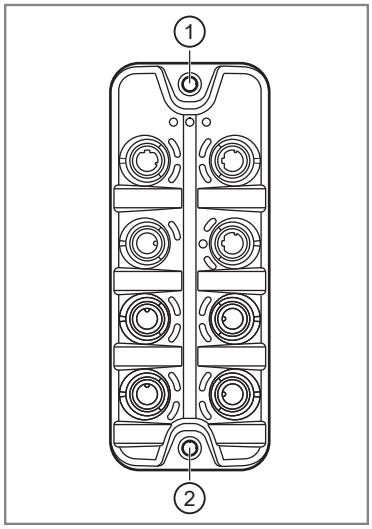
4.6 Digital inputs

The ports X01...X04 each have an additional digital input (type 2 according to EN 61131-2). The digital inputs are on pin 2.

The digital inputs are supplied via US. They refer to the potential of US (pin 3).

5 Installation

5.1 Overview



1: Upper mounting lug
2: Lower mounting lug

6 Electrical connection

6.1 General wiring information

The unit must be connected by a qualified electrician.

▶ Observe the national and international regulations for the installation of electrical equipment.

The unit is only suitable for operation using SELV/PELV voltages.

▶ Take information about IO-Link configuration into consideration!

This device contains components that may be damaged or destroyed by electrostatic discharge (ESD).

▶ Please observe the required precautions against electrostatic discharge!

By means of basic insulation according to EN61010-1, the circuits are isolated from each other and from device surfaces that could be touched (secondary circuit with max. 30 V DC, supplied from mains circuit up to 300 V overvoltage category II).

By means of basic insulation according to EN61010-1, the communication interfaces are separated from each other and from device surfaces that could be touched (secondary circuit with V DC maximum, supplied from mains circuit up to 300 V overvoltage category II). They are designed for network environment 0 according to IEC TR62102).

6.1.1 Connection technology

The threaded connections in the device correspond to the M12 standard. To ensure compliance with the specified protection rating, only cables that comply with this standard may be used. In the case of self-assembled cables, the system manufacturer is responsible for the protection rating.

▶ Use connectors with gold-plated contacts.

▶ Check the screw connection 2 weeks after installation and retighten to the correct torque if necessary.

▶ During installation, place the connectors vertically so that the coupling nut will not damage the thread.

▶ Before connecting the connector, check that there is an undamaged O-ring in the socket.

▶ Observe the coding of the connectors during installation.

▶ Cover unused connections with protective covers. Tightening torque: 1.3 ± 0.1 Nm

For UL applications:



CAUTION

Short circuit bewtween the sensor inputs of the IO-Link ports

▷ Fire Hazard / Danger of electric shock

▶ Do not interconnect terminations.

▶ To connect the device and the IO-Link devices, only use UL-certified cables belonging to category CYJV or PVVA with a minimum temperature of 80 °C (75 °C in case of a maximum ambient temperature of 40 °C).

6.2 Ethernet ports

The device is connected to the EtherNet/IP network via the Ethernet ports (e. g. EtherNet/IP controller, additional EtherNet/IP device).

Wiring:



1: TX +
2: RX +
3: TX -
4: RX -
5: not used

▶ Connect the device to the EtherNet/IP network via the X21, X22 ports.

▶ For connection, use M12 connectors (minimum protection rating: IP 65 / IP 66 / IP 67).

▶ Tighten the cable plug using 1.3 ± 0.1 Nm.

6.3 IO-Link ports (class A)

IO-Link devices (sensors, actuators) are connected to the IO-Link ports (class B).

The IO-Link ports meet the requirements of the IO-Link specifications 1.0 to 1.1.2.

The ports are equipped with short-circuit detection (US).

The ports have an additional digital input (type 2, according to IEC 61131-2).

Wiring:



1: Sensor supply (US) L+
2: Digital input
3: Sensor supply (US) L-
4: C/Q IO-Link
5: not used

6.3.1 Connecting IO-Link devices (class A)

Wiring information:

- The connected IO-Link devices must be supplied exclusively via the IO-Link master.

▶ Connect the IO-Link devices to ports X01...X04. Maximum cable length per port: 20 m.

▶ For connection, use M12 connectors (minimum protection rating: IP 65 / IP 66 / IP 67).

▶ Tighten the cable plug using 1.3 ± 0.1 Nm.

6.3.2 Connecting IO-Link devices (Class B)

Wiring information:

- The connection of IO-Link devices (Class B) requires the supply with an additional auxiliary voltage UA. Feeding is done with the help of a Y-connection cable (→ accessories).

CAUTION

Non-compliance with the electrical separation of the circuits

▷ Risk of fire

▶ Ensure that the external supply UA is electrically separated from the power circuit of the unit by basic insulation (according to IEC 61010-1, secondary current circuit with max. 30 V DC, derived from mains circuit up to 300 V of overvoltage category II).

▶ Ensure that the IO-Link devices and the connection technology support the electrical separation.

- When connecting an IO-Link device (Class B), the additional digital input at pin 2 of the port is not available.

▶ Connect IO-Link devices via a Y-connection cable with ports X01...X04.

▶ Connect Y-connection cable to the supply voltage 24 V DC (20…30 V SELV/PELV).

▶ For connection, use M12 connectors (minimum protection rating: IP 65 / IP 66 / IP 67).

▶ Tighten the cable plug using 1.3 ± 0.1 Nm.

6.4 Ground connection

The FE potential is connected to the following points of the device:

- Upper mounting lug of the housing

To ensure the protection of the device against electrical interference and to ensure the safe function of the device, the housing has to be connected to the GND of the installation using the shortest possible route.

▶ Ground the device via the mounting screw of the upper mounting lug.

7 Operating and display elements

7.1 LEDs

7.1.1 Status

LED	Description	Colour	State	Description
RDY	Gateway status	--	Off	Not active or reboots
		green	flashes (5 Hz)	Error
			flashes (200 ms on, 800 ms off)	Firmware update running
			On	OK
NET	Network status	--	off	Not powered, no IP address: device has no IP address or no voltage applied or voltage applied is too low
		green / red	flashes	Self test: device in self-test after start (→ MOD-LED)
		green	flashes (1 Hz)	No connection: no CIP connection established and no Exclusive Owner connection timeout
			on	Connected: device has IP address and at least one CIP connection established and no Exclusive Owner connection timeout
		red	flashes (1 Hz)	Connection timeout: device has IP address and Exclusive Owner connection timeout
			on	Duplicate: IP address used twice
MOD	EtherNet/IP module status	--	off	No power: no voltage is applied or the applied voltage is too low
		green / red	flashes	Self test: device in self-test
		green	flashes (2 Hz)	Standby: device not yet configured (no IP address)
			on	Device operational: device functions reliably (normal operation)
		red	flashes (1 Hz)	Major recoverable fault: serious, recoverable error (e.g. incorrect configuration)
			on	Major unrecoverable fault: serious, unrecoverable error (e.g. module failed)

7.1.2 Ethernet

LED	Description	Colour	State	Description
LNK	Status of the connection	Green	Off	No Ethernet connection
			On	Ethernet connection established
ACT	Status of the transmission	Yellow	Off	No data transmission
			Flashes	Data transmission

7.1.3 IoT

LED	Description	Colour	State	Description
LNK	Status of the connection	Green	Off	No Ethernet connection
			On	Ethernet connection established

LED	Description	Colour	State	Description
IoT	Device identification	Green	Flashes	Device identification active
ACT	Status of the data transmission	Yellow	Off	No data transmission
			Flashes	Data transmission

7.1.4 IO-Link ports (Class A)

LED	Description	Colour	State	Description
	Status of the IO-Link port (pin 4)	Yellow	Off	Port mode DI / DO: Pin 4 (C/Q) = OFF
			On	Port mode DI / DO: Pin 4 (C/Q) = ON
		Green	Flashes (1 Hz)	Port mode IO-Link: No IO-Link device found
			Flashes (5 Hz)	Port mode IO-Link: “PREOPERATE” state
			On	Port mode IO-Link: “OPERATE” state
		Red	Flashes (1.2 Hz)	IO-Link communication error
			On	Port configuration error or short circuit / overload at US
DI	Status of the digital input (pin 2)	Yellow	Off	Digital input: Pin 2 = OFF
			Flashes (5 Hz)	Digital input: Pin 2 = ON

7.1.5 Voltage supply

LED	Description	Colour	State	Description
US	Status of the supply voltage US	Green	Off	No supply voltage is applied or the applied voltage is too low
			On	Supply voltage applied

8 Set-up

▶ Install the unit correctly.

▶ Establish a correct electrical connection with the device.

▷ Once connected to the supply voltage, the unit will start.

▷ The LEDs show status and error conditions.

▷ The unit is ready for operation.

▷ The device can be configured.

9 Settings

9.1 Parameter setting software

9.1.1 Supported parameter setting software

For parameterising the IO-Link master and the connected IO-Link devices a parameter setting software is required.

Supported parameter setting software

- ifm moneo OS (art no. QMS001) + module licence ifm moneo|configure (art. no. QMP020)
- ifm moneo|configure free

▶ For a correct installation: observe the installation instruction for ifm moneo.

▶ Install the desired parameter setting software.

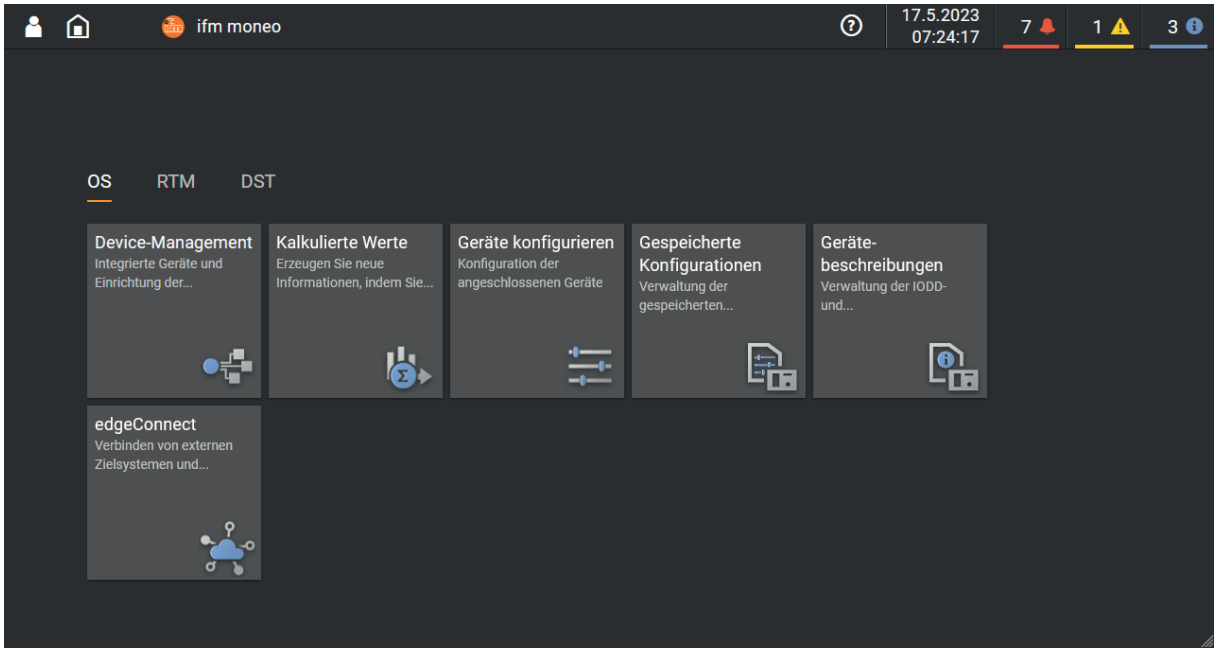
▶ Activate the licences required for operation.

▷ The installed parameter setting software can be used for parameter setting of the device.

9.1.2 Getting started

Requirements:

✓ The laptop / PC is connected directly or via a suitable network coupling element (e.g. switch) to an IoT port (X23) of the device.



▷ View of [connected devices] appears.

▶ Scan the network for devices.

▷ ifm moneo detects the IO-Link master.

▶ Optional: Adapt the IP settings of the IO-Link master.

9.1.2.1 Online parameter setting

The parameters of the IO-Link master and the connected sensors and actuators can be set before installation and set-up or during operation.

If you change parameters during operation, this will influence the function of the plant.

▶ Ensure that there will be no malfunctions in your plant.

During the parameter setting process, the IO-Link master and the connected IO-Link devices stay in operating mode. They continue to perform their functions with the existing parameters until the parameter setting has been completed.

9.1.2.2 Offline parameter setting

The device supports offline parameter setting. The user creates a configuration for the IO-Link master and the connected IO-Link devices without being connected to the device. The configuration created can be stored as a file (*.lrp) and loaded to the device and activated at a later point.

9.1.3 Configuring IP settings

For communication with the IT network, the IP parameters of the IoT interface must be configured.

Available parameters:

Parameter	Description	Value range	Access
[DHCP]	Enable / disable the DHCP client	• [Static IP]: DHCP client disabled; IP parameters are set by the user • [DHCP]: DHCP client enabled; IP parameters are set by the network's DHCP server.	rw [1]
[IP address]	IP address of the IoT interface	e.g. 192.168.1.100 • 169.254.x.x(default)	rw [1] [2]
[Subnet mask]	Subnet mask of the Ethernet network	e.g. 255.255.255.0 • 255.255.0.0 (Default)	rw [1] [2]
[Default gateway IP address]	IP address of the network gateway	e.g. 192.169.1.1 • 0.0.0.0 (Default)	rw [1] [2]
[MAC address]	MAC address of the IoT interface	e.g. 00:02:01:0E:66:C1	ro [3]

[1] Read and write

[2] can only be changed if DHCP is disabled

[3] Read only

To configure the IoT interface:

Requirements:

✓ The parameter setting software has been started.

✓ The connection to the device has been established.

✓ The detailed view of the device is active.

▶ Select [IoT] menu.

▷ The menu page shows the current settings.

▶ Set IP parameters.

▶ Write the changed values to the device.

▷ IP settings of the IoT interface are configured.

9.1.4 IoT interface

The [IoT] menu provides access to the parameters of the IoT interface.

9.1.4.1 Configuring access rights

The device can be integrated in parallel into a fieldbus environment and into an IT network structure for IIoT applications (“Y-path”). To avoid competing access to parameters and process data, the rights of the instances must be set.

Available parameters:

Parameter	Description	Value range	Access
[Access rights]	Access rights to parameters, process data and alarms / events	• [Fieldbus + IoT]: – Fieldbus and ifm IoT Core have read and write access rights to parameters and process data – Fieldbus and ifm IoT Core have read access rights to events / alarms • [Fieldbus + IoT (read only)]: – Fieldbus has read and write access rights to parameters and process data – Fieldbus has read access rights to events / alarms – ifm IoT Core has read access rights to parameters, process data and events / alarms • [IoT only]: – ifm IoT Core has read and write access rights to parameters and process data – ifm IoT Core has read access rights to events / alarms – Fieldbus has no access rights	rw [1]

[1] Read and write

When setting the parameters of the access rights in the parameter setting software, observe the following notes:

- If the access rights in the fieldbus projection software and ifm moneo|configure are set to the [Fieldbus + IoT] value, the parameter values set on the fieldbus side always apply.
- For exclusive access to the device via ifm moneo|configure, set the access rights to the [IoT only] value and set the access rights to [Keep settings] in the fieldbus projection software.
- If the access rights in have been set to the [Fieldbus + IoT (read only)] value, the access rights in ifm moneo|configure can no longer be changed. To regain write access with ifm moneo|configure, set the access rights in the fieldbus projection software to the [Fieldbus + IoT] value.

To configure the access rights:

Requirements:

✓ The parameter setting software has been started.

✓ The connection to the device has been established.

▶ Select the [IoT] menu.

▷ The menu page shows the current settings.

▶ Set the access rights.

▶ Write the changed values to the device.

▶ Restart the device.

▷ The changed access rights are active.

9.1.4.2 Configuring IP settings

For communication with the IT network, the IP parameters of the IoT interface must be configured.

Available parameters:

Parameter	Description	Value range	Access
[DHCP]	Enable / disable the DHCP client	• [Static IP]: DHCP client disabled; IP parameters are set by the user • [DHCP]: DHCP client enabled; IP parameters are set by the network's DHCP server.	rw [1]
[IP address]	IP address of the IoT interface	e.g. 192.168.1.100 • 169.254.x.x(default)	rw [1] [2]
[Subnet mask]	Subnet mask of the Ethernet network	e.g. 255.255.255.0 • 255.255.0.0 (Default)	rw [1] [2]
[Default gateway IP address]	IP address of the network gateway	e.g. 192.169.1.1 • 0.0.0.0 (Default)	rw [1] [2]
[MAC address]	MAC address of the IoT interface	e.g. 00:02:01:0E:66:C1	ro [3]

[1] Read and write

[2] can only be changed if DHCP is disabled

[3] Read only

To configure the IoT interface:

Requirements:

✓ The parameter setting software has been started.

✓ The connection to the device has been established.

✓ The detailed view of the device is active.

▶ Select [IoT] menu.

▷ The menu page shows the current settings.

▶ Set IP parameters.

▶ Write the changed values to the device.

▷ IP settings of the IoT interface are configured.

9.1.4.3 Configuring the interface to the monitoring software

To enable transmission of the process data of the IO-Link master to the monitoring software (e.g. ifm moneo suite), the interface must be configured accordingly.

Available parameters:

Name	Description	Value range	Access
[IP address LR Agent or SMARTOBSERVER]	IP address of the monitoring software	e.g. 255.255.255.255 (default)	rw [1]
[Port LR Agent or SMARTOBSERVER]	Port number of the monitoring software	• 0: 0 … • 35100: 35100 (default) … • 65535: 65535	rw [1]
[Interval LR Agent or SMARTOBSERVER]	Interval for data transmission to the monitoring software (value in milliseconds)	• [Disabled]: No transmission (default) • 500: 500 ms … • 2147483647: 2147483647 ms	rw [1]
[Application tag]	Source identifier of the device in the monitoring software	e.g., factory 2 plant 1	rw [1]

[1] Read and write

To set the interface to the monitoring software:

After changing the parameters [Port LR Agent or SMARTOBSERVER] or [Application Tag], it may take 120 seconds before the device establishes a new TCP connection.

To prevent the delay:

▶ When the parameter has been changed, restart the IO-Link master.

Requirements:

✓ The parameter setting software has been started.

✓ The connection to the device has been established.

✓ The detailed view of the device is active.

