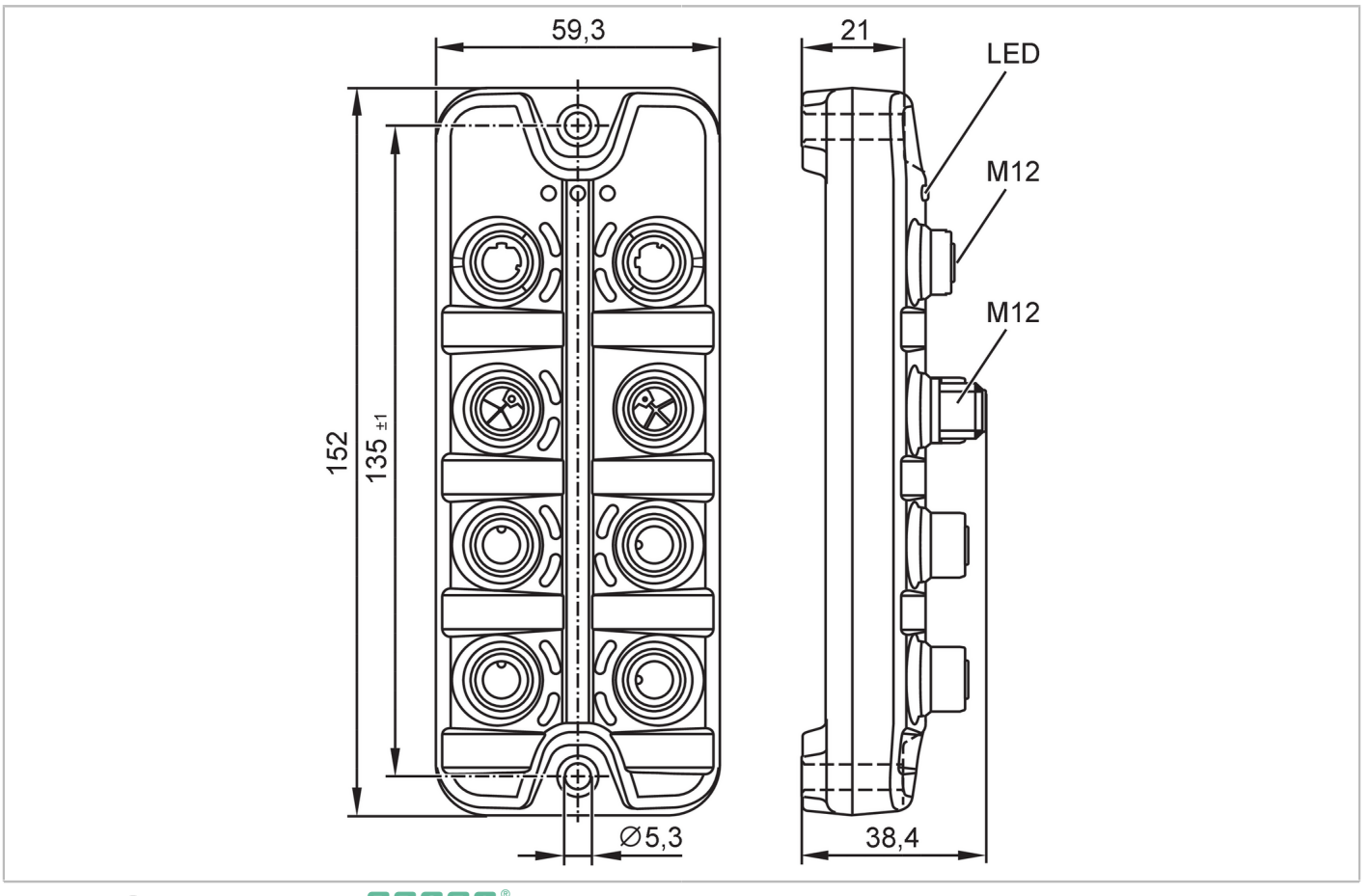
AL1401

IO-Link master with Profinet interface

IO-Link Master PFL PN 4P IP69K



Application		
Application		hygienic systems; I/O modules for field applications
Daisy-chain function		voltage supply; fieldbus interface
Electrical data		
Operating voltage	[V]	20...28 DC; (US ; to PELV)
Current consumption	[mA]	300...3900; (US)
Protection class		III
Additional voltage supply	[V]	20...30 DC; (UA)
Actuator supply UA		
Max. current load total	[A]	8
Current rating per port	[A]	2; (adjustable: 0...2; Factory setting: 2)
Sensor supply US		
Max. current load total	[A]	3.6
Current rating per port	[A]	2; (adjustable: 0...2; Factory setting: 0,45)
Inputs / outputs		
Total number of inputs and outputs		12; (configurable)
Number of inputs and outputs		Number of digital inputs: 4; Number of digital outputs: 8

AL1401

IO-Link master with Profinet interface

IO-Link Master PFL PN 4P IP69K

Inputs		
Number of digital inputs		4; (IO-Link Port Class B: 4 x 1)
Switching level high	[V]	11...30
Switching level low	[V]	0...5
Digital inputs protected against short circuits		yes
Outputs		
Number of digital outputs		8; (IO-Link Port Class B: 4 x 2)
Short-circuit proof		yes
Actuator supply UA		
Max. current load per output	[mA]	2000
Sensor supply US		
Max. current load per output	[mA]	2000
Interfaces		
Communication interface		Ethernet; IO-Link
Ethernet - PROFINET		
Transmission standard		100Base-TX
Transmission rate		100 MBit/s
Protocol		PROFINET
Factory settings		IP address: 0.0.0.0
		subnet mask: 0.0.0.0
		gateway IP address: 0.0.0.0
		MAC address: see type label
Note on interfaces		IO-Link Integration Edition 2
		CC-C (Conformance Class C) (IRT-Switch)
		S2 redundancy
		Netload Class III
		CiR (Configuration in Run)
		SNMP (Simple Network Management Protocol)
		MRP (Media Redundancy Protocol)
		Supported network topologies: line
		ring
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 B		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; IP 69K; (operation with stainless steel protective caps: IP 69K)
Protection rating (NEMA 250)		6P
Pollution degree		2

AL1401

IO-Link master with Profinet interface

IO-Link Master PFL PN 4P IP69K

Chemical media		ISO 16750-5	HLP, CC, DB, DC, DD, CA
		NEMA 250 5.13.1	AA
		DIN EN ISO 175, Ecolab test method 40-1	
		the following media were tested for 28 days at constant room temperature using the dipping test method	P3-topax 990
			Topactive 200
			Topactive 500
			Topactive OKTO

Tests / approvals

EMC		EN 61000-6-2	
		EN 61000-6-4	
Shock resistance		DIN EN 60068-2-27	
Vibration resistance		DIN EN 60068-2-64 2009-04	
		DIN EN 60068-2-6 2008-10	
MTTF	[years]	60	

Mechanical data

Weight	[g]	321.9
Housing		rectangular
Type of mounting		Backplane mounting
Dimensions	[mm]	152 x 59.3 x 38.4
Material		housing: PA grey; Socket: stainless steel (1.4404 / 316L)
Sealing material		EPDM

Accessories

Items supplied	Protective cap: 1 x M12, stainless steel, E12542

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: EPDM

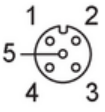


IN / OUT XF1, XF2

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

Electrical connection - IO-Link

Connector: 4 x M12; coding: A; Contacts: 5; sealing: EPDM



AL1401

IO-Link master with Profinet interface

IO-Link Master PFL PN 4P IP69K

IO-Link Port Class B X1...X4	
1	Sensor supply (US) L +
2	Actuator supply / Digital output (UA) L+
3	Sensor supply (US) L-
4	C/Q IO-Link
5	Actuator supply (UA) L-

Electrical connection - voltage supply IN

Connector: 1 x M12; coding: L; Contacts: 5



XD1	
1	+ 24 V DC (US) brown
2	GND (UA) white
3	GND (US) blue
4	+ 24 V DC (UA) black
5	FE grey

Electrical connection - voltage supply OUT

Connector: 1 x M12; coding: L; Contacts: 5; sealing: EPDM



XD2	
1	+ 24 V DC (US) brown
2	GND (UA) white
3	GND (US) blue
4	+ 24 V DC (UA) black
5	FE grey

Operating instructions

IO-Link master with PROFINET interface
PerformanceLine
4 ports
IP 65 / IP 66 / IP 67 / IP 69K

AL1401

Firmware: 3.1.x

English

80295491 / 01 04 / 2021

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1 Preliminary note

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1.1 Legal and copyright information

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1.2 Purpose of the document

34227

This document is only for device types "IO-Link master - PROFINET gateway (PerformanceLine) 4 port IP 65 / IP 66 / IP 67 / IP 69K" (art. no.: AL1401).

It is part of the device and contains information about the correct handling of the product.

► Read this document before using the device.

► Keep this document during the service life of the device.

1.3 Explanation of Symbols

34171

WARNING

Warning of serious personal injury.

Death or serious irreversible injuries may result.

CAUTION
Warning of personaly injury.
Slight reversible injuries may result.

NOTICE
Warning of damage to property

Important note
Non-compliance can result in malfunction or interference

Information
Supplementary note

► ... Request for action

> ... Reaction, result

→ ... "see"

abc Cross-reference

123 Decimal number
0x123 Hexadecimal number
0b010 Binary number

[...] Designation of pushbuttons, buttons or indications

1.4 Modification history

34492

Version	Topic	Date
00	New creation of document	10 / 2020
01	Added: Derating UL	04 / 2021
02	Deleted: ifm IoT Core – DNS support	10 / 2021

2 Safety instructions

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28333

2.1 General

58525

- The device described is a subcomponent for integration into a system. The manufacturer is responsible for the safety of the system. The system manufacturer 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 manufacturer 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 (→ **Functions and features** (→ S. 9)).
- 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, programming, configuration, operation and maintenance of the product must be carried out by personnel qualified and authorised for the respective activity.
- Protect units and cables against damage.

2.2 Required background knowledge

34185

This document is intended for specialists. Specialists are people who, based on their relevant training and experience, are capable of identifying risks and avoiding potential hazards that may be caused during operation or maintenance of the product.

The document contains information about the correct handling of the product.

2.3 Safety symbols on the device

34199



General warning
Observe instructions in chapter "Electrical connection" (→ **Electrical connection** (→ S. 13))!

2.4 IT security

58235

NOTICE!

If the device is operated in an unprotected network environment:

> Unauthorised read or write access to data is possible.

> Unauthorised manipulation of the device function is possible.

► Check and restrict access options to the device.

3 Functions and features

58284

The device may only be used for the following purposes:

- as IO-Link master for configuration, management and operation of IO-Link devices
- as gateway between IO-Link devices and AS-i network

The device is designed for use without a control cabinet in the food industry.

► Only use the device within the limits of the technical data (→ **Technical data** (→ S. 91)).

4 Function

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4.1 Parameter setting

34583

The device provides the following configuration options:

- Parameter setting of the IO-Link master of the AL1401 with parameter setting software LR DEVICE and/or PROFINET projection software
- Parameter setting of the connected IO-Link devices (sensors, actuators) with parameter setting software LR DEVICE and/or PROFINET projection software
- Storage of parameter sets of the connected IO-Link devices for automatic recovery (data storage)

4.2 Visual indication

34192

The device has the following visual indicators:

- Status and error indication of the gateway, of the PROFINET connection and of the system
- Status display of the voltage supply
- Status and activity display of the Ethernet connection
- Status, error and short circuit/overload indication of the IO-Link ports

4.3 PROFINET

57560

The device offers the following ProfiNet functions:

- PROFINET RT Device (Conformance Class C)
- 2-port switch for access to the PROFINET interface; integrated switch complies with RT and IRT according to PROFINET V2.3
- Gateway for transmission of the process and parameter data between the connected IO-Link devices and the higher-level PROFINET controller
- Configuration in Run (CiR)
- Supported protocols: SNMP, LLDP, MRP, DCP, RTA, RTC Class 1 (not synchronised)
- Profinet functions: FSU, I&M0 - 4 read / write, S2 redundancy
- Device description: GSDML file

4.4 Internet of Things (IoT)

58240

The device offers the following IoT functions:

- 2-port switch for access to the IoT interface (XF1 / XF2)
- Gateway for the transmission of process, parameter and monitoring data between IO-Linkmaster / IO-Link devices and the IT network level
- REST-API to access process and parameter data
- Supported protocols: TCP/IP JSON

4.5 IO-Link

34084

The device offers the following IO-Link functions:

- IO-Link master (IO-Link revision 1.0 and 1.1)
- 4 IO-Link ports for connection of IO-Link devices
- Provision of process data of the connected IO-Link devices for LR SMARTOBSERVER monitoring software (→ www.ifm.com)

4.5.1 IO-Link supply

57561

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

The X1...X4 ports are class B ports.

The pin 2 (UA) of the X1...X4 ports supports different operating modes (disconnected from power, supply voltage UA, digital output).

The current intensity of the supply voltages US and UA of the X1...X4 ports can be adjusted.

Every supply provides short circuit monitoring.

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).

4.5.2 Digital outputs

57562

The device has 4 digital outputs that can be activated as an option (switching output DC-13 according to IEC 60947-5-1, 20 W).

The digital outputs are connected to pin 2 of the X1...X4 ports.

The digital outputs are supplied with the UA voltage. They refer to the potential of UA (pin 5).

4.6 Voltage output

57563

The device has a voltage output (XD2) to supply an additional device. This makes it possible to supply several "PerformanceLine"-type devices with one voltage source (daisy chain).

5 Mounting

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34058

5.1 Installing the device

57564

- ► Disconnect power before installation.
- ► Please observe the maximum tightening torque.
- ► Use a plane mounting surface for installation.

► Fix the unit to the mounting surface using 2 M5 mounting screws and washers.
  - Tightening torque: 1.8 Nm

6 Electrical connection

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33805

6.1 Remarks

34179

A qualified electrician must connect the unit.

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

Device is only suitable for operation on SELV/PELV voltages.

► Observe the information concerning IO-Link circuits!

The device contains components that can be damaged or destroyed by electrostatic discharge (ESD).

► Observe the required safety measures against electrostatic discharge!

The IP rating depends on the individual protection ratings of the unit, the applied connection elements and the corresponding protective covers.

The M12 connection parts in the device comply with the ingress resistance requirements of the standard EN 61076-2-101. To adhere to the protection rating, only cables certified to this standard must be used. The system creators undertake to ensure ingress resistance for cables which they cut to length themselves.

► Carry out the fitting according to the indications of the cable manufacturer. A maximum of 0.8 Nm is permitted.

► During installation, place the M12 connector vertically so that the coupling nut will not damage the thread.

► Depending on the mounting conditions, cables must be provided with a strain relief to avoid unacceptable loads on the mounting points and M12 connections.

► Make sure that the M12 connection parts are correctly seated and mounted correctly. The specified protection rating can not be guaranteed if this is not observed.

For UL applications:

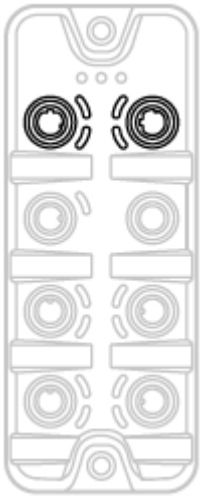
► For connecting the device and the IO-Link devices use UL certificated cables of category CYJV or PVVA with a minimum temperature rating of 80°C (75 °C for max. ambient temperature of 40 °C).

Wiring: → **Technical data** (→ S. 91)

The communication interfaces are separated from each other and from device surfaces that could be touched by means of basic insulation according to EN61010-1 (secondary circuit with 28 V DC maximum, supplied from mains circuit up to 300 V of overvoltage category II). They are designed for network environment 0 according to IEC TR62102.

6.2 Connect PROFINET ports

57565



- ► Connect the device via the M12 socket XF1 and/or XF2 with the PROFINET network (e.g. PROFINET PLC, additional PROFINET device)
- ► Connect the device via the M12 socket XF1 and/or XF2 with the IT network (e.g. PC with parameter setting software LR DEVICE, PC with monitoring software LR SMARTOBSERVER, PC with software capable of http requests)
- ► To connect the devices, use M12 connectors with protection rating IP 65 / IP 66 / IP 67 / IP 69K or higher (→ **Accessories** (→ S. 89)).
- ► Cover the unused sockets with M12 protective caps (art. no.: E12542).
  - Tightening torque 0.6...0.8 Nm

6.3 Connect IO-Link ports

57566

Wiring information:

- The connected IO-Link devices may only be supplied via the AL1401.
- The ports of the device meet the requirements of the IO-Link specifications 1.0 to 1.1.2.
- The additional digital outputs of the ports X1...X4 (pin 2) meet the requirements of the utilisation category DC-13 according to the standard IEC 60947-5-1: 20 W. The connected electronics must be electrically suited for this.

CAUTION

Connection of IO-Link Class A devices with Class B ports using 4/5 pole connectors

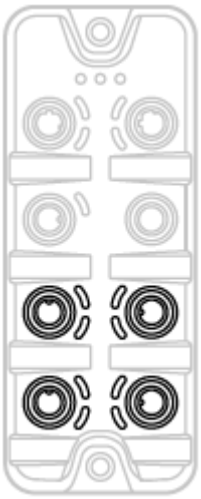
> Risk of fire

> Impairment of electrical safety

> Malfunctions

► To connect IO-Link Class A devices to Class B ports, use 3-pole connectors only!

Detailed information: → IO-Link planning directive www.io-link.com



► Connect the IO-Link devices with the M12 sockets X1...X4.
  - Maximum cable length per port: 20 m

► To connect the devices, use M12 connectors with protection rating IP 65 / IP 66 / IP 67 / IP 69K or higher (→ **Accessories** (→ S. 89)).

► Cover the unused sockets with M12 protective caps (art. no.: E12542).
  - Tightening torque: 0.6...0.8 Nm

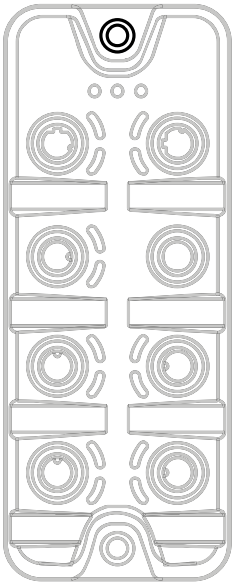
6.4 Ground the device

57568

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

- Upper mounting lug of the housing
- Ports XD1 and XD2: Pin 5 (FE)
- Ports XF1 and XF2

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 unit via the mounting screw of the upper mounting lugs.
  - Tightening torque: 1.8 Nm

► Optional: Connect pin 5 of the port XD1 or XD2 via an L-coded M12 connector with the FE socket of the power supply.

6.5 Connect the device

52464

CAUTION

Exceeding the maximum input current of 16 A

> Fire hazard

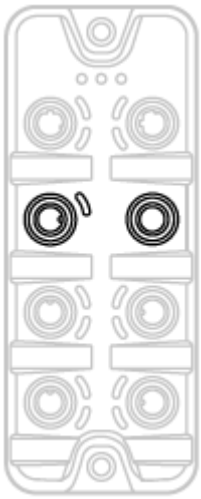
► Select I_U and I_A of the power supplies US and UA taking into account the derating characteristics of the AL1401 (→ **Derating behaviour** (→ S. 92))!

NOTICE

Missing reverse polarity protection in case of cross polarity between US and UA: The supply voltages US and UA are individually protected against reverse polarity. The supply voltages US and UA are not protected against cross polarity reversal.

> Damage to the device

► Make sure that the supply voltages US and UA are connected correctly.



► Disconnect power.

► Connect the device via M12 socket X31 to US and UA supplying 24 V DC each (20...28 V SELV/PELV; according to IEC 61010-1, secondary circuit with maximum 28 V DC, supplied from mains circuit up to 300 V of overvoltage category II).

- Recommended maximum cable length: 25 m

► To connect the device, use L-coded M12 connectors with at least protection rating IP 65 / IP 66 / IP 67 / IP 69K (→ **Accessories** (→ S. 89)).

Optional: Supply of an additional PerformanceLine devices (Daisy chain):

► Connect additional PerformanceLine Master to M12 socket X32 of the AL1401 (Daisy-chain function).

- Recommended maximum cable length: 25 m

► To connect the device, use L-coded M12 connectors with at least protection rating IP 65 / IP 66 / IP 67 / IP 69K (→ **Accessories** (→ S. 89)).

In case of cables that are longer than 25 m, take the voltage drop and the necessary minimum supply voltage of 20 V into consideration!

