



Operating instructions

IO-Link master with Modbus TCP interface

DataLine

4 ports

IP 65 / IP 66 / IP 67 / IP 69K

AL1341

Firmware: 3.1.x

English

Contents

1	Preliminary note	5
1.1	Legal and copyright information.....	5
1.2	Purpose of the document.....	5
1.3	Explanation of Symbols	5
1.4	Change history	6
2	Safety instructions	7
2.1	General	7
2.2	Required background knowledge	7
2.3	Safety symbols on the device	7
2.4	IT security.....	8
3	Functions and features	9
4	Function	10
4.1	Communication, parameter setting, evaluation	11
4.1.1	IO-Link.....	11
4.1.2	Modbus TCP	11
4.1.3	Internet of Things (IoT)	11
4.1.4	Security mode	11
4.1.5	Parameter setting	11
4.1.6	Visual indication	12
4.2	Digital inputs.....	12
4.3	IO-Link supply	12
5	Mounting	13
5.1	Mount the device.....	13
6	Electrical connection	14
6.1	Notes.....	14
6.2	Connecting the Modbus TCP ports.....	15
6.3	Connecting the IoT port	15
6.4	IO-Link ports.....	16
6.4.1	Connecting IO-Link devices for Class A operation	16
6.5	Connecting the device	17
7	Operating and display elements	18
7.1	Overview	18
7.2	LED indicators.....	19
7.2.1	Status LEDs	19
7.2.2	Ethernet ports.....	19
7.2.3	IoT port.....	20
7.2.4	Voltage supply.....	20
7.2.5	IO-Link Ports (Class A).....	20

8	Set-up	21
9	Configuration	22
9.1	LR DEVICE	23
9.1.1	Remarks	24
9.1.2	IoT: Configure IP settings	24
9.1.3	IoT: Configure security mode	25
9.1.4	IoT: Configuring access rights	26
9.1.5	IoT: Configure the interface to LR AGENT or LR SMARTOBSERVER	27
9.1.6	Fieldbus: Configure IP settings.....	28
9.1.7	Fieldbus: set the length of the process data	29
9.1.8	IO-Link ports: Activate data transfer to LR AGENT or LR SMARTOBSERVER	29
9.1.9	IO-Link ports: Configure operating mode.....	30
9.1.10	IO-Link ports: Set the device validation and data storage	31
9.1.11	IO-Link ports: set fail-safe values	32
9.1.12	Info: Show device information	32
9.1.13	Firmware: Reset device to factory settings.....	33
9.1.14	Firmware: Reboot the device.....	33
9.1.15	Configure IO-Link devices	34
9.2	ifm IoT Core	35
9.2.1	Programmers' notes	36
9.2.2	First steps	40
9.2.3	General functions	40
9.2.4	IoT: Configuring access rights	44
9.2.5	IoT: Configuring IP settings	44
9.2.6	IoT: Configuring the LR AGENT or LR SMARTOBSERVER interface	45
9.2.7	IoT: Configuring security mode.....	45
9.2.8	Fieldbus: Configuring the IP settings	48
9.2.9	Fieldbus: Configuring the fieldbus interface	48
9.2.10	Fieldbus: Setting fail-safe values.....	49
9.2.11	IO-Link ports: Setting the operating mode of pin 4 (US).....	49
9.2.12	IO-Link ports: Configuring device validation and data storage	50
9.2.13	IO-Link ports: Configuring data transfer to LR AGENT or LR SMARTOBSERVER.....	52
9.2.14	IO-Link ports: Reading / writing process data.....	52
9.2.15	IO-Link ports: Indicating port events	55
9.2.16	IO-Link devices: Accessing parameters	55
9.2.17	IO-Link devices: Reading an writing device information	57
9.2.18	IO-Link devices: Indicating IO-Link events	57
9.2.19	Gateway: Resetting, rebooting and localising the device	57
9.2.20	Gateway: Reading device information	58
9.2.21	Gateway: Reading status and diagnostic information.....	58
9.2.22	Gateway: Updating the firmware	59
9.2.23	Gateway: Setting the application tag	60
9.2.24	Subscribing to notifications.....	61
9.2.25	Using Web Socket	65
9.2.26	MQTT support	67
9.2.27	Using the IoT-Core Visualizer.....	71
9.3	Modbus TCP	78
9.3.1	Integrate the AL1341 into the Modbus project.....	78
9.3.2	Set IO-Link master	79
9.3.3	Set IO-Link ports	80
9.3.4	Read input data of several IO-Link ports	81
9.3.5	Read input data of individual IO-Link ports.....	82
9.3.6	Write output data of several IO-Link ports	83
9.3.7	Write output data of individual IO-Link ports.....	84
9.3.8	Read diagnostic information and events	85
9.3.9	Read device information.....	86
9.3.10	Control IO-Link master	86
9.3.11	Configure IO-Link devices	86
9.3.12	Modbus TCP: Programmers' notes	87

10	Operation	89
10.1	Using web-based management	89
11	Maintenance, repair and disposal	90
11.1	Cleaning process	90
11.2	Updating the firmware.....	90
11.3	Replacing IO-Link device	90
12	Factory settings	91
13	Accessories	92
14	Appendix	93
14.1	Technical data.....	94
14.1.1	Application.....	94
14.1.2	Electrical data.....	94
14.1.3	Inputs / outputs.....	94
14.1.4	Inputs	95
14.1.5	Outputs.....	95
14.1.6	Interfaces.....	95
14.1.7	Operating conditions	96
14.1.8	Approvals / tests.....	96
14.1.9	Mechanical data	96
14.1.10	Electrical connection	97
14.2	Modbus TCP	98
14.2.1	Register	99
14.2.2	Acyclic commands.....	113
14.3	ifm IoT Core	122
14.3.1	Overview: IoT profile	123
14.3.2	Overview: IoT types.....	130
14.3.3	Overview: IoT services	131
15	Index	145