▶ Select the [IoT] menu.

▷ The menu page shows the current settings.

▶ Set the parameters of the interface.

▶ Write the changed values to the device.

▷ Interface to the monitoring software has been set.

9.1.5 Fieldbus interface

The [Fieldbus] menu provides access to the parameters of the EtherNet/IP interface.

9.1.5.1 Configuring the EtherNet/IP interface

For communication with the EtherNet/IP network, the IP parameters of the EtherNet/IP interface must be configured.

Available parameters:

Name	Description	Value range	Access
[DHCP]	Enable / disable the DHCP client of the device	• [Static IP]: IP parameters are set by the user • [DHCP]: IP parameters are set by a DHCP server in the network • [BOOTP]: IP parameters are set via Bootstrap Protocol (BOOTP)	rw [1]
[IP address]	IP address of the EtherNet/IP interface	e.g. 192.168.82.100 192.168.1.250 (default)	rw [1]
[Subnet mask]	Subnet mask of the EtherNet/IP network	e.g. 255.255.0.0 • 255.255.255.0 (default)	rw [1]
[Default gateway IP address]	IP address of the network gateway	e.g. 192.168.82.1 • 0.0.0.0 (default)	rw [1]
[Host name]	EtherNet/IP name of the device (max. 240 characters)	e.g. iol12.plant1	rw [1]
[MAC address]	MAC address of the device's EtherNet/IP interface	e.g. 00:02:01:0f:c8:8f	ro [2]
[Fieldbus firmware]	Version of the fieldbus firmware	e.g. 5.3.0.10 (EtherNet/IP Adapter)	ro [2]

[1] Read and write

[2] Read only

Requirements:

✓ The parameter setting software has been started.

✓ The connection to the device has been established.

✓ The detailed view of the device is active.

▶ Select the [Fieldbus] menu.

▷ The menu page shows the current settings.

▶ Set the parameters of the EtherNet/IP interface.

▶ Save the changes on the device.

▷ IP settings of the interface are configured.

9.1.5.2 Setting the EtherNet/IP configuration mode

The device supports the fieldbus configuration modes "top-down" and "independent". For the configuration mode "Independent", the user can additionally select the connection type.

Available parameters:

Parameter	Description	Value range	Access
[Independent mode]	EtherNet/IP configuration mode	• [Independent mode off]: Configuration via fieldbus PLC • [Independent mode on]: Configuration via the device	rw [1] [2]
[Process data length]	Length of process data (per IO-Link port)	• [2 bytes input 2 bytes output]: 2 bytes input data, 2 bytes output data • [4 bytes input 4 bytes output]: 4 bytes input data, 4 bytes output data • [8 bytes input 8 bytes output]: 8 bytes input data, 8 bytes output data • [16 bytes input 16 bytes output]: 16 bytes input data, 16 bytes output data • [32 bytes input 32 bytes output]: 32 bytes input data, 32 bytes output data	rw [1] [2]
[Swap]	Swap the order of the bytes in the data word of the process data	• [off]: as Array of Bytes • [on]: as Integer16 value; during an update of the process data, the bytes are exchanged	rw [1] [2]

[1] Read and write

[2] Read and write; parameter can only be changed if no active connection to fieldbus controller

Requirements:

✓ The parameter setting software has been started.

✓ The connection to the device has been established.

✓ The detailed view of the device is active.

▶ Select the [Fieldbus] menu.

▷ The menu page shows the current settings.

▶ Set the configuration mode.

▶ Optional: Select connection type.

▶ Set arrangement of the bytes in the process data.

▶ Save the changes on the device.

▷ EtherNet/IP configuration mode is set.

9.1.6 IO-Link ports

The [Port x](x:1...4) menues provide access to the parameters of the IO-Link portsX01...X04.

9.1.6.1 Setting data transmission to the monitoring software

Available parameters:

Name	Description	Value range	Access
[Transmission to LR Agent or SMARTOBSERVER]	Enable / Disable the transmission of process data of the port to the monitoring software	• [Disabled]: Process data is not transmitted • [Enabled]: Process data is transmitted	rw [1]

[1] Read and write

To set the data transmission:

Requirements:

✓ The parameter setting software has been started.

✓ The connection to the device has been established.

✓ The detailed view of the device is active.

✓ Interface to the monitoring software has been configured.

▶ Select the [Port x] (x = 1…4) menu.

▷ The menu page shows the current settings.

▶ Set the parameters.

▶ Write the changed values to the device.

▷ Data transmission to the monitoring software has been set.

9.1.6.2 Setting the operating mode Pin 4 (US)

Available parameters:

Parameter	Description	Value range	Access
[Mode Pin4 US]	Operating mode of Pin 4 (C/Q) of the port	• [Disabled]: Port deactivated • [DI]: Digital input • [DO]: Digital output • [IO-Link]: IO-Link process data	rw [1]

[1] Read and write

Requirements:

✓ The parameter setting software has been started.

✓ The connection to the device has been established.

✓ The detailed view of the device is active.

▶ Select the [Port x] (x = 1…4) menu.

▷ The menu page shows the current settings.

▶ Set the operating mode.

▶ Save the changes on the device.

▷ Operating mode of pin 4 (US) of the port has been set.

9.1.6.3 Setting the cycle time

In the IO-Link operating mode, the cycle time of the port can also be set.

Available parameters:

Parameter	Description	Value range	Access
[Cycle time actual]	Current cycle time between the IO-Link master and the IO-Link device (value in µs)	• 0: best possible cycle time … • 132800: 132800 µs	ro [1] [2]

Parameter	Description	Value range	Access
[Cycle time preset]	Cycle time between the IO-Link master and the IO-Link device (value in µs)	• 0: best possible cycle time • 1: 1 µs … • 132800: 132800 µs	rw [3] [2]
[Bit rate]	Transmission rate between the IO-Link master and the IO-Link device	• COM1: 4.8 kbaud • COM2: 38.4 kbaud • COM3: 230.4kbaud	ro [1] [2]

[1] Read only

[2] Parameter only available if operating mode pin 4 (US) = IO-Link and IO-Link device is connected to the port

[3] Read and write

Requirements:

✓ The parameter setting software has been started.

✓ The connection to the device has been established.

✓ The detailed view of the device is active.

✓ Operating mode of pin 4 of the port is "IO-Link".

▶ Select the [Port x] > [IO-Link] menu (x = 1…4).

▶ Set the cycle time.

▶ Write the changed values to the device.

▷ Cycle time of the IO-Link port is set.

9.1.6.4 Setting the device validation and data storage

The device supports the functions device validation and backup / restore of parameter data of the connected IO-Link devices.

The following options are available:

Option	Validation of the connected IO-Link device	Backup of parameter values	Restore of parameter values
[No check and clear]	No	No	No
[Type compatible V1.0 device]	Yes, test compatibility with IO-Link standard V1.0	No	No
[Type compatible V1.1 device]	Yes, test compatibility with IO-Link standard V1.1	No	No
[Type compatible V1.1 device with Backup + Restore]	Yes, test compatibility with IO-Link standard V1.1 and identity of design (vendor ID, device ID)	Yes, automatic backup of parameter values; Changes to the current parameter values will be stored	Yes, restore of parameter values when connecting an identical IO-Link device with factory settings
[Type compatible V1.1 device with Restore]	Yes, test compatibility with IO-Link standard V1.1 and identity of design (vendor ID, device ID)	No, there is no automatic backup; Changes to the parameter values are not stored	Yes, restore of parameter values when connecting an identical IO-Link device with factory settings

Device validation and backup / restore of parameter values are only available if the “IO-Link” operating mode of the port has been activated.

For options [Type compatible V1.1 device with Backup + Restore] and [Type compatible V1.1 device with Restore]: If the parameters [Vendor ID] or [Device ID] are changed in online mode, the data memory is deleted and the parameter values of the connected IO-Link device are backed-up again in the IO-Link master.

Available parameters:

Parameter	Description	Value range	Access
Validation / Data Storage	Validation of the connected IO-Link devices and automatic restore of parameter sets of the IO-Link device	• No check and clear • Type compatible V1.0 device • Type compatible V1.1 device • Type compatible V1.1 device with Backup + Restore • Type compatible V1.1 device with Restore	rw [1] [2]
Vendor ID	Vendor ID of the IO-Link device to be validated against	e.g., 310: ifm electronic gmbh	rw [1] [2]
Device ID	Device ID of the IO-Link device to be validated against	e.g., 1129: TCC501 (ifm temperature sensor)	rw [1] [2]

[1] Read and write

[2] Parameter only available if operating mode pin 4 (US) = IO-Link and IO-Link device is connected to the port

To configure the device validation and the backup / restore of parameter values:

Requirements:

✓ The parameter setting software has been started.

✓ The connection to the device has been established.

✓ The detailed view of the device is active.

✓ Operating mode of pin 4 of the port is "IO-Link".

▶ Select the [Port x] > [IO-Link] menu (x = 1…4).

▷ The menu page shows the current settings.

▶ Set the parameters for device validation and backup / restore of parameter values.

▶ Optional: Enter the vendor ID and device ID.

▶ Save the changes on the device.

▷ Device validation and backup / restore of parameter values have been configured.

9.1.6.5 Setting fail-safe values

The user can set the fail-safe values of the outputs of the IO-Link ports for the "Independent" configuration mode. The fail-safe values will only be enabled if the EtherNet/IP connection is interrupted.

Available parameters:

Parameter	Description	Value range	Access
[Fail-safe digital out]	Fail-safe value of the output for operating mode "digital output (DO)"	• [Reset]: default value • [Old]: most recent process value • [Set]: HIGH level	rw [1] [2]
[Fail-safe IO-Link]	Fail-safe value of the output for "IO-Link" operating mode	• [Off]: Fail-safe deactivated • [Reset]: Fail-safe activated – default value • [Old]: Fail-safe activated – most recent process value • [Pattern]: Fail-safe activated - byte sequence	rw [1] [2]

[1] Read and write

[2] Read and write; parameter can only be changed if no active connection to fieldbus controller

Requirements:

✓ The parameter setting software has been started.

✓ The connection to the device has been established.

✓ The detailed view of the device is active.

✓ Configuration mode “Independent” is enabled.

▶ Select the [Port x] (x = 1…4) menu.
  ▷ The menu page shows the current settings.
▶ Setting fail-safe values
▶ Write the changed values to the device.
▷ Fail-safe values are configured.

9.1.7 Device information

The [Info] menu provides access to the identification information of the device.

9.1.7.1 Reading identification information

Available information:

To read the device information:

Requirements:

✓ The parameter setting software has been started.
✓ The connection to the device has been established.
✓ The detailed view of the device is active.
▶ Select [Info] menu.
▷ The menu page shows the device information.

9.1.8 Device control

The [Firmware] menu provides access to functions for controlling the device.

9.1.8.1 Resetting the device

Requirements:

✓ The parameter setting software has been started.
✓ The connection to the device has been established.
✓ The detailed view of the device is active.
▶ Select the [Firmware] menu.
▶ Click on [Factory reset].
▷ The device is reset to factory settings.
▷ All parameters are set to their default values.
▷ The device is read again.

9.1.8.2 Restarting the device

Requirements:

✓ The parameter setting software has been started.
✓ The connection to the device has been established.
✓ The detailed view of the device is active.
▶ Select the [Firmware] menu.
▶ Click on [Reboot].
▷ The device is restarted.

▷ All set parameter values will be retained.

9.1.9 Updating the firmware

To update the firmware of the device:

Requirements:

✓ New firmware has been downloaded. documentation.ifm.com

✓ The parameter setting software has been started.

✓ The connection to the device has been established.

✓ The detailed view of the device is active.

▶ In the header: Click on ⬆.

▷ A dialogue window appears.

▶ Click on [Import firmware file].

▷ The file explorer appears.

▶ Select the firmware file (.bin) and click on [Open].

▷ The new firmware file is selected.

▶ Click on [OK].

▷ The firmware of the device is updated.

▷ The status of the update process is displayed.

▷ The firmware of the device has been updated.

9.1.10 Setting the parameters of IO-Link devices

The device supports access to connected IO-Link devices (sensors, actuators).

Information about the parameters of the IO-Link device:

→ Operating instructions IO-Link device

→ IODD description of the IO-Link device

Requirements:

✓ ifm moneo|configure has been started.

✓ Operating mode pin 4 (US) of the port with the IO-Link device is „IO-Link“.

✓ IoT has read and write access rights for the IO-Link master.

✓ The IO-Link device is properly connected to the IO-Link port of the device.

✓ The IODD library of ifm moeno|configure contains the IODD of the IO-Link device.

▶ Scan the network for devices.

▷ ifm moneo|configure detects the IO-Link master.

▶ Estblish connection to the IO-Link master.

▷ ifm moneo|configure detects the connected IO-Link device.

▶ In the row of the IO-Link device: Click on ⚙.

▷ The detailed view of the IO-Link device appears.

▷ The detailed view shows the current parameter values of the IO-Link device.

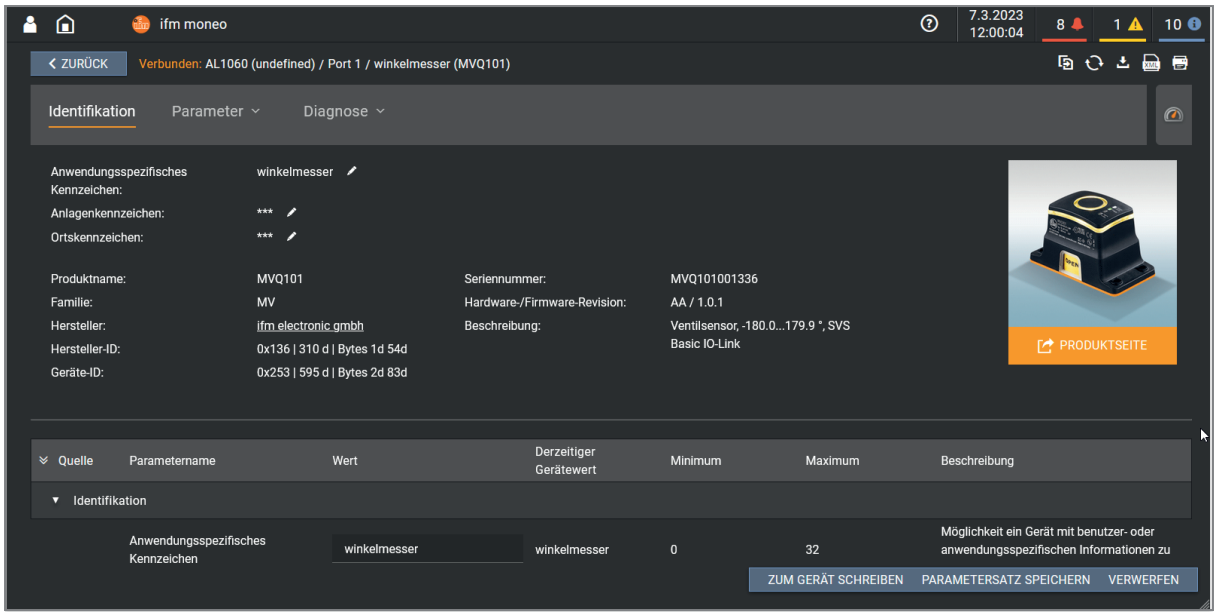


Fig. 1: Example: Detailed view of the MVQ101 sensor

▶ Configure the IO-Link device.

▶ Store the chenged configuration on the IO-Link device.

▷ The parameters of the IO-Link device have been set.

9.2 ifm IoT Core REST API

9.2.1 ifm IoT Core: General information

The device has the ifm IoT Core. The ifm IoT Core represents the functionality of the device. The functionality consists of a set of data, services and events. The elements of the ifm IoT Core are arranged in a JSON object in a hierarchical tree structure. The ifm IoT Core makes these elements available to the outside world via standard interfaces (e.g. HTTP) . This allows the user and other devices to access data (parameters, process data), events and functions (services) of the device.

9.2.1.1 Accessing the ifm IoT Core

Any element of the ifm IoT Core is accessed via its address (e.g. `root/port1/pin2`). The address is composed of the path leading to the element (`root/port1`) and the identifier of the element (`pin2`).

The user can access the ifm IoT Core via HTTP requests. The following methods are supported.

9.2.2 Getting started

To read the device description:

▶ Send the following POST request to the ifm IoT Core:
`{"code":"request","cid":-1,"adr":"gettree"}`

▷ The ifm IoT Core returns the device description as a structured JSON object.

▶ Identify all substructures and the data points contained therein in the tree structure of the JSON object.

▶ Identify the applicable services for the access to substructures and the data points contained therein.

9.2.3 General functions

The device has the type “device” (→ Types 🗋 72). The following services can be applied to the root element of the device tree:

Service	Description
../gettree	Provide the complete tree or subtree of the device description (JSON)
../getidentity	Read identification information of the unit
../getdatamulti	Read multiple elements sequentially
../getelementinfo	Read detailed information of an element
../getsubscriberlist	Provide a list of all active notification subscriptions
../querytree	Search device description for specific elements

The following services can be applied to elements of the type `data` depending on the configured access rights:

Service	Description
../getdata	Read the value of the element
../setdata	Write the value of the element

9.2.3.1 Example: Reading properties of an element

Task: Determine the data type and value range of the accessrights parameter.

Solution: Read the properties of the element `iotsetup/accessrights` of the `getelementinfo` service. The fields type (data type) and valuation (range of values) contain the required information.

Request:

```
{
  "code":"request",
  "cid":4711,
  "adr":"getelementinfo",
  "data":{"adr":"iotsetup/accessrights"}
}
```

Response:

```
{
  "cid":4711,
  "data":{
    "identifier":"accessrights",
    "type":"data",
    "profiles":["parameter"],
    "format":{
      "type":"enum",
      "namespace":"json",
      "encoding":"integer",
      "valuation":{
        "valuelist":{
          "0":"Fieldbus + IoT",
          "1":"Fieldbus + IoT (read-only)",
          "3":"IoT only"
        }
      }
    }
  },
  "code":200
}
```

The accessrights parameter has the data type ENUM with the valid values "Fieldbus + IoT", "Fieldbus + IoT (read only)" and "IoT only".

9.2.3.2 Example: Outputting the subtree

Task: Output all direct sub-elements of the node firmware.