7 Operating and display elements

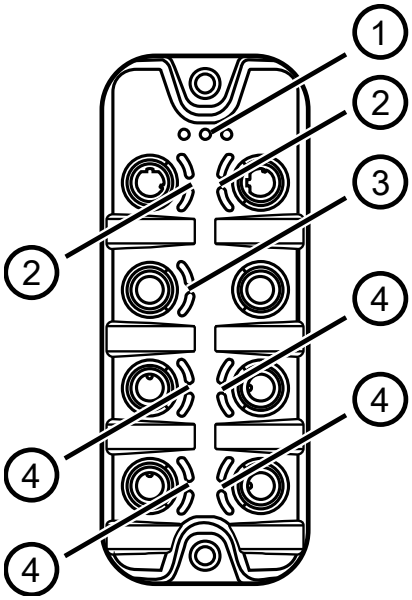
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7.1 Overview

57569



1. Status LEDs RDY, BF and SF (→ **Status LEDs** (→ S. 19))
2. Status LEDs LNK and ACT of the PROFINET interfaces 1 (XF1) and 2 (XF2) (→ **Ethernet ports** (→ S. 19))
3. Status LEDs US and UA of the voltage supply (XD1/XD2) (→ **Voltage supply** (→ S. 20))
4. Status LEDs IOL and UA/DO of the IO-Link Class B ports (X1...X4) (→ **IO-Link Ports (Class B)** (→ S. 20))

7.2 LED indicators

34047

The device only has the following LED indicators:

7.2.1 Status LEDs

34549

The RDY LED shows the status of the gateway.
The BF LED (Bus Failure) shows the status of the PROFINET connection.
The SF LED (System Failure) shows the status of the system.

Status LED			Description
RDY	green	on	Status: OK
		flashes 5 Hz	Status: Error
		flashes (200 ms on, 800 ms off)	Status: Firmware update is running
		off	Status: Gateway not running or gateway booting
BF	red	on	Bus error
		flashes 1 Hz	No connection to the PROFINET controller
		off	error-free
SF	red	on	▪ Error in gateway ▪ At least 1 IO-Link device sends warning / alarm (temperature, over/under current, over/under voltage, shortcut)
		off	error-free

7.2.2 Ethernet ports

34348

Each Ethernet port has 2 LEDs (LNK and ACT). The LEDs indicate the status of the Ethernet connection.

Status LED			Description
LNK	green	on	Ethernet connection established
		off	No Ethernet connection
ACT	yellow	flashes	Data is transmitted via the Ethernet interface.
		off	No data transmission

7.2.3 Voltage supply

57570

The port for the voltage supply (XD1) has the LEDs with the designation US and UA. The LEDs indicate the status of the supply voltage.

Status LED			Description
US	green	on	Supply voltage US is connected
		off	either there is no supply voltage or the connected supply voltage is too low
UA	green	on	Supply voltage UA is connected
		Off	either there is no supply voltage or the connected supply voltage is too low

7.2.4 IO-Link Ports (Class B)

57571

Each IO-Link Port Class B has 2 LEDs with the designation IOL and UA/DO. The LEDs show the status of the IO-Link ports.

Status LED			Description
IOL	yellow	Off	Port configured as DI/DO: pin 4 (C/Q) = OFF
		on	Port configured as DI/DO: pin 4 (C/Q) =ON
	green	flashing 1 Hz	Port configured asIO-Link: no IO-Link device found
		Flashing with 2 Hz	Port configured asIO-Link: Status PREOPERATE
		on	Port configured asIO-Link: Status OPERATE
	red	Flashing with 2 Hz	Port configuration error or short circuit / overload on US
		on	Transmission error
UA/DO	yellow	Off	Digital output: Pin 2 (UA) = OFF
		on	Digital output: Pin 2 (UA) = ON
	green	Off	IO-Link type A supply: Pin 2 (UA) = OFF
		on	IO-Link type B supply: Pin 2 (UA) = ON (not switchable)
	red	on	Error: Overcurrent or undervoltage

8 Setup

57572

When the supply voltages have been switched on, the AL1401 starts with the factory settings. The LEDs signal the current operating status of the device and the ports (→ **LED indicators** (→ S. 19)).

8.1 Parameter setting options

59779

The device can be configured withe the following options:

- Software LR DEVICE (→ **LR DEVICE** (→ S. 23)
- REST API for IoT Core (→ **ifm IoT Core** (→ S. 115, → S. 34)
- PROFINET projecting software (→ **PROFINET** (→ S. 69)

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33858

9.1 LR DEVICE

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33692

On delivery, the AL1401 is configured with the factory settings (→ **Factory Settings** (→ S. 88)).

Required software: LR DEVICE (1.6.x or higher) (art.-no.: QA0011/QA0012)

9.1.1 Remarks

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34180

Online parameter setting

57575

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 parameters are changed 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 sensor stay in operating mode. They continue their monitoring functions with the existing parameters until the parameter setting has been completed.

Offline parameter setting

34060

The AL1401 supports the offline parameter setting. In this context, the user creates and stores a configuration for the IO-Link master and the connected IO-Link devices without being connected to the AL1401 (OFFLINE mode). The configuration created in this way can be stored as a file (*.lrp) and loaded to the AL1401 and activated at a later date.

Further information about offline parameter setting: → Operating instructions LR DEVICE

VPN connection

34382

An active VPN connection blocks the access of the parameter setting software LR DEVICE to the PROFINET interface of the AL1401.

► Deactivate the VPN connection in order to be able to access the AL1401 with the LR DEVICE.

9.1.2 First access with LR DEVICE to the IO-Link master

57576

With factory settings, the IO-Link master works in the DCP mode. In the DCP mode, the configuration options are limited. For parameter setting with LR DEVICE, the IO-Link master and the PC used for parameter setting must be configured for the same IP address range.

To access the AL1401 with LR DEVICE:

1 Preparations

► Install LR DEVICE on the PC (→ User documentation "LR DEVICE").

► Establish Ethernet connection between PC and Port XF1 or XF2.

2 Start LR DEVICE and update the device library

► Start LR DEVICE.

► Update the device library.

> The device library contains the IO-Link device description file of the IO-Link master.

3 Look for IO-Link master

► Im LR DEVICE: Scan the network for devices.

> LR DEVICE searches the network for IO-Link masters and IO-Link devices.

> LR DEVICE shows IO-Link masters in the device tree.

4 Configure IP settings

► Click on [AL1401].

> LR DEVICE shows the DCP view of the IO-Link master.

► Adapt the IP settings of the IO-Link master.

► Save changed values on the device.

> LR DEVICE writes the changed values on the device.

> The IO-Link master can be configured.

9.1.3 IoT: Configuring access rights

34046

The access rights define which instance may read and / or write the parameter data, process data and event/diagnostic messages.

In order to configure the access rights to the IO-Link master:

► Select [IoT] menu.

> The menu page shows the current settings.

► Set the following parameters as required:

Name	Description	Possible values	
[Access Rights]	The access rights to the parameter data, process data and the event/diagnostic messages of the IO-Link master as well as the connected IO-Link devices	[PROFINET + IoT]*	▪ PROFINET and IoT Core have read and write access rights to parameters and process data ▪ PROFINET and IoT Core have read access rights to events/alarms
		[PROFINET + IoT (read-only)]	▪ PROFINET has read and write access rights to parameters and process data ▪ PROFINET has read access rights to events/alarms ▪ IoT Core only has read access rights to parameters, process data and events/alarms
		[IoT only]	▪ IoT Core has read and write access rights to parameters and process data ▪ IoT has read access rights to events/alarms ▪ PROFINET has no access rights

* ... Factory setting

► Save changed values on the device.

If in LR DEVICE and PROFINET projection software the parameter [Access Rights] is = [PROFINET + IoT], the parameter values set in the PROFINET projection software will always apply.

If the parameter [Access Rights] in LR DEVICE is = [IoT only], set the parameter [Access Rights] = [Keep settings] in the PROFINET projection software.

If the parameter [Access Rigts] in LR DEVICE is = [<Fieldbus> + IoT (read-only)], write access to the device configuration via LR DEVICE and IoT core services is blocked. To enable write access again, set the parameter to [<Fieldbus> + IoT] via fieldbus configuration software.

Changes of the parameter [Access Rights] will only be effective after restarting the IO-Link master (→ **Firmware: Reboot the device** (→ S. 32)).

9.1.4 IoT: Configure the interface to LR AGENT or LR SMARTOBSERVER

34048

To enable transfer of process data from the IO-Link master to LR AGENT or LR SMARTOBSERVER, the interface has to be configured accordingly.

► Select [IoT] menu.

> The menu page shows the current settings.

► Set the following parameters as required:

Name	Description	Possible values	
[IP address LR Agent or SMARTOBSERVER]	IP address of LR AGENT or LR SMARTOBSERVER	Factory setting: 255.255.255.255	
[Port LR Agent or SMARTOBSERVER]	Port number that is used to send process data to LR AGENT or LR SMARTOBSERVER	0 ... 65535	Factory setting:: 35100
[Interval LR Agent or SMARTOBSERVER]	Cycle time for the transfer of the process data to LR AGENT or LR SMARTOBSERVER (value in milliseconds)	[Off]	no transfer
		500 ... 2147483647	500 ms ... 2147483647 ms
[Application Tag]	Source identifier of the IO-Link master in the structure of LR AGENT or LR SMARTOBSERVER (String32)	Factory setting: AL1401	

After changing the parameter [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:

► Reboot the device after changing the the parameter.

► Save changed values on the device.

9.1.5 Fieldbus: Configure IP settings

57577

To be able to access the IO-Link master from the PROFINET network or with the LR DEVICE parameter setting software, the IP settings of the PROFINET interface must be adapted correspondingly.

► Select [Fieldbus] menu.

> The menu page shows the current settings.

► Set the following parameters as required:

Name	Description	Possible values
[IP address]	IP address of the PROFINET interface	Factory setting: 0.0.0.0
[Subnet mask]	Subnet mask of the PROFINET network	Factory setting: 0.0.0.0
[Default gateway IP address]	IP address of the PROFINET gateway	Factory setting: 0.0.0.0
[MAC address]	MAC address of the IO-Link master	The value is firmly set.
[Fieldbus firmware]		

► Save changed values on the device.

9.1.6 IO-Link ports: Activate data transfer to LR AGENT or LR SMARTOBSERVER

33690

The user can decide separately for each IO-Link port whether the process data of the connected IO-Link devices should be transferred to LR AGENT or LR SMARTOBSERVER.

To transfer process data the interface to the LR AGENT or LR SMARTOBSERVER has to be correctly configured (→ **IoT: Configure the interface to LR AGENT or LR SMARTOBSERVER** (→ S. 27)).

To activate / deactivate data transfer:

► Select [Port x] menu (x = 1...4).

> The menu page shows the current settings.

► Set the following parameters as required:

Name	Description	Possible values	
[Transmission to LR Agent or SMARTOBSERVER]	Transfer of process data of the connected IO-Link device to LR AGENT oder LR SMARTOBSERVER	[Disabled]	Transfer process data
		[Enabled]	Don't transfer process data

► Save changed values on the device.

9.1.7 IO-Link ports: Set the operating mode Pin 2 (UA)

57578

The pin 2 of the IO-Link ports X1...X4 supports the following operating modes:

- Off: no voltage on pin; port functions as IO-Linkport type A
- On: the voltage UA is applied to pin 2; ports functions as IO-Linkport type B
- Digital output (DO): binary output signal is on pin 2; port functions as digital switching output

The user can set the operating mode separately for each IO-Link port.

To set the operating mode of pin 2 (UA) of an IO-Link port:

► Select menu [Port x] (x = 1...X1...X4)

> The menu page shows the current settings.

► Set the following parameters as required:

Name	Description	Possible values	
[Mode Pin2 UA]	Operating mode of pin 2 of the port	[Off (IO-Link Type A Supply)]	IO-Link Port type A
		[On (IO-Link Type B Supply)]	IO-Link Port type B
		[Digital Output]	Digital switching output

► Save changed values on the device.

9.1.8 IO-Link ports: Limit the current intensity

57579

For the IO-Link ports X1...X4, the following features can be set:

- Max. current intensity of the supply voltage US
- Max. current intensity of the supply voltage UA

To set the max. current intensity of the supply voltages US and UA of an IO-Link port:

► Select [Port x] menu (x = 1...4).

> The menu page shows the current settings.

► Set the following parameters as required:

Name	Description	Possible values	
[Current Limit Pin2 UA]	Max. current intensity of the supply voltage UA on the port (value in milliamps)	0 ... 2000*	0 mA* 2000 mA
[Current Limit Pin1 + Pin4 US]	Max. current intensity of the supply voltage US on the port (value in milliamps)	0 ... 450* ... 2000	0 mA 450 mA 2000 mA

* ... Factory setting

► Save changed values on the device.

9.1.9 IO-Link ports: setting the operating mode Pin 4 (US)

57580

The pin 4 of the IO-Link-Ports X1...X4 supports the following operating modes:

- Disabled: no data transmission on pin 4 (C/Q) of the IO-Link ports
- Digital input (DI) binary input signal on pin 4 (C/Q) of the IO-Link ports
- Digital output (DO): binary output signal on pin 4 (C/Q) of the IO-Link ports
- IO-Link: IO-Link data transfer via pin 4 (C/Q) of the IO-Link ports

The user can set the operating mode separately for each IO-Link port.
To set the operating type of pin 4 (US) of an IO-Link port:

► Select [Port x] menu (x = 1...4).

> The menu page shows the current settings.

► Set the following parameters as required:

Name	Description	Possible values	
[Mode Pin4 US]	Operating mode of the pin 4 of the port	[Disabled]	no data transmission
		[DI]	Digital input
		[DO]	Digital output
		[IO-Link]	IO-Link data
[Cycle time actual]**	Current cycle time of the data transfer between IO-Link master and IO-Link device on the port (value in microseconds)	Parameter can only be read	
[Cycle time preset]*	Cycle time of the data transfer between the IO-Link master and the IO-Link device at the port (value in microseconds)	0	The device automatically sets the fastest possible cycle time.
		1 ... 132800	1 microsecond ... 132800 microseconds
[Bitrate]**	Current transmission rate of the data transfer between the IO-Link master and the IO-Link device on the port	Parameter can only be read	

* ... Parameter only available if [Mode] = [IO-Link]
** ... Parameter only visible if IO-Link Device am IO-Link port is connected.

► Save changed values on the device.

9.1.10 IO-Link ports: Set the device validation and data storage

33697

The user can choose how the IO-Link ports are to behave with regard to the device validation and the storage / recovery of parameter data of the connected IO-Link device.

The following options are available:

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

The options only apply if the IO-Link port is in the operating mode "IO-Link".

For options [Type compatible V1.1 device with Backup + Restore] and [Type compatible V1.1 device with Restore]: If the vendor ID and device ID are changed in the online mode, the data memory will be deleted and a new backup of the parameter values of the connected IO-Link device will be created in the IO-Link master.

To configure the device validation and the data storage:

► select [Port x] menu (x = 1...4).

> The menu page shows the current settings.

► Set the following parameters as required:

Name	Description	Possible values	
[Validation / Data Storage]	Supported IO-Link standard and behaviour of the IO-Link master when connecting a new IO-Link device at port x (x = 1...4)	[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]	
[Vendor ID]	ID of the manufacturer that is to be validated	0...65535	Factory setting: 0# ifm electronic: 310
[Device ID]	ID of the IO-Link device that is to be validated	0...16777215	Factory setting: 0

► Save changed values on the device.

9.1.11 Info: Show device information

34065

To read the general information of the ifm IO-Link master:

► Select [Info] menu.

> The menu page shows the current settings.

Name	Description	Possible values
[Product code]	Article number of the IO-Link master	AL1401
[Device family]	Device family of the IO-Link master	IO-Link master
[Vendor]	Vendor	ifm electronic gmbh
[SW-Revision]	Firmware of the IO-Link master	
[HW revision]	Hardware version of the IO-Link master	
[Bootloader revision]	Bootloader version of the IO-Link master	
[Serial number]	Serial number	

9.1.12 Firmware: Reset device to factory settings

33838

When the IO-Link master is reset, all parameters are set to the factory settings:

To reset the device to factory settings:

► Select [Firmware] menu.

> The menu page shows the current settings.

► Click on [Factory Reset] to reset the device.

> LR DEVICE sets the device to the factory settings.

9.1.13 Firmware: Reboot the device

33832

When rebooting the device, all settings are kept.

To restart the AL1401:

► Select [Firmware] menu.

> The menu page shows the current settings.

► Click on [Reboot] to reboot the device.

> LR DEVICE reboots the ifm IO-Link master.

9.1.14 Configure IO-Link devices

33856

To configure the IO-Link devices connected to the device with the LR DEVICEparameter setting software:

Requirements:

> IO-Link master is correctly installed and connected to the LR DEVICE parameter setting software.

> The IO-Link device is connected correctly with the AL1401.

> Operating mode of the IO-Link port is "IO-Link" (→ **IO-Link ports: setting the operating mode Pin 4 (US)** (→ S. 30)).

> IoT has write access rights to the IO-Link master (→ **IoT: Configuring access rights** (→ S. 26)).

1 Select IO-Link master

► Start LR DEVICE.

► Update IODD file library
OR:
Import IODD file of the IO-Link device manually.

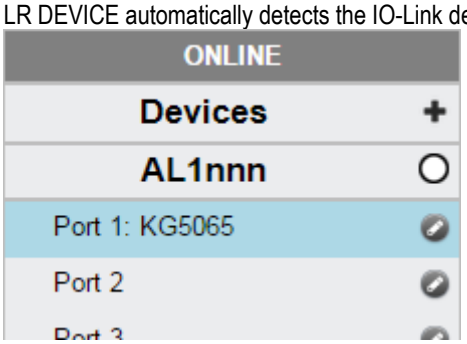
► Scan network for devices.

> LR DEVICE detects IO-Link master.

2 Add IO-Link device

► Under [ONLINE]: Click on the required IO-Link master.

> LR DEVICE automatically detects the IO-Link devices connected to the IO-Link master (e.g. ifm sensor KG5065).



3 Configure IO-Link device

► Mouse click on the port to which the IO-Link device is connected.

> LR DEVICE reads and shows the current parameter values of the IO-Link device.

► Configure IO-Link device.

Information about the available parameters of the IO-Link device: → IO Device Description (IODD) des IO-Link Devices

► Save the changed configuration on the IO-Link device.

9.2 ifm IoT Core

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52244

General notes on the ifm IoT Core: → **Programmers' notes** (→ S. 35)

9.2.1 Programmers' notes

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34229

IoT Core: General information

52256

The PerformanceLine device family has an IoT Core. The IoT Core allows the user to address the AL1401 from IT networks via a REST API and to integrate it into Internet-of-Things applications.

A device description is stored on the AL1401. This device description is a structured, machine-readable data object in JSON format. All current values of parameters, process data, diagnostic data and device information are mapped in this data object. These data values can be read and changed by means of services.

Access the ifm IoT Core

52257

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

GET request

33804

Using the GET method the user has read access to a data point.

The syntax of the request to the IoT Core is:

```
http://ip/datapoint/service
```

Parameter	Description
ip	IP address of the IoT interface
data_point	Data point which is to be accessed
service	Service

The syntax of the return of the IoT Core is:

```
{
"cid":id,
"data":{"value":resp_data},
"code":diag_code
}
```

Parameter	Description
id	Correlation ID for the assignment of request and return
resp_data	Value of the data point; depending on the data type of the data point
diag_code	Diagnostic code (→ **IoT core: Diagnostic codes** (→ S. 38))

Example: GET request

54033

Request (via browser):

```
http://192.168.0.250/devicetag/applicationtag/getdata
```

Response:

```
{
"cid":-1,
"data":{"value":"AL1401"},
"code":200
}
```

POST request

34212

Using the POST method the user has read and write access to a data point.
The syntax of the request to the IoT Core is:

```
{
"code":"code_id",
"cid":id,
"adr":"data_point/service",
"data":{req_data}
}
```

Field	Parameter	Description	
code	code_id	service class	
		▪ Request	Request
		▪ Transaction	Transaction
		▪ Event	Event
cid	id	Correlation ID for the assignment of request and response; id freely setable by the user	
adr	data_point	Data point of element tree which is to be accessed	
	service	Service to be called (→ **Overview: IoT services** (→ S. 124))	
data*	req_data	Data to be transferred to the IoT Core (e.g. new values); syntax depending on the service	

* = optional: only required for services which send data to the IoT core (e.g. setdata)

The syntax of the return of the IoT Core is:

```
{
"cid":id,
"data":{"value":resp_data},
"code":diag_code
}
```

Field	Parameter	Description
cid	id	Correlation ID for the assignment of request and return
data*	resp_data	Value of the data point; depending on the data type of the data point
code	diag_code	Diagnostic code (→ **IoT core: Diagnostic codes** (→ S. 38))

* = optional: only required for services which receive data from the IoT core (e.g. getdata)

Example: POST request

54035

Request:

```
{
"code":"request",
"cid":4711,
"adr":"devicetag/applicationtag/getdata"
}
```

Response:

```
{
"cid":4711,
"data":{"value":"AL1401"},
"code":200
}
```

IoT core: Diagnostic codes

58223

Code	Text	Description
200	OK	Request successfully processed
230	OK but needs reboot	Request successfully processed; IO-Link master must be restarted
231	OK but block request not finished	Request successfully processed; blockwise request, but not yet finished
232	Data has been accepted, but internally modified	New values have been accepted, but were adjusted by the IO-Link master (Master cycle time)
400	Bad request	Invalid request
403	Forbidden	Forbidden request
500	Internal Server Error	Internal fault
503	Service Unavailable	The service is not available (e. g. IO-Link port in wrong operating mode; no IO-Link device at IO-Link port)
530	The requested data is invalid	Invalid process data
531	IO-Link Error	Error in IO-Link Master / device
532	PLC connected Error	Error while setting data, because IO-Link master is still connected to fieldbus PLC

9.2.2 First steps

52245

To read the device description of the AL1401:

► Send the following POST request to the AL1401:
`{"code":"request","cid":-1,"adr":"gettree"}`

> AL1401 returns the device description as 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

61148

The AL1401 has the type `device` (→ **Overview: IoT types** (→ S. 123)).