1 Preliminary note

Content

Legal and copyright information	5
Purpose of the document	5
Explanation of Symbols	5
Change history	6

33203

1.1 Legal and copyright information

33117

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

All product names, pictures, companies or other brands used on our pages are the property of the respective rights owners:

- AS-i is the property of the AS-International Association, (→ www.as-interface.net)
- CAN is the property of the CiA (CAN in Automation e.V.), Germany (→ www.can-cia.org)
- CODESYS™ is the property of the CODESYS GmbH, Germany (→ www.codesys.com)
- DeviceNet™ is the property of the ODVA™ (Open DeviceNet Vendor Association), USA (→ www.odva.org)
- EtherNet/IP® is the property of the → ODVA™
- EtherCAT® is a registered trade mark and patented technology, licensed by Beckhoff Automation GmbH, Germany
- IO-Link® is the property of the → PROFIBUS Nutzerorganisation e.V., Germany (→ www.io-link.com)
- ISOBUS is the property of the AEF – Agricultural Industry Electronics Foundation e.V., Deutschland (→ www.aef-online.org)
- Microsoft® is the property of the Microsoft Corporation, USA (→ www.microsoft.com)
- Modbus® is the property of the Schneider Electric SE, France (→ www.schneider-electric.com)
- PROFIBUS® is the property of the PROFIBUS Nutzerorganisation e.V., Germany (→ www.profibus.com)
- PROFINET® is the property of the → PROFIBUS Nutzerorganisation e.V., Germany
- Windows® is the property of the → Microsoft Corporation, USA

1.2 Purpose of the document

34227

This document is only for device types "IO-Link master - Modbus TCP gateway (DataLine) 4 port IP 65 / IP 66 / IP 67 / IP 69K" (art. no.: AL1341).

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 personal 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 Change history

61443

Version	Topic	Date
00	New creation of the document	04 / 2019
01	Correction: Technical data - current rating per output	09 / 2019
02	<ul style="list-style-type: none"> ▪ Added: New IoT Core functions ▪ Added: IoT Core Visualizer ▪ Correction: Description SENS PWR and AUX PWR ▪ Correction: Description of IoT Core service getsubscriptioninfo 	10 / 2020
03	Deleted: ifm IoT Core – DNS support	10 / 2021

2 Safety instructions

Content

General.....	7
Required background knowledge.....	7
Safety symbols on the device.....	7
IT security.....	8

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** (→ p. 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** (→ p. 14))!

2.4 IT security

54678

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:
 - Restrict access to authorised persons.
 - Do not connect the device to open networks or the internet.

If access from the internet is inevitable:

- ▶ choose a safe method to connect with the device (e. g. VPN).
- ▶ Use encrypted data transmission (e. g. https / TLS).

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** (→ p. [94](#))).

4 Function

Content

Communication, parameter setting, evaluation	11
Digital inputs	12
IO-Link supply.....	12

33836

4.1 Communication, parameter setting, evaluation

Content

IO-Link	11
Modbus TCP	11
Internet of Things (IoT)	11
Security mode	11
Parameter setting	11
Visual indication	12

33860

4.1.1 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)

4.1.2 Modbus TCP

33676

The device offers the following Modbus TCP functions:

- Provision of the functions of a Modbus TCP Slave
- 2 port switch for access to the Modbus TCP interface (X21/X22)
- Gateway for transmission of the process and parameter data between the connected IO-Link devices and the higher-level Modbus TCP controller

4.1.3 Internet of Things (IoT)

54679

The device offers the following IoT functions:

- 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, MQTT

4.1.4 Security mode

54697

The IoT interface offers the following optional security functions:

- Secure data transfer via encrypted connection (Secure Layer Transport - TLS)
- Access protection via authentication

4.1.5 Parameter setting

34210

The device provides the following configuration options:

- Parameter setting of the IO-Link master of the AL1341 with LR DEVICE parameter setting software, Modbus TCP projection software or ifm IoT-Core services.
- Parameter setting of the connected IO-Link devices (sensors, actuators) with LR DEVICE parameter setting software, Modbus TCP projection software or ifm IoT-Core services

- Storage of parameter sets of the connected IO-Link devices for automatic recovery (data storage)

4.1.6 Visual indication

34192

The device has the following visual indicators:

- Status and error indication of the gateway, of the Modbus TCP 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

4.2 Digital inputs

33817

The device has 4 additional digital inputs (type 2 according to EN 61131-2).

The digital inputs are on pin 2 of the ports X01...X04.

All inputs refer to the potential of the device supply (pin 3).

4.3 IO-Link supply

34077

The device has 4 supplies for IO-Link devices.

The IO-Link ports X01...X04 are ports class A.

Every supply provides short circuit monitoring.

The device ensures fire protection for the connected IO-Link devices by providing a power-restricted circuit at the IO-Link ports (according to IEC61010-1 and Class 2 according to UL1310).

5 Mounting

Content

Mount the device	13
------------------------	----

34058

5.1 Mount the device

34059



- ▶ Disconnect the system from power before installation.
 - ▶ For installation choose a flat mounting surface.
 - ▶ Please observe the maximum tightening torque.
-
- ▶ Fix the unit to the mounting surface using 2 M5 mounting screws and washers.
 - Tightening torque: 1.8 Nm
 - ▶ Ground the unit via the two mounting screws of the upper mounting lugs.

6 Electrical connection

Content

Notes	14
Connecting the Modbus TCP ports	15
Connecting the IoT port.....	15
IO-Link ports	16
Connecting the device.....	17

33805

6.1 Notes

51957



A qualified electrician must connect the unit.

- ▶ The national and international regulations setting up electrical equipment must be complied with.

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

- ▶ Please note the information concerning IO-Link wiring!

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

- ▶ Please observe the required precautions against electrostatic discharge!