Solution: Use the service gettree to output the required subtree (root node: `firmware`, sub-levels to display: `1`)

Request:

```
{
  "code":"request",
  "cid":4711,
  "adr":"gettree",
  "data":{
    "adr":"firmware",
    "level":1
  }
}
```

Response:

```
{
  "cid":4711,
  "data":{
    "identifier":"firmware",
    "type":"structure",
    "profiles":["software","software/uploadablesoftware"],
    "subs":[{
      "identifier":"version",
      "type":"data",
      "profiles":["parameter"],
      "format":{
        "type":"string",
        "namespace":"json",
        "encoding":"UTF-8"
      }
    },
    {
      "identifier":"type",
      "type":"data",
      "format":{
        "type":"string",
        "namespace":"json",
        "encoding":"UTF-8"
      }
    },
    {
      "identifier":"install",
      "type":"service"
    },
    {
      "identifier":"factoryreset",
      "type":"service"
    },
    {
      "identifier":"signal",
      "type":"service"
    },
    {
      "identifier":"container",
      "type":"data",
      "format":{
        "type":"binary",
        "namespace":"json",
        "encoding":"base64"
      }
    },
    {
      "identifier":"reboot",
      "type":"service"
    }
    ]
  },
  "code":200
}
```

9.2.3.3 Example: Changing a parameter value

Task: The Application Tag parameter of the device is to be written with the value "Do not use". The new value is only supposed to be valid until the next reboot of the device.

Solution: Write the new value of the `/devicetag/applicationtag` element with the `setdata` service. To keep the new value only until the next restart of the unit, pass on the duration option with the uptime value.

Request:

```
{
  "code":"request",
  "cid":4711,
  "adr":"/devicetag/applicationtag/setdata",
  "data":{
    "duration":"uptime",
    "newvalue":"Do not use"
  }
}
```

Response:

```
{
  "cid":4711,
  "code":200,
}
```

9.2.3.4 Example: Read multiple elements sequentially

Task: The following current values of the device are to be read consecutively: temperature, serial number

Solution: Read the current parameter values using the service `getdatamulti` (data point temperature: `/processdatamaster/temperature`; data point serial number: `/deviceinfo/serialnumber`)

Request:

```
{
  "code":"request",
  "cid":4711,
  "adr":"/getdatamulti",
  "data":{"datatosend":[
    "/processdatamaster/temperature",
    "/deviceinfo/serialnumber"]
  }
}
```

Response:

```
{
  "cid":4711,
  "data":{
    "processdatamaster/temperature":{
      "code":200,
      "data":44
    },
    "deviceinfo/serialnumber":{
      "code":200,
      "data":"000174210147"
    }
  },
  "code":200
}
```

9.2.3.5 Example: Browsing device description

Task: All elements with the "timer" profile are to be listed.

Solution: Use the `querytree` service to search the device description with parameter "timer" (profile).

Request:

```
{
  "cid":4711,
  "code":"request",
  "adr":"querytree",
  "data":{
    "profile":"timer"
  }
}
```

Response:

```
{
  "cid":4711,
  "data":{
    "adrList":[
      "device/timer[1]",
      "device/timer[2]"
    ]
  },
  "code": 200
}
```

9.2.4 IoT: Configuring access rights

The device can be integrated in parallel into a fieldbus environment and into an IT network structure for IIoT applications (“Y-path”).

Changes to the Gateway: Resetting, rebooting and localising the device (→ 🗋 54) data point will only take effect after the device has been restarted.

Substructure: iotsetup

Available data points:

When parameterising the access rights with the ifm IoT Core, observe the following notes:

- If the access rights in the fieldbus projection software and the parameter setting software are set to the [Fieldbus + IoT] value, the parameter values set on the fieldbus side always apply.
- For exclusive access to the device via the parameter setting software, set the access rights to the [IoT only] value and set the access rights to [Keep settings] in the fieldbus projection software.
- If the access rights in the ifm IoT Core are set to the value [Fieldbus + IoT (read only)], the access rights can no longer be changed via the ifm IoT Core. To regain write access with the parameter setting software, set the access rights in the fieldbus projection software to the [Fieldbus + IoT] value.

9.2.5 IoT: Configuring IP settings

Substructure: iotsetup/network

Available data points:

Parameter	Description	Value range	Access
../dhcp	Activate / deactivate DHCP mode	• static ip: DHCP client disabled; IP parameters are set by the user • dhcp: DHCP client enabled; IP parameters are set by the network's DHCP server.	rw [1]
../ipaddress	IP address of the IoT interface	e.g. 192.168.1.100 • 169.254.x.x (default)	rw [1]
../subnetmask	Subnet mask of the network segment	e.g. 255.255.255.0 • 255.255.0.0 (default)	rw [1]
../ipdefaultgateway	IP address of the network gateway	e.g. 192.169.1.1 • 0.0.0.0 (default)	rw [1]

[1] Read and write

Applicable services:

Name	Description
../setblock	write all data points of the substructure blockwise

Write the data points of the substructure only with the `setblock` service!

9.2.6 IoT: Configuring security mode

The unit provides a security mode. The security mode makes it possible to protect access to IO-Link masters and connected IO-Link devices from the IT network. When security mode is activated, the following restrictions apply:

- Access only by authentication (password protection)
- Access only via encrypted connection (TLS - Transport Layer Security)

The security mode only protects access and data transmission via the IoT interface.

▷ The user name `administrator` cannot be changed.

▷ The set password cannot be read with getdata.

The current status of the security mode can be read with the getidentity service (→ Service: getidentity 🗋 74).

For the authentication, the user must additionally provide the POST requests with a valid user name and password in the field "auth". The user name and the password are shown as Base64-coded character strings.

The following requests can be done if the security mode is enabled, also without authentication:

- `getidentity`
- `deviceinfo/vendor/getdata`
- `deviceinfo/productcode/getdata`

Substructure: `iotsetup`

Available data points:

Name	Description	Value range	Access
../security/securitymode	Enabling / disabling security mode	• disabled: Security mode deactivated • enabled: Security mode activated	rw [1]
../security/password	Password for authentication (Base64 coded)		wo [2]

[1] Read and write

[2] write only

Valid character set for the Base64 coding / decoding of the password: UTF-8

Online tool for coding / decoding: www.base64encode.org

9.2.6.1 Example: Activating security mode

Task: The security mode of the IoT interface is to be activated. The valid password is to be set to "password" (BASE64-coded: cGFzc3dvcmQ=).

Solution: Activating the security mode with data point `iotsetup/security/securitymode`. Writing the password to the data point `iotsetup/security/password`.

Activating security mode

Request:

```
{
  "code":"request",
  "cid":1,
  "adr":"/iotsetup/security/securitymode/setdata",
  "data":{"newvalue":1}
}
```

Response:

```
{
  "cid":-1,
  "code":200
}
```

Setting the password

Request:

```
{
  "code":"request",
  "cid":2,
  "adr":"/iotsetup/security/password/setdata",
  "data":{"newvalue":"cGFzc3dvcmQ="}
}
```

Response:

```
{
  "cid":2,
  "code":200
}
```

9.2.6.2 Example: Request with authentication

Task: The temperature of the IO-Link master is to be read. The security function is enabled (current password: password).

Solution: Read the data point processdatamaster/temperature. The request must be sent using https. The user name and the password are transferred as a Base64-coded character string ("administrator" = "YWRtaW5pc3RyYXRvcg==", "password" = "cGFzc3dvcmQ=")

Request:

```
{
  "code":"request",
  "cid":1,
  "adr":"processdatamaster/temperature/getdata",
  "auth":{
    "user":"YWRtaW5pc3RyYXRvcg==",
    "passwd":"cGFzc3dvcmQ="
  }
}
```

Response:

```
{
  "cid":1,
  "data":{"value":37},
  "code":200
}
```

9.2.6.3 Example: Resetting the password

Task: The existing password is to be reset.

Solution: To reset a password, disable the security mode. To disable it, enter the user name and the password (the fields "user" and "passwd").

Request:

```
{
  "code":"request",
  "cid":-1,
  "adr":"iotsetup/security/securitymode/setdata",
  "data":{"newvalue":0},
  "auth":{
    "user":"YWRtaW5pc3RyYXRvcg==",
    "passwd":"SW9UNGlmbQ=="
  }
}
```

Response:

```
{
  "cid":-1,
  "code":200
}
```

9.2.7 IoT: Configuring the interface to the monitoring software

To enable transmission of the process data of the IO-Link master to the monitoring software (e.g. ifm moneo suite), the interface must be configured accordingly.

Substructure: iotsetup

Available data points:

Name	Description	Value range	Access
../smobip	IP address of the monitoring software	e.g. 255.255.255.255 (default)	rw [1]

Name	Description	Value range	Access
../smobport	Port number of the monitoring software	• 0: 0 … • 35100: 35100 (default) … • 65535: 65535	rw [1]
../smobinterval	Interval for data transmission to the monitoring software (value in milliseconds)	• 0: Off – no transmission (default) • 500: 500 ms … • 2147483647: 2147483647 ms	rw [1]

[1] Read and write

9.2.8 Fieldbus: Configuring the EtherNet/IP interface

For communication with the EtherNet/IP network, the EtherNet/IP interface must be configured.

Substructure: fieldbussetup

Available data points:

Name	Description	Values	Access
../network/dhcp	Status of the DHCP client	• 0: Static IP address: • 1: DHCP (Dynamic Host Configuration Protocol) • 2: BOOTP (Bootstrap Protocol)	rw [1]
../network/ipaddress	IP address of the Ethernet interface:	e.g. 192.200.0.100 • 192.168.1.250 (Default)	rw [1] [2]
../network/subnetmask	Subnet mask of the network segment	e.g. 255.255.192.0 • 255.255.255.0 (Default)	rw [1] [2]
../network/ipdefaultgateway	IP address of the network gateway	e.g. 192.200.63.1 • 0.0.0.0 (Default)	rw [1] [2]
../network/macaddress	MAC address of the Ethernet interface	e.g. 00:02:01:0E:10:7C	ro [3]
../hostname	EtherNet/IP hostname	e.g. alxx2x	rw [1]
../fieldbusfirmware	Firmware of the fieldbus	e.g. 5.3.0.10 (EtherNet/IP Adapter)	ro [3]
../connectionstatus	Status of the fieldbus connection	• 0: Not connected • 1: Connected	ro [3]

[1] Read and write

[2] Read and write; parameter can only be changed if no active connection to fieldbus controller

[3] Read only

Applicable services:

Name	Description
../network/setblock	Write all values of the substructure blockwise

▶ Change the parameters in the substructure network only block by block with the service setblock!

9.2.9 Fieldbus: Setting the EtherNet/IP configuration mode

The device supports the EtherNet/IP configuration modes "Top-Down Mode" and "Independent Mode".

Substructure: fieldbussetup/configuration

Available data points:

Name	Description	Value range	Access
../independentmode	Configuration mode	• 0: Independent mode off • 1: Independent mode on	rw [1] [2]
../explicitmodepd	Connection types (Input Assembly, Output Assembly)	• 0: Explicit Process Data Mode off • 1: Explicit Process Data Mode with IO-Link I/O + Acyclic + Diag • 2: Explicit Process Data Mode with IO-Link I/O + Acyclic • 3: Explicit Process Data Mode with IO-Link I/O	rw [1] [2]
../processdataconfiguration	Length of the process data	• 0: 2 bytes input 2 bytes output • 1: 4 bytes input 4 bytes output • 2: 8 bytes input 8 bytes output • 3: 16 bytes input 16 bytes output • 4: 32 bytes input 32 bytes output	rw [1] [2]
../swap	Swap of the bytes in process data	• 0: Off • 1: On	rw [1] [2]

[1] Read and write

[2] Read and write; parameter can only be changed if no active connection to fieldbus controller

9.2.10 Fieldbus: Setting fail-safe values of the outputs

If the EtherNet/IP connection is interrupted, fail-safe values can be set for the configured outputs of the ports.

Substructure: fieldbussetup/configuration/port[x] (x:1…4)

Available data points:

Name	Description	Value range	Access
../failsafedigitalout	Fail-safe value for the digital output - pin 4 (DO)	• 0: Failsafe – Reset value: default value • 1: Failsafe – Old value: most recent process value • 2: Failsafe – Set value: HIGH level	rw [1] [2]
../failsafeiolink	Fail-safe value for IO-Link output data - Pin 4 (IO-Link)	• 0: No failsafe: Fail-safe deactivated • 1: Failsafe – Reset value: Fail-safe activated – default value • 2: Failsafe – Old value: Fail-safe – most recent process value • 3: Failsafe with Pattern: Fail-safe – byte sequence	rw [1] [2]

[1] Read and write

[2] Read and write; parameter can only be changed if no active connection to fieldbus controller

9.2.11 Ports: Setting the operating mode Pin 4 (US)

Pin 4 of ports X01...X04 supports the following operating modes:

- Disabled: No data transmission at pin 4 (C/Q) of the port
- Digital input: Binary input signal at pin 4 (C/Q) of the port
- Digital output Binary output signal at pin 4 (C/Q) of the port
- IO-Link: IO-Link data transmission via pin 4 (C/Q) of the port

The set operating mode must match the operating mode of the device connected to the port (sensor, actuator, IO-Link device).

Substructure: iolinkmaster/port[x] (x: 1…4)

Available data points:

Name	Description	Value range	Access
…/mode	Operating mode of pin 4 (US) of the port	• 0: Disabled - port deactivated • 1: DI - digital input • 2: DO - digital output • 3: IO-Link - IO-Link data	rw [1] [2]
../mastercycletime_actual	Current cycle time of the data transfer between port and IO-Link device (value in µs)	• 0: best possible cycle time • 1: 1 µs … • 132800: 132800 µs	ro [3]
../comspeed	Current transfer rate between port and IO-Link device	• 0: COM1 - 4.8 kBaud • 1: COM2 - 38.4 kBaud • 2: COM3 - 230.4 kBaud	ro [3]
../mastercycletime_preset	Cycle time of the data transfer between port and IO-Link device (value in µs); only in IO-Link operating mode	• 0: Automatically set the best possible cycle time • 1: 1 µs … • 132800: 132800 µs	rw [1] [2]

[1] Read and write

[2] Read and write; parameter can only be changed if no active connection to fieldbus controller

[3] Read only

9.2.12 Ports: Configuring device validation and data storage

The device supports the functions device validation and backup / restore of parameter data of the connected IO-Link devices.

The following options are available:

Option	Validation of the connected IO-Link device	Backup of parameter values	Restore of parameter values
[No check and clear]	No	No	No
[Type compatible V1.0 device]	Yes, test compatibility with IO-Link standard V1.0	No	No
[Type compatible V1.1 device]	Yes, test compatibility with IO-Link standard V1.1	No	No
[Type compatible V1.1 device with Backup + Restore]	Yes, test compatibility with IO-Link standard V1.1 and identity of design (vendor ID, device ID)	Yes, automatic backup of parameter values; Changes to the current parameter values will be stored	Yes, restore of parameter values when connecting an identical IO-Link device with factory settings
[Type compatible V1.1 device with Restore]	Yes, test compatibility with IO-Link standard V1.1 and identity of design (vendor ID, device ID)	No, there is no automatic backup; Changes to the parameter values are not stored	Yes, restore of parameter values when connecting an identical IO-Link device with factory settings

Device validation and backup / restore of parameter values are only available if the “IO-Link” operating mode of the port has been activated.

For options [Type compatible V1.1 device with Backup + Restore] and [Type compatible V1.1 device with Restore]: If the parameters [Vendor ID] or [Device ID] are changed in online mode, the data memory is deleted and the parameter values of the connected IO-Link device are backed-up again in the IO-Link master.

Substructure: iolinkmaster/port[x] (x: 1…4)

Available data points:

Name	Description	Value range	Access
../validation_datastor-age_mode	Behaviour of the port when connecting a new IO-Link device	• 0: No check and clear • 1: Type compatible V1.0 device • 2: Type compatible V1.1 device • 3: Type compatible V1.1 device with Backup + Restore • 4: Type compatible V1.1 device with Restore	rw [1] [2]
../validation_vendorid	IO-Link ID of the manufacturer that is to be validated	0…655535	rw [1] [2]
../validation_deviceid	IO-Link ID of the device to be validated	0…16777215	rw [1] [2]
../datastorage	Structure for port data storage	-	rw [1] [2]
../datastorage/maxsize	Maximum size of the data storage content (in bytes)	e.g. 2066: 2066 bytes	ro [3]
../datastorage/chunksize	Size of a data segment (in bytes)	e.g. 256: 256 bytes	ro [3]
../datastorage/size	Size of the data storage content (in bytes)	e.g. 1024: 2 bytes	ro [3]

[1] Read and write

[2] Read and write; parameter can only be changed if no active connection to fieldbus controller

[3] Read only

Applicable services:

Name	Description
../validation_useconnecteddevice	Validate the IO-Link device
../datastorage/getblobdata	Reading the content of the data storage area
../datastorage/stream_set	Transfer an individual data segment
../datastorage/start_stream_set	Start sequential transmission of several data segments

9.2.12.1 Example: Cloning the data memory of an IO-Link port

Task: The data memory of port 2 of IO-Link master 1 is to be cloned to IO-Link master 2.

Solution: The cloning consists of 2 steps. In the first step, the data memory of the port is read by IO-Link master 1. In the second step, the read data is stored in the data memory of the port of IO-Link master 2.

Read data memory

▶ Read segment size of the data storage (h = number of bytes)

```
{
  "code":"request",
  "cid": -1,
  "adr":"/iolinkmaster/port[2]/datastorage/chunksize/getdata"
}
```

Example: h = 256

▶ Read total size of the data storage (g = number of bytes)

```
{
  "code":"request",
  "cid":-1,
  "adr": "/iolinkmaster/port[2]/datastorage/size/getdata"
}
```

Example: g = 550

▶ Calculate the number of reading steps n: n = first integer value for which applies: g < n*h

Example: n= 3, da 550 < 3*256

▶ Read the data storage segment by segment ("pos" indicates the byte offset at which the read process starts with the length "length").

```
{
  "code":"request",
  "cid":-1,
  "adr":"/iolinkmaster/port[2]/datastorage/getblobdata",
  "data":{"pos":0,"length":h}
}
{
  "code":"request",
  "cid":-1,
  "adr":"/iolinkmaster/port[2]/datastorage/getblobdata",
  "data":{"pos":h,"length":h}
}
{
  "code":"request",
  "cid":-1,
  "adr":"/iolinkmaster/port[2]/datastorage/getblobdata",
  "data":{"pos":2*h,"length":h}
}
...
{
  "code":"request",
  "cid":-1,
  "adr":"/iolinkmaster/port[2]/datastorage/getblobdata",
  "data":{"pos":n*h,"length":h}
}
```

Example:

1st read command: pos = 0, length = 256

2nd read command: pos = 256, length =256

3rd read command: pos = 512, length = 256

Each segment is returned as a BASE64-encoded string.