The following services can be used on the root element of the type `device`:

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

Depending on the read and write access rights, the following services can be applied to elements of type `data`:

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

Example: Reading properties of an element

59782

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",
"uid":null,
"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".

Example: output subtree

61149

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 be shown: 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
}
```


Example: Read several parameter values of the IO-Link master simultaneously

33840

Task: The following current values are to be read by the IO-Link master: temperature, serial number

Solution: Read the current parameter values using the getdatamulti service (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
}
```

Example: Browsing device description

61150

Task: List all elements with the designation "status" and the profile "runcontrol".

Solution: Use the service querytree to browse the device description with the parameters "status" (name) and "runcorntrol" (profile)

- Request:

```
{
"cid":4711,
"adr":"querytree",
"code":"request",
"data":{
"profile":"runcontrol",
"name":"status"}
}
```

- Response:

```
{
"cid":4711,
"data":{
"adrList":[
"device/connections/mqttConnection/status",
"device/connections/mqttConnection/mqttCmdChannel/status"]},
"code":200
}
```

Setting the storage duration

61153

The IoT Core offers the possibility to set the storage duration of data and notifications. The Services **Service: setdata** (→ S. 134) and **Service: subscribe** (→ S. 135) therefore have the parameter "duration".

Example: Subscribing to notifications

61154

Task: The current values of the following parameters are to be sent regularly to a network server with IP address 192.168.0.4:

- Product name of the IO-Link Devices an IO-Link port X02
- Cyclic input data of the IO-Link Devices an IO-Link port X02
- Operating temperature of the IO-Link master.

The subscription is only to be active until the next restart 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":"http://192.168.0.4:80/temp",
"datatosend":[
"/iolinkmaster/port[2]/iolinkdevice/productname",
"/iolinkmaster/port[2]/iolinkdevice/pdin",
"/processdatamaster/temperature"],
```

```
"duration":"uptime"}
}
```

- Response:

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

9.2.4 Fieldbus: Configuring IP settings

59808

Substructure: `fieldbussetup`

Available data points:

Name	Description	Access
../hostname	Name of the IO-Link master in the fieldbus project	rw
../fieldbusfirmware	Firmware version of the IO-Link master	r
../network/macaddress	MAC address of the fieldbus port	r
../network/ipaddress	IP address of the fieldbus port	rw*
../network/subnetmask	Subnet mask of the network segment	rw*
../network/ipdefaultgateway	IP address of the network gateway	rw*
../connectionstatus	Status of the connection to the PROFINET network	r

r ... read only
rw ... read and write
* ... only changeable, if the PROFINET controller is not in RUNNING state

9.2.5 IoT: Configuring access rights

59785

Substructure: `iotsetup`

Available data points:

Name	Description	Access
../accessrights	Access rights to the IO-Link master	rw

rw ... read and write

If in IoT and PROFINET projection software the parameter [Access Rights] is = [PROFINET + IoT], the parameter values set in the PROFINET projection software will always apply.

If in IoT the parameter [Access Rights] is = [IoT only], set the parameter [Access Rights] = [Keep settings] in the PROFINET projection software.

If in LR DEVICE the parameter [Access Rigts] is = [EtherCAT + IoT (read-only)], write access to the device configuration via LR DEVICE and IoT core services is blocked. To enable write access again, set the parameter to [EtherCAT + IoT] via fieldbus configuration software.

Changes of the parameter [Access Rights] will only be effective after restarting the IO-Link master (→ **Firmware: Reboot the device** (→ S. 32)).

9.2.6 IoT: Configuring the LR AGENT or LR SMARTOBSERVER interface

59786

Substructure: `iotsetup`

Avalable data points:

Name	Description	Access
../smobip	IP address of the LR SMARTOBSERVER	rw
../smobport	Port number of the LR SMARTOBSERVER	rw
../smobinterval	Cycle time for data transmission to LR SMARTOBERVER (value in milliseconds)	rw

rw ... read and write

9.2.7 IO-Link ports: Limiting current values

59805

Substructure: `iolinkmaster/port[n]/powercontrol` (n = 1...4).

Available data points:

Name	Description	Access
../mode_ua	Operating mode of supply UA (pin 2) of the port	rw*
../current_us_max	Max. current value of the supply voltage US (pin 1 and 4) at the port (value in mA)	rw*
../current_us	Present current value of supply US (pin 1 and 4) at the port (value in mA)	r
../current_ua_max	Max. current value of the supply voltage UA (pin 2) at the port (value in mA)**	rw*
../current_ua	Present current value of supply voltage UA (pin 2) at the port (value in mA)**	r
../status	Status of the supply voltages US and UA at the port	r

r ... read only
rw ... read and write
* ... only changeable, if the PROFINET plc is not in RUNNING state
** ... only available for IO-Link ports class B

9.2.8 IO-Link ports: Setting the operating mode of pin 4 (US)

59793

Substructure: `iolinkmaster/port[n]` (n = 1...4).

Available data points:

Name	Description	Access
../mode	Operating mode of the IO-Link port	rw*
../mastercycletime_preset	Cycle time of the data transfer at the IO-Link port (value in ms)	rw*
../mastercycletime_actual	Current cycle time of the data transfer at the IO-Link port (value in ms)	r
../comspeed	Data transfer rate of the IO-Link port	r

r ... read only
rw ... read and write
* ... only changeable, if the <Feldsbus> plc is not in RUNNING state

9.2.9 IO-Link ports: Configuring device validation and data storage

59792

Substructure: `iolinkmaster/port[n]` (n = 1...4).

Available data points:

Name	Description	Access
../validation_datastorage_mode	Response of the IO-Link port when a new IO-Link device is connected	rw*
../validation_vendorid	IO-Link ID of the manufacturer that is to be validated	rw*
../validation_deviceid	IO-Link ID of the device that is to be validated	rw*
../datastorage	Structure for port data storage	rw
../datastorage/maxsize	Maximum size of the data storage content (in bytes)	r
../datastorage/chunksize	Size of a data segment (in bytes)	r
../datastorage/size	Size of the data storage content (in bytes)	r

r ... read only
rw ... read and write
* ... can only be changed if the PROFINET PLC is not in RUNNING state

Applicable services:

Service	Description
../validation_useconnecteddevice	Validate the IO-Link device connected to the IO-Link port*
../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*

* ... can only be changed if the PROFINET PLC is not in the RUNNING state

Example: Clone the Data Storage of an IO-Link port

52344

Task: Save the Data Storage of IO-Link port X02 of IO-Link master 1 and restore the data at IO-Link master 2.

Solution: The cloning process consists of 2 steps. In the first step, the Data Storage of the IO-Link port of IO-Link master 1 is saved. In the second step, the saved data is restored at the Data Storage of port IO-Link port of IO-Link master 2.

Save Data Storage:

1 Preparations

- ► Read size of segments of Data Storage (h = number of bytes):
  {"code":"request", "cid": -1,"adr":"/iolinkmaster/port[2]/datastorage/chunksize/getdata"}
  Example: h = 256
- ► Read total size of Data Storage area (g = number of bytes):
  {"code": "request", "cid": -1, "adr": "/iolinkmaster/port[2]/datastorage/size/getdata"}
  Example: g = 550
- ► Calcuate the number of reading steps n: n = first integer value to which the following applies: g < n*h
  Example: n= 3, because 550 < 3*256

2 Read Data Storage of IO-Link port

- ► Read Data Storage segment by segment ("pos" is the byte offset, at which the reading process with length "length" starts).
  {"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 request: pos = 0, length = 256
2nd read resquest: pos = 256, length =256
3rd read request: pos = 512, length = 256

> Each segment value will be returned as BASE64 coded string.

► Join segments.

Restore Data Storage:

1 Preparations

► Determine the size of the saved Data Storage value (n = number of bytes).
Example: n = 550

► Read size of segments (s = number of bytes):
{"code":"request", "cid": -1,"adr":"/iolinkmaster/port[1]/datastorage/chunksize/getdata"}
Example: s = 256

2 Transfer Data Storage strings

► Start transfer of Data Storage string ("size" = size of Data Storage string):
{"code":"request", "cid": -1, "adr":"/iolinkmaster/port[1]/datastorage/start_stream_set", "data": {"size": n}}
Example: size = 550

► Transfer Data Storage string segment by segment ("value" = string value of length s):
{"code": "request", "cid": -1, "adr": "/iolinkmaster/port[1]/datastorage/stream_set", "data": {"value": "aWZtfgIAAABBTDF4NXhfY25faXRfdDIuMi43Nw..."}

9.2.10 IO-Link ports: Configuring data transfer to LR AGENT or LR SMARTOBSERVER

59795

Substructure: `iolinkmaster/port[n]` (n = 1...4).

Available data points:

Name	Description	Access
../senddatatosmob	Process data to LR AGENT or LR SMARTOBSERVER	rw

rw ... read and write

9.2.11 IO-Link ports: Reading and writing process data

59801

Substructure: `iolinkmaster/port[n]` (n = 1...4)

Available data points:

Name	Description	Access
../pin2out	Value of the digital output on pin 2 of the IO-Link port	rw*
../iolinkdevice/pdin	Value of the IO-Link input on pin 4 of the IO-Link port	r
../iolinkdevice/pdout	Value of the IO-Link output on pin 4 of the IO-Link port	rw*

r = only read
rw = read and write
* = only changeable, if the PROFINET plc is not in RUNNING state

Example: Read IO-Link process data (operating mode "IO-Link")

33842

Task: Read the current measured value of the ifm temperature sensor TN2531 at IO-Link port X02

Solution: Read the data point for the process input data with the `getdata` service.

- Request:

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

- Response:

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

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**1111001001**

Temperature value: 0b11110010 = 242

Therefore: The current temperature value is 24.2 °C.

Example: Writing IO-Link value (operating mode "IO-Link")

59804

Task: Switch on the buzzer of DV2500 at IO-Link Port X2. The DV2500 operates in On/Off mode.

Solution: The IODD of the DV2500 shows the structure of the IO-Link process value (→ e.g. LED activity). The buzzer will be switched using bit 40 of the process value (OFF = 0, ON = 1).

To switch the buzzer:

1. Read the current process value (→ **Example: Read IO-Link process data (operating mode "IO-Link")** (→ S. 48)).
2. Set bit 40 of the read value to 1.
3. Write the process value to the IO-Link device.

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
}
```

Example: Writing digital output (operating mode "DO")

59803

Task: Set the output value of the IO-Link devices at IO-Link Port X1 to "ON". The operating mode of the IO-Link port is "Digital Output (DO)".

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

- Request:

```
{
"code":"request",
"cid":10,
"adr":"iolinkmaster/port[1]/iolinkdevice/pdout/setdata",
"data":{"newvalue":"01"}
}
```

- Response:

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

Example: Reading digital input (operating mode "DI")

59802

Task: Read the current input value of the IO-Link device at IO-Link port X5. The operating mode of the IO-Link port is "Digital Intput (DI)".

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

- Request:

```
{
"code":"request",
"cid":10,
"adr":"iolinkmaster/port[5]/iolinkdevice/pdin/getdata"
}
```

- Response:

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

9.2.12 IO-Link ports: Indicating port events

59796

Substructure: iolinkmaster/port[n] (n = 1...4).

Available data points:

Name	Description	Access
../portevent	Indication of the following events at IO-Link port n: ▪ plugging IO-Link device ▪ pulling IO-Link device ▪ changing operating mode of IO-Link port	r

r ... read only

Subscribing events: → **Subscribing to notifications** (→ S. 57)

9.2.13 IO-Link devices: Accessing parameters

59800

The ifm IoT Core supports the configuration of the connected IO-Link devices. A parameter is accessed via IO-Link index and subindex (→ IO Device Description (IODD) of the device).

Substructure: `iolinkmaster/port[n]/iolinkdevice` (n = 1...4)

Applicable services:

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

Example: Read the parameter value of an IO-Link device

33847

Task: Read the serial number of the ifm temperature sensor TN2531 at IO-Link port X02

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}
}
```

- **Return:**

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

The returned value is given in hexadecimal format. The conversion of the HEX value in a STRING value is: G0214280710

Example: Change the parameter value of an IO-Link device

33844

Task: Set the output configuration OUT1 of the ifm temperature sensor TN2531 at IO-Link port X02 to the value "Hnc / hysteresis function, normally closed".

Solution: Change the parameter [ou1] of the sensor to the value 4 using the iolwriteacyclicdata service. 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 has to be given in hexadecimal format. The conversion of the STRING value in a HEX value is: 34.

- Response:

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

9.2.14 IO-Link devices: Reading an writing device information

59797

Substructure: `iolinkmaster/port[n]/iolinkdevice` (n = 1...4)
Available data points:

Name	Description	Access
../status	Status of the connected IO-Link device	r
../vendorid	IO-Link ID of the vendor	r
../deviceid	IO-Link ID of the IO-Link device	r
../productname	Product name of the IO-Link device	r
../serial	Serial number of the IO-Link device	r
../applicationspecifictag	Device-specific identification (application tag)	rw

r ... read only
rw ... read and write

9.2.15 IO-Link devices: Indicating IO-Link events

59798

Substructure: `iolinkmaster/port[n]/iolinkdevice` (n = 1...4).
Available data points:

Name	Description	Access
../iolinkevent	Indication of IO-Link events	r

r ... read only

Subscribing events: → **Subscribing to notifications** (→ S. 57)

9.2.16 Gateway: Resetting, rebooting and localising the device

59790

Substructure: `firmware`
Applicable services:

Name	Description
../factoryreset	Reset IO-Link master to factory settings
../reboot	Reboot IO-Link master
../signal	Trigger the flashing of the status LED

9.2.17 Gateway: Reading device information

59787

Substructure: `deviceinfo`

Available data points:

Name	Description	Access
../productcode	Article number	r
../vendor	Producer	r
../devicefamily	Device family	r
../hwrevision	Hardware revision	r
../serialnumber	Serial number	r
../swrevision	Firmware version	r
../bootloaderrevision	Bootloader version	r
../extensionrevisions	Firmware and bootloader version	r
../fieldbustype	Fieldbus	r

r ... read only

Additional information about the AL1401 can be read with the `getidentity` service (→ **Service: getidentity** (→ S. 127)).

9.2.18 Gateway: Reading status and diagnostic information

59788

Substructure: `processdatamaster`

Available data points:

Name	Description	Access
../temperature	Temperature of the IO-Link master (value in °C)	r
../voltage	Voltage applied (value in mV)	r
../current	Current (value in mA)	r
../supervisionstatus	Diagnostic information of the device supply	r
../voltage_ua	Voltage value of power supply UA (value in mV)	r
../current_ua	Current value of power supply UA (value in mA)	r
../supervisionstatus_ua	Status of power supply UA	r

r ... read only

9.2.19 Gateway: Updating the firmware

59789

Substructure: `firmware`

Available data points:

Name	Description	Access
../version	Software version	r
../type	Software type	r
../container	Structure for updating the firmware	w
../container/maxsize	Maximum size of the container structure (in bytes)	r
../container/chunksize	Size of a data segment (in bytes)	r
../container/size	Size of the container content (in bytes)	r

r = only read
w = write only

Applicable services:

Name	Description
../install	Install firmware transferred to the IO-Link master
../container/stream_set	Transfer an individual data segment
../container/start_stream_set	Start sequential transmission of several data segments

Example: Update firmware

52252

Task:

Update the firmware of the device; size of the firmware file: 356676 bytes

Solution:

The firmware is transferred to the device in fragments (chunks). The size of the fragments depends on the size of the flash memory of the IO-Link master. To transfer the firmware, the firmware file must be converted into a character string using BASE64.

1 Preparations

► Determine the size of the fragments (g = number of bytes):
{"code":"request", "cid": -1, "adr":"/firmware/container/chunksize/getdata"}

► Convert the firmware file into a BASE64 string.

2 Start the transfer of the firmware

► Start the transfer of the firmware via the service start_stream_set (parameter "size": size of the firmware file):
{"code":"request", "cid": -1, "adr":"/firmware/container/start_stream_set", "data":{"size":356676}}

3 Load the firmware into the flash memory of the IO-Link master

► Send the BASE64 string of the firmware file to the IO-Link master fragment by fragment (value = string value with length g).
{"code": "request", "cid": -1, "adr": "/firmware/container/stream_set", "cid": -1, "data": {"value": "aWZtfgIAAABBTDF4NXhfY25faXRfdDIuMi43Nw..."}

► Repeat step 3 until all fragments of the firmware file have been sent to the IO-Link master.

> IO-Link master stores the segments received in the container area.

4 Install firmware

► Start the installation of the transmitted firmware.
{"code": "request", "cid": -1, "adr": "/firmware/install", "data": {}}

9.2.20 Gateway: Setting the application tag

59791

Substructure: `devicetag`

Available data points:

Name	Description	Access
../applicationtag	Name of the IO-Link master (application tag)	rw

rw ... read and write

For the storage of the applicationtag 32 bytes are available on the IO-Link master. If the memory area is exceeded during writing with setdata, the IoT core aborts the write process and returns the diagnostics code 400.

When writing the application tag, 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

Example: Change name of the IO-Link master

a33823

Task: Set the name of the IO-Link master to AL1401 for the representation in the LR SMARTOBSERVER.

Solution: Change the parameter [Application Tag] with the setdata service to the value [AL1401].

The data point of the parameter [Application Tag] in the device description object is /devicetag/applicationtag.

- Request:

```
{
"code":"request",
"cid":4711,
"adr":"/devicetag/applicationtag/setdata",
"data":{"newvalue":"AL1401"}
}
```

- Response:

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

9.2.21 Subscribing to notifications

61159

If a data point has the sub-element `datachanged`, the user can subscribe to notifications on value and condition changes. Notifications can be triggered by the expiration of a timer or an event. The IoT Core supports the output of notifications in CSV or JSON format.

Available data points:

Name	Description	Access
timer[x]/counter	Timer for triggering a notification	rw
timer[x]/interval	Cycle time of the update of the subscribed values	rw
iolinkmaster/port[n]/portevent	Display of the following events on IO-Link port n: ▪ IO-Link device connected ▪ IO-Link device disconnected ▪ Operating mode of the IO-Link port changed	rw
iolinkmaster/port[n]/iolinkdevice/iolinkevent	Display of IO-Link events	rw

r ... read only
rw ... read and write
x = [1,2]
n = 1...4

Applicable services:

Name	Description
../datachanged/subscribe	Subsrscibe to notification
../datachanged/unsubsribe	Unsubscribe notification
../datachanged/getsubscriptioninfo	Show information about notifications

Additionally, the user can use **Service: getsubscriberlist** (→ S. 128) show all active subscriptions.

Example: Subscribing to notifications

33853

Task: The current values of the following parameters are to be sent regularly to a network server with IP address 192.168.0.4:

- cyclic input data of the IO-Link Devices an IO-Link port X02
- Operating temperature of the IO-Link master.

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

The following options are additionally available:

- via WebSockets (ws://): **Example: Using WebSockets** (→ S. 60)

- 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"]
}
}
```

In addition, the time interval of the timer[1] must be set to a value between 500 ms and 2147483647 ms.