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:

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

Wiring: → **Technical data** (→ p. [94](#))

By means of basic insulation according to EN61010-1, the circuits are separated from each other and from device surfaces that could be touched (secondary circuit with 28 V DC maximum, supplied from mains circuit up to 300 V overvoltage category II).

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

6.2 Connecting the Modbus TCP ports

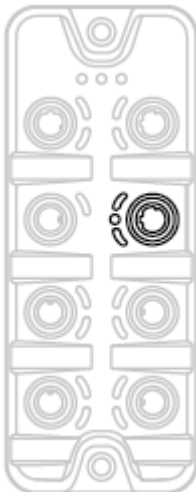
33671



- ▶ Connect the device via the M12 socket X21 and/or X22 to the Modbus TCP network (e.g. Modbus TCP PLC, additional Modbus TCP device)
- ▶ To connect the devices, use M12 connectors with protection rating IP 65 / IP 66 / IP 67 / IP 69K or higher (→ **Accessories** (→ p. [92](#))).
- ▶ Cover the unused sockets with M12 protective caps (art no. E12542).

6.3 Connecting the IoT port

34044



- ▶ Connect the device via the M12 socket X23 to the IT network (e.g. laptop/PC with LR DEVICE parameter setting software, laptop/PC with LR SMARTOBSERVER monitoring software, laptop/PC with software capable of processing http requests).
- ▶ To connect the devices, use M12 connectors with protection rating IP 65 / IP 66 / IP 67 / IP 69K or higher (→ **Accessories** (→ p. [92](#))).
- ▶ Cover the unused sockets with M12 protective caps (art no. E12542)

6.4 IO-Link ports

51958

The IO-Link ports of the AL1341 meet the requirements of the IO-Link specifications 1.0 to 1.1.2.

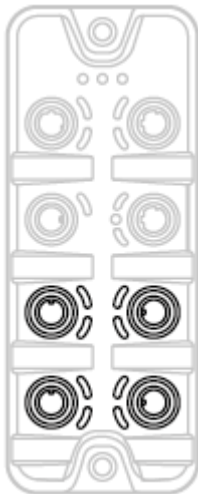
- ▶ Please note the information concerning IO-Link wiring!
- ▶ Cover unused sockets with M12 protective caps (art. no.: E12542).

6.4.1 Connecting IO-Link devices for Class A operation

51959

Wiring information:

- The connected IO-Link devices must be supplied exclusively via the IO-Link master.
- The additional digital inputs IO-Link ports X01...X04 (pin 2) have a type 2 behaviour according to the standard EN61131-2. The connected electronics must be electrically suited for this.



- ▶ Connect the connectors of the IO-Link devices with the M12 sockets of the IO-Link ports X01...X04.
 - Maximum cable length per IO-Link port: 20 m
- ▶ To connect the devices, use M12 connectors with protection rating IP 65 / IP 66 / IP 67 / IP 69K or higher (→ **Accessories** (→ p. [92](#))).

6.5 Connecting the device

33882



- ▶ Disconnect power.
- ▶ Connect the IO-Link Master via M12 socket X31 to 24 V DC (20...28 V SELV/PELV; according to EN61010-1, secondary circuit with maximum 30 V DC supplied by mains circuit up to 300 V of overvoltage category II).
 - Maximum cable length: 25 m
- ▶ To connect the device, use M12 connectors with protection rating IP 65 / IP 66 / IP 67 / IP 69K or higher (→ **Accessories** (→ p. [92](#))).



When using cable length greater than 25 m keep in mind the voltage drop as well as the required minimum voltage supply of 20 V!

7 Operating and display elements

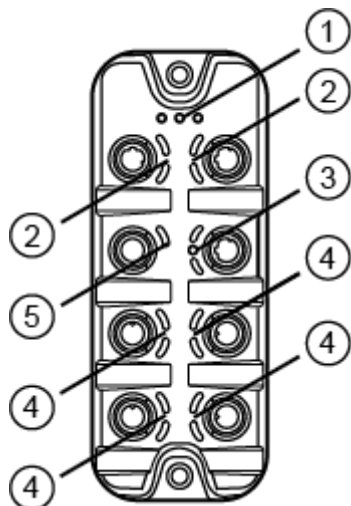
Content

Overview.....	18
LED indicators	19

34063

7.1 Overview

34356



- ① RDY, RUN and ERR status LEDs
→ **Status LEDs** (→ p. [19](#))
- ② LNK and ACT status LEDs of the Modbus TCP interfaces 1 (X21) and 2 (X22)
→ **Ethernet ports** (→ p. [19](#))
- ③ LNK, ACT status-LEDs and IoT LED of the IoT interface (X23)
→ **IoT port** (→ p. [20](#))
- ④ IOL and DI status-LEDs of the IO-Link port (X01...X04)
→ **IO-Link Ports (Class A)** (→ p. [20](#))
- ⑤ PWR status LED of the voltage supply (X31)
→ **Voltage supply** (→ p. [20](#))

7.2 LED indicators

34047

The device only has the following LED indicators:

7.2.1 Status LEDs

34436

The RDY LED indicates the status of the gateway.

The RUN LED indicates the current state of the Modbus TCP state machine.

The ERR LED indicates occurring errors.

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
ERR	red	on	communication error
		flashes 10 Hz	boot error
		flashes (200 ms on, 200 ms off, 200 ms on, 1000 ms off)	watchdog error (Modbus TCP or process data)
		flashes (200 ms on, 1000 ms off)	local error
		flashes 2.5 Hz	invalid configuration
		off	no error
RUN	green	on	connection established
		flashes 1 Hz	ready, but not yet configured
		flashes 5 Hz	waiting for connection
		off	not ready

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 IoT port

34043

The IoT port has the 3 LNK, ACT and IoT LEDs. The LEDs indicate the status of the Ethernet connection and the device identification.

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
IoT	green	flashes	Device identification active

7.2.4 Voltage supply

34191

The interface for voltage supply (X31) has the LED that is marked as US. The LED indicates the status of the voltage supply.