▶ Connect segments (concatenate).

Restore data memory

▶ Determine the size of the backed-up data storage content (n = number of bytes).

Example: n = 550

▶ Read segment size (s = number of bytes)

```
{
  "code":"request",
  "cid":-1,
  "adr":"/iolinkmaster/port[1]/datastorage/chunksize/getdata"
}
```

Example: s = 256

▶ Start writing the data storage string segment by segment ("size" = size of the read data storage)

```
{
  "code":"request",
  "cid":-1,
  "adr":"/iolinkmaster/port[1]/datastorage/start_stream_set",
  "data": {"size": n}
}
```

Example: size = 550

▶ Transmit data storage string segment by segment ("value" = string value with length s)

```
{
  "code":"request",
  "cid":-1,
  "adr":"/iolinkmaster/port[1]/datastorage/stream_set",
  "data": {"value": "aWZtfgIAAABBTDF4NXhfY25faXRfdDIuMi43Nw..."
}
```

9.2.13 Ports: Setting data transmission to the monitoring software

Substructure: iolinkmaster/port[x] (x: 1…4)

Available data points:

Name	Description	Value range	Access
../senddatatosmob	Enable / Disable the transmission of process data of the port to the monitoring software	• 0: Disabled – process data will not be transmitted • 1: Enabled – process data will be transmitted	rw [1]

[1] Read and write

9.2.14 Ports: Reading / writing process data

Substructure: iolinkmaster/port[x] (x: 1…4)

Available data points:

Name	Description	Value range	Access
../pin2in	Digital input (pin 2)	• 0: OFF • 1: ON	ro [1]
../iolinkdevice/pdin	Input data (pin 4)	"DI" operating mode: • 0x00: OFF • 0x01: ON "IO-Link" operating mode: • Process value in hexadecimal representation	ro [1]
../iolinkdevice/pdout	Output data (pin 4)	"DO" operating mode: • 0x00: OFF • 0x01: ON "IO-Link" operating mode: • Process value in hexadecimal representation	rw [2] [3]

[1] Read only

[2] Read and write

[3] Read and write; parameter can only be changed if no active connection to fieldbus controller

9.2.14.1 Example: Reading an IO-Link process value (operating mode "IO-Link")

Task: Read the current measured value of the ifm temperature sensor TN2531 at port 2.

Solution: Read the value of the pdin data point.

Request:

```
{
  "code":"request",
  "cid":4711,
  "adr":"/iolinkmaster/port[2]/iolinkdevice/pdin/getdata"
}
```

Response:

```
{
  "cid":4711,
  "data":{"value":"03C9"},
  "code":200
}
```

The return value is displayed in hexadecimal format. The return value is given in hexadecimal format. Besides the temperature value the return value comprises additional information (→ IO Device Description (IODD) of the sensor). The temperature value is shown in bits 2 to 15.

0x03C9 = 0b**11110010**01

Temperature value: 0b11110010 = 242

This means that The current temperature value is 24.2 °C.

9.2.14.2 Example: Reading an IO-Link process value (operating mode "IO-Link")

Task: The buzzer of the DV2500 at port 2 is to be switched on. The DV2500 operates in On/Off mode.

Solution: Write the value of the pdout data point. The IODD of the DV2500 shows the structure of the process value (e.g. LED activity). The buzzer is switched via bit 40 of the process value (OFF = 0, ON = 1).

Course:

1. Read the current process value Example: Reading an IO-Link process value (operating mode "IO-Link") (→ 🗋 46).
2. Set bit 40 of the read value to 1.
3. Write the new process value.

Example:

Read process value:

0x0000 0000 004D = 0b0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0100 1101

New process value:

0b0000 000**1** 0000 0000 0000 0000 0000 0000 0000 0000 0100 1101 = 0x0100 0000 004D

Request:

```
{
  "code":"request",
  "cid":10,
  "adr":"iolinkmaster/port[2]/iolinkdevice/pdout/setdata",
  "data":{"newvalue":"01000000004D"}
}
```

Response:

```
{
  "cid":10,
  "code":200
}
```

9.2.14.3 Example: Reading the digital input value (operating mode "DI")

Task: The digital input value of the IO-Link device at port 2 (pin 4) is to be read. The operating mode of the IO-Link port is "Digital Intput (DI)".

Solution: Read the process value of the pdin data point. The process value is returned as a hexadecimal value with a length of 1 byte (OFF = "00", ON = "01"').

Request:

```
{
  "code":"request",
  "cid":10,
  "adr":"iolinkmaster/port[2]/iolinkdevice/pdin/getdata"
}
```

Response:

```
{
  "cid":10,
  "data":{
    "value":"00"
  },
  "code":200
}
```

9.2.14.4 Example: Writing the digital output value (operating mode "DO")

Task: The digital output value of the IO-Link device at port 2 (pin 4) is to be set. The operating mode of the IO-Link port is "Digital Output (DO)".

Solution: Write the process value of the pdout data point. The value has to be written as a hexadecimal value with a length of 1 byte (OFF = "00", ON = "01"').

Request:

```
{
  "code":"request",
  "cid":10,
  "adr":"iolinkmaster/port[2]/iolinkdevice/pdout/setdata",
  "data":{
    "newvalue":"01"
  }
}
```

Response:

```
{
  "cid":10,
  "code":200
}
```

9.2.15 Ports: Reading port events

A port event contains information about events on the IO-Link port (e.g. IO-Link device connected or disconnected, change of the operating mode of the port).

Substructure: iolinkmaster/port[x] (x: 1…4)

Available data points:

Name	Description	Value range	Access
../portevent	Port event Structure: 0xYYZZ00 • 0xYY: Device Status - Status of the IO-Link devices • 0xZZ: Connection Status - Status of the connection	Device status: • 0x00: No IO-Link device connected • 0x40: Wrong IO-Link device connected • 0x80: IO-Link device connected and in PREOPERATE state • 0xFF: IO-Link device connected and in OPERATE state Connection Status: • 0x00: Port deactivated • 0x01: Port activated, but no device connected • 0x02: Port activated and in “IO-Link” operating mode • 0x03: Port activated and in “DI” operating mode • 0x04: Port activated and in “DO” operating mode • 0x1B: Repetitions detected • 0x1E: Short circuit detected at pin 4 • 0x42: Wrong revision of the IO-Link device • 0x43: Wrong vendor ID (V1.1 Revision) • 0x44: Wrong device ID (V1.1 Revision) • 0x45: Wrong vendor ID (V1.0 Revision) • 0x46: Wrong device ID (V1.0 Revision) • 0x48: Wrong cycle time	ro [1]

[1] Read only

9.2.16 Timer: Configuring the timers

The unit has 2 timers. The timers can be used for time-triggered transmission of notifications.

The timers are active by default.

Substructure: timer[1] | timer[2]

Available data points:

Name	Description	Value range	Access
../counter	Counter reading	• 0…4294967295	rw [1]
../interval	Counting interval (value in ms)	• 1000: 1000 ms … • 86400000: 86400000 ms	rw [1]
../interval/unit	Unit of the counting interval	• ms: milliseconds	ro [2]

[1] Read and write

[2] Read only

9.2.16.1 Set the counting interval

Task: The counting interval of timer 2 is to be set to 2.5 s.

Solution: Using the `setdata` service to write the new value 2500 to the data point `/timer[2]/interval` (2500 ms = 2.5 s).

Request:

```
{
  "code": "request",
  "cid": 1,
  "adr": "/timer[2]/interval/setdata",
  "data": {
  "newvalue": 2500
  }
}
```

Response:

```
{
  "cid": 1,
  "code": 200
}
```

9.2.17 IO-Link devices: Accessing parameters

The ifm IoT Core supports access to the parameters of connected IO-Link devices via the IT network using ISDU (Index Service Data Unit). Each parameter can be addressed via its ISDU index and ISDU subindex (→ IODD of the IO-Link device). If access to the IO-Link device is faulty, the ISDU error code will also be output in the response (→ IODD of the IO-Link device).

Substructure: iolinkmaster/port[x]/iolinkdevice (x: 1…4)

Applicable services:

Name	Description
../iolreadacyclic	Read a parameter of an IO-Link device (acyclic)
../iolwriteacyclic	Write a parameter of an IO-Link device (acyclic)

When using the validation level "Type compatible V1.1 Device with Backup + Restore":

After changing a parameter via ISDU write access, the user must end the parameter setting process with the "ParamDownloadStore" system command and activate the data storage mechanism on the IO-Link device.

▶ Set the SystemCommand object (ISDU index: 0x0002) to the value 0x05 (command "ParamDownloadStore") via acyclic ISDU write access.

▷ The parameter setting process is finished.

▷ The data storage mechanism on IO-Link device will be activated.

▷ The IO-Link device synchronises changed parameter values with data storage of the IO-Link master.

9.2.17.1 Example: Reading a parameter value of an IO-Link device

Task: Reading the serial number of the ifm temperature sensor TN2531 at port 2.

Solution: Read the serial number with the `iolreadacyclic` service from the IO-Link device (index: 21, subindex: 0)

Request:

```
{
  "code":"request",
  "cid":4711,
  "adr":"/iolinkmaster/port[2]/iolinkdevice/iolreadacyclic",
  "data":{
    "index":21,
    "subindex":0
  }
}
```

Response:

```
{
  "cid":4711,
  "data":{"value":"4730323134323830373130"},
  "code":200
}
```

The returned value is displayed in hexadecimal format. Converting the HEX value to a STRING value results in: G0214280710.

9.2.17.2 Example: Writing a parameter value of an IO-Link device

Task: Setting the output configuration OUT1 of the ifm temperature sensor TN2531 at port 2 to the value "Hnc / hysteresis function, normally closed".

Solution: Set the parameter [ou1] of the sensor with the service `iolwriteacyclic` to the value 4. The parameter can be accessed via IO-Link Index 580, Subindex 0 (→ IO-Link description of the sensor).

Request:

```
{
  "code":"request",
  "cid":4711,
  "adr":"/iolinkmaster/port[2]/iolinkdevice/iolwriteacyclic",
  "data":{
    "index":580,
    "subindex":0,
    "value":"34"
  }
}
```

The value must be passed in hexadecimal format. Converting the STRING value to a HEX value results in: 34.

Response:

```
{
  "cid":4711,
  "code":200
}
```

9.2.18 IO-Link devices: Reading and writing device information

Substructure: iolinkmaster/port[x]/iolinkdevice (x: 1…4)

Available data points:

Name	Description	Value range	Access
../status	Status of the connected IO-Link device	• 0: State not connected - State not connected • 1: State preoperate - State PREOPERATE • 2: State operate - State OPERATE • 3: State communication error - State communication error	ro [1]
../vendorid	IO-Link ID of the manufacturer	e.g. 310: ifm electronic	ro [1]
../deviceid	IO-Link ID of the IO-Link device	e.g. 712: ifm pressure sensor, PV7003	ro [1]
../productname	Product name of the IO-Link device	e.g. PV7003	ro [1]
../serial	Serial number of the IO-Link device	e.g. 000008500706	ro [1]
../applicationspecifictag	Application specific identification (application tag)	e.g. sensor1_machine3	rw [2]

[1] Read only

[2] Read and write

9.2.19 IO-Link devices: Reading IO-Link events

The device supports IO-Link events. IO-Link events are event and error messages. IO-Link events can be generated in the IO-Link master and in the connected IO-Link devices. IO-Link events generated in the IO-Link devices are forwarded to the IO-Link master and stored there.

An IO-Link event message has the following structure:

Byte 0…1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6
Event Code	Source	Validity	Type	Mode	Instance

Legend

• Instance	IO-Link Event Qualifier: Trigger	1 byte	• 0x00: unknown • 0x01: PL (Physical Layer) • 0x02: DL (Data Layer) • 0x03: AL (Application Layer) • 0x04: APPL (Application)
• Mode	IO-Link Event Qualifier: Event trigger	1 byte	• 0x40: One-time event or warning (single shot) • 0xC0: Error disappeared • 0x80: Error appeared
• Type	IO-Link Event Qualifier: Event category	1 byte	• 0x10: Notification • 0x20: Warning • 0x30: Error
• Validity	Validity of the process data	1 byte	• 0x00: Valid • 0x40: Invalid
• Source	IO-Link Event Qualifier: Event source	1 byte	• 0x00: IO-Link device • 0xFF: IO-Link master
• Event Code	IO-Link event code (bytes are swapped!)	2 bytes	→ IO-Link specification

Substructure: iolinkmaster/port[x]/iolinkdevice (x: 1…4)

Available data points:

Name	Description	Value range	Access
../iolinkevent	IO-Link event	See note	ro [1] [2]

[1] Read only

[2] Parameter only available if operating mode pin 4 (US) = IO-Link and IO-Link device is connected to the port

9.2.20 Gateway: Set the application tag

Substructure: devicetag

Available data points:

Name	Description	Value range	Access
../applicationtag	Bezeichnung des Geräts (Application Tag)	e.g. “factory 2 plant 1”	rw [1]

[1] Read and write

32 bytes are available on the device for storing the applicationtag parameter. If the memory range is exceeded, the device will abort the write process (diagnostic code 400).

▶ When writing the applicationtag parameter, note the different memory requirements of the individual UTF-8 characters (characters 0-127: 1 byte per character; characters >127: more than 1 byte per character).

9.2.21 Gateway: Update firmware

Substructure: firmware

Available data points:

Name	Description	Value range	Access
../version	Firmware version	AL1x2x_cn_ei_v3.1.95	ro [1]
../type	Software type	firmware	ro [1]
../container	Structure for firmware (BLOB)	-	wo
../container/maxsize	Container size (in bytes)	e.g. 4194304	ro [1]
../container/chunksize	Size of a data segment (in bytes)	e.g. 4096	ro [1]
../container/size	Size of firmware file in container (in bytes)	e.g. 634523	ro [1]

[1] Read only

Applicable services:

Name	Description
../install	Install firmware
../container/stream_set	Transfer an individual data segment
../container/start_stream_set	Start sequential transmission of several data segments

ifm recommends using the IoT Core Visualizer (→ IoT Core Visualizer 64) to update the firmware.

9.2.22 Gateway: Reading status and diagnostic information

Substructure: processdatamaster

Available data points:

9.2.23 Gateway: Reading device information

Substructure: deviceinfo

Available data points:

Additional information about the can be read with the service getidentity (→ Service: getidentity 74).

9.2.24 Gateway: Resetting, rebooting and localising the device

Substructure: firmware

Applicable services:

Name	Description
../factoryreset	Reset device to factory settings
../reboot	Restart the device.
../signal	Trigger the flashing of the status LEDs

9.2.25 Notifications

The ifm IoT-Core offers the possibility to send notifications. A notification can contain the current values of individual or multiple process data.

Notifications can be triggered either time-controlled or event-controlled.

Notifications can be transmitted using the following protocols:

- HTTP (Hypertext Transfer Protocol)
- MQTT (Message Queuing Telemetry Transport)
- TCP (Transmission Control Protocol)
- WS (WebSocket)

Notifications can be transmitted in the following formats:

- JSON
- CSV

The activity duration of a notification can be set:

- once: Notification is only active once and is then deleted
- uptime: Notification is active until the next restart of the unit and is then deleted
- lifetime: Notification is permanently active

Notifications are set up with the subscribe service.

Active notifications can be changed with the subscribe service.

All active notifications can be displayed with the getsubscriberlist service (→ Service: getsubscriberlist 🗋 75).

Information about an active notification can be displayed with the getsubscriptioninfo service (→ Service: getsubscriptioninfo 🗋 75).

Active notifications can be unsubscribed using the unsubscribe service.

9.2.25.1 Event-controlled notifications

All elements of the ifm IoT Core with a sub-element of the type `event` can be used as triggers for event-triggered notifications.

Name	Description
../datachanged	Node for displaying value changes of the parent data node
../eventcollection	Node for displaying value changes of multiple data nodes of the IoT Core
../treechanged	Node for displaying structural changes in the IoT Core

Applicable services:

Name	Description
../subscribe	Subscribe to notifications

Name	Description
../unsubscribe	Unsubscribe from notifications
../getsubscriptioninfo	Display information about notifications

9.2.25.2 Time-controlled notifications

The ifm IoT Core offers 2 timers that can be used as triggers for time-triggered notifications.

Name	Description
../timer[1]/counter/datachanged	Counter of timer 1
../timer[2]/counter/datachanged	Counter of timer 2

The interval time of the timers can be set. Each counting pulse triggers a notification.

Applicable services:

Name	Description
../subscribe	Subscribe to notifications
../unsubscribe	Unsubscribe from notifications
../getsubscriptioninfo	Display information about notifications

9.2.25.3 Example: Subscribing to notifications

Task: Every 0.5 seconds, the current values of the following parameters are to be sent regularly to a network server with the IP address 192.168.0.4/temp.

- Cyclic IO-Link input data of the IO-Link device at IO-Link port 2
- Operating temperature of the IO-Link master.

The following options are additionally available:

via WebSockets (ws://): Example: Using WebSockets (→ 🗋 63)

via MQTT (mqtt://): Example: Configure and activate MQTT command channel (→ 🗋 60)

Solution:

▶ Subscribe to the required data using the subscribe service.

- Request:

```
{
  "code":"request",
  "cid":4711,
  "adr":"/timer[1]/counter/datachanged/subscribe",
  "data":{
    "callback":"http://192.168.0.4:80/temp",
    "datatosend":[
      "/iolinkmaster/port[2]/iolinkdevice/pdin",
      "/processdatamaster/temperature"]
  }
}
```

▶ Set the timer to 500 ms.

- Request:

```
{
  "code":"request",
  "cid":4712,
  "adr":"/timer[1]/interval/setdata",
  "data":{
    "newvalue":500
  }
}
```

- Response:

```
{
  "cid":4712,
  "code":200
}
```

- Notification (Format: JSON)

```
{
  "code":"event",
  "cid":4711,
  "adr":"",
  "data":{
    "eventno":"6317",
    "srcurl":"/timer[1]/counter/datachanged",
    "payload":{
      "/timer[1]/counter":{"code":200,"data":1},
      "/processdatamaster/temperature":{"code":200,"data":39},
      "/iolinkmaster/port[2]/iolinkdevice/pdin":{"code":200,"data":"03B0"}
    }
  }
}
```

9.2.25.4 Example: Changing a notification

Task: The existing sbscription is to be changed (→ Example: Subscribing to notifications 55). Instead of the temperature of the IO-Link master, the operating voltage applied is to be transmitted.