- Request:

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

- Response:

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

- Notification (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"}}}
}
```

Example: Changing a subscription

61161

Task: The existing subscription (**Example: Subscribing to notifications** (→ S. 57)) is to be changed. 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"]}
}
```

Example: Unsubscribing from notifications

61163

Task: The existing subscription (**Example: Subscribing to notifications** (→ S. 57)) 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.

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

Example: Checking subscriptions

61164

Task: Information about the existing subscription (**Example: Subscribing to notifications** (→ S. 57)Show **Example: Subscribing to notifications** (→ S. 57)).

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:

```
{
"cid." 4711,
"data":{
"callback":"http://192.168.0.4:80/temp",
"datatosend":[
"/iolinkmaster/port[2]/iolinkdevice/productname",
"/iolinkmaster/port[2]/iolinkdevice/pdin",
"/processdatamaster/temperature"]},
"code":200
}
```

9.2.22 Using Web Socket

61349

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

WebSockets can be used for the following services:

- subscribe / unsubsribe



Maximum number of WebSocket connections: 1

Fail-safe WebSocket connections (wss://) are not supported.

To transmit notifications via a WebSockets connection:

► Establish the WebSocket connection (e.g. "`ws://192.168.0.55:80/websocket`")

- Option 1. without parameter "callback"

► make subscribe/unsusbribe request without parameter "callback".

> IoT-Core sends notifications about existing WebSocket connections.

- Option 2. with parameter "callback"

► make subscribe/unsubscribe requests with parameter "callback" ("`ws:///myTopic`").