Status LED			Description
US	green	on	The supply voltage Us is applied.
		off	No supply voltage is applied or the applied supply voltage is too low.

7.2.5 IO-Link Ports (Class A)

34074

Each IO-Link Port Class A has 2 LEDs labelled IOL and DI. The LEDs indicate the status of the IO-Link port.

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	
DI	yellow	Off	Digital input: pin 2 = OFF
		on	Digital input: pin 2 = ON

8 Set-up

52357

When the supply voltage is switched on, the AL1341 starts with the factory settings. The display elements signal the current operating mode (→ **Operating and display elements** (→ p. [18](#))).

To enable parameter setting of the AL1341, the IoT interface and / or the fieldbus interface must be configured according to the network environment.

- ▶ Configure IoT interface (LR DEVICE: → **IoT: Configure IP settings** (→ p. [24](#)) or → **IoT: Configuring IP settings** (→ p. [44](#))).
- ▶ Configure fieldbus interface (LR DEVICE: → **Fieldbus: Configure IP settings** (→ p. [28](#)) or IoT: → **Fieldbus: Configuring the IP settings** (→ p. [48](#))).
- > IoT / fieldbus interface has valid IP settings.
- > User can set the parameters of the AL1341.

Further steps:

- Optional: Update firmware of AL1341 (→ **Updating the firmware** (→ p. [90](#))).
- Set the parameters of the AL1341 (→ **Configuration** (→ p. [22](#))).

9 Configuration

Content

LR DEVICE.....	23
ifm IoT Core.....	35
Modbus TCP.....	78

33858

9.1 LR DEVICE

Content

Remarks	24
IoT: Configure IP settings.....	24
IoT: Configure security mode	25
IoT: Configuring access rights	26
IoT: Configure the interface to LR AGENT or LR SMARTOBSERVER	27
Fieldbus: Configure IP settings	28
Fieldbus: set the length of the process data.....	29
IO-Link ports: Activate data transfer to LR AGENT or LR SMARTOBSERVER	29
IO-Link ports: Configure operating mode	30
IO-Link ports: Set the device validation and data storage.....	31
IO-Link ports: set fail-safe values	32
Info: Show device information	32
Firmware: Reset device to factory settings	33
Firmware: Reboot the device.....	33
Configure IO-Link devices	34

33692

On delivery, the AL1341 is configured with the factory settings (→ **Factory settings** (→ p. [91](#))).
Required software: LR DEVICE (1.5.0.x or higher) (art.-no.: QA0011/QA0012)

9.1.1 Remarks

Content

Offline parameter setting	24
Parameter setting with LR DEVICE	24

34180

Offline parameter setting

34060

The AL1341 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 AL1341 (OFFLINE mode). The configuration created in this way can be stored as a file (*.lrp) and loaded to the AL1341 and activated at a later date.



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

Parameter setting with LR DEVICE

34437

Parameter setting of the AL1341 with the LR DEVICE is only possible via the IoT interface X23.

9.1.2 IoT: Configure IP settings

34049

For access to the IO-Link master via the IT infrastructure the user has to set the IP settings of the IoT port.



To configure the IP settings with DHCP, a DHCP server has to be active in the IT network. If no DHCP server can be reached in the IT network, an IP address is automatically assigned to the IoT port with the Zeroconfig protocol (address range: → **Factory settings** (→ p. [91](#))).

To configure the IP settings of the IoT interface:

- ▶ Select [IoT] menu.
- > The menu page shows the current settings.
- ▶ Set the following parameters as required:

Name	Description	Possible values	
[DHCP]	Activate/deactivate the DHCP client of the device	[Static IP]	IP settings were set by the user
		[DHCP]	IP settings are set by a DHCP server in the network.
[IP address]*	IP address of the IoT port	Factory setting: 169.254.X.X	
[Subnet mask]*	Subnet mask of the Ethernet network	Factory setting: 255.255.0.0	
[Default gateway IP address]*	IP address of the network gateway	Factory setting: 0.0.0.0	
[MAC address]	MAC address of the IoT port	The value is firmly set.	

* ... can only be edited if parameter [DHCP] = [Static IP]

- ▶ Save changed values on the device.

9.1.3 IoT: Configure security mode

The IoT interface of the IO-Link offers a security mode. It enables secure data transmission via transport encryption and restriction of the access to IO-Link masters and IO-Link devices via user authentication.

To configure the security mode:

- ▶ Select [IoT] menu.
- > The menu page shows the current settings.
- ▶ Set the following parameters as required:

Name	Description	Possible values	
[Security mode HTTPS]	Set the security mode	[Disabled]	Security mode disabled
		[Enabled]	Security mode enabled
[Security password]	Password Note: The set password is not displayed.		

- ▶ Save changed values on the device.



The security mode only protects the access to the device via the IoT interface.
The user name "administrator" cannot be changed.



The security mode can be enabled without setting the password. During the attempt to write to the device, LR DEVICE requires to enter and confirm the password.

After entering the password, the user has unrestricted access to IO-Link masters and connected IO-Link devices. The password will only be requested again if the current LR DEVICE session is over (e. g. after restarting the LR DEVICE).

To change the set password:

- ▶ Sign in with a valid password.
- ▶ Enter the new password in the field [Security password].
- ▶ Write changes to the device.
- > The new password is set.

9.1.4 IoT: Configuring access rights

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	[Modbus TCP + IoT]*	<ul style="list-style-type: none"> ▪ Modbus TCP and IoT Core have read and write access rights to parameters and process data ▪ Modbus TCP and IoT Core have read access rights to events/alarms
		[Modbus TCP + IoT (read-only)]	<ul style="list-style-type: none"> ▪ Modbus TCP has read and write access rights to parameters and process data ▪ Modbus TCP has read access rights to events/alarms ▪ IoT Core only has read access rights to parameters, process data and events/alarms
		[IoT only]	<ul style="list-style-type: none"> ▪ IoT Core has read and write access rights to parameters and process data ▪ IoT has read access rights to events/alarms ▪ Modbus TCP has no access rights

* ... Factory setting

- ▶ Save changed values on the device.