Solution: Overwrite the existing subscription. For this purpose, the parameter values for "cid" and "callback" in the request must be the same as those of the existing subscription.

- Request:

```
{
  "code":"request",
  "cid":4711,
  "adr":"/timer[1]/counter/datachanged/subscribe",
  "data":{
    "callback":"http://192.168.0.4:80/temp",
    "datatosend":[
      "/iolinkmaster/port[2]/iolinkdevice/pdin",
      "/processdatamaster/voltage"]
  }
}
```

9.2.25.5 Example: Subscribing to a notification in CSV format

Task: Every 2 seconds, the current values of the following parameters are to be sent to a network server with the IP address 192.168.0.4

- Cyclic IO-Link input data of the IO-Link device at port 2
- Operating temperature of the IO-Link master.

The data should be transmitted in CSV format (comma separator).

Solution:

▶ Use the subscribe service to subscribe to the required data and set the output format to "csv0".

Data in CSV format can only be sent via TCP connection.

- Request:

```
{
  "code":"request",
  "cid": 1,
  "adr":"/timer[1]/counter/datachanged/subscribe",
  "callback":"tcp://192.168.50.59:1883/topic",
  "codec":"csv0",
  "data":{
    "datatosend":[
      "/iolinkmaster/port[2]/iolinkdevice/pdin",
      "/processdatamaster/temperature"]
  }
}
```

▶ Set the interval of the timer to 2 seconds:

- Request:

```
{
  "code":"request",
  "cid":4712,
  "adr":"/timer[1]/interval/setdata",
  "data":{"newvalue":2000}
}
```

The cyclically sent notification has the following structure:

```
/timer[1]/counter/datachanged,6317,200,1,200,39,200,03B0
```

9.2.25.6 Example: Unsubscribing from a notification

Task: The existing subscription Example: Subscribing to notifications (→ 🗋 55) is to be deleted.

Solution: Use the unsubscribe service to delete the subscription. For this purpose, the value of the parameter "callback" in the request must be equal to the value of the existing subscription.

- Request:

```
{
  "code":"request",
  "cid":4711,
  "adr":"/timer[1]/counter/datachanged/unsubscribe",
  "data":{
    "callback":"http://192.168.0.4:80/temp"
  }
}
```

9.2.25.7 Example: checking a notification

Task: Display information about the existing subscription Example: Subscribing to notifications (→ 🗋 55).

Solution: Use the service getsubscriptioninfo and the parameter values cid, "adr" and "callback" of the existing subscription to retrieve the information.

- Request:

```
{
  "code":"request",
  "cid":4711,
  "adr":"/timer[1]/counter/datachanged/getsubscriptioninfo",
  "data":{
    "callback":"http://192.168.0.4:80/temp"
  }
}
```

- Response:

```
{
  "code":"request",
  "cid": 4711,
  "data":{
    "callback":"http://192.168.0.4:80/temp",
    "datatosend":[
      "/iolinkmaster/port[2]/iolinkdevice/productname",
      "/iolinkmaster/port[2]/iolinkdevice/pdin",
      "/processdatamaster/temperature"]
  }
}
```

9.2.25.8 MQTT support

The ifm IoT Core supports the MQTT protocol. MQTT lets a client communicate with the ifm IoT Core via a broker to request and receive data. The ifm IoT Core can publish data to an MQTT broker.

▶ Establish MQTT connections only on IoT port X23 of the device.

To enable MQTT communication, the user needs to configure the MQTT command channel. The configuration consists of the following sub-steps:

▶ Check that the MQTT broker can be reached.

▶ Check that the requested port of the MQTT broker is open.

▶ Activate the MQTT command channel.

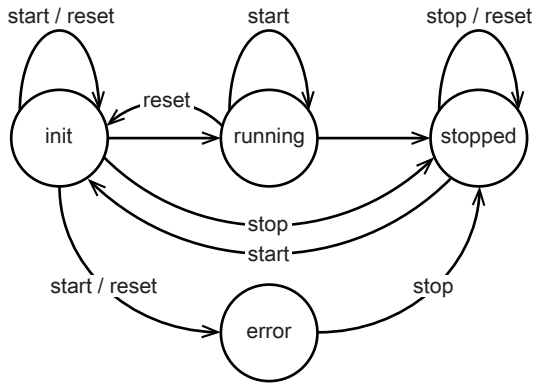
▶ Configure the MQTT command channel.

▶ Configure the MQTT connection.

▷ The MQTT connection is configured and activated.

Configuring the MQTT connection

The following status diagram shows how the `start`, `stop` and `reset` services influence the current status of an MQTT connection:



After successful initialisation in the [init] state, the connection automatically changes to the [running] state.

The connection automatically assumes the [error] state if at least one of the following events occurs:

- no MQTT broker can be reached

Maximum number of MQTT broker: 1

Maximum number of simultaneous MQTT connections: 3

Substructure: connections/mqttConnection

Available data points:

Name	Description	Value range	Access
../type	Type of the connection (MQTT)	mqtt: MQTT connection	ro [1]
../status	Status of the MQTT connection	• init: [init] state – initialisation • stopped: [stopped] state – connection stopped • running: [running] state – connection running • error: [error] state	ro [1]
../status/preset	Presetting of the status of the MQTT connection	• running: [running] state (default)	ro [1]
../MQTTSetup	Substructure for general MQTT settings		
../MQTTSetup/QoS	Quality of Service (QoS) of the MQTT connection	• 0: QoS level 0 - PUBLISH (without confirmation) (default) • 1: QoS level 1 - PUBLISH > PUBREC (single confirmation) • 2: QoS level 2 - PUBLISH > PUBREC > PUBREL > PUBCOMP (double confirmation)	rw [2]
../MQTTSetup/version	MQTT version	e.g. 3.1.1	ro [1]

[1] Read only

[2] Read and write

Applicable services:

Name	Description
../status/start	Activate MQTT.
../status/stop	Deactivate MQTT.
../status/reset	Reset MQTT.

Configuring the MQTT command channel

Make sure that the MQTT broker can be reached and that the selected port of the MQTT broker is released for data transfer.

The wildcards “+” and “#” are not supported in topic names.

Substructure: connections/mqttConnection/mqttCmdChannel

Available data points:

Name	Description	Value range	Access
../type	Type of the command channel	• mqtt: MQTT command channel (default)	ro [1]
../status	Status of the command channel	• init: [init] state • stopped: [stopped] state • running: [running] state (default) • error: [error] state	ro [1]
../status/preset	Preset channel state	• running: RUN state (default)	ro [1]
../mqttCmdChannelSetup	Substructure for settings of the command channel	--	
../mqttCmdChannelSetup/brokerIP	IP address of the MQTT broker	e.g. 3.69.1.9	rw [2]
../mqttCmdChannelSetup/brokerPort	Port number of the MQTT broker	e.g. 1883	rw [2]
../mqttCmdChannelSetup/cmdTopic	Designation of the MQTT command topic	e.g. reqTopic	rw [2]
../mqttCmdChannelSetup/defaultReplyTopic	Designation of the MQTT standard response topic	e.g. respTopic	rw [2]

[1] Read only

[2] Read and write

Applicable services:

Name	Description
../status/start	Start the MQTT command channel
../status/stop	Stop the MQTT command channel
../status/reset	Reseit the MQTT command channel

Example: Configure and activate MQTT command channel

Task: Configuring and activating the MQTT command channel (IP address of the MQTT broker): 192.168.82.100, port: 1883, command topic: reqTopic, standard response topic: respTopic, Quality of Service: Level 2)

Solution:

▶ Check whether MQTT broker can be reached and the port has been released.

▶ Set QoS level.

Request:

```
{
  "code":"request",
  "cid":1,
  "adr":"/connections/mqttConnection/MQTTSetup/cmdChannel/QoS/setdata"
  "data":{"newvalue":2}
```

}

▶ Activate MQTT connection

Request:

```
{
  "code":"request",
  "cid":1,
  "adr":"connections/mqttConnection/MQTTSetup/cmdChannel/Status/start"
}
```

▶ Set the IP address of the MQTT broker.

Request:

```
{
  "code":"request",
  "cid":2,
  "adr":"connections/mqttConnection/mqttCmdChannel/mqttCmdChannelSetup/
brokerIP/setdata",
  "data":{
    "newvalue":"192.168.82.100"
  }
}
```

▶ Set the port number of the MQTT broker.

Request:

```
{
  "code":"request",
  "cid":3,
  "adr":"connections/mqttConnection/mqttCmdChannel/mqttCmdChannelSetup/
brokerPort/setdata",
  "data":{
    "newvalue":"1883"
  }
}
```

▶ Set the command topic.

Request:

```
{
  "code":"request",
  "cid":4,
  "adr":"connections/mqttConnection/mqttCmdChannel/mqttCmdChannelSetup/
cmdTopic/setdata",
  "data":{
    "newvalue":"reqTopic"
  }
}
```

▶ Set standard response topic.

Request:

```
{
  "code":"request",
  "cid":5,
  "adr":"/connections/mqttConnection/mqttCmdChannel/mqttCmdChannelSetup/
defaultReplyTopic/setdata",
  "data":{
    "newvalue":"respTopic"
  }
}
```

Example: Publishing the temperature to an MQTT broker

Task: The temperature of the unit is to be published to an MQTT broker every 5 seconds (MQTT broker: 192.168.82.100, port: 1883, topic: deviceTemp).

Solution:

▶ Setting the interval of the timer

Request:

```
{
  "code":"request",
  "cid":1,
  "adr":"/timer[1]/interval/setdata",
  "data":{
    "newvalue":5000
  }
}
```

▶ Publishing the temperature to an MQTT broker

Request:

```
{
  "code":"request",
  "cid":2,
  "adr":"/timer[1]/counter/datachanged/subscribe",
  "data":{
    "callback":"mqtt://192.168.82.100:1883/deviceTemp",
    "datatosend":["processdatamaster/temperature"]
  }
}
```

Response:

```
{
  "cid":2,
  "code":200
}
```

9.2.25.9 WebSocket support

The ifm IoT-Core supports communication via WebSocket protocol. With WebSocket, the user can establish a full-duplex communication channel via a TCP connection.

WebSocket can be used for the following services:

- subscribe
- unsubscribe

Maximum number of simultaneous WebSocket connections: 8

Secure WebSocket connections (wss://) are not supported.

To transmit notifications via a WebSocket connection:

▶ Establish a WebSocket connection (e.g. "ws://192.168.0.55:80/mywebsocket")

- Option 1: without parameter "callback”

▶ Send a subscribe/unsubscribe request without "callback” parameter.

▷ ifm IoT-Core sends notifications about existing WebSocket connections.

- Option 2: with parameter "callback”

▶ Send subscribe/unsubscribe requests with "callback” parameter ("ws:///myTopic").

▷ ifm IoT-Core sends notifications about existing WebSocket connections to the `myTopic` topic.

Example: Using WebSockets

Task: The current values of the following parameters are to be sent regularly to the myTopic data sink via an existing WebSocket connection:

- Product name of the IO-Link device at IO-Link port 2
- Cyclic IO-Link input data of the IO-Link device at IO-Link port 2
- Operating temperature of the IO-Link master.

Solution: Subscribe to the required data using the subscribe service.

- Request:

```
{
  "code":"request",
  "cid":4711,
  "adr":"/timer[1]/counter/datachanged/subscribe",
  "data":{
    "callback":"ws:///myTopic",
    "datatosend":[
      "/iolinkmaster/port[2]/iolinkdevice/productname",
      "/iolinkmaster/port[2]/iolinkdevice/pdin",
      "/processdatamaster/temperature"]
  }
}
```

If the notifications are to be transmitted via the existing WebSocket connection, but without a special data sink, the callback parameter is not required.

- Request:

```
{
  "code":"request",
  "cid":4711,
  "adr":"/timer[1]/counter/datachanged/subscribe",
  "data":{
    "datatosend":[
      "/iolinkmaster/port[2]/iolinkdevice/productname",
      "/iolinkmaster/port[2]/iolinkdevice/pdin",
      "/processdatamaster/temperature"]
  }
}
```

9.3 IoT Core Visualizer

The IoT Core Visualizer provides a graphical user interface to access the functions of the ifm IoT Core.

9.3.1 Starting the IoT-Core Visualizer

To start the IoT-Core Visualizer:

Requirements:

✓ The IoT interface is configured.

▶ Start the web browser.

▶ Go to the following URL: http://<ip-address>/web/subscribe (e. g. `http://192.168.82.100/web/subscribe`)

▷ The web browser displays the start page of the IoT-Core Visualizer.

The navigation menu gives access to the following functions:

- [Notification]: Managing notifications (→ 🗋 65)
- [Elements]: Searching for elements of the IoT Core (→ 🗋 66)
- [Parameter]: Configuring the IO-Link master (→ 🗋 67)
- [Processdata]: Accessing process data (→ 🗋 68)
- [Update]: Update firmware (→ 🗋 69)

9.3.2 Managing notifications

The [Notification] menu page gives access to the following functions:

- Creating notifications
- Showing active notifications
- Deleting notifications (single, all)

Requirements:

✓ IoT Core Visualizer has been started.

▶ Select the [Notification] menu.

▷ Menu page for managing notifications appears.

▷ Table shows all active notifications.

9.3.2.1 Creating a new notification

A wizard is used to register new notifications.

Requirements:

✓ The [Notification] menu page is open.

▶ Click on **+** on the right side of the table.

▷ The wizard for creating notifications appears.

▶ Use the wizard to enter the required notification parameters step by step.

▷ The wizard generates a notification.

▷ The created notification is displayed in the table.

▶ For cyclical notifications via timer[1] or timer[2], set the interval time of the corresponding timer.

9.3.2.2 Deleting a notification

To delete an active IODD:

Requirements:

✓ The [Notification] menu page is open

✓ At least one notification is active.

▶ Click on the x symbol in the [Unsubscribe] column.

▷ The selected notification will be deleted (unsubscribe).

9.3.3 Searching for elements of the IoT Core

The [Elements] menu page allows you to search the IoT Core tree for elements with specific properties and output the results.

The following properties can be searched for:

- [identifier]: Name of the element
- [profile]: Profile of the element
- [type]: Type of the element

Requirements:

✓ IoT Core Visualizer has been started.

✓ The [Elements] menu is active.

▶ Select the search criteria for the required element in the selection lists [identifier], [profile] and [type].

▶ Click on [Search for…].

▷ IoT Core Visualizer searches the device description for elements with selected search criteria.

▷ The result list shows all the elements found.

9.3.4 Configuring the IO-Link master

The [Parameter] menu page allows to configure the IO-Link master.

Available options:

- Reading and writing individual parameters
- Backup and restore the current configuration of the machine.

Requirements:

✓ IoT Core Visualizer has been started.

▶ Select the [Parameter] menu.

▷ The menu page shows the available parameters of the IO-Link master.

▷ Current parameter values are displayed.

▶ Optional: Click on ↻ next to an element to manually update the process value.

To change a parameter:

▶ Navigate to the desired parameter in the device description.

▶ Changing the parameter value

▶ Click on ✎ to save the change on the IO-Link master.

▷ The changed parameter value is active.

▶ Optional: Repeat the procedure to change further parameter values.

9.3.5 Accessing process data

The [Processdata] menu page makes it possible to read and write the process data of the IO-Link master and the connected IO-Link devices

Requirements:

✓ IoT Core Visualizer has been started.

▶ Select the [Processdata] menu.

▷ Menu page shows the substructures of the device description that contain process data and events.

▷ The current process values are displayed.

▶ Optional: Activate the [Polling] option and change the update interval.

▷ The process values will be updated with the set interval.

▶ Optional: Click on ↻ next to an element to manually update the process value.

To change the value of a process date:

▶ Navigate to the required process date in the device description.

▶ Change the process value.

▶ Click on ✎ to save the change on the IO-Link master.

▷ Changes are saved on the IO-Link master.

▷ The changed process value is active.

▶ Optional: Repeat the procedure to change further process values.

9.3.6 Update firmware

The [Update] menu page allows you to update the firmware of the device:

Requirements:

✓ IoT Core Visualizer has been started.

✓ New firmware has been downloaded. documentation.ifm.com

▶ Select the [Update] menu.

▷ Menu page shows information about the current firmware version.

▶ Click on [Load software file] and select the new firmware file (*.bin).

▶ Click on [Update] to start the update process.

▷ The firmware of the device is updated.

▷ The progress of the update process is displayed.

▷ After successful update: The device reboots automatically.

9.4 EtherNet/IP

9.4.1 Note: Startup package

ifm electronic provides Startup Packages for the integration of the device in EtherNet/IP environments with controllers from different manufacturers.

The Startup Packages can be downloaded from the ifm website: documentation.ifm.com

10 Maintenance, repair and disposal

The operation of the unit is maintenance-free.

▶ Dispose of the device in an environmentally friendly way in accordance with the applicable national regulations when it is no longer used.

10.1 Cleaning the housing surface

Clean the surface of the device when necessary.

▶ Disconnect the device.

▶ Clean the device from dirt using a soft, chemically untreated and dry cloth.

▶ In case of severe soiling, use a cloth moistened with water.

▶ Do not use any caustic cleaning agents for this!

10.2 Update firmware

The firmware of the device can be updated using the following methods:

- ifm IoT Core Visualizer: Update firmware (→ 🗋 69)
- ifm moneo: Updating the firmware (→ 🗋 29)

11 Appendix

11.1 ifm IoT Core

11.1.1 Profiles

Profile	Description
blob	Binary Large Object
deviceinfo	Identification information of a device
devicetag	Device-specific identification
iolinkdevice_full	IO-Link device
iolinkmaster	IO-Link master
network	Network
parameter	Parameter
processdata	Process data
service	Service
software	Software
software/uploadable-software	upgradeable software
timer	Counter

11.1.2 Types

Type	Description
data	Data point
device	Root element representing a device
event	Event that can be triggered by the firmware and sends notifications
service	Service that can be addressed from the network
structure	Structural element (e.g. a folder in the file system)

11.1.3 Services

11.1.3.1 Service: factoryreset

Name: `factoryreset`

Description: The service sets the parameters of the device to the factory settings.

Request (“data” field): none

Response (“data” field): none

11.1.3.2 Service: getblobdata

Name: `getblobdata`

Description: The service reads a Binary Large Object (blob).