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

Example: Using WebSockets

61166

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

- Product name of the IO-Link Devices an IO-Link port X02
- cyclic input data of the IO-Link Devices an IO-Link port X02
- 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"]}
}
```

9.2.23 Using the IoT-Core Visualizer

Content

Managing notifications 63
Searching for elements in the device tree 65
Configuring IO-Link the master 66
Reading and writing process data 67
Updating the firmware 68

61173

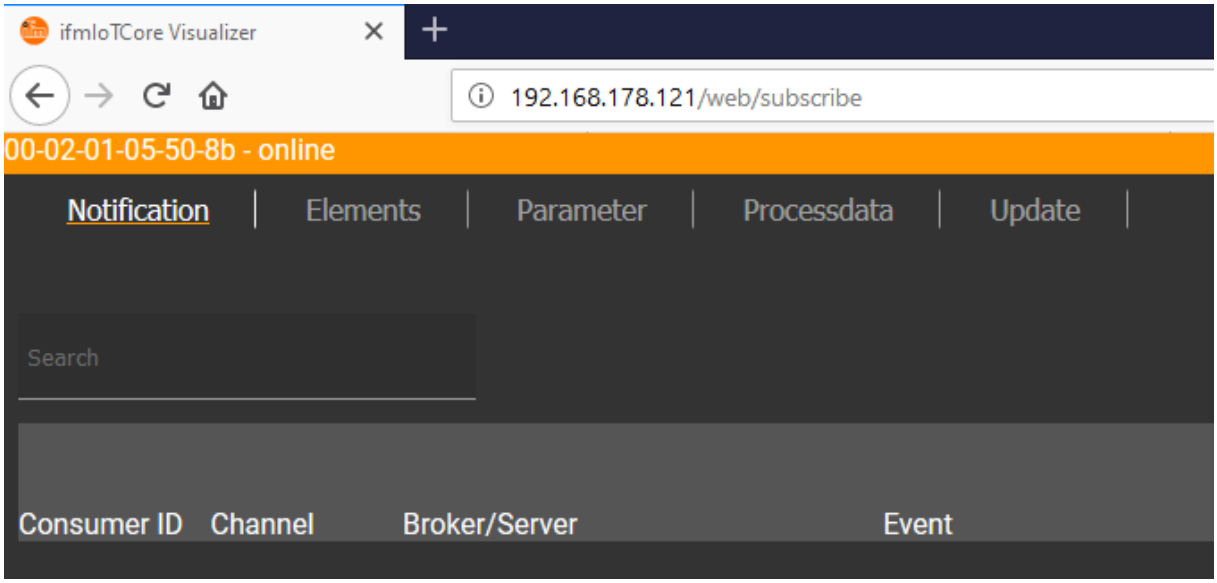
The ifm-IoT Core Visualizer of the IO-Link master provides a graphical user interface for accessing functions of the ifm-IoT Core.

To start the IoT Core Visualizer:

► Start web browser.

► Call the following address: http://ipaddress/web/subscribe

> Browser shows IoT Core Visualizer:



The navigation menu gives the user access to the following functions:

- [Notification]: Creating and managing notifications (subscribe / unsubscribe)
- [Elements]: Searching for elements in device description
- [Parameter]: Configuring IO-Link master
- [Processdata]: Reading and writing process data
- [Update]: Updating the firmware of the IO-Link master

Managing notifications

61174

The menu page allows you to perform the following functions

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

Requirements:

- Iot-Core Visualizer has been started.

► Click on [Notification].

> The menu page for managing notifications appears.

> The menu page shows all registered notifications in a table

Creating a new notification

61175

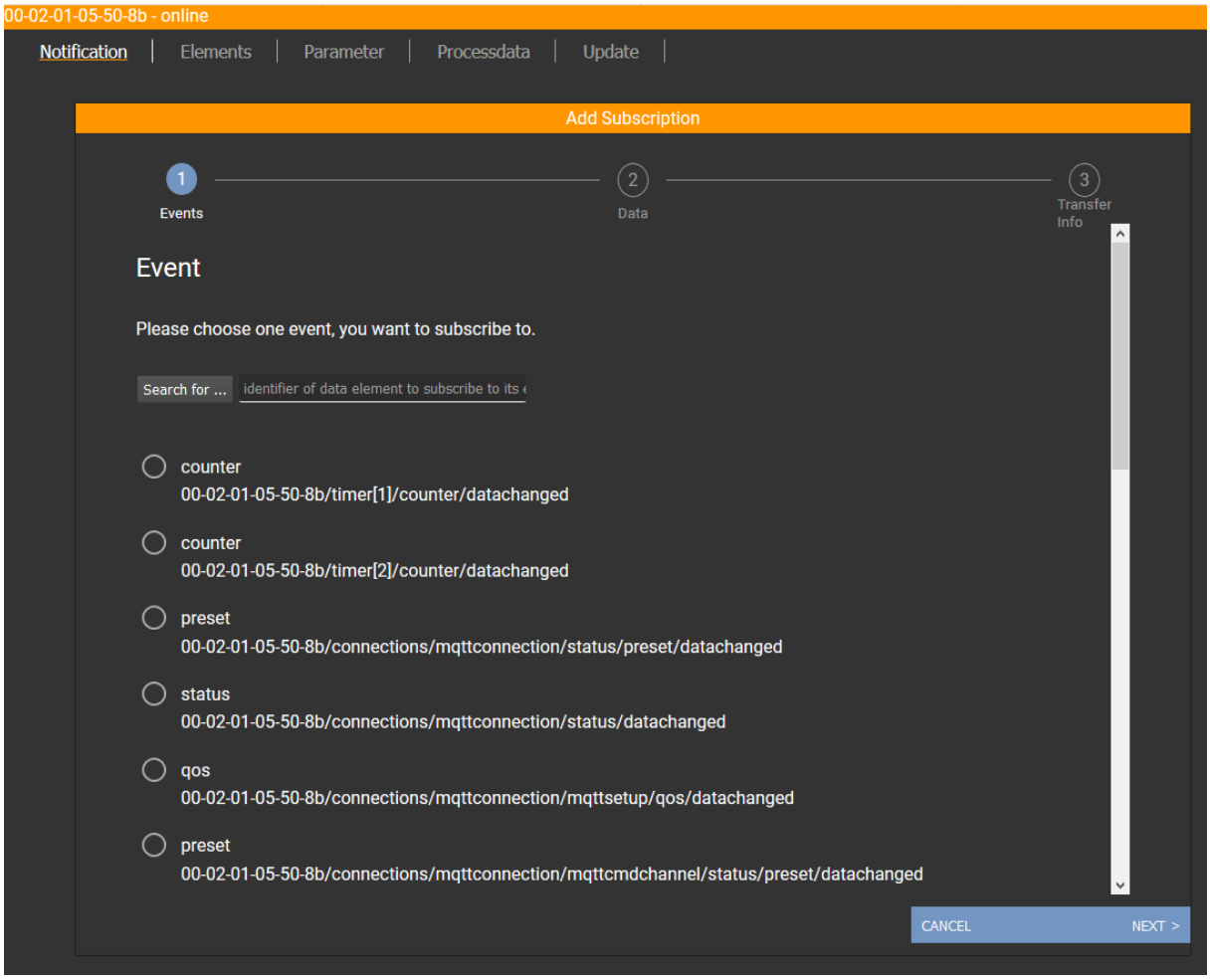
A wizard is used to register new notifications.

Requirements:

- The [Notification] menu page is open.

► Click on [+] on the right side of the table.

> The wizard for the creation of notifications appears.



► Use the wizard to enter the required notification parameters step by step.
> Created notification subscription is displayed in the table.

For cyclical notifications via timer[1] or timer[2], the user also needs to set the interval time of the timer in question.

Deleting a notification

61176

Requirements:

- The [Notification] menu page is open.
- At least one notification is active.

► Click on [x] in the column [Unsubscribe].
> The selected notification will be deleted (unsubscribe).

Searching for elements in the device tree

61177

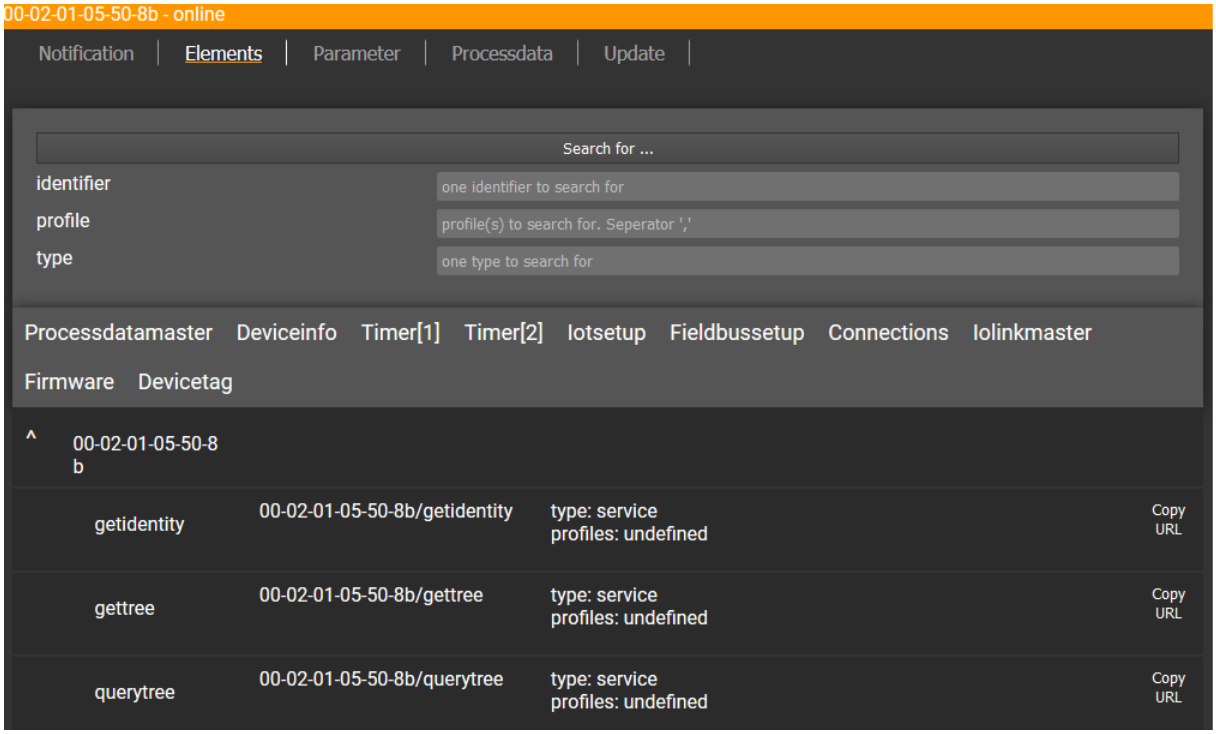
The [Elements] menu page allows you to search the device description for elements with specific properties (status, profile, name) and to output the results.

Requirements:

- Iot-Core Visualizer has been started.

► Click on [Elements].

> The input mask appears.



► Enter the search criteria of the required item in the [identifier], [profile] and [type] boxes.

► Click on [Search for ...].

> IoT-Core Visualizer searches device description for elements with selected search criteria.

> The result list shows all elements found.

Configuring IO-Link the master

61178

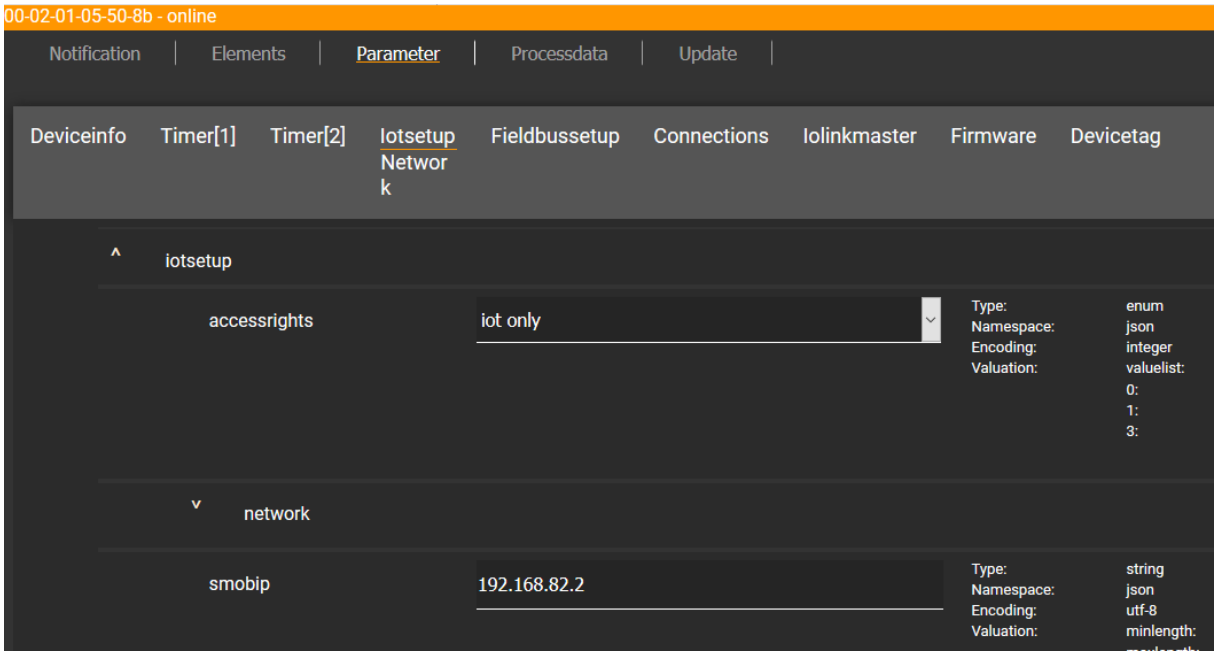
The [Parameter] menu page allows you to configure the IO-Link master.
Available options:

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

Requirements:

- Iot-Core Visualizer has been started.

► Click on [Parameter].
> The menu page shows the available parameters of the IO-Link master.
> Current parameter values are displayed.
> Editable parameters can be changed.



To change a parameter:

► Navigate to the desired parameter in the device description.
► Changing the parameter value
► Click on the pencil icon to save the change on the IO-Link master.
> The changed parameter value is active.
► Optional: Repeat the procedure to change further parameter values.

Reading and writing process data

61179

The menu page allows the process data of the IO-Link master and the connected IO-Link devices to be read and written.

Requirements:

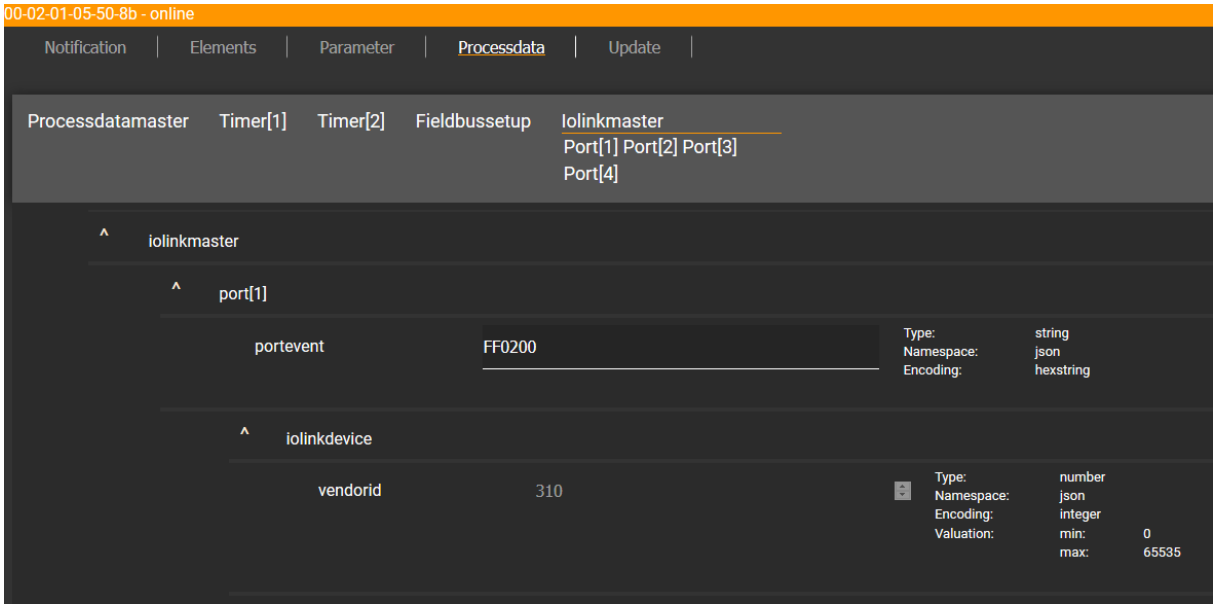
- Iot-Core Visualizer has been started.

► Click on [Processdata].

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

> The current process values are displayed.

> Editable process data can be changed.



To change the value of a process date:

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

► Change the process value.

► Click on the pencil icon to save the change on the IO-Link master.

> The changed process value is active.

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

Updating the firmware

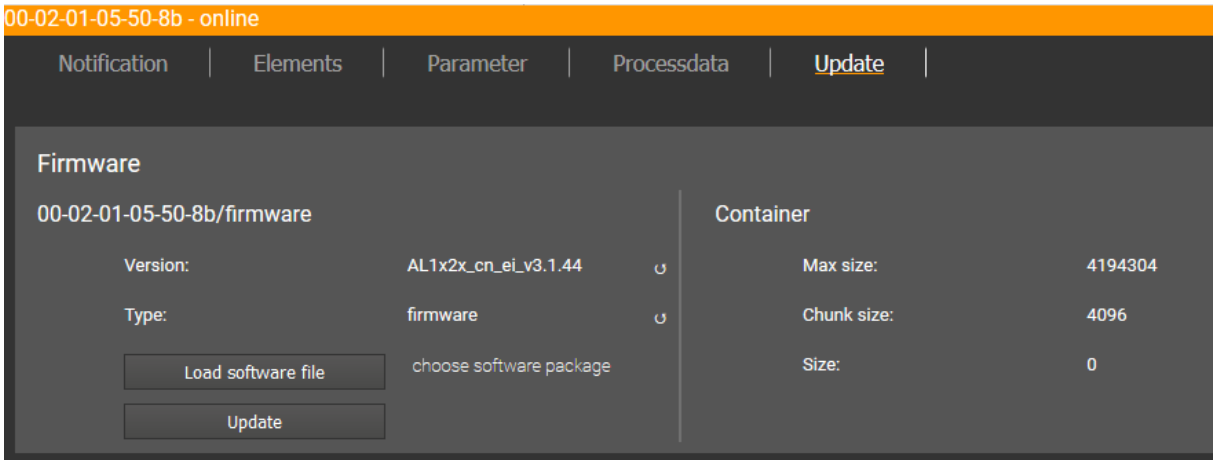
61180

The [Update] menu page allows you to update the firmware of the IO-Link master:
Requirements:

- Iot-Core Visualizer has been started.

► Click on [Update].

> Menu page displays information about the current firmware version.



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

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

> The firmware of the IO-Link master will be updated.

> The area shows the progress bar.

> If the update process has been successful, the IO-Link master will restart automatically.

9.3 PROFINET

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Configure IO-Link devices 76
Read and write process data 77
Saving and restoring data storage 78
Using Suspend / Resume 80
Detect diagnostic information and alarms 82
Read I&M datasets 85

34541

On the field bus side, the device can be configured with the following options:

- PROFINET projection software STEP 7 (version 5.5 SP 4 or higher)
- PROFINET projection software TIA portal

Further information about operation and functions of the PROFINET parameter setting software:

► Use the help function of the PROFINET projection software!

9.3.1 Install GSD Files

57582

ifm provides a GSD file to map the IO-Link masters of the AL14 device family in the PROFINET projecting software. The user can download the GSD file from the ifm website (→ www.ifm.com).

To add the IO-Link masters to the hardware catalogue of the PROFINET projection software:

► Download the GSD file of the IO-Link masters from the ifm website.

► Launch the PROFINET projection software.

► Install GSD Files.

Once the GSD file is installed, the IO-Link masters are in the hardware catalogue in the following folder:

[Other field devices] > [PROFINET IO] > [ifm electronic] > [ifm electronic]

9.3.2 Integrate the IO-Link master in the project

57583

Using the installed GSD file, the IO-Link master can be added to a project.

► Create a new project / open an existing project.
► Open the [Devices & networks] view.
► Create and configure PROFINET controller and coupling units.
► Create and configure PROFINET connection.
► Drag the IO-Link from the hardware catalogue and drop it in the project.
> The IO-Link master is loaded with a default configuration into the project.
> The IO-Link master is part of the project.

To integrate the IO-Link master in the infrastructure, the IP settings of the fieldbus interface must be configured correspondingly.

► In the [Devices & networks] view: Double-click on the IO-Link master
> The overview [Device overview] of the IO-Link master.
► Select the slot [0 X1] (PN-IO).
> The window [Properties] > [General] shows features of the fieldbus interface.
► Select the menu point [Ethernet addresses].
► Select PROFINET connection.
► Adapt the IP settings of the Ethernet interface to the features of the PROFINET connection.
► Optional: Configure further settings of the Ethernet interface.
► Save the project.
► Connect with the PROFINET controller and load the project to the controller.

Note: Use S2 redundancy

61350

The AL1401 supports redundant system design according to S2 for the construction of fail-safe systems.

► AL1401 add to PROFINET project.
► AL1401 via PROFINET networks to the redundant controllers.
► In the settings of AL1401, check whether the connections to the redundant controllers are active.
► In the properties of the PROFINET interface (slot [PN_IO]), set the watchdog time to 200 ms.

Note: Use CiR

61351

The AL1401 supports Cofiguration-in-Run. This function enables the user to load changes and extensions of the hardware configuration in the fieldbus project planning software to the controller without needing to put the controller in the "stop" state.

9.3.3 Configure the IO-Link master

Content

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IO-Link master: Setting the module parameters 73

57584

Access to the configuration of the IO-Link master via the following slots:

Slot	Description
[1]	Profile of the IO-Link master
[1 IOLM proxy]	IOLM Proyx module

IO-Link Master: Adjust profile

57585

The IO-Link master can be operated with different profiles.
The selection of the profile determines the following properties of the IO-Link master:

- Type and size of the process data of the IO-Link master
- available sub-models for IO-Link ports

Profile	Module	IO-Link Master Proxy	Description
Mix Mode - Standard	4 ports	IO-Link Master Proxy 4P	Standard IO-Link master IOLM Proxy: ▪ 1 byte of cyclic input data (digital inputs) ▪ 1 byte of cyclic output data (digital outputs) IOLD proxy (per port): ▪ max. 33 bytes of cyclical process data (digital inputs, IO-Link inputs, PQI) ▪ max 32 bytes of cyclical process data (IO-Link outputs)
Mix Mode - Energy Monitoring*	4 ports	IO-Link Master Proxy 4P EnMo	Standard IO-Link master with active energy monitoring IOLM Proxy: ▪ 28 bytes of cylical input data (digital inputs, energy monitoring) ▪ 1 byte of cyclic output data (digital outputs) IOLD proxy (per port): ▪ max. 33 bytes of cyclical input data (digital inputs, IO-Link inputs, PQI) ▪ max. 32 bytes of cyclical output data (digital outputs, IO-Link outputs)
IO Mode	4 ports - IO Mode	IO-Link Master Proxy 4P IO-Mode	IO-Link master with compact transmission of digital process data IOLM Proxy: ▪ 2byte of cyclic input data (digital inputs) ▪ 2byte of cyclic output data (digital outputs) IOLD proxy (per port): ▪ max. 33 bytes of cyclical input data (IO-Link inputs, PQI) ▪ max. 32 bytes of cyclical output data (IO-Link outputs)

* ... Factory setting

To adjust the profile of the IO-Link master:

> The device catalogue is open.
► In the project: Double click onAL1401
> The window [Device overview] of the AL1401 appears.
► In the device catalogue: Drag the required module from the [Module] folder to slot [1].
> The selected profile is loaded with the preset IOLM proxy module.

Optional: Change the IOLM proxy module

► In [Device overview]: Select slot [1 IOLM proxy] and remove the active IOLM proxy module.
► In the device catalogue: Drag the required module from the folder [Submodules] > [IO-Link Master Proxy] and drop it at slot [1 IOLM-proxy].
> The selected IOLM proxy module will be loaded.
► Save the project.

Further steps:

- **IO-Link Master: Module-Parameter einstellen**
- **Configure IO-Link ports** (→ S. 74)

IO-Link master: Setting the module parameters

59814

	IOLM proxy module		
Parameter	**IO mode**	**IO-Link Master Proxy 4P**	**IO-Link Master Proxy EnMo 4P**
Enable Port Diagnosis	X	X	X
Enable Port Configuration without Tool	X	X	X
Mode Pin2 (Actuator Supply UA)	X	X	X
Current Limit Pin2 (Actuator Supply UA [mA])	X	X	X
Current Limit Pin1 + Pin4 (Sensor Supply US) [mA])	X	X	X
Fails Safe DO Mode Pin2 (Actuator Supply UA)	X	X	X
Module Failure	X	X	-

Details about the parameters of the IOLM proxy modules: → **Parameters of the IOLM proxy modules** (→ S. 101)

To set the parameters of an IOLM proxy module:

> The profile of the IO-Link master is set (→ **IO-Link Master: Adjust profile** (→ S. 72)).
> The device catalogue is open.
► In the project: Double click on AL1401
> The window [Device overview] shows the slot configuration of the AL1401.
► Select slot [1 IOLM proxy].
> The window [Properties] > [General] shows properties of the IO-Link master.
► Select the [Module parameters] menu.
> The window shows available parameters of the IOLM proxy module.
► Change the parameter values.
► Save the project.

Wenn sowohl über LR DEVICE If there needs to be a write access to the IO-Link master both via LR DEVICE (IoT) and via the PROFINET projecting software, the following is to be considered: The parameter values set in the PROFINET projecting software always have the highest priority.

If write access to the IO-Link master is to be only via the LR DEVICE / IoT, please make the following settings:

- LR DEVICE / IoT: Parameter [Access Rights] = [IoT only]
- PROFINET projection software: Parameter [Access Rights] = [Keep settings]

Changes of the parameter [Access Rights] will only be effective after restarting the IO-Link master.

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

9.3.4 Configure IO-Link ports

57587

Access to the configuration of the IO-Link ports via the following slots:

Slot	Description
[1 X1 (B-Port)]	Configuration of port X1
[1 X2 (B-Port)]	Configuration of port X2
[1 X3 (B-Port)]	Configuration of port X3
[1 X4 (B-Port)]	Configuration of port X4

IO-Link Ports: Configuration of the operating mode and process data

57588

The IO-Link ports are configured with IOLD proxy modules. The IOLD proxy modules determine the following properties:

- Operating mode of the port (pin 4)
- Type and size of the process data



Details of the available IOLD proxy modules: → **IOLD proxy modules** (→ S. 102)

The available IOLD proxy modules depend on the selected profile of the IO-Link master.

	Profile		
Port modules	**IO Mode**	**Mix Mode - Standard**	**Mix Mode - Energy Monitoring**
Deactivated	X	X	X
Digital Input		X	X
Digital Input without PD	X		
Digital Output		X	X
Digital Output without PD	X		
IO-Link Input + PQI	X	X	X
IO-Link Output + PQI	X	X	X
IO-Link Input + Output + PQI	X	X	X

X ... Parameter available

To configure the process data of a port:

Requirements:

> The profile of the IO-Link master is set.

> The device catalogue is open.

> The [Device overview] view of the AL1401 is activated.

► In the device catalogue: Drag the required IOLD proxy module from the [Submodules] folder and drop it on the slot of the port.

> The IOLD proxy module will be loaded with the factory settings.

> IEC addresses for process data of the port will be generated.

► Save the project.

IO-Link Ports: Parameter setting

57589

The different IOLD proxy modules have specific parameter sets.

	IOLD proxy modules						
Parameter	**Digital Input**	**Digital Input without PD**	**Digital Output**	**Digital Output without PD**	**IO-Link Input + PQI**	**IO-Link Output + PQI**	**IO-Link Input + Output + PQI**
Fail Safe Mode	-	-	X	X	-	X	X
Pattern Value	-	-	-	-	-	X	X
Enable Port Diagnosis	X	X	X	X	X	X	X
Enable Process Alarm	X	X	X	X	X	X	X
Port Configuration without Tool	-	-	-	-	X	X	X
Enable Pull/Plug	-	-	-	-	X	X	X
Port Mode	-	-	-	-	X	X	X
Validation / Data Storage	-	-	-	-	X	X	X
Vendor ID (VID)	-	-	-	-	X	X	X
Device ID (DID)	-	-	-	-	X	X	X
Port Cycle Time	-	-	-	-	X	X	X

X ... Parameter available

Details about the parameters of the IOLD proxy modules: → **Parameters of the IOLD proxy modules** (→ S. 104)

To set the parameters of an IOLD proxy module:

> The operating mode and the process data of the port are set.
> Detailed view [Device overview] is opened.
► In [Device overview]: Select the slot of the port.
> the window [Properties] > [General] shows information via the port module.
► Select the menu item [Module parameters].
> The detailed view shows the current settings of the module parameters.
► Set the parameters as required.
► Save the project.

Note: Supress pull/plug alarms

61352

The AL1401 supports the deactivation of the pull/plug alarms.
If the parameter is deactivated, dragging an IO-Link device produces the following reactions:

> TIA portal: Pull alarm on sublot of the port is not indicated.
> IO-Link master: Status LED "SF" is not lit red.
> Port Qualifier Information (PQI): Bit "DevCom" = 0x0 (= IO-Link Device not available).

9.3.5 Configure IO-Link devices

57590

The AL1401 supports the configuration of the connected IO-Link devices via the PROFINET application. The configurable parameters depend on the IO-Link device that is used.

Configurable parameters of the IO-Link devices: → IO Device Description (IODD) des IO-Link Devices

The following options are available:

Function block	Description	Remarks
IO_LINK_DEVICE	Acyclic access to the parameters of an IO-Link device	Input parameters: ▪ CAP: Access point for function AL1401: 0xB400 ▪ PORT: Slot/sub-slot of the IO-Link interface of the connected IO-Link device Port X1: 1 Port X2: 2 ... Port X4: 4 ▪ IOL_INDEX and IOL_SUBINDEX: Index and sub-index of the parameter (depends on the IO-Link device: → IO Device Description (IODD))
IOL_CALL	Acyclic access to the parameters of an IO-Link device (obsolete)	→ IO_LINK_DEVICE

9.3.6 Read and write process data

57591

During the configuration of the IO-Link master and of the ports, IEC address ranges are automatically reserved for all process data.

Depending on the selected IO-Link master profile, the digital process data of the ports (operating modes: "digital input", "digital output") will be mapped to different address ranges:

- Mix Mode: each digital process value (pin 4) receives a separate address
- IO-Mode: Digital process data of the ports (pin 4) are transferred as a compact unit in a coherent address range in the IOLM proxy.

To enable access to the cyclic process data in the application, the user must couple the reserved IEC addresses with symbolic variables. This happens in the global variable list of the project (step 7: [Symbols]; TIA portal: [PLC tags]).

Execute the following actions in the global variable list of the project:

► Create a new symbol and select the data type.

► Assign the required IEC address to the symbol.

► Adjust the properties of the symbol (write access, visibility, etc.).

Using the symbolic name, the user can read the inputs and write the outputs from the application.

► To check the validity of the cyclic process data, evaluate the PQI byte (→ **Mapping: Port Qualifier Information (PQI)** (→ S. 111)).

Even if the fieldbus connection is interrupted, the PQI byte indicates that the process data is valid. This may have an unintended impact on the control process.

► Take suitable measures to detect an interruption of the fieldbus connection.

9.3.7 Saving and restoring data storage

61353

The device supports backup (IOLD Backup) and restore (IOLD Restore) of the data storage area of a port for serial commissioning of multiple IO-Link devices.

To back up and restore the data storage area, the following conditions must be met.

- Data storage of the port is enabled.
- The IO-Link device is connected to the port.

To back up the data storage area of one of the devices.

► Saving the Data Storage with FB RDREC

To restore the complete data storage area of AL1401.

► Restoring the data storage with FB WRREC

Note: FB "RDREC"

61354

To back up the data storage of a port, use FB "RDREC" to perform a read operation:

Parameter	Description	Possible values	
REQ	Trigger for execution of the function	FALSE	do not execute
		TRUE	execute FB
ID	Hardware identification of the port	see port properties	
INDEX	Index of the service	0xB901	Data Storage
LEN	Length of the data image (in bytes)		
RECORD	Name of the data image to which the Data Storage is to be saved	e.g. Array of Bytes	

Note: FB "WRREC"

61355

► Do not change the read data storage image! The FB "WRREC" detects a manipulation and refuses the write operation.

► After successful execution of the FB (xDone = TRUE), reset the input REQ.

The value at input LEN must be at least as large as the length of the read out data storage (output LEN of FB "RDREC").

Parameters of the FB "WRREC":

Parameter	Description	Possible values	
REQ	Trigger for execution of the function	FALSE	do not execute
		TRUE	execute FB
ID	Hardware identification of the port	see port properties	
INDEX	Index of the service	0xB901	Data Storage
LEN	Length of the data image	see output LEN of FB "RDREC	
RECORD	Name of the data image containing the data storage to be written		

After writing the data storage area, the "NewPar" bit of the Port Qualifier Information (PQI) indicates that the data storage of the device has changed.

► To reset the bit, perform a read operation with "RDREC" on index 0xB901.

9.3.8 Using Suspend / Resume

61356

The AL1401 supports the Suspend & Resume function for automatic tool change. During execution of the suspend function, all diagnostic messages from the affected IO-Link ports and connected IO-Link devices to the PLC will be suppressed.

To use the suspend & resume function, the OB "IOL_CALL" must be changed. Contact ifm support for the modified version.