If in LR DEVICE and Modbus TCP projection software the parameter [Access Rights] is = [Modbus TCP + IoT], the parameter values set in the Modbus TCP 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 Modbus TCP projection software.

If the parameter [Access Rights] 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** (→ p. 33)).

9.1.5 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: AL1341	



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.

9.1.6 Fieldbus: Configure IP settings

54698



The configuration of the IP settings of the fieldbus port is only possible via LR DEVICE and IoT.

To configure the IP settings of the Modbus TCP interface:

- ▶ Select [Fieldbus] menu.
- > The menu page shows the current settings.
- ▶ Set the following parameters as required:

Name	Description	Possible values	
[DHCP]	Activate / deactivate the DHCP client of the device	[Static IP]	IP parameters are set by the user
		[DHCP]	IP parameters are set by a DHCP server in the network.
		[BOOTP]	IP parameters are set via the Bootstrap Protocol (BOOTP)
[IP address]*	IP address of the Modbus TCP interface	Factory setting:: 192.168.1.250	
[Subnet mask]*	Subnet mask of the IP network	Factory setting: 255.255.255.0	
[Default gateway IP address]*	IP address of the gateway	Factory setting: 0.0.0.0	
[MAC address]	MAC address of the Modbus TCP interface	The value is firmly set.	
[Fieldbus firmware]	Firmware version of the Modbus TCP stack	e.g. 2.6.0.5	
[connectiontimeout]	Max. value for Connection Timeout (value in milliseconds)	1 ... 300000	

* ... Parameter nur editierbar, wenn Parameter [DHCP] = [Static IP]

- ▶ Save changed values on the device.

9.1.7 Fieldbus: set the length of the process data

54681

To set the length of the process data to be transmitted and the arrangement of the bytes:

- ▶ Select [Fieldbus] menu.
- > The menu page shows the current settings.
- ▶ Set the following parameters as required:

Name	Description	Possible values	
[Process data length]	Length of the process input data and process output data per IO-Link port	2 bytes input 2 bytes output	2 bytes input data, 2 bytes output data
		4 bytes input 4 bytes output	4 bytes input data, 4 bytes output data
		8 bytes input 8 bytes output	8 bytes input data, 8 bytes output data
		16 bytes input 16 bytes output	16 bytes input data, 16 bytes output data
		32 bytes input 32 bytes output	32 bytes input data, 32 bytes output data
[Swap]	Arrangement of the bytes in process data	off	as Array of Bytes
		on	as Integer16 value; during an update of the process data, bytes are exchanged word by word (input data and output data)

- ▶ Save changed values on the device.

9.1.8 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** (→ p. [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.

9.1.9 IO-Link ports: Configure operating mode

The IO-Link ports X01...X04 of the device support the following operating modes:

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

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

To set the operating mode 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 pin 4 of the IO-Link port	[Disabled]	Port deactivated
		[DI]	Operation as digital input
		[DO]	Operation as digital output
		[IO-Link]	Operation as IO-Link interface
[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	1 microsecond
	
		132800	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 the IO-Link device is connected to the IO-Link port.

- ▶ 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 IO-Link ports: set fail-safe values

34459

In case the Modbus TCP connection is interrupted, fail-safe values can be assigned to the outputs of the IO-Link ports.

To set the fail-safe values of the IO-Link ports:

- ▶ Select [Port x] menu (x = 1...4).
- > The menu page shows the current settings.
- ▶ Set the following parameters as required:

Name	Description	Possible values	
[Fail-safe digital out]	Fail-safe values for output (operating mode "DO")	Reset	Reset value (LOW)
		Old	hold old value
		Set	Set value (HIGH)
[Fail-safe IO-Link]	Fail-safe value for output (operating mode "IO-Link")	Off	no fail-safe value
		Reset	reset value
		Old	hold old value
		Pattern	provide sample

- ▶ Save changed values on the device.

9.1.12 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	AL1341
[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	

9.1.13 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.

9.1.14 Firmware: Reboot the device

33832

When rebooting the device, all settings are kept.

To restart the AL1341:

- ▶ 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.

9.1.15 Configure IO-Link devices

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

Requirements:

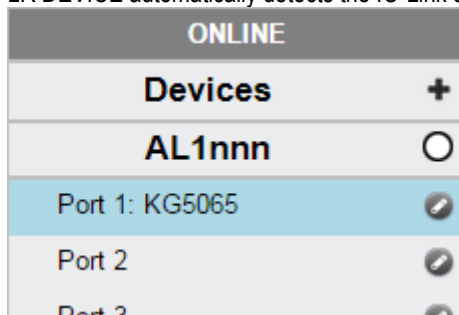
- > IO-Link master is correctly installed and connected to the LR DEVICE parameter setting software.
- > The IO-Link device is connected correctly with the AL1341.
- > Operating mode of the IO-Link port is "IO-Link" (→ **IO-Link ports: Configure operating mode** (→ p. 30)).
- > IoT has write access rights to the IO-Link master (→ **IoT: Configuring access rights** (→ p. 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

Content

Programmers' notes	36
First steps	40
General functions	40
IoT: Configuring access rights	44
IoT: Configuring IP settings	44
IoT: Configuring the LR AGENT or LR SMARTOBSERVER interface	45
IoT: Configuring security mode	45
Fieldbus: Configuring the IP settings.....	48
Fieldbus: Configuring the fieldbus interface	48
Fieldbus: Setting fail-safe values.....	49
IO-Link ports: Setting the operating mode of pin 4 (US)	49
IO-Link ports: Configuring device validation and data storage.....	50
IO-Link ports: Configuring data transfer to LR AGENT or LR SMARTOBSERVER	52
IO-Link ports: Reading / writing process data	52
IO-Link ports: Indicating port events.....	55
IO-Link devices: Accessing parameters	55
IO-Link devices: Reading an writing device information	57
IO-Link devices: Indicating IO-Link events	57
Gateway: Resetting, rebooting and localising the device.....	57
Gateway: Reading device information.....	58
Gateway: Reading status and diagnostic information	58
Gateway: Updating the firmware	59
Gateway: Setting the application tag	60
Subscribing to notifications.....	61
Using Web Socket	65
MQTT support	67
Using the IoT-Core Visualizer	71