Request (“data” field):

Parameter	Mandatory field	Data type	Description
Pos	Mandatory	NUMBER	Byte position
length	Mandatory	NUMBER	Size of the object (number of bytes)

Response (“data” field):

Parameter	Mandatory field	Data type	Description
data	Mandatory	STRING	Data to be decoded (BASE64-encoded)
crc	Optional	HEX STRING	CRC of the data after decoding
md5	Optional	HEX STRING	MD5 checksum of the data after decoding

11.1.3.3 Service: getdata

Name: `getdata`

Description: The service reads the value of a data point and provides it.

Request (“data” field): none

Response (“data” field):

Parameter	Mandatory field	Data type	Description
value	Mandatory	STRING	Value of the data point

11.1.3.4 Service: getdatamulti

Name: `getdatamulti`

Description: The service sequentially reads the values of multiple data points and outputs them. The value and a diagnostic code are output for each data point.

Request (“data” field):

Parameter	Mandatory field	Data type	Description
datatosend	Mandatory	ARRAY OF STRINGS	List of data points to be requested; data points must support the getdata service ("datatosend”:[“url1”, “url2”,..., “urlx”])

Response (“data” field):

Parameter	Mandatory field	Data type	Description
url	Mandatory	STRING	Data point that was queried
code	Mandatory	INT	Diagnostic code of the request
data	Mandatory	STRING	Value of the data point

11.1.3.5 Service: getelementinfo

Name: `getelementinfo`

Description: The service reads the properties of an element of the IoT tree.

Request ("data" field):

Parameter	Mandatory field	Data type	Description
adr	mandatory	STRING	URL of the element whose proerties are to be changed

Return ("data" field):

Parameter	Mandatory field	Data type	Description
identifier	mandatory	STRING	Identifier of the element
type	mandatory	STRING	Type of the element
format	optional	JSON object	Format of the data or of the service content
uid	optional	STRING	
profiles	optional	JSON-ARRAY	Element profiles
hash	optional	STRING	

11.1.3.6 Service: getidentity

Name: `getidentity`

Description: The service reads device information and outputs it.

Request (field „data“): keine

Response (field „data“):

Parameter	Mandatory field	Data type	Description
iot		device	Device description as JSON object
iot.name	mandatory	STRING	Type of the element
iot.uid	optional	STRING	
iot.version	mandatory	STRING	
iot.catalogue	optional	ARRAY OF OBJECTS	
iot.deviceclass	optional	ARRAY OF STRING	Device class
iot.serverlist	optional	ARRAY OF OBJECTS	
device	optional		Article nummer
device.serialnumber	optional		Serial number
device.hwrevision	optional		Hardware version
device.swrevision	optional		Software version
device.custom	optional		

11.1.3.7 Service: getsubscriberlist

Name: `getsubscriberlist`

Description: The service provides a list of all active subscriptions.

Request (“data” field): none

Response (“data” field):

Parameter	Mandatory field	Data type	Description
adr	Mandatory	STRING	Notification trigger
datatosend	Mandatory	ARRAY OF STRINGS	List with URLs of the data elements; URLs are comma separated
cid	Mandatory	STRING	ID of the active notification
callbackurl	Mandatory	STRING	Destination address for the notifications
duration	Mandatory	STRING	Activity duration

11.1.3.8 Service: getsubscriptioninfo

Name: `getsubscriptioninfo`

Description: The service provides information about an active notification (subscribe). The following parameters of the active notification are to be used for the query:

- `cid` (e.g. 4711)
- `adr` (e.g. timer[1]/counter/datachanged)
- `callback` (e.g. http://192.168.82.121:8080/topic)

Request ("data" field):

Parameter	Mandatory field	Data type	Description
callback	mandatory	STRING	Destination address of the notifications; complete URL (e.g. http://ipaddress:port/path)

Return ("data" field):

Parameter	Mandatory field	Data type	Description
subscription	mandatory	BOOL	Status of the transferred parameters of the notification • FALSE: Parameter incorrect • TRUE: Parameter correct; Notification found
datatosend	mandatory	STRING	List with URLs of the data elements; URLs are comma separated
cid	mandatory	STRING	ID of the active notification
callbackurl	mandatory	STRING	Destination address of the notifications

11.1.3.9 Service: gettree

Name: `gettree`

Description: The service reads the device description of the unit and outputs it as a JSON object. The output can be limited to a subtree of the device description.

Request (“data” field):

Parameter	Mandatory field	Data type	Description
adr	Optional	STRING	Root element of the subtree

Parameter	Mandatory field	Data type	Description
level	Optional	STRING	Max. level up to which the subtree is output • no entry: all levels will be displayed • 0: do not display sub-elements (“subs”) • 1: display sub-elements • 2: display sub-elements up to the 2nd level • 3: display sub-elements up to the 3rd level ... • 20: display sub-elements up to the 20th level

Response (“data” field):

Parameter	Mandatory field	Data type	Description
identifier	Mandatory	STRING	Identifier of the root element
type	Mandatory	STRING	Type of the element
format	Optional	JSON object	Format of the data content
uid	Optional	STRING	
profiles	Optional	JSON array	
subs	Mandatory	JSON array	Sub-elements
hash	Optional	STRING	

11.1.3.10 Service: install

Name: `install`

Description: The service installs the firmware stored in a memory area of the unit.

Request ("data" field): none

Return ("data" field): none

11.1.3.11 Service: iolreadacyclic

Service: `iolreadacyclic`

Description: The service acyclically reads the parameter value of an IO-Link device. It is accessed via IO-Link index and subindex.

Request ("data" field):

Parameter	Mandatory field	Data type	Description
index	mandatory	NUMBER	IO-Link index of the parameter
subindex	mandatory	NUMBER	IO-Link subindex of the parameter

Return ("data" field):

Parameter	Mandatory field	Data type	Description
value	mandatory	STRING	Parameter value (value in hexadecimal format)

11.1.3.12 Service: iolwriteacyclic

Name: `iolwriteacyclic`

Description: The service acyclically writes the parameter value of an IO-Link device. It is accessed via IO-Link index and subindex.

Request ("data" field):

Parameter	Mandatory field	Data type	Description
index	mandatory	NUMBER	IO-Link index of the parameter
subindex	mandatory	NUMBER	IO-Link subindex of the parameter
value	mandatory	STRING	Parameter value (value in hexadecimal format)

Return ("data" field): none

11.1.3.13 Service: querytree

Name: `querytree`

Description: The service searches a device tree for the criteria `profile`, `type` and `identifier` and outputs a list with the URLs of the elements found. At least one of the search criteria must be specified. The service can only be executed on the root node of the unit.

Request (“data” field):

Parameter	Mandatory field	Data type	Description
profile	Optional	STRING	Profile of the requested element
type	Optional	STRING	Type of the requested element
identifier	Optional	STRING	Name of the requested element

Response (“data” field): none

Parameter	Mandatory field	Data type	Description
urlList	Mandatory	ARRAY	Array with URLs of the found elements; URLs are separated by commas

11.1.3.14 Service: reboot

Name: `reboot`

Description: The service reboots the device.

Request (“data” field): none

Response (“data” field): none

11.1.3.15 Service: reset

Name: `reset`

Description: The service resets a connection to the initialisation state.

Request (“data” field): none

Response (“data” field): none

11.1.3.16 Service: setblock

Name: `setblock`

Description: The service simultaneously sets the values of multiple data points of a structure.

Request (“data” field):

Parameter	Mandatory field	Data type	Description
datatoset	Mandatory	ARRAY OF OBJECTS	List of data points and their new values; Data points must support the `setdata` service

Parameter	Mandatory field	Data type	Description
consistent	Optional	BOOL	Response within a certain time

Response (“data” field): none

11.1.3.17 Service: setdata

Name: `setdata`

Description: The service sets the value of a data point.

Request (“data” field):

Parameter	Mandatory field	Data type	Description
newvalue	Mandatory	STRING	New value of the data point
duration	Optional	STRING	Duration of value storage • lifetime: value is saved with IoT Core; value remains valid even after restart of the device • uptime: value is saved until the next restart of the device

Response (“data” field): none

11.1.3.18 Service: signal

Name: `signal`

Description: The service triggers the flashing of the status LEDs of the unit.

Request (“data” field): none

Response (“data” field): none

11.1.3.19 Service: start

Name: `start`

Description: The service starts a function (e.g. connection, timer).

Request (“data” field): none

Response (“data” field): none

11.1.3.20 Service: start_stream_set

Name: `start_stream_set`

Description: The service starts the sequential transmission of several data fragments.

Request (“data” field):

Parameter	Mandatory field	Data type	Description
size	Mandatory	STRING	Overall length of the data to be transmitted (number of bytes)

Response (“data” field): none

11.1.3.21 Service: stop

Name: `stop`

Description: The service stops a function (e.g. connection, timer).

Request (“data” field): none

Response (“data” field): none

11.1.3.22 Service: stream_set

Name: `stream_set`

Description: The service transfers a data segment.

Request (“data” field):

Parameter	Mandatory field	Data type	Description
value	Mandatory	BIN (BASE64)	Segment of the binary data (BASE64-encoded)

Response (“data” field): none

11.1.3.23 Service: validation_useconnecteddevice

Name: `validation_useconnecteddevice`

Description: The service checks whether the device ID and the vendor ID of the connected IO-Link device match the data points `../validation_vendorid` and `../validation_deviceid` .

Request ("data" field): none

Return ("data" field): none

11.2 EtherNet/IP

11.2.1 Parameters

11.2.1.1 Configuration Assembly (Instance 199)

Byte (Offset)	Bit							
	7	6	5	4	3	2	1	0
0	Communication profile							
1	Port Process Data Size							
2…13	Port X01: Port Configuration (→ Mapping: Port Configuration 81)							
14…25	Port X02: Port Configuration (→ Mapping: Port Configuration 81)							
26…37	Port X03: Port Configuration (→ Mapping: Port Configuration 81)							
38…49	Port X04: Port Configuration (→ Mapping: Port Configuration 81)							
50…61	Port X05: Port Configuration (→ Mapping: Port Configuration 81)							
62…73	Port X06: Port Configuration (→ Mapping: Port Configuration 81)							
74…85	Port X07: Port Configuration (→ Mapping: Port Configuration 81)							
86…97	Port X08: Port Configuration (→ Mapping: Port Configuration 81)							

Legend:

• Communication profile	The access rights to the parameters, process data and events/diagnostic messages of the IO-Link master and the connected IO-Link devices	1 BYTE	• 0x00: EtherNet/IP + LineRecorder • 0x01: EtherNet/IP + LineRecorder (ro) • 0x02: EtherNet/IP only • 0x03: Keep setting (Default)
• Port Process Data Size	Length of the process data (inputs and outputs)	1 BYTE	• 0x00: 2 bytes – Input Assemby: 206 bytes – Output Assembly: 62 bytes • 0x01: 4 bytes – Input Assemby: 222 bytes – Output Assembly: 78 bytes • 0x02: 8 bytes – Input Assemby: 254 bytes – Output Assembly: 110 bytes • 0x03: 16 bytes – Input Assemby: 318 bytes – Output Assembly: 174 bytes • 0x04: 32 bytes – Input Assemby: 446 bytes – Output Assembly: 302 bytes

Mapping: Port Configuration

Byte (Offset)	Content
n	Port Mode
n+1	Port Cycle Time
n+2	Swap
n+3	Validation / Data Storage
n+4	Vendor ID (LSB)
n+5	Vendor ID (MSB)
n+6	Device ID (LSB)
n+7	Device ID
n+8	Device ID (MSB)
n+9	reserved
n+10	Failsafe Mode – Pin 4 (IO-Link)
n+11	Failsafe Mode – Pin 4 (DO)

Legend:

• Mode	Operating mode of the port (pin 4)	1 BYTE	• 0x00: Disabled • 0x01: digital input (pin 4) • 0x02: digital output (pin 4)] • 0x03: IO-Link (pin 4)
• Port Cycle Time	Cycle time of the data transmission between the IO-Link master and the IO-Link device	1 BYTE	• 0x00: As fast as possible • 0x01: 2 ms • 0x02: 4 ms • 0x03: 8 ms • 0x04: 16 ms • 0x05: 32 ms • 0x06: 64 ms • 0x07: 128 ms
• Swap	Swap arrangement of bytes in process data (EtherNet/IP uses little-endian format (Intel), IO-Link uses big-endian format (Motorola))	1 BYTE	• 0x00: Enabled • 0x01: Disabled
• Validation / Data Storage	Validation mode / data storage mode	1 BYTE	• 0x00: No device check and clear • 0x01: Type compatible V1.0 device • 0x02: Type compatible V1.1 device • 0x03: Type compatible V1.1 device with Backup + Restore • 0x04: Type compatible V1.1 device with Restore
• Vendor ID	Vendor ID of the manufacturer of the IO-Link device Vendor ID = 0x1234 • Vendor ID (MSB): 0x12 • Vendor ID (LSB): 0x34	2 BYTE	• 0x00…0x7FFF
• Device ID	Device ID of the IO-Link device Device ID = 0x123456 • Device ID (MSB): 0x12 • Device ID 0x34 • Device ID (LSB): 0x56	3 BYTE	• 0x000000…0xFFFFFF
• Failsafe Mode – Pin 4 (IO-Link)	Fail-safe mode for output data of the port if the EtherNet/IP connection is interrupted (only valid for port mode: IO-Link)	1 BYTE	• 0x00: No failsafe • 0x01: Failsafe Reset Value • 0x02: Failsafe Old Value • 0x03: Failsafe with Pattern

• Failsafe Mode – Pin 4 (DO)	Fail-safe value for output data of the port if the EtherNet/IP connection is interrupted (only valid for port mode: Digital Output (DO)	1 BYTE	• 0x00: Failsafe Reset Value • 0x01: Failsafe Old Value • 0x02: Failsafe Set Value

11.2.2 Cyclic data

11.2.2.1 Input Assembly (Instance 100)

Byte (Offset)	Bit							
	7	6	5	4	3	2	1	0
0…1	Digital Input (→ Mapping: Digital Input 86)							
2…3	Status Information (→ Mapping: Status Information 87)							
4…45	Acyclic Command Channel: Response (→ Response channel 94)							
46…47	Port X01: Mapping: Port Qualifier Information (PQI) (→ 88)							
48…63	Port X01: Mapping: IO-Link information + events (→ 88)							
64…65	Port X02: Mapping: Port Qualifier Information (PQI) (→ 88)							
66…81	Port X02: Mapping: IO-Link information + events (→ 88)							
82…83	Port X03: Mapping: Port Qualifier Information (PQI) (→ 88)							
84…99	Port X03: Mapping: IO-Link information + events (→ 88)							
100…101	Port X04: Mapping: Port Qualifier Information (PQI) (→ 88)							
102…117	Port X04: Mapping: IO-Link information + events (→ 88)							
118	Port X01: Input Data IO-Link (n Bytes) [1]							
118+n	Port X02: Input Data IO-Link (n Bytes) [1]							
118+2n	Port X03: Input Data IO-Link (n Bytes) [1]							
118+3n	Port X04: Input Data IO-Link (n Bytes) [1]							

[1] n: {2, 4, 8, 16, 32}; n is determined by the parameter [Port Process Data Size] in the configuration assembly (→ Configuration Assembly (Instance 199) 80)

11.2.2.2 Input Assembly (Instance 101)

Byte (Offset)	Bit							
	7	6	5	4	3	2	1	0
0…1	Digital Input (→ Mapping: Digital Input 86)							
2…3	Status Information (→ Mapping: Status Information 87)							
4…45	Acyclic Command Channel: Response (→ Response channel 94)							
46…47	Port X01: Port Qualifier Information (→ Mapping: Port Qualifier Information (PQI) 88)							
48…49	Port X02: Port Qualifier Information (→ Mapping: Port Qualifier Information (PQI) 88)							
50…51	Port X03: Port Qualifier Information (→ Mapping: Port Qualifier Information (PQI) 88)							
52…53	Port X04: Port Qualifier Information (→ Mapping: Port Qualifier Information (PQI) 88)							
54	Port X01: Input Data IO-Link (n Bytes) [1]							
54+n	Port X02: Input Data IO-Link (n Bytes) [1]							
54+2n	Port X03: Input Data IO-Link (n Bytes) [1]							
54+3n	Port X04: Input Data IO-Link (n Bytes) [1]							

[1] n: {2, 4, 8, 16, 32}; n is determined by the parameter [Port Process Data Size] in the configuration assembly (→ Configuration Assembly (Instance 199) 80)

11.2.2.3 Input Assembly (Instance 102)

Byte (Offset)	Bit							
	7	6	5	4	3	2	1	0
0…1	Digital Input (→ Mapping: Digital Input 86)							
2…3	Status Information (→ Mapping: Status Information 87)							
4…5	Port X01: Port Qualifier Information (→ Mapping: Port Qualifier Information (PQI) 88)							
6…7	Port X02: Port Qualifier Information (→ Mapping: Port Qualifier Information (PQI) 88)							
8…9	Port X03: Port Qualifier Information (→ Mapping: Port Qualifier Information (PQI) 88)							
10…11	Port X04: Port Qualifier Information (→ Mapping: Port Qualifier Information (PQI) 88)							
12	Port X01: Input Data IO-Link (n Bytes) [1]							
12+n	Port X02: Input Data IO-Link (n Bytes) [1]							
12+2n	Port X03: Input Data IO-Link (n Bytes) [1]							
12+3n	Port X04: Input Data IO-Link (n Bytes) [1]							

[1] n: {2, 4, 8, 16, 32}; n is determined by the parameter [Port Process Data Size] in the configuration assembly (→ Configuration Assembly (Instance 199) 80)

Mapping: Digital Input

Legend:

• DI Pin 4	Signal status of the digital input on Pin 4 of the port	1 BIT	• 0x0: LOW • 0x1: HIGH
• DI Pin 2	Signal status of the digital input on Pin 2 of the port	1 BIT	• 0x0: LOW • 0x1: HIGH

Mapping: Status Information

Legend:

• SC / OL	Short Circuit / Overload: Indication of a short circuit or of an overvoltage in the IO-Link port	1 BIT	• 0x0: No error • 0x1: Short circuit or overvoltage
• SENS PWR	Status of the voltage supply US	1 BIT	• 0x0: No error • 0x1: Excessive current on US (> 3.6 V)

Mapping: Port Qualifier Information (PQI)

Mapping: IO-Link information + events

Byte (Offset)	Bit							
	7	6	5	4	3	2	1	0
n	Vendor ID (LSB)							
n+1	Vendor ID (MSB)							
n+2	Device ID (LSB)							
n+3	Device ID							
n+4	Device ID (MSB)							
n+5	reserved							
n+6	Event 1: Mode		Event 1: Type		Event 1: Src	Event 1: Instance		
n+7	Event Code 1 (LSB)							
n+8	Event Code 1 (MSB)							
n+9	Event 2: Mode		Event 2: Type		Event 2: Src	Event 2: Instance		
n+10	Event 2 (LSB)							
n+11	Event 2 (MSB)							
n+12	Event 3: Mode		Event 3: Type		Event 3: Src	Event 3: Instance		
n+13	Event 3 (LSB)							
n+14	Event 3 (MSB)							
n+15	reserved							

Legend:

• VID	Vendor ID of the connected IO-Link device VID = 0x1234 • DID (MSB): 0x12 • DID (LSB): 0x34	2 BYTE	0x0000...0x7FFF
• DID	Device ID of the connected IO-Link device DID = 0x123456 • DID (MSB): 0x12 • DID: 0x34 • DID (LSB): 0x56	3 BYTE	0x000000...0xFFFFFF
• Event m: Mode	Mode Mode of the event	2 BIT	• 0x0: reserved • 0x1: One-time event • 0x2: Event has disappeared • 0x3: Event has appeared
• Event m: Type	Type: category of the event	2 BIT	• 0x0: reserved • 0x1: Notification • 0x2: Warning • 0x3: Error
• Event m: Src	Src: Source of the event	1 BIT	• 0x0: IO-Link device • 0x1: IO-Link master
• Event m: Instance	Instance: Trigger of the event	3 BIT	• 0x0: Unknown • 0x1...0x3: reserved • 0x4: Application • 0x5...0x7: reserved

• Event m: Code	Code Event code Code = 0x1234 • Code (MSB): 0x12 • Code (LSB): 0x34	2 BYTE	depending on the device (→ IODD description of the IO-Link device)

11.2.2.4 Output Assembly (Instance 150)

Byte (Offset)	Bit							
	7	6	5	4	3	2	1	0
2…3	reserved							
4…45	Acyclic Command Channel: Request (→ Request channel 93)							

11.2.2.5 Output Assembly (Instance 151)

Mapping: Digital output

Legend:

• DO Pin 4	Signal status of the digital output on pin 4 of the port	1 BIT	• 0x0: LOW • 0x1: HIGH

11.2.3 Acyclical data

11.2.3.1 Acyclic command channel

In the cyclic process data, command channels for the transmission of acyclic data is available.