The suspend function only suppresses the diagnostic messages of the port, the IO-Link devices are not disabled.

The Suspend & Resume function can only be carried out with identical devices (Vendor ID and Device ID of the devices must be identical).

To use the Suspend / Resume function, implement the following procedure:

► Execute the suspend function for IO-Link port with FB "IOL_CALL".

> Port Qualifier Information (PQI):

- Bit "PortActive" = 0x0

► Disconnect the old IO-Link device from the port.

> Port Qualifier Information (PQI):

- Bit "PQ" = 0x0
- Bit "DevCom" = 0x0

► Connect new IO-Link device to port.

> Port Qualifier Information (PQI):

- Bit "PQ" = 0x1
- Bit "DevComm" = 0x1

► Execute the resume function for the IO-Link port with the FB "IOL_CALL”.

> Port Qualifier Information (PQI):

- Bit "PortActive" = 0x1

Note: Suspend with FB "IOL_CALL”

61357

Parameter of FB "IOL_CALL" for suspend function:

Parameter	Description	Possible value	
IOL_ID	Hardware identification	277	IO-Link Master Proxy
CAP	Access point for function	0xB400	IO-Link call protocol
RD_WR	Read access / write access	TRUE	Write
PORT	IO-Link port of the device	1	Port X1
		...	...
		4	Port X4
IOL_INDEX	Index	0xFFFF	IO-Link master
IOL_SUBINDEX	Subindex	3	Command "Suspend”
IOL_LEN	Length of the transferred data	0	

Note: resume with FB "IOL_CALL”

61358

Parameter of FB "IOL_CALL" for resume function:

Parameter	Description	Possible value	
IOL_ID	Hardware ID	277	IO-Link Master Proxy
CAP	Access point for function	0xB400	IO-Link call protocol
RD_WR	Read access / write access	TRUE	Write
PORT	IO-Link port of the device	1	Port X1
		...	...
		4	Port X4
IOL_INDEX	Index	0xFFFF	IO-Link master
IOL_SUBINDEX	Subindex	4	Command "Resume”
IOL_LEN	Length of the transferred data	0	

9.3.9 Detect diagnostic information and alarms

61359

All occurring IO-Link events of the IO-Link master, the ports and the IO-Link devices are mapped to PROFINET diagnostic information (Extended Channel Diagnostic). The user can read the event messages with FB RALRM. All read events will be stored in an array (bytes) AINFO. The relevant information is stored in bytes 26...39.

Byte	Content	Description
26..27	Format Identifier	Identification of the format ▪ 0x8002 = Extended Channel Diagnostic
28...29	Channel Number	Channel number ▪ 0x8000 = whole submodule ▪ 0x0001 ... 0x0004 = Port X1 ... X4
30...31	Channel Properties	Properties of the channel ▪ 0x0800 = diagnostics
32...33	Channel Error Type	Source of the event ▪ 0x9502 = IO-Link master / port ▪ 0x9500 = IO-Link device
34...35	Ext. Channel Error Type	Error code ▪ IO-Link master error codes: ▪ IO-Link device error codes:
36...39	Additional Error Information	additional information ▪ 0x0000 0000 = reserved

Reading IO-Link master events

61360

Available event codes:

AINFO	Error type: Trigger	Diagnostic message
▪ **Channel Number:** 0x8000 ▪ **Channel Error Type:** 0x0x9502 ▪ **Ext. Channel Error Type:** 0x1600	Overvoltage US (warning): Supply voltage US > 31 V	"US error message"
▪ **Channel Number:** 0x8000 ▪ **Channel Error Type:** 0x9502 ▪ **Ext. Channel Error Type:** 0x1601	Overvoltage UA: Supply voltage UA > 31 V	"UA error message"
▪ **Channel Number:** 0x8000 ▪ **Channel Error Type:** 0x9502 ▪ **Ext. Channel Error Type:** 0x1806	Undervoltage US (warning): Supply voltage US < 18.5 V	"US error message"
▪ **Channel Number:** 0x8000 ▪ **Channel Error Type:** 0x9502 ▪ **Ext. Channel Error Type:** 0x180E	Undervoltage UA: Supply voltage UA <18.5 V or not applied	"P24 (Class B) missing or undervoltage"
▪ **Channel Number:** 0x8000 ▪ **Channel Error Type:** 0x9502 ▪ **Ext. Channel Error Type:** 0x1807	Excessive current: Sum of the currents of supply voltage US > 3.6 A	"Overcurrent at L+ - check power supply (e.g. L1+)"
▪ **Channel Number:** 0x1 ... 0x4 ▪ **Channel Error Type:** 0x9502 ▪ **Ext. Channel Error Type:** 0x1806	short circuit: pins 1 + 3	"Short circuit at L+ - check wire connection"
▪ **Channel Number:** 0x1 *) 0x4 ▪ **Channel Error Type:** 0x9502 ▪ **Ext. Channel Error Type:** 0x1804	short circuit: Port operating mode "IO-Link" and pin 4 + 3 or pin 1 + 3	“Short circuit at C/Q - check wire connection"
▪ **Channel Number:** 0x1 ... 0x4 ▪ **Channel Error Type:** 0x9502 ▪ **Ext. Channel Error Type:** 0x1811	Short circuit: Port operating mode "DO" and Pin 4 + 3 or Pin 1 + 3	"Short circuit at C/Q - check load"
▪ **Channel Number:** 0x1 ... 0x4 ▪ **Channel Error Type:** 0x9502 ▪ **Ext. Channel Error Type:** 0x180F	Short circuit: ▪ Port operating mode "DO" and pin 2 + 5 or ▪ Type B supply and pin 2 + 5	"Short circuit at P24 (Class B) - check wire connection (e.g. L2+)"
▪ **Channel Number:** 0x1 ... 0x4 ▪ **Channel Error Type:** 0x9502 ▪ **Ext. Channel Error**Type:0x1800	IO-Link - No device information: no IO-Link device connected - pull/plug deactivated	"No Device"
▪ **Channel Number:** 0x1 ... 0x4 ▪ **Channel Error Type:** 0x9502 ▪ **Ext. Channel Error Type:** 0x1803	IO-Link - incorrect device ID: connected IO-Link device does not match the set Device ID (DID)	"Incorrect DeviceID"
▪ **Channel Number:** 0x1 ... 0x4 ▪ **Channel Error Type:** 0x9502 ▪ **Ext. Channel Error Type:** 0x1802	IO-Link - incorrect Vendor ID: connected IO-Link device does not match the set Vendor ID (VID)	"Incorrect VendorID"
▪ **Channel Number:** 0x1 ... 0x4 ▪ **Channel Error Type:** 0x9502 ▪ **Ext. Channel Error Type:**0x6001	IO-Link - incorrect revision: connected IO-Link device does not match the set revision	"Revision fault"
▪ **Channel Number:** 0x1 ... 0x4 ▪ **Channel Error Type:** 0x9502 ▪ **Ext. Channel Error Type:** 0x6000	IO-Link - incorrect cycle time: connected IO-Link device does not match the set cycle time	"Invalid cycle time"
▪ **Channel Number:** 0x1 ... 0x4 ▪ **Channel Error Type:** 0x9502 ▪ **Ext. Channel Error Type:** 0x1801	IO-Link - wrong sensor: connected IO-Link device does not match the set validation value - unspecific - IO-Link device not recognised	"Startup parametrization error"

Reading an IO-Link device event

61361

AINFO	Error type	Diagnostic message / error
▪ **Channel Number:** 0x1 ... 0x4 ▪ **Channel Error Type:** 0x9500 ▪ **Ext. Channel Error Type:** Event Code	IO-Link Event (IOLD Event)	depending on IO-Link device
▪ **Channel Number:** 0x1 ... 0x4 ▪ **Channel Error Type:** 0x9501 ▪ **Ext. Channel Error Type:** Event Code & MSB = 0	IO-Link Event (IOLD Event)	depending on IO-Link device



The event codes are device-specific (see IODD of the IO-Link device).

9.3.10 Read I&M datasets

52484

I&M0 provide the user with device-specific basic information. This ensures reliable identification of the device, the device's hardware and software components as well as the manufacturer.

The datasets I&M1 to 3 offer the programmer the possibility to store project-specific information on the device.

The programmer can access the I&M0 datasets of the slots 0 and 1 in the PROFINET projection software by means of the following functions:

Symbol	Description	Notes
GET_IM_DATA	▪ Function block for reading the I&M datasets of a device ▪ GET_IM_DATA only supports the reading of the I&M0 dataset	Input parameters: ▪ IM_TYPE = 0
RDREC	Function block for acyclic reading of datasets	Input parameters: ▪ I&M0: Index = 0xAFF0 ▪ I&M1: Index = 0xAFF1 ▪ I&M2: Index = 0xAFF2 ▪ I&M3: Index = 0xAFF3
WRREC	▪ Function block for acyclic writing of datasets ▪ Observe access rights on datasets!	Input parameters: ▪ I&M1: Index = 0xAFF1 ▪ I&M2: Index = 0xAFF2 ▪ I&M3: Index = 0xAFF3

10 Operation

Content

Use web-based management 86

34061

10.1 Use web-based management

57592

The device has an integrated web server The web server generates a website with the following data:

- Status information of the ports
- Diagnostic information of the device
- Version information of the installed firmware components

To access the web interface of the IO-Link master:

► Connect the IO-Link master via port XF1 or XF2 with the laptop / PC.

► Optional: Check the IP settings of the PROFINET interface.

► Start web browser.

► In the address field of the web browser, enter the IP address of the PROFINET interface and confirm with [ENTER].

> The web browser shows the website with the status and diagnostic information of the device.

11 Maintenance, repair and disposal

Content

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Updating the firmware....87
Exchanging the IO-Link device....87

51990

The operation of the unit is maintenance-free.

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

11.1 Cleaning process

51991

► Clean the surface of the unit when necessary.
► Do not use any caustic cleaning agents for this!
► In case of severe soiling, use a damp cloth.
► Do not use any caustic cleaning agents for this!

11.2 Updating the firmware

57593

The firmware of the IO-Link master can be updated via the IoT Core Visualizer↘→ **Updating the firmware** (→ S. 87).

► During the firmware update, ensure that the device is connected to the supply voltages US and UA.

11.3 Exchanging the IO-Link device

57594

To exchange an IO-Link device:

Requirements:

> The new IO-Link device is in the default state, as on delivery (factory settings).
> The new IO-Link device supports the IO-Link standard 1.1 or higher.

1 Store the parameter set of the old IO-Link device

► Create the following parameter of the IO-Link port
Device validation and data storage = [Type compatible V1.1 device with Restore]
► Save the changes on the device.
> The IO-Link master saves the parameter values of the connected IO-Link device in the data memory.

2 Exchange IO-Link device

► Disconnect the old IO-Link device from the IO-Link master.
► Connect the new IO-Link device with the same IO-Link port of the AL1401.
> The IO-Link master transfers the parameter values from the data memory to the new IO-Link device.
> The new IO-Link device works with the restored parameter set.

12 Factory Settings

34591

In the factory settings, the device has the following parameter settings:

Parameter	Factory setting
[IP address]	0.0.0.0
[Subnet mask]	0.0.0.0
[IP gateway address]	0.0.0.0
[Host name]	blank
Data Storage	empty

13 Accessories

33870

List of accessories of AL1401: → www.ifm.com > Product page > Accessories

14 Appendix

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33879

14.1 Technical data

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34188

14.1.1 Application

33878

Application	
Application	Hygienic areas; I/O modules for field applications
Daisy-chain function	Voltage supply; Fieldbus interface

14.1.2 Electrical data

57595

Electrical data	
Operating voltage [V]	20...28 DC; (US; according to SELV/PELV)
Current consumption [mA]	300...3900; (US)
protection class	III
Additional voltage supply[V]	20...28 DC; (UA)
Sensor supply US	
Total current rating [A]	3,6
Current rating per port [A]	2; (configurable: 0...2; factory setting: 0.45)
Actuator supply UA	
Total current rating [A]	8
Current rating per port [A]	2; (configurable: 0...2; factory setting: 2)

Derating behaviour

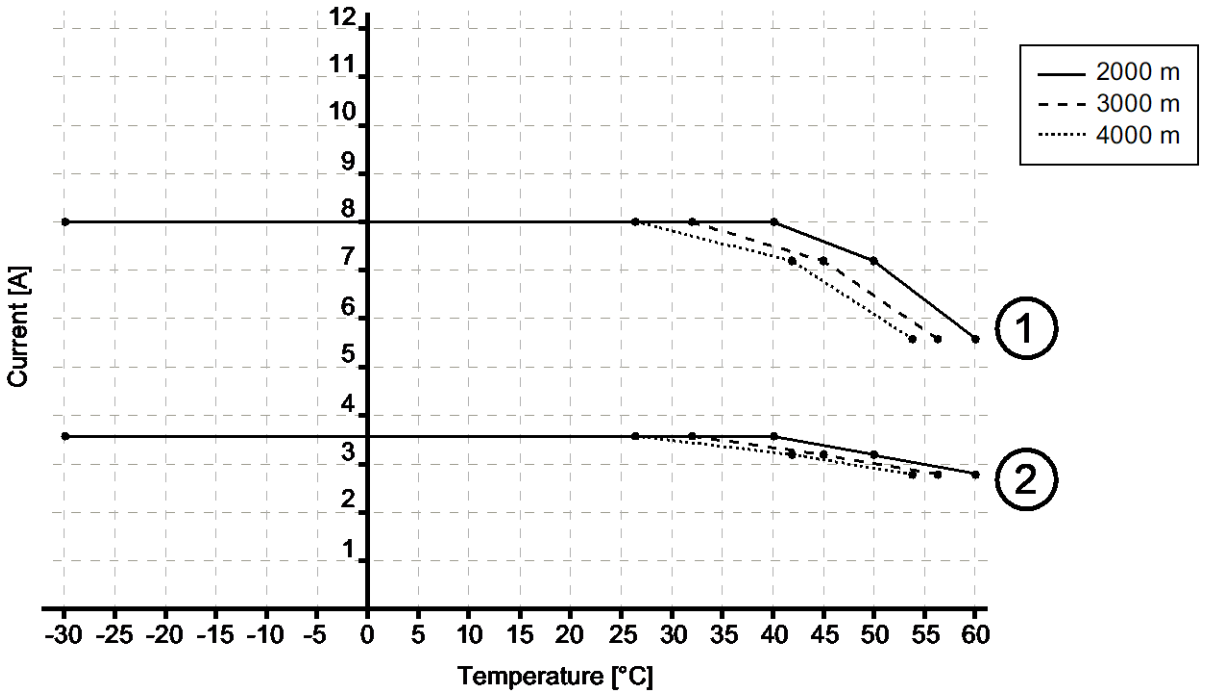
28.06.2020 22:29:00

The derating measurements were performed under the following conditions:

- Supply voltages US / UA: 24 V DC

Derating without Daisy Chain

59780



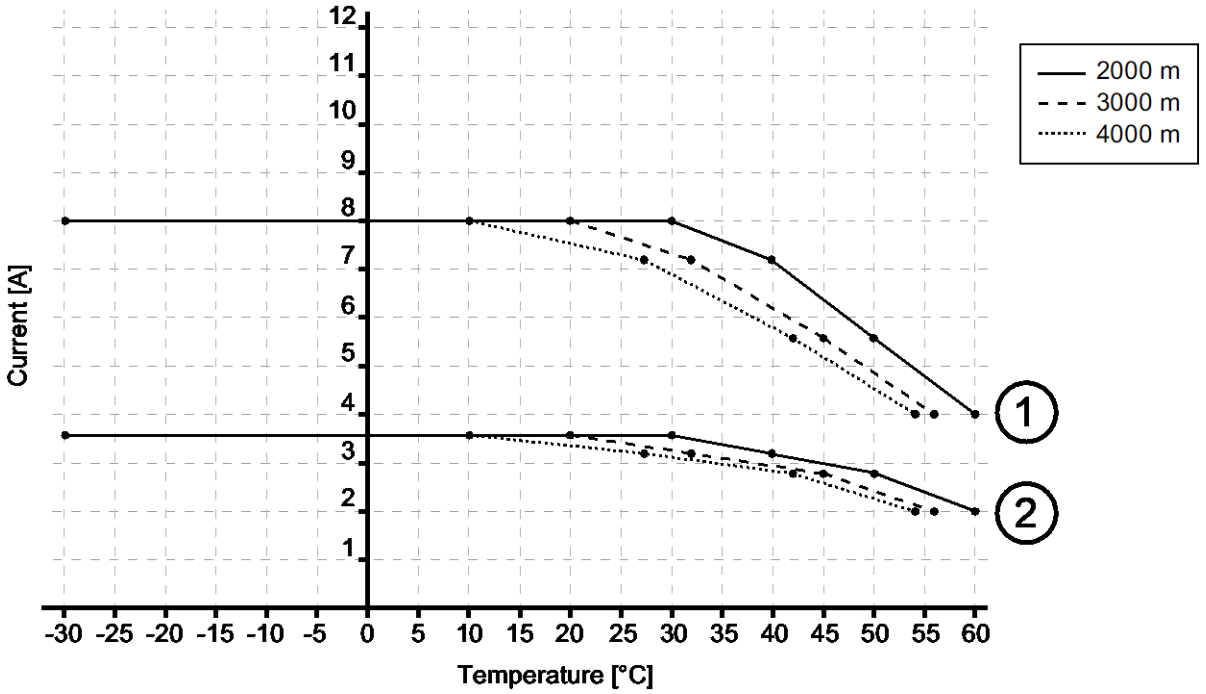
(1) I_{UA} at port X1...X4

(2) I_{US} at port X1...X4

Derating with Daisy Chain

59781

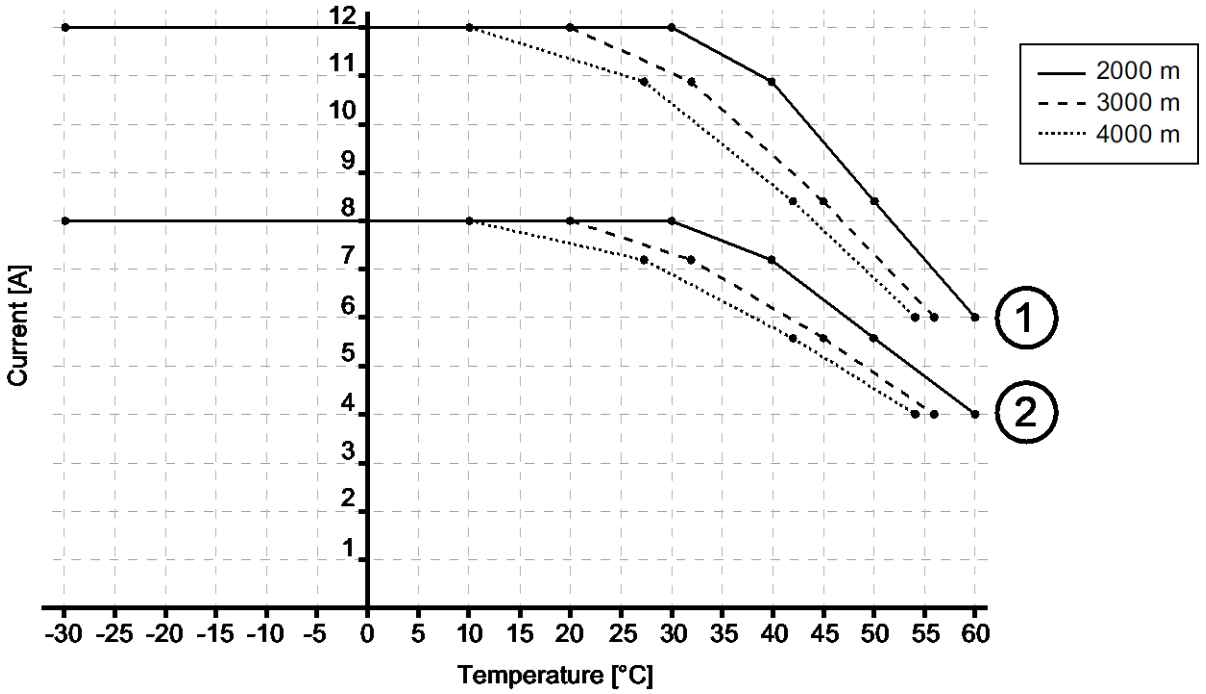
Port X1…X4:



(1) I_{UA} at port X1...X4

(2) I_{US} at Port X1...X4

Port XD2:



① $I_{US\text{-}daisy\text{-}chain}$

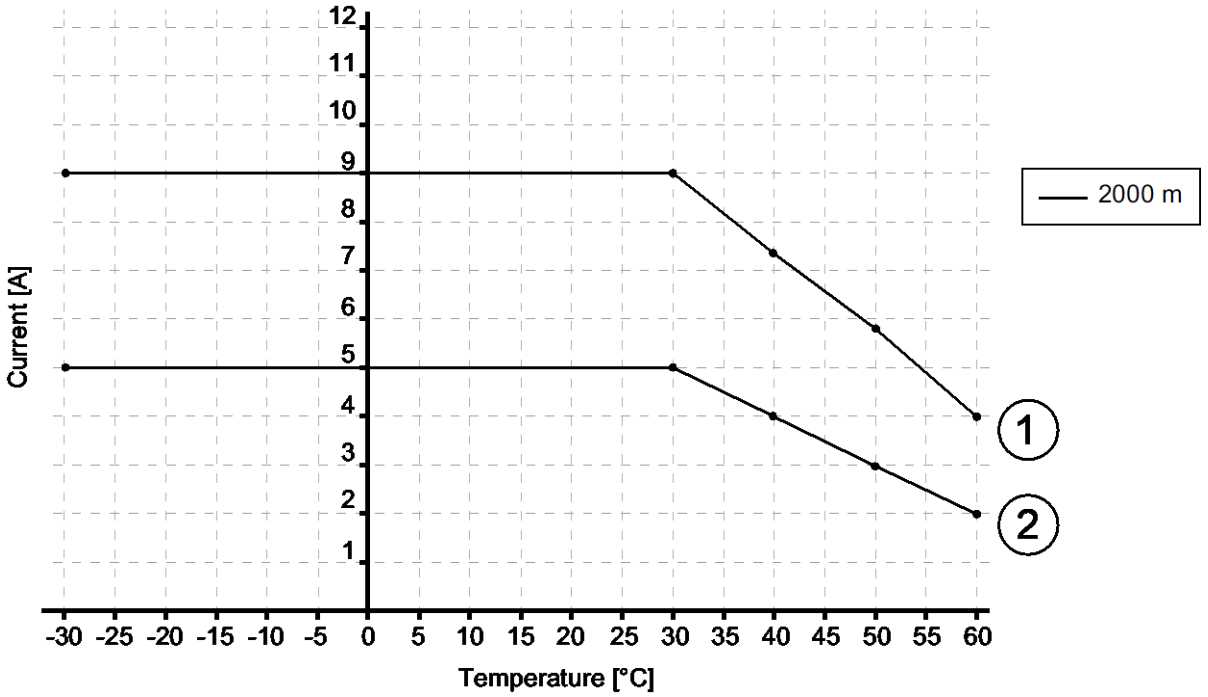
② $I_{UA\text{-}daisy\text{-}chain}$

Example:

Temperature	I_{UA} (X1…X4)	I_{US} (X1…X4)	$I_{UA\text{-}daisy\text{-}chain}$ (XD2)	$I_{US\text{-}daisy\text{-}chain}$ (XD2)
30°C	8 A	3,6 A	8 A	12 A

For UL applications:

Port XD2:



(1) $I_{US\text{-}daisy\text{-}chain}$

(2) $I_{UA\text{-}daisy\text{-}chain}$

Example:

Temperature	**I_{UA} (X1...X4)**	**I_{US} (X1...X4)**	**$I_{UA\text{-}daisy\text{-}chain}$ (XD2)**	**$I_{US\text{-}daisy\text{-}chain}$ (XD2)**
30°C	8 A	3,6 A	5 A	9 A

14.1.3 Inputs/outputs

57599

Inputs/outputs	
total number of inputs and outputs	12; (configurable)
Number of inputs and outputs	Number of digital inputs: 4; Number of outputs: 8

14.1.4 Inputs

34069

Inputs	
Number of digital inputs	4; (IO-Link Port Class B: 4x1)
Switching level high [V]	11...28
Switching level low [V]	0...5
Digital inputs protected against short circuits	yes

14.1.5 Outputs

57600

Outputs	
Number of digital outputs	8; (IO-Link port Class A: 4 x 1 IO-Link Port Class B: 4 x 2)
Short-circuit protection	yes
Actuator supply UA	
Max.current load per output [mA]	2000
Sensor supply US	
Max. current load per output [mA]	2000

14.1.6 Interfaces

57601

Interfaces	
Communication interface	Ethernet; IO-Link
Ethernet	
Transmission standard	10Base-T; 100Base-TX
Transmission rate [MBit/s]	10; 100
Protocol	PROFINET IO
Factory settings	▪ IP address: 0.0.0.0 ▪ Subnet mask: 0.0.0.0 ▪ Gateway IP address: 0.0.0.0 ▪ MAC Address: see type label
Addition	CC-C (Conformance Class C); S2 redundancy; Configuration in Run (CiR); IRT capability; SNMP
IO-Link Master	
Type of transmission	COM 1 / COM 2 / COM 3
IO-Link revision	1.1
Number of class B ports	4

14.1.7 Environmental conditions

57602

Environmental conditions	
Applications	Indoor use
Ambient temperature [°C]	-25...60 (up to 2000 m) -25...50 (up to 3000 m) -25...40 (up to 4000 m)
Storage temperature [°C]	-25...85
Max. perm. relative air humidity [%]	90
Protection rating	IP 65; IP 66; IP 67; IP 69K; (Operation with stainless steel sealing caps: IP 69K)
Degree of soiling	2

14.1.8 Approvals / tests

57603

Approvals / tests	
EMC	▪ EN 61000-6-2 ▪ EN 61000-6-4
Shock resistance	DIN EN 60068-2-27
Vibration resistance	▪ DIN EN 60068-2-64 2009-04 ▪ DIN EN 60068-2-6 2008-10

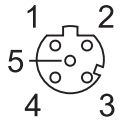
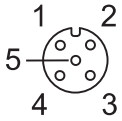
14.1.9 Mechanical data

34050

Mechanical data	
Weight [g]	321.9
Materials	Housing: PA grey; Socket: stainless steel (316L / 1.4404);

14.1.10 Electrical connection

57604

Voltage supply IN XD1		
Connector	M12 (L-coded)	
Wiring		1: + 24 V DC (US) 2: GND (UA) 3: GND (US) 4: +24 V DC (UA) 5: FE
Voltage supply OUT XD2		
Connector	M12 (L-coded)	
Wiring		1: + 24 V DC (US) 2: GND (UA) 3: GND (US) 4: +24 V DC (UA) 5: FE
Ethernet IN / OUT XF1, XF2		
Connector	M12	
Wiring		1: TX + 2: RX + 3: TX - 4: RX - 5: -
Process connection Ports Class B X1...X4		
Connector	M12	
Wiring		1: Sensor supply (US) L+ 2: Actuator supply (UA) L+ / DO 3: Sensor supply (US) L- 4: C/Q IO-Link 5: Actuator supply (UA) L-

14.2 PROFINET

Content

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14.2.1 Device structure

57606

Slot	Subslot	Label	Description
0	0x8000	X1	Parameter PROFINET-IO
	0x8001	X1 P1	Parameter Port XF1
	0x8002	X1 P2	Parameter Port XF2
1	0x1	IOLM proxy	→ **IOLM proxy module** (→ S. 100) → **Parameters of the IOLM proxy modules** (→ S. 101)
	0x2	X1 (B-Port)	→ **IOLD proxy modules** (→ S. 102) → **Parameters of the IOLD proxy modules** (→ S. 104)
	0x3	X2 (B-Port)	
	0x4	X3 (B-Port)	
	0x5	X4 (B-Port)	

14.2.2 Parameter data

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57607

IOLM proxy module

57608

Module	IO-Link Master Proxy	Description
4 ports	IO-Link Master Proxy 8P	Standard IO-Link master
4 ports	IO-Link Master Proxy 8P EnMo	IO-Link master with energy monitoring
4 ports - IO mode	IO-Link Master Proxy 8P IO-Mode	IO-Link master IO mode

Parameters of the IOLM proxy modules

57609

Parameter	Description	Possible values	
[Enable Port Diagnosis]	Enable / disable diagnostic data of the port	Disabled	deactivated
		Enabled	activated
[Port Configuration without Tool]	Enable configuration of the IO-Link ports via IODD and the communication tool	Disabled	deactivated
		Enabled	activated
[Access Rights]	The access rights to the parameter data, process data and events/diagnostic messages of the IO-Link master and the connected IO-Link devices	PROFINET + IoT	▪ PROFINET and LR DEVICE have read and write access rights to parameters and process data ▪ PROFINET and LR DEVICE have read access rights to events/alarms
		PROFINET + IoT (ro)	▪ PROFINET has read and write access rights to parameters and process data ▪ PROFINET has read access rights to events/alarms ▪ LR DEVICE only has read access rights to parameters, process data and events/alarms
		PROFINET only	▪ PROFINET has read and write access rights to parameters and process data ▪ PROFINET has read access rights to events/alarms ▪ LR DEVICE has no access rights (parameters, process data, events/alarms, web interface, firmware update)
		keep setting	previous setting is valid*
[Mode Pin2 (Actuator Supply UA)]	Operating mode of the supply voltage UA on pin 2 of the IO-Link port	OFF (IO-Link Type A Supply)	UA disables operation as IO-Link Port Class A*
		ON (IO-Link Type B Supply)	UA enabled: Operation as IO-Link port class B
		Digital output	Operation as digital output
[Current Limit Pin2 (Actuator Supply UA) [mA]]	maximum current value of the supply voltage UA on pin 2 of the IO-Link port (only for Class B Ports)	per IO-Link port:	
		0 ... 2000	0 mA 2000 mA
[Current Limit Pin1 + Pin4 (Sensor Supply US) [mA]]	maximum current voltage of the supply voltage US on pin 1 and pin 4 of the IO-Link port	per IO-Link port:	
		0 ... 450 ... 2000	0 mA 450 mA 2000 mA
[Fail Safe DO Mode Pin 2 (Actuator Supply UA]	Behaviour of the additional digital output if the PROFINET connection is interrupted	Fail Safe Reset Value	Failsafe enabled: reset value
		Fail Safe Old Value	Failsafe enabled: hold last value*
		Fail Safe Set Value	Failsafe enabled: set the defined value

* ... Factory settings

IOLD proxy modules

Content

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57610

Port modules: Mix Mode

57611

Module	Port Mode	Process data
IO-Link 1 I / 1 O Byte + PQI	IO-Link	1 byte input data and 1 byte output data and PQI
IO-Link 1 I / 15 O Byte + PQI	IO-Link	1 byte input data and 15 bytes output data and PQI
IO-Link 2 I / 2 O Byte + PQI	IO-Link	2 bytes input data and 2 bytes output data and PQI
IO-Link 4 I / 1 O Byte + PQI	IO-Link	4 bytes input data and 1 byte output data and PQI
IO-Link 4 I / 4 O Byte + PQI	IO-Link	4 bytes input data and 4 bytes output data and PQI
IO-Link 8 I / 1 O Byte + PQI	IO-Link	8 bytes input data and 1 byte output data and PQI
IO-Link 8 I / 8 O Byte + PQI	IO-Link	8 bytes input data and 8 bytes output data and PQI
IO-Link 16 I / 1 O Byte + PQI	IO-Link	16 bytes input data and 1 byte output data and PQI
IO-Link 16 I / 16 O Byte + PQI	IO-Link	16 bytes input data and 16 bytes output data and PQI
IO-Link 32 I / 1 O Byte + PQI	IO-Link	32 bytes input data and 1 byte output data and PQI
IO-Link 32 I / 32 O Byte + PQI	IO-Link	32 bytes input data and 32 bytes output data and PQI
IO-Link 1 I Byte + PQI	IO-Link	1 byte input data and PQI
IO-Link 2 I Byte + PQI	IO-Link	2 bytes input data and PQI
IO-Link 4 I Byte + PQI	IO-Link	4 bytes input data and PQI
IO-Link 8 I Byte + PQI	IO-Link	8 bytes input data and PQI
IO-Link 16 I Byte + PQI	IO-Link	16 bytes input data and PQI
IO-Link 32 I Byte + PQI	IO-Link	32 bytes input data and PQI
IO-Link 1 O Byte + PQI	IO-Link	1 byte output data and PQI
IO-Link 2 O Byte + PQI	IO-Link	2 bytes output data and PQI
IO-Link 4 O Byte + PQI	IO-Link	4 bytes output data and PQI
IO-Link 8 O Byte + PQI	IO-Link	8 bytes output data and PQI
IO-Link 16 O Byte + PQI	IO-Link	16 bytes output data and PQI
IO-Link 32 O Byte + PQI	IO-Link	32 bytes output data and PQI
Digital Input	DI	digital input
Digital Output	DO	digital output
Disabled	disabled	Port deactivated

Port modules: I/O Mode

57612

Module	Port Mode	Process data
IO-Link 1 I / 1 O Byte + PQI	IO-Link	1 byte input data and 1 byte output data and PQI
IO-Link 1 I / 15 O Byte + PQI	IO-Link	1 byte input data and 15 bytes output data and PQI
IO-Link 2 I / 2 O Byte + PQI	IO-Link	2 bytes input data and 2 bytes output data and PQI
IO-Link 4 I / 1 O Byte + PQI	IO-Link	4 bytes input data and 1 byte output data and PQI
IO-Link 4 I / 4 O Byte + PQI	IO-Link	4 bytes input data and 4 bytes output data and PQI
IO-Link 8 I / 1 O Byte + PQI	IO-Link	8 bytes input data and 1 byte output data and PQI
IO-Link 8 I / 8 O Byte + PQI	IO-Link	8 bytes input data and 8 bytes output data and PQI
IO-Link 16 I / 1 O Byte + PQI	IO-Link	16 bytes input data and 1 byte output data and PQI
IO-Link 16 I / 16 O Byte + PQI	IO-Link	16 bytes input data and 16 bytes output data and PQI
IO-Link 32 I / 1 O Byte + PQI	IO-Link	32 bytes input data and 1 byte output data and PQI
IO-Link 32 I / 32 O Byte + PQI	IO-Link	32 bytes input data and 32 bytes output data and PQI
IO-Link 1 I Byte + PQI	IO-Link	1 byte input data and PQI