52244



General notes on the ifm IoT Core: → **Programmers' notes** (→ p. [36](#))

9.2.1 Programmers' notes

Content

IoT Core: General information	36
Access the ifm IoT Core	37
IoT Core: Diagnostic codes	39

34229

IoT Core: General information

52256

The DataLine device family has an IoT Core. The IoT Core allows the user to address the AL1341 from IT networks via a REST API and to integrate it into Internet-of-Things applications.

A device description is stored on the AL1341. 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 (→ p. 39))

Example: GET request

54033

Request (via browser):

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

Response:

```
{
  "cid":-1,
  "data":{"value":"AL1341"},
  "code":200
}
```

POST request

54700

Using a POST request 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"},
"auth":{"user":"usr_id","passwd":"password"}
}
```

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 assignable by the user	
adr	data_point	Data point of the element tree which is to be accessed	
	service	Service to be performed (→ Overview: IoT services (→ p. 131))	
data*	req_data	Data to be transferred to the IoT Core (e.g. new values); syntax depending on the service	
auth**	usr_id	user name (base64 coded); default value: administrator	
	password	password (base64 coded)	

* = optional; only required for services, that submit data to the IoT core (e. g. setdata)

** = optional; only required, if security mode is activated

The syntax of the return of the IoT Core is:

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

Field	Parameter	Description
cid	id	Correlation ID for the assignment of request and response (see request)
data*	resp_data	Value of the data point; syntax depending on the service
code	diag_code	Diagnostic code (→ IoT Core: Diagnostic codes (→ p. 39))

* = optional; only required for services, that 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":"AL1341"},
  "code":200
}
```

IoT Core: Diagnostic codes

54688

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)
233	IP settings (of IoT-Port) have been updated. Application needs to reload device. Wait at least 1 second before reloading device.	IP settings have been successfully changed, IO-Link master will be reloaded; wait for at least 1 second
400	Bad request	Invalid request
401	Unauthorized	Non authorised 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 AL1341:

- ▶ Send the following POST request to the AL1341:

```
{"code":"request","cid":-1,"adr":"gettree"}
```
- > AL1341 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 AL1341 has the type device (→ **Overview: IoT types** (→ p. 130)).

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 "runcontrol" (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** (→ p. [141](#)) and **Service: subscribe** (→ p. [143](#)) 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 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 Modbus TCP projection software the parameter [Access Rights] is = [Modbus TCP + IoT], the parameter values set in the Modbus TCP projection software will always apply.

If in IoT the parameter [Access Rights] is = [IoT only], set the parameter [Access Rights] = [Keep settings] in the Modbus TCP 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** (→ p. 33)).

9.2.5 IoT: Configuring IP settings

61155

Substructure: iotsetup

Available data points:

Name	Description	Access
../network/dhcp	Configuration of the IP settings of the IoT port	rw
../network/ipaddress	IP address of the IoT port	rw
../network/subnetmask	Subnet mask of the network segment	rw
../network/ipdefaultgateway	IP address of the network gateway	rw

rw ... read and write

Applicable services:

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



Change the IP parameters in the substructure network only blockwise with the setblock service!

9.2.6 IoT: Configuring the LR AGENT or LR SMARTOBSERVER interface

59786

Substructure: `iotsetup`

Available data points:

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

rw ... read and write

9.2.7 IoT: Configuring security mode

54683

The access to the IoT interface of the IO-Link master can be protected with a security mode:

Substructure: `iotsetup`

Available data points:

Name	Description	Access
<code>../security/securitymode</code>	active security mode	rw
<code>../security/password</code>	Password for authentication (Base64 coded)	w

rw ... read and write

w ... write only



Valid character set for the Base64 coding / decoding of the password: UTF-8
 Online tool for coding / decoding: → www.base64encode.org

Note: Security mode

54684

The security mode enables restricting access to the IO-Link master and the connected IO-Link devices from the IT network. In the activated security mode, the following restrictions apply:

- Access only with authentication (password-protected user account)
- Access only via secure https connection (Transport Layer Security - TLS)



The security mode only protects the access to the device via the IoT interface.
 The standard value for users is: administrator
 The set password cannot be read with `getdata`.

The current status of the security function can be read with the `getidentity` service (→ **Service: `getidentity`** (→ p. 134)).

For the authentication, the user must additionally provide the POST requests with a valid user name and password in the field "auth". The user name and the password will be shown as Base64-coded character strings (→ **Example: Request with authentication** (→ p. 46)).

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

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

Example: Activate security mode

54701

Task: Activate the security mode of the IO-Link interface of the IO-Link master. Set the password "password" (Base64 coded: cGFzc3dvcmQ=)

Solution: The activation consists of 2 steps:

1 Activate security mode

Use service setdata with datapoint iotsetup/security/securitymode to activate the security mode.

- Request:

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

- Response:

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

2 Set required password

Use service setdata with data point iotsetup/security/password to set the required password.

- Request:

```
{
  "code": "request",
  "cid": -1,
  "adr": "/iotsetup/security/password/setdata",
  "data": {"newvalue": "cGFzc3dvcmQ="}
}
```

- Response:

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

Example: Request with authentication

54685

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

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

- Request:

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

- Response:

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

Example: reset password

54686

Task: The existing password is to be reset.