Object	Content	Byte	Access
Output assembly	Request channel (EtherNet/IP controller ➞ IO-Link master) Request channel (→ 🗋 93)	4…45	rw [1]
Input assembly	Response channel (IO-Link master ➞ EtherNet/IP controller) Response channel (→ 🗋 94)	4…45	ro [2]

[1] Read and write

[2] Read only

Request channel

Byte (offset)	Bit							
	7	6	5	4	3	2	1	0
4	Port No. (LSB)							
5	Port No. (MSB)							
6	Index (LSB)							
7	Index (MSB)							
8	Subindex (LSB)							
9	Subindex (MSB)							
10	Trigger	Command ID						
11	Data Length							
12	Data (Byte 0)							
13	Data (Byte 1)							
…	…							
43	Data (Byte 31)							
44	reserved							
45	reserved							

Legend:

• Port No.	IO-Link Port Port No. 0x1234 • Port No. (MSB): 0x12 • Port No. (LSB): 0x34	1 WORD	• 0x0001: Port 1 • 0x0002: Port 2 • 0x0003: Port 3 • 0x0004: Port 4
• Index	Index of the ISDU object Index: 0x1234 • Index (MSB): 0x12 • Index (LSB): 0x34	1 WORD	0x0000…0xFFFF
• Subindex	Subindex of the ISDU object Subindex 0x1234 • Subindex (MSB): 0x12 • Subindex (LSB): 0x34	1 WORD	0x0000…0xFFFF
• Trigger	Control of the command execution	1 BIT	• 0x0: no action • 0x1: Execute command
• Command ID	Command number	7 BIT	• 0x01: Get • 0x02: Write
• Data Length	Number of bytes that contain relevant user data	1 BYTE	• 0x00: 0 bytes … • 0x20: 32 bytes
• Data (byte n)	User data (byte n)	1 BYTE	Pro byte: • 0x00…0xFF

Response channel

Byte (offset)	Bit							
	7	6	5	4	3	2	1	0
4	Port No. (LSB)							
5	Port No. (MSB)							
6	Index (LSB)							
7	Index (MSB)							
8	Subindex (LSB)							
9	Subindex (MSB)							
10	Handshake	Command ID						
11	Result							
12	Data Length							
13	Data (Byte 0) | Error Code							
14	Data (Byte 1) | Additional Code							
	…							
44	Data (Byte 31)							
45	reserved							

Legend:

• Port No.	IO-Link Port Port No. 0x1234 • Port No. (MSB): 0x12 • Port No. (LSB): 0x34	1 WORD	• 0x0001: Port 1 • 0x0002: Port 2 • 0x0003: Port 3 • 0x0004: Port 4
• Index	Index of the ISDU object Index: 0x1234 • Index (MSB): 0x12 • Index (LSB): 0x34	1 WORD	0x0000…0xFFFF
• Subindex	Subindex of the ISDU object Subindex 0x1234 • Subindex (MSB): 0x12 • Subindex (LSB): 0x34	1 WORD	0x0000…0xFFFF
• Handshake	Validity of the IO-Link response data	1 BIT	• 0x0: data invalid • 0x1: data valid
• Command ID	Command number	7 BIT	• 0x01: Get • 0x02: Write
• Result	Status of the command processing	1 BYTE	• 0x00: OK • 0x0F: OK, data user read > 32 bytes • 0xFF: Error
• Data Length	Number of bytes that contain relevant user data	1 BYTE	• 0x00: 0 bytes … • 0x20: 32 bytes
• Data (Byte 0) | Error Code	User data (byte 0) or error codes	1 BYTE	• User data: 0x00…0xFF • Error Code: Error Code (→ 🗋 95)
• Data (Byte 1) | Additional Code	User data (byte 1) or additional error codes	1 BYTE	• User data: 0x00…0xFF • Additional Code: Additional Code (→ 🗋 95)
• Data (byte n)	User data (byte n)	1 BYTE	Pro Byte: 0x00…0xFF

Error Code

Error code	Description
0x71	Service not available (unknown command has been sent to the IO-Link port)
0x72	Port blocked (another cyclic process accesses the IO-Link port)
0x73	Forbidden (access rights prohibit command execution)
0x74	Invalid data (wrong parameter has been sent in the command)
0x76	Wrong port (wrong port number)
0x77	Wrong port function (wrong port function or wrong parameter has been sent to the device)
0x78	Invalid length (set length is > 0x20)
0x80	Error in the device application Consider additional code (Additional Code (→ 95))

Additional Code

Additional Code only valid if Error Code = 0x80 (→ Error Code 95).

Code	Name	Description
0x00	APP_DEV	Error in the device application - no details
0x11	IDX_NOTAVAIL	Index not available
0x12	SUBIDX_NOTAVAIL	Subindex not available
0x20	SERV_NOTAVAIL	Service temporarily unavailable
0x21	SERV_NOTAVAIL_LOCCTRL	Service temporarily unavailable - local
0x22	SERV_NOTAVAIL_DEVCTRL	Service temporarily unavailable - device
0x23	IDX_NOT_WRITEABLE	Access denied
0x30	PAR_VALOUTOFRNG	Parameter value outside the valid range
0x31	PAR_VALGTLIM	Parameter value above the threshold
0x32	PAR_VALLTLIM	Parameter value below the threshold
0x33	VAL_LENOVRRUN	Parameter length exceeded
0x34	VAL_LENUNDRUN	Parameter length not reached
0x35	FUNC_NOTAVAIL	Function not available
0x36	FUNC_UNAVAILTEMP	Function temporarily unavailable
0x40	PAR_SETINVALID	Invalid parameter set
0x41	PAR_SETINCONSIST	Inconsistent parameter set
0x82	APP_DEVNOTRDY	Application not ready

11.2.3.2 Acyclic commands

Set Mode (0x10)

The command changes the operating mode of an IO-Link port of the device.

Command request

Byte (offset)	Bit							
	7	6	5	4	3	2	1	0
4	Port No. (LSB)							
5	Port No. (MSB)							
6	reserved							
7	reserved							
8	reserved							
9	reserved							
10	Trigger	0x10						
11	Target Mode							
12	reserved							
…	…							
45	reserved							

Legend:

• Port No.	IO-Link Port Port No. 0x1234 • Port No. (MSB): 0x12 • Port No. (LSB): 0x34	1 WORD	• 0x0001: Port 1 • 0x0002: Port 2 • 0x0003: Port 3 • 0x0004: Port 4
• Trigger	Control of the command execution	1 BIT	• 0x0: no action • 0x1: Execute command
• Target Mode	Operating mode of the IO-Link port	1 BYTE	• 0x00: deactivated • 0x01: Digital input (DI) • 0x02: Digital output (DO) • 0x03: IO-Link

Command response

Byte (offset)	Bit							
	7	6	5	4	3	2	1	0
4	Port No. (LSB)							
5	Port No. (MSB)							
6	reserved							
7	reserved							
8	reserved							
9	reserved							
10	Handshake	0x10						
11	Result							
12	Target Mode							
13	reserved							
…	…							
45	reserved							

Legend:

• Port No.	IO-Link Port Port No. 0x1234 • Port No. (MSB): 0x12 • Port No. (LSB): 0x34	1 WORD	• 0x0001: Port 1 • 0x0002: Port 2 • 0x0003: Port 3 • 0x0004: Port 4
• Handshake	Validity of the IO-Link response data	1 BIT	• 0x0: data invalid • 0x1: data valid
• Result	Status of the command processing	1 BYTE	• 0x00: OK • 0x0F: OK, data user read > 32 bytes • 0xFF: Error
• Target Mode	Operating mode of the IO-Link port	1 BYTE	• 0x00: deactivated • 0x01: Digital input (DI) • 0x02: Digital output (DO) • 0x03: IO-Link

Set validation ID / data storage (0x20)

The command sets the behaviour of the IO-Link master when connecting a new IO-Link device to an IO-Link port of the device.

Command request

Byte (offset)	Bit							
	7	6	5	4	3	2	1	0
4	Port No. (LSB)							
5	Port No. (MSB)							
6	reserved							
7	reserved							
8	reserved							
9	reserved							
10	Trigger	0x20						
11	Validation ID							
12	reserved							
…	…							
45	reserved							

Legend:

• Port No.	IO-Link Port Port No. 0x1234 • Port No. (MSB): 0x12 • Port No. (LSB): 0x34	1 WORD	• 0x0001: Port 1 • 0x0002: Port 2 • 0x0003: Port 3 • 0x0004: Port 4
• Trigger	Control of the command execution	1 BIT	• 0x0: no action • 0x1: Execute command
• Validation ID	Validation type and data storage behaviour of the port	1 BYTE	• 0x00: No check • 0x01: Type compatible V1.0 device • 0x02: Type compatible V1.1 device • 0x03: Type compatible V1.1 device with Backup + Restore • 0x04: Type compatible V1.1 device with Restore

Command response

Byte (offset)	Bit							
	7	6	5	4	3	2	1	0
4	Port No. (LSB)							
5	Port No. (MSB)							
6	reserved							
7	reserved							
8	reserved							
9	reserved							
10	Handshake	0x20						
11	Result							
12	Validation ID							
13	reserved							
…	…							
45	reserved							

Legend:

• Port No.	IO-Link Port Port No. 0x1234 • Port No. (MSB): 0x12 • Port No. (LSB): 0x34	1 WORD	• 0x0001: Port 1 • 0x0002: Port 2 • 0x0003: Port 3 • 0x0004: Port 4
• Handshake	Validity of the IO-Link response data	1 BIT	• 0x0: data invalid • 0x1: data valid
• Result	Status of the command processing	1 BYTE	• 0x00: OK • 0x0F: OK, data user read > 32 bytes • 0xFF: Error
• Validation ID	Validation type and data storage behaviour of the port	1 BYTE	• 0x00: No check • 0x01: Type compatible V1.0 device • 0x02: Type compatible V1.1 device • 0x03: Type compatible V1.1 device with Backup + Restore • 0x04: Type compatible V1.1 device with Restore

Set fail-safe data pattern (0x30)

The command sets the behaviour of the outputs when the EtherNet/IP connection and the corresponding fail-safe values are interrupted.

Command response

Byte (Offset)	Bit							
	7	6	5	4	3	2	1	0
4	Port No. (LSB)							
5	Port No. (MSB)							
6	reserved							
7	reserved							
8	reserved							
9	reserved							
10	Handshake	0x30						
11	Result							
12	Fail-safe mode							
13	reserved							
…	…							
45	reserved							

- Handshake — Validity of the IO-Link response data — 1 BIT
  - 0x0: data invalid
  - 0x1: data valid
- Result — Status of the command processing — 1 BYTE
  - 0x00: OK
  - 0x0F: OK, data user read > 32 bytes
  - 0xFF: Error
- Fail-safe mode — Fail-safe mode for the outputs of the IO-Link ports in case of an interruption of the EtherNet/IP connection — 1 BYTE
  - 0x00: No Fail-safe
  - 0x01: Fail-safe - Reset Value
  - 0x02: Fail-safe - Old Value
  - 0x03: Fail-safe - Pattern

11.2.4 Object directory

11.2.4.1 CIP object classes

Supported object classes:

Class Code	Name	Description
0x01	Identity Object	Identity Object (Class Code: 0x01) (→ 🗋 102)
0x02	Message Router Object	Message Router Object (Class Code: 0x02) (→ 🗋 103)
0x04	Assembly Object	Assembly Object (Class Code: 0x04) (→ 🗋 104)
0x06	Connection Manager Object	Connection Manager Object (Class Code: 0x06) (→ 🗋 105)
0x47	Device Level Ring Object	Device Level Ring Object (Class Code: 0x47) (→ 🗋 106)
0x48	Quality Of Service Object	Quality Of Service Object (Class Code: 0x48) (→ 🗋 107)
0x80	IO-Link Request Object	IO-Link Request Object (Class Code: 0x80) (→ 🗋 108)
0xF5	TCP/IP Object	TCP/IP Object (Class Code: 0xF5) (→ 🗋 112)
0xF6	Ethernet Link Object	Ethernet Link Object (Class Code: 0xF6) (→ 🗋 115)

11.2.4.2 CIP class and instance services

Supported class and instance services:

Service code	Name	Description
0x01	Get Attribute All	Read all attributes
0x02	Set Attribute All	Write all attributes
0x05	Reset	Reset
0x09	Delete	Delete
0x0E	Get Attribute Single	Read single attribute
0x10	Set Attribute Single	Write single attribute
0x4B	Read ISDU	Read ISDU
0x4C	Write ISDU	Write ISDU
0x4D	Write Failsafe Pattern	Write fail-safe values
0x4E	Forward Close	Close connection
0x54	Forward Open	Open new connection

11.2.4.3 Identity Object (Class Code: 0x01)

Class attributes

Attr. ID	Access	Name	Data type	Description	Value
1	Get	Revision	UINT	Revision of the object	2.003
2	Get	Max. Instance	UINT	Max. number of instances of the object	1
6	Get	Max. ID Number Class Attributes	UINT	Max. ID number of a class attribute	7
7	Get	Max. ID Number Instance Attributes	UINT	Max. ID number of the instance attribute	9

Instance attributes

Attr. ID	Access	Name	Data type	Description	Default
1	Get	Vendor ID	UINT	Manufacturer ID	322
2	Get	Device Type	UINT	Device type	12
3	Get	Product Code	UINT	Product code of the device	1005
4	Get	Revision	STRUCT	Revision of the device	2.003
		• Major Revision	USINT	Major revision (1...127)	2
		• Minor Revision	USINT	Minor revision (3 digits)	003
5	Get	Status	WORD	Overall status of the device	
6	Get	Serial Number	UDINT	Serial number of the device	--
7	Get	Product Name	SHORT STRING	Product name of the device	IO-Link Master DL EIP 4P IP67
8	Get	State	USINT	State of the device (State machine) • 0: Nonexistent • 1: Device Self Testing • 2: Standby • 3: Operational • 4: Major Recoverable Fault • 5: Major Unrecoverable Fault • 6-254: Reserved • 255: Default for “Get_Attributes_All” service	

Services

Code	Service	Class	Instance	Description
0x01	Get Attribute All	Yes	Yes	Read all attributes
0x05	Reset	Yes	Yes	Reset
0x0E	Get Attribute Single	Yes	Yes	Read single attribute

If an Identity Object receives a reset request, it carries out the following actions:

- It checks if it supports the requested reset type.
- It responds to the request.
- It tries to execute the requested reset type.

Supported reset types:

- 0: reboot the device (mandatory for all EtherNet/IP devices).
- 1: restore factory settings and reboot the device.

11.2.4.4 Message Router Object (Class Code: 0x02)

Class attributes

Attr. ID	Access	Name	Data type	Description	Value
1	Get	Revision	UINT	Revision of the object	1
2	Get	Max. Instance	UINT	Max. number of instances of the object	1
3	Get	Number of instances	UINT	Number of instances	1
6	Get	Max. ID Number Class Attributes	UINT	Max. ID number of a class attribute	7
7	Get	Max. ID Number Instance Attributes	UINT	Max. ID number of the instance attribute	0

Instance attributes

The object class has no instance attributes.

Services

Code	Service	Class	Instance	Description
0x0E	Get Attribute Single	Yes	Yes	Read single attribute

11.2.4.5 Assembly Object (Class Code: 0x04)

Class attributes

Attr. ID	Access	Name	Data type	Description	Value
1	Get	Revision	UINT	Revision of the object	2
2	Get	Max. Instance	UINT	Max. number of instances of the object	0x00C7
3	Get	Number of instances	UINT	Number of instances	3
6	Get	Max. ID Number Class Attributes	UINT	Max. ID number of the class attribute	7
7	Get	Max. ID Number Instance Attributes	UINT	Max. ID number of the instance attribute	4

Instance attributes

The following object instances are available:

Services

Code	Service	Class	Instance	Description
0x0E	Get Attribute Single	Yes	Yes	Read single attribute
0x10	Set Attribute Single	No	Yes	Write single attribute

11.2.4.6 Connection Manager Object (Class Code: 0x06)

Class attributes

Attr. ID	Access	Name	Data type	Description	Value
1	Get	Revision	UINT	Revision of the object	1
2	Get	Max. Instance	UINT	Max. number of instances of the object	1
3	Get	Number of instances	UINT	Number of instances	3
6	Get	Max. ID Number Class Attributes	UINT	Max. ID number of a class attribute	7
7	Get	Max. ID Number Instance Attributes	UINT	Max. ID number of the instance attribute	0

Instance attributes

The object class has no instance attributes.