IO-Link 2 I Byte + PQI	IO-Link	2 bytes input data and PQI
IO-Link 4 I Byte + PQI	IO-Link	4 bytes input data and PQI
IO-Link 8 I Byte + PQI	IO-Link	8 bytes input data and PQI
IO-Link 16 I Byte + PQI	IO-Link	16 bytes input data and PQI
IO-Link 32 I Byte + PQI	IO-Link	32 bytes input data and PQI
IO-Link 1 O Byte + PQI	IO-Link	1 byte output data and PQI
IO-Link 2 O Byte + PQI	IO-Link	2 bytes output data and PQI
IO-Link 4 O Byte + PQI	IO-Link	4 bytes output data and PQI
IO-Link 8 O Byte + PQI	IO-Link	8 bytes output data and PQI
IO-Link 16 O Byte + PQI	IO-Link	16 bytes output data and PQI
IO-Link 32 O Byte + PQI	IO-Link	32 bytes output data and PQI
Digital Input without PD	DI	digital input
Digital Output without PD	DO	digital output
Disabled	disabled	Port disabled

Parameters of the IOLD proxy modules

57613

Parameter	Description	Possible values	
[Enable Port Diagnosis]	Enable / disable diagnostic messages of the port	Disabled	disabled
		Enabled*	enabled
[Enable Process Alarm]	enable/disable process alarms	Disabled	disabled
		Enabled*	enabled
[Port Configuration without Tool]	Enable configuration of the IO-Link ports via IODD and the communication tool	Disabled	disabled
		Enabled*	enabled
[Enable Pull/Plug]	enable/disable pull/plug alarm	Disabled	Alarm disabled
		Enabled*	Alarm enabled
[Port Mode]	Configuration mode for ports when booting	Deactivated	Port deactivated
		Apply Port Configuration	Use values projected in PROFINET
		Autostart	Use the set values of the IO-Link device
		DI Pin4	digital input
		DO Pin4	digital output
[Validation / Data Storage]	Supported IO-Link standard and behaviour of the AL1401 when connecting new IO-Link devices to the IO-Link port	no Device check and clear*	▪ no verification of the vendor ID and device ID ▪ no data storage
		type compatible Device (V1.0)	▪ IO-Link device is compatible with the V1.0 IO-Link standard ▪ Verification whether it is an IO-Link device of the same type (validation via vendor ID and device ID) ▪ no data storage
		type compatible Device (V1.1)	▪ IO-Link device is compatible with the V1.1 IO-Link standard ▪ Verification whether it is an IO-Link device of the same type (validation via vendor ID and device ID) ▪ no data storage
		type compatible Device (V1.1) with Backup + Restore	▪ IO-Link device is compatible with the V1.1 IO-Link standard ▪ Verification whether it is an IO-Link device of the same type (validation via vendor ID and device ID) ▪ The IO-Link master saves the parameter values of the connected IO-Link device; The changes of the parameter values are saved as well ▪ When connecting an IO-Link device with factory settings, the parameter values stored in the IO-Link master are restored automatically on the IO-Link device.

Parameter	Description	Possible values	
		type compatible Device (V1.1) with Restore	▪ IO-Link device is compatible with the V1.1 IO-Link standard ▪ Verification whether it is an IO-Link device of the same type (validation via vendor ID and device ID) ▪ The IO-Link master stores the parameter values of the connected IO-Link device once if the data memory of the AL1401 is empty. ▪ When connecting an IO-Link device with factory settings, the parameter values stored in the IO-Link master are restored automatically on the IO-Link device.
[Port cycle time]	Cycle time of the data transmission on the IO-Link port	As fast as possible*	The device automatically sets the fastest possible cycle time
		2.0 ms	2 milliseconds
		4.0 ms	4 milliseconds
		8.0 ms	8 milliseconds
		16.0 ms	16 milliseconds
		32.0 ms	32 milliseconds
		64.0 ms	64 milliseconds
		128.0 ms	128 milliseconds
[Vendor ID]	ID of the manufacturer that is to be validated	0* ... 65535	ID of the manufacturer of the IO-Link device (ifm electronic: 310)
[Device ID]	ID of the IO-Link device that is to be validated	0* ... 16777215	ID of the IO-Link device
[Fail safe Mode]	Behaviour in case the PROFINET connection is interrupted	No Fail Safe	disabled
		Fail Safe Reset Value	Failsafe enabled: reset to default values
		Fail Safe Old Value	Failsafe enabled: maintain the most recent valid process value
		Fail Safe Set Value	Failsafe enabled:
		Fail Safe with Pattern	Failsafe enabled: set user-defined values
[Pattern Value]	▪ required values for the process data in case the connection is interrupted (as hexadecimal value) ▪ Pattern depends on the size of the selected PROFINET module	Per output 0x00*...0xFF	

14.2.3 Cyclic data

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57614

IOLM Proxy: I/O Mode

57615

Input data: 2 bytes

Byte (offset)	Contents							
	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
n	reserved	reserved	reserved	reserved	reserved	reserved	reserved	reserved
n+1	reserved	reserved	reserved	reserved	Port X4: digital input (pin 4)	Port X3: digital input (pin 4)	Port X2: digital input (pin 4)	Port X1: digital input (pin 4)

Legend:

▪ [Port Xn: Digital Input (Pin 2)]	Switching status of the digital input of the Xn port (pin 2)	1 bit	0x0	OFF
			0x1	ON
▪ [Port Xm: Digital Input (Pin 4)]	Switching status of the digital input of the Xm port (pin 4)	1 bit	0x0	OFF
			0x1	ON

Output data: 2 bytes

Byte (offset)	Contents							
	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
n	reserved	reserved	reserved	reserved	Port X4: digital output (pin 2)	Port X3: digital output (pin 2)	Port X2 digital output (pin 2)	Port X1: digital output (pin 2)
n+1	reserved	reserved	reserved	reserved	Port X4: digital output (pin 4)	Port X3: digital output (pin 4)	Port X2 digital output (pin 4)	Port X1: digital output (pin 4)

Legend:

▪ [Port Xn: Digital Output (Pin 2)]	Switching status of the digital output of the Xn port (pin 2)	1 bit	0x0	OFF
			0x1	ON
▪ [Port Xm: Digital Output (Pin 4)]	Switching status of the digital output of the Xm port (pin 4)	1 bit	0x0	OFF
			0x1	ON

IOLM Proxy: Mix Mode

57616

Input data: 1 byte

Byte (offset)	Contents							
	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
n	reserved.	reserved	reserved	reserved	reserved	reserved	reserved	reserved

Legend:

▪ [Port Xn: Digital Input (Pin 2)]	Switching status of the digital input of the Xn port (pin 2)	1 bit	0x0	OFF
			0x1	ON

Output data: 1 byte

Byte (offset)	Contents							
	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
n	reserved	reserved	reserved	reserved	Port X4: digital output (pin 2)	Port X3: digital output (pin 2)	Port X2 digital output (pin 2)	Port X1: digital output (pin 2)

Legend:

▪ [Port Xn: Digital Output (Pin 2)]	Switching status of the digital output of the Xn port (pin 2)	1 bit	0x0	OFF
			0x1	ON

IOLM Proxy: Mix Mode with Energy Monitoring

57617

Input data: 28 bytes

Byte (offset)	Contents							
	Bit 7	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
n	reserved	reserved	reserved	reserved	reserved	reserved	reserved	reserved
n+1	reserved	reserved	reserved	reserved	reserved	reserved	Status Actuator Supply UA	Status Sensor Supply US
n+2	Supply Voltage Actuator [mV] (MSB)							
n+3	Supply Voltage Actuator [mV] (LSB)							
n+4	Supply Current Actuator [mA] (MSB)							
n+5	Supply Current Actuator [mA] (LSB)							
n+6	Supply Voltage Sensor [mV] (MSB)							
n+7	Supply Voltage Sensor [mV] (LSB)							
n+8	Supply Current Sensor [mA] (MSB)							
n+9	Supply Current Sensor [mA] (LSB)							
n+10	reserved	reserved	reserved	reserved	Port X4: Status Actuator Port	Port X3: Status Actuator Port	Port X2: Status Actuator Port	Port X1: Status Actuator Port
n+11	Port X1: Actuator Current [mA] (MSB)							
n+12	Port X1: Actuator Current [mA] (LSB)							
n+13	Port X2: Actuator Current [mA] (MSB)							
n+14	Port X2: Actuator Current [mA] (LSB)							
n+15	Port X3: Actuator Current [mA] (MSB)							
n+16	Port X3: Actuator Current [mA] (LSB)							
n+17	Port X4: Actuator Current [mA] (MSB)							
n+18	Port X4: Actuator Current [mA] (LSB)							
n+19	reserved	reserved	reserved	reserved	Port X4: Status Sensor Port	Port X3: Status Sensor Port	Port X2: Status Sensor Port	Port X1: Status Sensor Port
n+20	Port X1: Sensor Current [mA] (MSB)							
n+21	Port X1: Sensor Current [mA] (LSB)							
n+22	Port X2: Sensor Current [mA] (MSB)							
n+23	Port X2: Sensor Current [mA] (LSB)							
n+24	Port X3: Sensor Current [mA] (MSB)							
n+25	Port X3: Sensor Current [mA] (LSB)							
n+26	Port X4: Sensor Current [mA] (MSB)							
n+27	Port X4: Sensor Current [mA] (LSB)							

Legend:

▪ [Port Xn: Digital Input (Pin 2)]	Switching status of the digital input of the Xn port (pin 2)	1 bit	0x0	OFF
			0x1	ON

▪ [Status Actuator Supply UA]	Status of the supply voltage UA	1 bit	0x0	UA is connected and no error
			0x1	Defects
▪ [Status Actuator Supply US]	Status of the supply voltage US	1 bit	0x0	no error
			0x1	error
▪ [Supply Voltage Actuator [mV]]	Present voltage of the supply voltage UA (value in mV)	2 bytes	0x0000 ... 0xFFFF	
▪ [Supply Current Actuator [mA]]	Present current intensity of the supply voltage UA (value in mA)	2 bytes	0x0000 ... 0xFFFF	
▪ [Supply Voltage Sensor [mV]]	Present voltage of the supply voltage US (value in mV)	2 bytes	0x0000 ... 0xFFFF	
▪ [Supply Current Sensor [mA]]	Present current intensity of the supply voltage US (value in mA)	2 bytes	0x0000 ... 0xFFFF	
▪ [Port Xn: Status Actuator Port]	Status of the supply voltage UA of the port	1 bit	0x0	no error
			0x1	error
▪ [Port Xn: Actuator Current [mA]]	Present current intensity of the supply voltage UA on pin 2 of port Xn (value in mA)	2 bytes	0x0000 ... 0xFFFF	
▪ [Port Xm: Status Sensor Port]	Status of the supply voltage US of the port	1 bit	0x0	no error
			0x1	error
▪ [Port Xm: Sensor Current [mA]]	Present current intensity of the supply voltage US on pin 1 and pin 4 of the Xm port (value in mA)	2 bytes	0x0000 ... 0xFFFF	

Output data: 1 byte

Byte (offset)	Contents							
	Bit 7	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
n	reserved	reserved	reserved	reserved	Port X4: digital output (pin 2)	Port X3: digital output (pin 2)	Port X2 digital output (pin 2)	Port X1: digital output (pin 2)

Legend:

▪ [Port Xn: Digital Output (Pin 2)]	Switching status of the digital output of the Xn port (pin 2)	1 bits	0x0	OFF
			0x1	ON

IOLD Proxy: IO-Link n I / m O + PQI

57618

Input data:

Byte	Contents
0	IO-Link input data (n bytes)
n	Port Qualifier Information (→ **Mapping: Port Qualifier Information (PQI)** (→ S. 111))

Legend:
n ... Number of bytes on input data (n = [0, 1, 2, 4, 8, 16, 32])

Output data:

Byte	Contents
0	IO-Link output data (m bytes)

Legend:
m ... Number of bytes on output data (m = [0, 1, 2, 4, 8, 16, 32])

Mapping: Port Qualifier Information (PQI)

56564

Bit							
7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
PQ	DevErr	DevCom	PortActive	SubstDev	NewPar	res.	res.

Legend:

▪ [NewPar]	1 bit	0x0	no IO-Link device parameter update detected
		0x1	Update of the IO-Link device parameters detected; Master has updated Data Storage, and a new IOLD backup object is available
▪ [SubstDev]	1 bit	0x0	No exchange IO-Link device detected (identical serial number)
		0x1	Exchange IO-Link device detected (different serial number)
▪ [PortActive]	1 bit	0x0	Disable the port via the port function
		0x1	Port enabled
▪ [DevCom]	1 bits	0x0	IO-Link device not available
		0x1	IO-Link device detected; IO-Link device in PREOPERATE or OPERATE mode
▪ [DevErr]	1 bit	0x0	no error/warning
		0x1	error/warning of IO-Link device or port
▪ [PQ]	1 bit	0x0	Invalid I/O process data from the IO-Link device
		0x1	Invalid I/O process data of the IO-Link device

IOLD Proxy: Digital Input

57619

Byte	Contents
0	Digital Input

- [Digital Input] Digital input (pin 4) 0x00 OFF
  0x01 ON

IOLD Proxy: Digital Output

57620

Byte	Contents
0	Digital Output

- [Digital Output] Digital output (pin 4) 0x00 OFF
  0x01...0xFF ON

14.2.4 Acyclic data

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33868

I&M datasets

34555

The AL1401 supports the following I&M datasets (I&M = Identification & Maintenance):

I&M0 (Slot 0)

34545

Variable	Description	Access	Size
Vendor ID	IO-Link ID of the manufacturer	r	2
OrderID	Order number of the device (ASCII)	r	20
Serial number	Serial number of the device (ASCII)	r	16
Hardware revision	Hardware revision of the device	r	2
Software revision prefix	Prefix of the software revision of the device (V, R, P, U or T)	r	1
Software Revision	Software revision (numbers, e.g. x y z in "Vx.y.z")	r	3
Revision Counter	Revision counter; is incremented with each parameter change	r	2
Profile ID	ID of sub-module profile (Slot 0: 0x0000)	r	2
Profile Specific Type	additional value for profile ID; 0, if not used	r	2
IMVersion	I&M version (default value: 0x0101)	r	2
IMSupported	Suported I&M datasets (0x1110 for I&M1-3)	r	2

r ... only read

I&M1 (Slot 0)

34543

Variable	Description	Access	Size
TagFunction of submodule	function of the device (ASCII)	r/w	32
TagLocation of submodule	Location of the device in the plant (ASCII)	r/w	22

r/w ... read and write

I&M2 (Slot 0)

34544

Variable	Description	Access	Size
Installation_Date	Installation date of the device (ASCII)	r/w	16
	reserved	r/w	38

r/w ... read and write

I&M3 (Slot 0)

34550

Variable	Description	Access	Size
Descriptor	Description of the device (ASCII)	r/w	54

r/w ... read and write

I&M0 (Slot 1)

34542

Variable	Description	Access	Size
Vendor ID	IO-Link ID of the manufacturer	r	2
OrderID	Order number of the device (ASCII)	r	20
Serial number	Serial number of the device (ASCII)	r	16
Hardware revision	Hardware revision of the device	r	2
Software revision prefix	Prefix of the software revision of the device (V, R, P, U or T)	r	1
Software revision	Software revision (numbers e.g. x y z in "Vx.y.z")	r	3
Revision counter	Revision counter; is incremented with each parameter change	r	2
Profile ID	ID of the sub-module profile (Slot 1: 0x4E01 = IOLink)	r	2
Profile Specific Type	additional value for profile ID; 0, if not used	r	2
IMVersion	I&M version (default value: 0x0101)	r	2
IMSupported	Supported I&M datasets (0x0E for I&M1-3)	r	2

r ... read only

14.3 ifm IoT Core

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14.3.1 Overview: IoT profile

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34054

Profile: blob

52264

Element (identifier)	Properties	Mandatory	Comment
blobname	▪ type = data ▪ profiles = blob		labels element as device information
../size	type = data	mandatory	
../chunksize	type = data	mandatory	
../setblobdata	type = service	optional	
../getblobdata	type = service	optional	
../start_stream_set	type = service	optional	
../stream_set	type = service	optional	
../clear	type = service	optional	
../getcrc	type = service	optional	
../getmd5	type = service	optional	
../getdata	type = service	optional	
../setdata	type = service	optional	

Profile: deviceinfo

34207

Element (identifier)	Properties	mandatory	Comments
deviceinfo	▪ type = structure ▪ profile = deviceinfo		characterises the element as device information
../devicename	type = data	optional	
../devicefamiliy	type = data	optional	
../devicevariant	type = data	optional	
../devicesymbol	type = data	optional	
../deviceicon	type = data	optional	
../serialnumber	type = data	mandatory	
../productid	type = data	optional	
../productname	type = data	optional	
../productcode	type = data	mandatory	
../producttext	type = data	optional	
../ordernumber	type = data	optional	
../productiondate	type = data	optional	
../productioncode	type = data	optional	
../hwrevision	type = data	mandatory	
../swrevision	type = data	mandatory	
../bootloaderrevision	type = data	optional	
../vendor	type = data	optional	
../vendortext	type = data	optional	
../vendorurl	type = data	optional	
../vendorlogo	type = data	optional	
../productwebsite	type = data	optional	
../supportcontact	type = data	optional	
../icon	type = data	optional	
../image	type = data	optional	
../standards	type = data	optional	

Profile: devicetag

34206

Element (identifier)	Properties	mandatory	Comments
devicetag	▪ type = structure ▪ profile = devicetag		
../applicationtag	type = data	mandatory	
../applicationgroup	type = data	optional	
../machinecode	type = data	optional	
../tenant	type = data	optional	

Profile: iolinkdevice_full

52265

Element (identifier)	Characteristics	Mandatory	Comments
iolinkdevice	▪ type = structure ▪ profile = iolinkdevice_full		Structure of an IO-Link device
../vendorid	type = data	mandatory	
../deviceid	type = data	mandatory	
../productname	type = data	mandatory	
../serial	type = data	mandatory	
../applicationspecifictag	type = data	mandatory	
../pdin	type = data	mandatory	
../pdout	type = data	mandatory	
../status	type = data	mandatory	
../iolreadacyclic	type = data	mandatory	
../iolwriteacyclic	type = data	mandatory	
../iolinkevent	type = data	mandatory	

Profile: iolinkmaster

34205

Element (identifier)	Properties	Mandatory	Comments
masterport	▪ type = structure ▪ profile = iolinkmaster		Executable service
../mode	▪ type = data ▪ profile = parameter	mandatory	
../comspeed	▪ type = data ▪ profile = parameter	mandatory	
../mastercycletime_actual	▪ type = data ▪ profile = parameter	mandatory	
../mastercycletime_preset	▪ type = data ▪ profile = parameter	mandatory	
../validation_datastorage_mode	▪ type = data ▪ profile = parameter	mandatory	
../validation_vendorid	▪ type = data ▪ profile = parameter	mandatory	
../validation_deviceid	▪ type = data ▪ profile = parameter	mandatory	
../additionalpins_in	▪ type = data ▪ profile = processdata	optional	
../additionalpins_out	▪ type = data ▪ profile = processdata	optional	
../portevent	▪ type = data	mandatory	
../iolinkdevice	▪ type = structure ▪ profile = iolinkdevice_full	mandatory	

Profile: network

52266

Element (identifier)	Characteristics	Mandatory	Comments
network	▪ type = structure ▪ profiles = deviceinfo		Characterises the element as device information
../macaddress	▪ type = data ▪ profile = parameter	mandatory	
../ipaddress	▪ type = data ▪ profile = parameter	optional	
../ipv6address	▪ type = data ▪ profile = parameter	mandatory	
../subnetmask	▪ type = data ▪ profile = parameter	mandatory	
../ipdefaultgateway	▪ type = data ▪ profile = parameter	mandatory	
../dhcp	▪ type = data ▪ profile = parameter	optional	
../ipversion	▪ type = data ▪ profile = parameter	optional	
../hostname	▪ type = data ▪ profile = parameter	optional	
../autonegotiation	▪ type = data ▪ profile = parameter	optional	
../portspeed	▪ type = data ▪ profile = parameter	optional	
../enablenetwork	type = service	optional	
../disablenetwork	type = service	optional	

Profile: parameter

34215

The profile is used to mark the elements of type `data` as parameters (acyclic data). The profile defines no substructure.

Profile: processdata

34225

The profile is used to mark the elements of type `data` as process data (cyclic data). The profile does not define a substructure.

Profile: service

34224

Element (identifier)	Properties	mandatory	Comments
service	▪ type = service ▪ profile = service		Executable service

Profile: software

34223

Element (identifier)	Properties	mandatory	Comments
software	▪ type = structure ▪ profile = software		characterises the element as software
../version	type = data	mandatory	
../type	type = data	mandatory	
../status	type = structure	optional	
../diag	type = structure	optional	

Profile: software/uploadedablesoftware

52267

Element (identifier)	Characteristics	Mandatory	Comments
software	▪ type = structure ▪ profiles = software/uploadablesoftware		Software that can be loaded to the device via the IoT Core
../lastinstall	type = data	optional	
../installhistory	type = data	optional	
../container	▪ type = data ▪ profile = blob	mandatory	
../preinstall	type = service	optional	
../install	type = service	mandatory	
../postinstall	type = service	optional	
../abortinstall	type = service	optional	
../installstatus	type = data	optional	

Profile: Timer

34226

Element (identifier)	Properties	Mandatory	Comment
timer	▪ type = structure ▪ profile = timer		
../counter	▪ type = data ▪ profile = parameter	mandatory	
../interval	▪ type = data ▪ profile = parameter	optional	
../start	type = service	optional	
../stop	type = service	optional	

14.3.2 Overview: IoT types

34055

The ifm IoT Core uses the following element types:

Name	Description
structure	Element is a structure element (like a folder in a file system)
service	Element is a service that can be addressed from the network
event	Element is an event that can be started by the firmware and sends messages.
data	Element is a data point
device	Root element a device represents

14.3.3 Overview: IoT services

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Service: factoryreset

34184

Name: factoryreset

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

Request data (field "data"): none

Response data (field "data"): none

Example:

```
{
"code": "request",
"cid": 4711,
"adr": "/firmware/factoryreset"
}
```

Service: getblobdata

52345

Name: getblobdata
Description: The service reads a binary large object (blob).
Applicable to: datastorage
Request data (field "data"):

Data field	Required field	Data type	Default	Description
pos	mandatory	number	0	Byte position
length	mandatory	number	-	Size of the object (number of bytes)

Return data (field "data"):

Data field	Required field	Data type	Default	Description
data	mandatory	STRING	0	Data to be decoded (BASE64 coded)
crc	optional	HEX STRING		CRC of the data after decoding
md5	optional	HEX STRING		MD5 checksum of the data after decoding

Service: getdata

34183

Name: getdata
Description: Service reads the value of a data point and provides it.
Request data (field "data"): none
Return data (field "data"):

Data field	Required field	Data type	Description
value	mandatory	STRING	Value of the element/data point

Example:

```
{
"code":"request",
"cid":4711,
"adr":"devicetag/applicationtag/getdata"
}
```

Service: getdatamulti

34174

Name: getdatamulti

Description: The service sequentially reads the values of several data points and provides them. The value and the diagnostic code are provided for each data point.

Request data (field "data"):

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

Response data (field "data"): for each requested data point

Data field	Required field	Data type	Description
url	mandatory	STRING	Data point request
code	mandatory	INT	Diagnostic code of the request
data	mandatory	STRING	Value of the data point

Service: getelementinfo

52269

Name: getelementinfo

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

Applicable to: Objects of the type `device`

Request data (field "data"):

Data field	Required field	Data type	Default	Description
adr	mandatory	STRING		URL of the element, which properties to be changed

Return data (field "data"):

Data field	Required field	Data type	Default	Description
identifier	mandatory	STRING		Identifier of the element
type	mandatory	STRING		Type of the element
format	optional	JSON object	blank	Format of the data or the service content
uid	optional	STRING	blank	
profiles	optional	JSON array	blank	
hash	optional	STRING	--	

Service: getidentity

34173

Name: getidentity

Description: The service reads the complete device description of the AL1401 and provides it as JSON object.

Applicable to: Objects of the `device` type

Request data: none

Return data (data):

Data field	Required field	Data type	Default	Description
iot		device		Device description as JSON object
iot.name	mandatory	STRING		
iot.uid	optional	STRING		
iot.version	mandatory	STRING		
iot.catalogue	optional	ARRAY OF OBJECTS		
iot.deviceclass	optional	ARRAY OF STRING		
iot.serverlist		ARRAY OF OBJECTS		
device	optional			AL1401
device.serialnumber	optional			Serial number
device.hwrevision	optional			Hardware version
device.swrevision	optional			Software version
device.custom	optional			

Service: getsubscriberlist

61191

Name: getsubscriberlist
Description: The service provides a list of all active subscriptions.
Request data ("data" field): none
Return data ("data" field): Array with the following data

Data field	Mandatory field	Data type	Description
adr	mandatory	STRING	Data source
datatosend	mandatory	ARRAY OF STRINGS	List with URLs of the subscribed data points
cid	mandatory	NUMBER	ID of the subscription
callbackurl	mandatory	STRING	Address to which IoT Core event notifications are to be sent;
duration	mandatory	STRING	Storage duration of the value

Example:

- **Request object:**

```
{
"code":"request",
"cid":4711,
"adr":"/getsubscriberlist"
}
```

- **Return object:**

```
{
"cid":4711,
"data":[
{
"adr":"/timer[1]/counter/datachanged/subscribe",
"datatosend":["/iolinkmaster/port[2]/iolinkdevice/pdin"],
"cid":1,
"callbackurl":"http://192.168.0.45:80/temp",
"duration":"lifetime"},
{
"adr":"/timer[1]/counter/datachanged/subscribe",
"datatosend":["/processdatamaster/temperature","/processdatamaster/voltage"],
"cid":2,
"callbackurl":"http://192.168.0.44:80/temp",
"duration":"lifetime"}
]
"code":200
}
```

Service: getsubscriptioninfo

61192

Name: getsubscriptioninfo
Description: The service provides information about an existing subscription (subscribe).

The following parameters of the existing subscription are to be used for the query:

- Value of the identifier cid (e.g. 4711)
- Number of the timer (e.g. timer[1])
- Name of the callback topic (e.g. B. temp)

Request data ("data" field):

Data field	Mandatory field	Data type	Description
callback	mandatory	STRING	Address to which IoT Core event notifications are to be sent; complete URL: http://ipaddress:port/path

Return data ("data" field):

Data field	Mandatory field	Data type	Description
subscription	mandatory	BOOL	Status of the transferred subscription parameter
datatosend	mandatory	ARRAY OF STRINGS	List with subscribed data points
cid	mandatory	NUMBER	ID of the subscribe request
callbackurl	mandatory	STRING	Address to which IoT Core event notifications are to be sent; complete URL: http://ipaddress:port/path

Example:

- **Request object:**

```
{
"code":"request",
"cid":4711,
"adr":"/timer[1]/counter/datachanged/getsubscriptioninfo",
"data":{
"callback":"http://192.168.0.44:80/temp"}
}
```

- **Return object:**

```
{
"cid": 4711,
"data":{
"subscription": true,
"datatosend":[
"/iolinkmaster/port[2]/iolinkdevice/productname",
"/iolinkmaster/port[2]/iolinkdevice/pdin",
"/processdatamaster/temperature"],
"callbackurl":"http://192.168.0.44:80/temp",
"duration":"lifetime"},
"code":200
}
```

Service: gettree

61193

Name: gettree

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

Request data ("data" field):

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

Return data ("data" field):

Data field	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	

Examples:

- output the complete device description

```
{
"code":"request",
"cid":4,
"adr":"/gettree"
}
```

- output the subtree counter[2] of the device description up to the 2nd level

```
{
"code":"request",
"cid":4,
"adr":"/gettree"
"data":{
"adr":"counter[2]",
"level":2}
}
```

Service: install

52343

Name: install
Description: The service installs the firmware stored in the container area of the device.
Applicable to: container
Request data (data): none
Return data (data): none

Service: iolreadacyclic

34178

Name: iolreadacyclic
Description: The service acyclically reads the parameter value of an IO-Link device. The parameter is accessed via IO-Link index and subindex.
Request data (field "data"):

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

Response data (field "data"):

Data field	Required field	Data type	Description
value	mandatory	STRING	Value of the parameter; Value in hexadecimal format

Service: iolwriteacyclic

34177

Name: iolwriteacyclic
Description: The service acyclically writes the parameter value of an IO-Link device. The parameter is accessed via IO-Link index and subindex.
Request data (field "data"):

Data field	Required 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	New value of the parameter; Value in hexadecimal format

Response data (field "data"): none

Service: querytree

61194

Name: querytree

Description: The service searches a device tree for the criteria profile, type and name 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 machine.

Return data ("data" field):

Data field	Mandatory field	Data type	Description
profile	optional	STRING	Profile of the searched element
type	optional	STRING	Type of the searched element
name	optional	STRING	Type of the searched element

Return ("data" field):

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

Service: reboot

34176

Name: reboot

Description: The service reboots the device.

Request data (field "data"): none

Return data (field "data"): none

Example:

```
{
"code":"request",
"cid":4,
"adr":"firmware/reboot"
}
```

Service: setblock

34186

Name: setblock

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

Request data (field "data"):

Data field	Required field	Data type	Description
datatoset	mandatory	ARRAY OF OBJECTS	List of data points and their new values; data points must support the service setdata
consistent	optional	BOOL	

Response data (field "data"): none

Example:

Request:

```
{
"code":"request",
"cid":4711,
"adr":"iotsetup/network/setblock",
"data":{
"datatoset":{
"ipaddress":"192.168.0.6",
"subnetmask":"255.255.255.0",
"ipdefaultgateway":"192.168.0.250",
"dhcp":0}
}
}
```

Response:

```
{
"cid":4711,
"code":233
}
```

Service: setdata

34195

Name: setdata
Description: The service sets the value of the data point.
Request data ("data" field):

Data field	Mandatory field	Data type	Description
newvalue	mandatory	STRING	New value of the element/data point
duration	mandatory	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

Return data ("data" field): none

Example:

```
{"code": "request",
"cid":4711,
"adr": "devicetag/applicationtag/setdata",
"data":{
"newvalue": "ifm IO-Link master
"duration": "lifetime"}
}
```

Service: signal

33819

Name: signal
Description: The service starts the flashing of the status LEDs of the AL1401.
Request data (field "data"): none
Return data (field "data"): none

Example:

```
{
"code":"request",
"cid":4711,
"adr":"firmware/signal"
}
```

Service: start_stream_set

52342

Name: start_stream_set
Description: The service starts the sequential transfer of multiple data segments.
Applicable to: Objects of type data
Request data (data):

Data field	Required field	Data type	Default	Description
size	mandatory	STRING		Total size of data to be transfered (number of bytes)

Return data (data): none

Service: stream_set

52341

Name: stream_set
Description: The service transfers a data segment.
Applicable to: Objects of type data
Request data (data):

Data field	Required field	Data type	Default	Description
value	mandatory	BIN (BASE64)	*	Segment of binary data (BASE64 coded)

Return data (data): none

Service: subscribe

61365

Name: subscribe
Description: The service subscribes to the values of data points. The data points to be subscribed are transferred as a list. The IoT Core sends changes to the data sink defined in callback.
Request data ("data" field):

Data field	Mandatory field	Data type	Description
callback	mandatory	STRING	Address to which IoT Core event notifications are to be sent; URL format: ▪ JSON: http://ipaddress:port/path ▪ CSV: tcp://ipaddress:port/path
datatosend	mandatory	ARRAY OF STRINGS	List from URLs of data elements; Elements must support getdata
codec	optional	STRING	Format of the returned data ▪ json: JSON formatted ▪ csv: CSV with standard separator (,) ▪ csv0: CSV formatted with comma separator (,) ▪ csv1: CSV formatted with semicolon separator (;)
duration	mandatory	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 ▪ once: send only one notification. After that, subscription will be cancelled.

Return data ("data" field): none

Service: unsubscribe

34197

Name: unsubscribe

Description: The service deletes an existing subscription. The service unsubcribe is successful if cid and the callback address are registered for an active subscription (subscribe). If the STRING "DELETE" is provided in callback, the IO-Link master deletes all active subscriptions.

Request data (field "data"):

Data field	Required field	Data type	Description
callback	mandatory	STRING	Address to which IoT Core event notifications are to be sent; complete URL: http://ipaddress:port/path

Response data (field "data"): none

Service: validation_useconnecteddevice

52340

Name: validation_connecteddevice

Description: The service checks, whether Device ID and Vendor ID of the connected IO-Link device match with the values of the datapoints `../validation_vendorid` and `../validation_deviceid`.

Applicable to: Objects of type `stucture`

Request data (data): none

Return data (data): none

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