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

- Request:

```
{
"code":"request",
"cid":-1,
"adr":"iotsetup/security/securitymode/setdata",
"data":{"newvalue":0},
"auth":{"user":"YWRtaW5pc3RyYXRvcg==","passwd":"SW9UNG1mbQ=="}
}
```

- Response:

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

9.2.8 Fieldbus: Configuring the IP settings

61435

Substructure: fieldbussetup

Available data points:

Name	Description	Access
../fieldbusfirmware	Firmware version of the IO-Link master	r
../network/macaddress	MAC address of the fieldbus interface	r
../network/ipaddress	IP address of the fieldbus interface	rw*
../network/subnetmask	Subnet mask of the network segment	rw*
../network/ipdefaultgateway	IP address of the network gateway	rw*
../network/dhcp	Activate / deactivate the DHCP client	rw
../connectionstatus	Status of the connection to the Modbus TCP network	r

r ... read only

rw ... read and write

* ... only editable, if the Modbus TCP plc ist not in RUNNING state

Applicable services:

Name	Description
../network/setblock	write all values of substructur at once



Change the IP parameters in the substructure network only blockwise by using the service setblock!

9.2.9 Fieldbus: Configuring the fieldbus interface

61440

Substructure: fieldbussetup/configuration

Available data points:

Name	Description	Access
../processdataconfiguration	Length of the process data	rw*
../connectiontimeout	max. value for fieldbus connection timeout	rw*
../swap	Byte order of process data	rw*

rw ... read and write

* ... only editate, if the Modbus TCP plc ist not in RUNNING state

9.2.10 Fieldbus: Setting fail-safe values

61441

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

Available data points:

Name	Description	Access
../failsafedigitalout	Fail-safe value for the digital output - pin 4 (DO)	rw*
../failsafeiolink	Fail-safe value for output data IO-Link - pin 4 (IO-Link)	rw*

rw ... read and write

* ... only editable, if the Modbus TCP plc ist not in RUNNING state

9.2.11 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 <Feldbus> plc is not in RUNNING state

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

59792

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

Available data points:

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

r ... read only

rw ... read and write

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

Applicable services:

Service	Description
<code>../validation_useconnecteddevice</code>	Validate the IO-Link device connected to the IO-Link port*
<code>../datastorage/getblobdata</code>	Reading the content of the data storage area
<code>../datastorage/stream_set</code>	Transfer an individual data segment*
<code>../datastorage/start_stream_set</code>	Start sequential transmission of several data segments*

* ... can only be changed if the Modbus TCP 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
- ▶ Calculate the number of reading steps n: n = first integer value to which the following applies: $g < n \cdot h$
 Example: n = 3, because $550 < 3 \cdot 256$

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 request: 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":  
"aWZtfglAAABBTDF4NXhfY25faXRfdDluMi43Nw..."}}
```

9.2.13 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

9.2.14 IO-Link ports: Reading / writing process data

61156

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

Available data points:

Name	Description	Access
../pin2in	Value of the digital input on pin 2 of the IO-Link port	r
../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 ... read only

rw ... read and write

*... can only be changed if the fieldbus 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 = 0b1111001001

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 IO-Link master 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")** (→ p. 52)).
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 0001 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 Input (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  
}
```

9.2.15 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: <ul style="list-style-type: none"> plugging IO-Link device pulling IO-Link device changing operating mode of IO-Link port 	r

r ... read only



Subscribing events: → **Subscribing to notifications** (→ p. [61](#))

9.2.16 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 `iolwritecyclicdata` 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/iolwritecyclic",
"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
}
```


9.2.17 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

9.2.18 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** (→ p. [61](#))

9.2.19 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

9.2.20 Gateway: Reading device information

52254

Substructure: deviceinfo

Available data points:

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

r ... read only

Additional information about the AL1341 can be read with the service `getidentity` (→ **Service: getidentity** (→ p. [134](#))).

9.2.21 Gateway: Reading status and diagnostic information

61157

Substructure: procesmdatamaster

Available data points:

Name	Description	Access
../temperature	Temperature of the IO-Link master (value in °C)	r
../voltage	Present voltage value of the supply voltage US (value in mV)	r
../current	Present current value of the sensor supply US (value in mA)	r
../supervisionstatus	Status of the device supply US	r

r ... read only

9.2.22 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": "aWZtfgIAAABBTFDF4NXhfY25faXRfdDluMi43Nw..."}}
- ▶ 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": {}}

9.2.23 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 AL1341 for the representation in the LR SMARTOBSERVER.

Solution: Change the parameter [Application Tag] with the setdata service to the value [AL1341].

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": "AL1341"}
}
```

- Response:

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

9.2.24 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
<code>timer[x]/counter</code>	Timer for triggering a notification	rw
<code>timer[x]/interval</code>	Cycle time of the update of the subscribed values	rw
<code>iolinkmaster/port[n]/portevent</code>	Display of the following events on IO-Link port n: <ul style="list-style-type: none"> ▪ IO-Link device connected ▪ IO-Link device disconnected ▪ Operating mode of the IO-Link port changed 	rw
<code>iolinkmaster/port[n]/iolinkdevice/iolinkevent</code>	Display of IO-Link events	rw

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

Applicable services:

Name	Description
<code>../datachanged/subscribe</code>	Subscribe to notification
<code>../datachanged/unsubscribe</code>	Unsubscribe notification
<code>../datachanged/getsubscriptioninfo</code>	Show information about notifications

Additionally, the user can use **Service: `getsubscriberlist`** (→ p. [135](#)) show all active subscriptions.

Example: Subscribing to notifications

61160

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: Subscribing notifications via WebSocket** (→ p. [65](#))
- via MQTT (`mqt://`): **Example: Configuring the MQTT command channel** (→ p. [68](#))

- 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** (→ p. 61)) 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: Subscribing to notifications in CSV format

61162

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

- cyclic IO-Link input data of the IO-Link device at port X02
- Operating temperature of the IO-Link master.