Services

Code	Service	Class	Instance	Description
0x0E	Get Attribute Single	Yes	Yes	Read single attribute
0x10	Set Attribute Single	No	Yes	Write single attribute
0x4E	Forward Close	Yes	No	Close connection
0x54	Forward Open	Yes	No	Open new connection

11.2.4.7 Device Level Ring Object (Class Code: 0x47)

Class attributes

Attr. ID	Access	Name	Data type	Description	Value
1	Get	Revision	UINT	Revision of the object	3
2	Get	Max. Instance	UINT	Max. number of instances of the object	1
6	Get	Max. ID Number Class Attributes	UINT	Max. ID number of the class attribute	7
7	Get	Max. ID Number Instance Attributes	UINT	Max. ID number of the instance attribute	12

Instance attributes

Attr. ID	Access	Name	Data type	Description	Default
1	Get	Network topology	USINT	Current network topology • 0: linear	0
2	Get	Network status	USINT	Current network status • 0: OK	0
10	Get	Active Supervisor	STRUCT	Identification of the supervisor	0
			• UDINT	IP address	
			• ARRAY(6) of USINT	MAC address of the active supervisor	
12	Get	Capability Flags	DWORD	DLR capability of the device • 0x82: Beacon based Ring Node, Flush Table Frame support	0x82

Services

Code	Service	Class	Instance	Description
0x01	Get Attribute All	No	Yes	Read all attributes
0x0E	Get Attribute Single	Yes	Yes	Read single attribute

11.2.4.8 Quality Of Service Object (Class Code: 0x48)

Class attributes

Attr. ID	Access	Name	Data type	Description	Value
1	Get	Revision	UINT	Revision of the object	1
2	Get	Max. Instance	UINT	Max. number of instances of the object	1
3	Get	Number of instances	UINT	Number of instances of the object	1
6	Get	Max. ID Number Class Attributes	UINT	Max. ID number of a class attribute	7
7	Get	Max. ID Number Instance Attributes	UINT	Max. ID number of the instance attribute	8

Instance attributes

Attr. ID	Access	Name	Data type	Description	Default
1	Get	802.1Q Tag Enable	USINT	Current network topology	0: deactivated
2	Get / Set	DSCP PTP Event	USINT	DSCP value for PTP event frames	59
3	Get / Set	DSCP PTP General	USINT	DSCP value for PTP general frames	47
4	Get / Set	DSCP PTP Urgent	USINT	DSCP value for implicit messages with “urgent” priority	55
5	Get / Set	DSCP Scheduled	USINT	DSCP value for implicit messages with “scheduled” priority	47
6	Get / Set	DSCP High	USINT	DSCP value for implicit messages with “high” priority	43
7	Get / Set	DSCP Low	USINT	DSCP value for implicit messages with “low” priority	31
8	Get / Set	DSCP Explicit	USINT	DSCP value for explicit messages with “scheduled” priority	27

Services

Code	Service	Class	Instance	Description
0x01	Get Attribute All	Yes	Yes	Read all attributes

11.2.4.9 IO-Link Request Object (Class Code: 0x80)

Class attributes

Attr. ID	Access	Name	Data type	Description	Value
1	Get	Revision	UINT	Revision of the object	4
2	Get	Max. Instance	UINT	Max. number of instances of the object	2
6	Get	Max. ID Number Class Attributes	UINT	Max. ID number of a class attribute	8

Instance attributes

The required IO-Link port of the device is addressed via the instance attribute.

Services

Read ISDU

With Read_ISDU, parameters of a connected IO-Link device can be read.

Request

CIP Attributes determines the IO-Link port to which the IO-Link device is connected. The area "CIP User Specific Service Data" contains the IO-Link index and the IO-Link sub-index of the IO-Link object whose value is to be read:

CIP Format	Data type	MSG Config	Description
CIP Class ID	UINT	0x80	IO-Link acyclic access
CIP Instance ID	UINT	0x01	IO-Link master
CIP Attribute	USINT	0x01…0x04	Port number
CIP Service Code ID	USINT	0x4B	“Read ISDU” service
CIP User Specific Service Data	UINT	0x0000…0xFFFF	ISDU object index
	USINT	0x00…0xFF	ISDU object subindex

Response

Fault-free processing

If the service has been executed successfully (CIP Error Code = 0), the read data are returned bit by bit (CIP User Specific Service Data). The response has the following format:

CIP Format	Data type	MSG Config	Description
CIP Class ID	UINT	0x80	IO-Link acyclic access
CIP Instance ID	UINT	0x01	IO-Link master
CIP Attribute	USINT	0x01…0x04	Port number
CIP Service Code ID	USINT	0x4B	“Read ISDU” service
CIP Error Code	USINT	0x00	Fault-free processing
CIP Extended Error Code	USINT	0x00	--
CIP User Specific Service Data	USINT	0x00…0xFF	Data (byte 0)
	USINT	0x00…0xFF	Data (byte 1)
	…	…	…
	USINT	0x00…0xFF	Data (byte n)

The read data is in the IO-Link format. If necessary, the user needs to adapt the byte arrangement of the read data to the CIP format.

Fault

If an error occurs while executing the service (CIP Error Code <> 0), an extended error code will be transmitted (CIP Extended Error Code). If the CIP Error Code = 0x1E, the CIP Extended Error Code is = 0x00 and the IO-Link Error Code and the IO-Link Additional Code will be transmitted in the CIP User Specific Service Data area. The response has the following format:

CIP Format	Data type	MSG Config	Description
CIP Class ID	UINT	0x80	IO-Link acyclic access
CIP Instance ID	UINT	0x01	IO-Link master
CIP Attribute	USINT	0x01…0x04	Port number
CIP Service Code ID	USINT	0x4B	“Read ISDU” service
CIP Error Code	USINT	<> 0x00	Error code (see below)
CIP Extended Error Code	USINT	0x00	Extended error code
CIP User Specific Service Data	USINT	<> 0x00	IO-Link Error Code: Error Code (→ 🗋 95)

CIP Format	Data type	MSG Config	Description
CIP User Specific Service Data	USINT	<> 0x00	IO-Link Additional Code: Additional Code (→ 95)

CIP Error Code:

Code	Description
0x02	Resource not available: The IO-Link port is busy processing another acyclic service.
0x05	Invalid class ID or instance ID
0x08	Wrong service ID: only service 0x4B, 0x4C or 0x4D is permitted
0x09	Wrong attribute ID: wrong port number
0x20	Invalid parameter value (e.g. invalid length)
0x1E	Embedded service error: Error occurred during an IO-Link service. Byte 0 and byte 1 of the CIP User Specific Service Data contain the IO-Link error code and an additional code returned by the IO-Link master.

Write ISDU

With Write_ISDU, the parameters of a connected IO-Link device can be changed.

Request

CIP Attributes determines the IO-Link port to which the IO-Link device is connected. The area "User Specific Service Data" contains the IO-Link index, the IO-Link sub-index of the IO-Link object whose value is to be changed. The value to be assigned to the parameter follows byte by byte.

CIP Format	Data type	MSG Config	Description
CIP Class ID	UINT	0x80	IO-Link acyclic access
CIP Instance ID	UINT	0x01	IO-Link master
CIP Attribute	USINT	0x01…0x04	Port number
CIP Service Code ID	USINT	0x4C	“Write ISDU” service
CIP User Specific Service Data	UINT	0x0000…0xFFFF	ISDU object index
	USINT	0x00…0xFF	ISDU object subindex
	USINT	0x00…0xFF	ISDU data (byte 0)
	USINT	0x00…0xFF	ISDU data (byte 1)

Response

Fault-free processing

If the service was executed successfully (CIP Error Code = 0), the area "User Specific Data" will remain empty. The response has the following format:

CIP Format	Data type	MSG Config	Description
CIP Class ID	UINT	0x80	IO-Link acyclic access
CIP Instance ID	UINT	0x01	IO-Link master
CIP Attribute	USINT	0x01…0x04	Port number
CIP Service Code ID	USINT	0x4C	“Write ISDU” service
CIP Error Code	USINT	0x00	Fault-free processing
CIP Extended Error Code	USINT	0x00	--

Fault

If an error occurs while executing the service (CIP Error Code <> 0), an extended error code is transmitted (CIP Extended Error Code). If the CIP Error Code = 0x1E, the CIP Extended Error Code is = 0x00 and the IO-Link Error Code and the IO-Link Additional Code will be transmitted in the CIP User Specific Service Data area. The response has the following format:

CIP Format	Data type	MSG Config	Description
CIP Class ID	UINT	0x80	IO-Link acyclic access
CIP Instance ID	UINT	0x01	IO-Link master
CIP Attribute	USINT	0x01…0x04	Port number
CIP Service Code ID	USINT	0x4C	“Write ISDU” service
CIP Error Code	USINT	<> 0x00	Error code (see below)
CIP Extended Error Code	USINT	0x00	Extended error code
CIP User Specific Service Data	USINT	<> 0x00	IO-Link Error Code: Error Code (→ 🗋 95)
	USINT	<> 0x00	IO-Link Additional Code: Additional Code (→ 🗋 95)

CIP Error Code:

Code	Description
0x02	Resource not available: The IO-Link port is busy processing another acyclic service.
0x05	Invalid class ID or instance ID
0x08	Wrong service ID: only service 0x4B, 0x4C or 0x4D is permitted
0x09	Wrong attribute ID: wrong port number
0x20	Invalid parameter value (e.g. invalid length)
0x1E	Embedded service error: Error occurred during an IO-Link service. Byte 0 and byte 1 of the CIP User Specific Service Data contain the IO-Link error code and an additional code returned by the IO-Link master.

Write Failsafe Pattern

Write Failsafe Pattern can be used to write the failsafe value of an IO-Link port.

Request

CIP Attribute determines the IO-Link port. The area CIP User Specific Service Data includes the fail-safe mode and the fail-safe value (Failsafe Pattern).

CIP Format	Data type	MSG Config	Description
CIP Class ID	UINT	0x80	IO-Link acyclic access
CIP Instance ID	UINT	0x01	IO-Link master
CIP Attribute	USINT	0x01…0x04	Port number
CIP Service Code ID	USINT	0x4D	“Write Failsafe Pattern” service
CIP User Specific Service Data	USINT	• 0x00: No Fail-safe • 0x01: Fail-safe Reset Value • 0x02: Fail-safe Old Value • 0x03: Fail-safe with Pattern	Fail-safe Mode
	USINT	0x00…0xFF	Fail-safe Pattern (MSB)
	USINT	0x00…0xFF	Fail-safe Pattern (LSB)

Response

Fault-free processing

If the service was executed successfully (CIP Error Code = 0), the area "User Specific Data" will remain empty. The response has the following format:

CIP Format	Data type	MSG Config	Description
CIP Class ID	UINT	0x80	IO-Link acyclic access
CIP Instance ID	UINT	0x01	IO-Link master
CIP Attribute	USINT	0x01…0x04	Port number

CIP Format	Data type	MSG Config	Description
CIP Service Code ID	USINT	0x4D	“Write Failsafe Pattern” service
CIP Error Code	USINT	0x00	Fault-free processing
CIP Extended Error Code	USINT	0x00	--

Fault

If an error occurs while executing the service (CIP Error Code <> 0), an extended error code will be transmitted (CIP Extended Error Code). The response has the following format:

CIP Format	Data type	MSG Config	Description
CIP Class ID	UINT	0x80	IO-Link acyclic access
CIP Instance ID	UINT	0x01	IO-Link master
CIP Attribute	USINT	0x01…0x04	Port number
CIP Error Code	USINT	<> 0x00	Error code (see below)
CIP Extended Error Code	USINT	0x00	Extended error code

CIP Error Code:

Code	Description
0x02	Resource not available: The IO-Link port is busy processing another acyclic service.
0x05	Invalid class ID or instance ID
0x08	Wrong service ID: only service 0x4B, 0x4C or 0x4D is permitted
0x09	Wrong attribute ID: wrong port number
0x20	Invalid parameter value (e.g. invalid length)
0x1E	Embedded service error: Error occurred during an IO-Link service. Byte 0 and byte 1 of the CIP User Specific Service Data contain the IO-Link error code and an additional code returned by the IO-Link master.
0x0F	Insufficient access rights

11.2.4.10 TCP/IP Object (Class Code: 0xF5)

Class attributes

Attr. ID	Access	Name	Data type	Description	Value
1	Get	Revision	UINT	Revision of the object	4
2	Get	Max. Instance	UINT	Max. number of instances of the object	1
3	Get	Number of instances	UINT	Number of instances of the object	1
6	Get	Max. ID Number Class Attributes	UINT	Max. ID number of a class attribute	7
7	Get	Max. ID Number Instance Attribute	UINT	Max. ID number of the instance attribute	13

Instance attributes

Attr. ID	Access	Name	Data type	Description	Default
1	Get	Status	UINT	Status of the TCP/IP interface • 0: interface not configured • 1: interface configured with DHCP, BOOTP or non-volatile memory	

Attr. ID	Access	Name	Data type	Description	Default
2	Get	Configuration Capability	DWORD	Configuration options for interface • Bit 0: BOOTP Client • Bit 2: DHCP Client • Bit 4: configuration adjustable • Bit 7: ACD-capable	0x95 (BOOTP, DHCP, TCP/IP configur-able, ACD capable)
3	Get / Set	Configuration Control	DWORD	Configuration control Bit 0..3: startup configuration • 0: statically assigned IP address • 1: configuration via BOOTP • 2: configuration via DHCP	0
4	Get	Physical Link Object Path	STRUCT of	Logical path to the physical communica-tion interface (Ethernet link object)	
		• Path Size	UINT	Length (number of words, little endian for-mat)	0x02 00
		• Path	Padded EPATH	Class ID: 0xF6 (Ethernet Link Object) • Instance ID: 0x1	0x20 F6 2 4 01
5	Get / Set	Interface configuration	STRUCT of	TCP/IP interface configuration	
		• IP Address	UDINT	IP address	192.168.1. 250
		• Network Mask	UDINT	Network mask	255.255.2 55.0
		• Gateway Address	UDINT	Gateway address	0.0.0.0
		• Name Server	UDINT	Primary name server	0.0.0.0
		• Name Server 2	UDINT	Secondary name server	0.0.0.0
		• Domain Name	STRING	Default domain name	0
6	Get / Set	Host Name	STRING	Host Name • 0: not configured	0
8	Get	TTL Value	UINT	TTL value	1
9	Get / Set	Mcast Config	UINT	Mcast configuration	0
10	Get / Set	SelectAcd	BOOL	ACD activation / deactivation • 0: deactivated • 1: activated	1
11	Get / Set	Last conflict detected	STRUCT of	Last conflict detected	0
		• AcdActivity	USINT	Condition of ACD activity at last conflict detected • 0: Noconflictdetected • 1: ProbeIpv4Address • 2: Ongoing Detection • 3: SemiActiveprobe	
		• Remote MAC	ARRAY(6) of USINT	MAC address of the remote node of the ARP PDU in which the conflict was de-tected	
		• ArpPdu	ARRAY(28) of USINT	Copy of the data of the ARP PDU in which the conflict was detected	
13	Get / Set	Encapsulation Inactivity Time-out	UINT	Inactivity before the TCP connection is deactivated (in seconds)	120

Services

Code	Service	Class	Instance	Description
0x01	Get Attribute All	No	Yes	Read all attributes
0x0E	Get Attribute Single	Yes	Yes	Read single attribute

Code	Service	Class	Instance	Description
0x10	Set Attribute Single	No	Yes	Write single attribute

11.2.4.11 Ethernet Link Object (Class Code: 0xF6)

Class attributes

Attr. ID	Access	Name	Data type	Description	Value
1	Get	Revision	UINT	Revision of the object	4
2	Get	Max. Instance	UINT	Max. number of instances of the object	2
3	Get	Number of instances	UINT	Number of instances	2
6	Get	Max. ID Number Class Attributes	UINT	Max. ID number of a class attribute	7
7	Get	Max. ID Number Instance Attribute	UINT	Max. ID number of the instance attribute	768

Instance attributes

Attr. ID	Access	Name	Data type	Description	Default
1	Get	Interface Speed	UDINT	Current transmission rate • 10: 10 Mbit/s • 100: 100 Mbit/s	100
2	Get	Interface Status Flag	DWORD	Interface status flags • Bit 0: link status • Bit 1: half/full duplex • Bit 2…4: negotiation status • Bit 5: manual change requires reset • Bit 6: local hardware error • Bit 7…31: reserved	0x20
3	Get	Physical Address	ARRAY(6) of USINT	MAC address	
4	Get	Interface Counters	STRUCT(11) of UDINT	Interface-specific counter	
5	Get	Media Counters	STRUCT(12) of UDINT	Medium-specific counter	
6	Get / Set	Interface Control	STRUCT of	Interface control	
		• Interface Settings	DWORD	Settings Bit 0: • 0: auto-negotiation on • 1: auto-negotiation off Bit 1: • 0: half duplex • 1: full duplex	0
		• Interface Speed	UINT	Transmission rate • 10: 10 Mbit/s • 100: 100 Mbit/s	
7	Get	Interface type	USINT	• 0: unknown • 1: internal interface • 2: twisted pair • 3: optical fibre	2
8	Get	Interface State	USINT	Current status of the interface • 0: unknown • 1: active; ready for transmission and reception • 2: not active • 3: test mode	0

Attr. ID	Access	Name	Data type	Description	Default
9	Get / Set	Admin State	USINT	Control of the access to the interface • 1: activate • 2: deactivate	1
10	Get	Interface Label	SHORT_STRING	Interface identifier	• X21 (instance 1) • X22 (instance 2)
11	Get	Interface Capability	STRUCT of	Interface capability	
		• Interface Speed	DWORD	Transmission rate • 10: 10 Mbit/s • 100: 100 Mbit/s	
		• Interface Duplex Mode	DWORD	Duplex mode • HD: half duplex • FD: full duplex	
768	Get / Set	MDIX	USINT	MDIX configuration • 1: MDIX_AUTO • 2: MDIX_MDI • 3: MDIX_MDIX	1

Services

Code	Service	Class	Instance	Description
0x01	Get Attribute All	No	Yes	Read all attributes
0x0E	Get Attribute Single	Yes	Yes	Read single attribute
0x10	Set Attribute Single	No	Yes	Write single attribute