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

Solution:

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



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

- Request:

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

- ▶ Set the interval of the timer to 2 seconds:

- Request:

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

The cyclically sent notification has the following structure:

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

Example: Unsubscribing from notifications

61163

Task: The existing subscription (**Example: Subscribing to notifications** (→ p. 61)) 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** (→ p. 61) Show **Example: Subscribing to notifications** (→ p. 61)).

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
}
```


9.2.25 Using Web Socket

61165

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 / unsubscribe



Maximum number of WebSocket connections: 8
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/unsubscribe 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: Subscribing notifications via WebSocket

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"]}  
}
```

9.2.26 MQTT support

61168

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

Configuring the MQTT command channel

61169

To enable MQTT communication, the user needs to activate and configure an MQTT command channel.

Substructure: `connections/mqttConnection`

Name	Description	Access
<code>../type</code>	Type of the connection (MQTT)	r
<code>../status</code>	Global MQTT status	r
<code>../status/preset</code>	Presetting of the MQTT status; Basic settings: running	r
<code>../MQTTSetup</code>	Substructure for general MQTT settings	w
<code>../MQTTSetup/QoS</code>	Quality of Service of the MQTT communication <ul style="list-style-type: none"> ▪ 0: QoS Level 0 - PUBLISH (without confirmation) ▪ 1: QoS Level 1 - PUBLISH > PUBREC (one-time confirmation) ▪ 2: QoS Level 2 - PUBLISH > PUBREC > PUBREL > PUBCOMP (double confirmation) 	rw
<code>../MQTTSetup/version</code>	MQTT version	r
<code>../mqttCmdChannel</code>	Substructure of the MQTT command channel	w
<code>../mqttCmdChannel/type</code>	Type of the MQTT command channel	r
<code>../mqttCmdChannel/status</code>	Status of the MQTT command channel	r
<code>../mqttCmdChannel/status/preset</code>	Presetting of the MQTT status; Basic setting: stopped	r
<code>../mqttCmdChannel/mqttCmdChannelSetup</code>	Structure for settings of the command channel	w
<code>../mqttCmdChannel/mqttCmdChannelSetup/brokerIP</code>	IP address of the MQTT broker	rw
<code>../mqttCmdChannel/mqttCmdChannelSetup/brokerPort</code>	Port number of the MQTT broker	rw
<code>../mqttCmdChannel/mqttCmdChannelSetup/cmdTopic</code>	Designation of the MQTT topic	rw
<code>../mqttCmdChannel/mqttCmdChannelSetup/defaultReplyTopic</code>	Standard response topic	rw

Applicable services:

Name	Description
<code>../status/start</code>	Enable MQTT
<code>../status/stop</code>	Deactivate MQTT
<code>../status/reset</code>	Reset MQTT
<code>../mqttCmdChannel/status/start</code>	Activate MQTT command channel
<code>../mqttCmdChannel/status/stop</code>	Deactivate MQTT command channel
<code>../mqttCmdChannel/status/reset</code>	Reset MQTT command channel



Notes on the states of an MQTT connection: **Note: Connection states** (→ p. [68](#))

To create an MQTT connection, perform the following steps in sequence:



Ensure that the MQTT broker can be reached and that the selected port of the MQTT broker is enabled for data transmission.

Max. number of simultaneous MQTT connections: 10

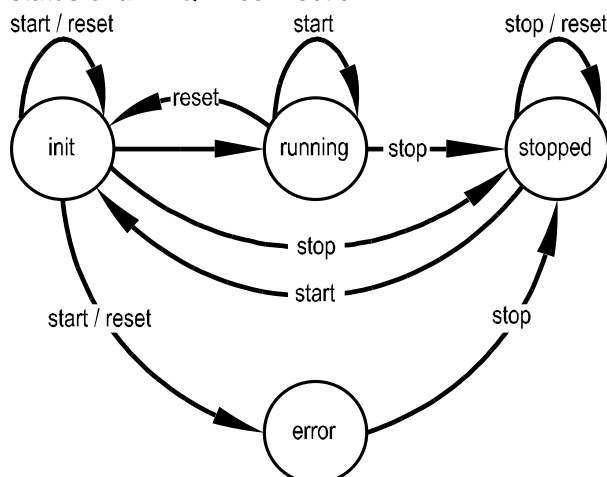
Wildcards "+" and "#" in topics are not supported.

- ▶ Activate MQTT command channel.
- ▶ Set the IP address of the MQTT.
- ▶ Set the port number of the MQTT broker.
- ▶ Set topic.
- ▶ Set standard response topic.
- > The command channel is created with the selected properties.
- > The user can publish on the topic with the IoT Core.
- > MQTT clients can subscribe to the topic.

Note: Connection states

61170

The following status diagram shows the influence of the services "start", "stop" and "reset" on the status of an MQTT connection:



After the initialisation in the "init" state has been completed, the connection automatically changes to the "running" state.

The connection automatically switches to the "error" state if at least one of the following events occurs:

- no MQTT broker available

Example: Configuring the MQTT command channel

61171

Task: Configuring and activating the MQTT command channel (IP address MQTT broker: 192.168.82.100, port: 1883, topic: abc).

Solution:

- ▶ Check whether MQTT broker can be reached and the port has been released.
- ▶ Activate command channel
- Request:

```
{
"code":"request",
"cid":4711,
"adr":"/connections/mqttConnection/MQTTSetup/mqttCmdChannel/status/start"
}
```

► Set the IP address of the MQTT broker/server.

- Request:

```
{
"code":"request",
"cid":4712,
"adr":"/connections/mqttConnection/mqttCmdChannel/mqttCmdChannelSetup/brokerIP/set
data"
"data":{"192.168.82.100"}
}
```

► Set the port number of the MQTT broker/server.

- Request:

```
{
"code":"request",
"cid":4713,
"adr":"/connections/mqttConnection/mqttCmdChannel/mqttCmdChannelSetup/brokerPort/s
etdata"
"data":{"1883"}
}
```

► Set topic.

- Request:

```
{
"code":"request",
"cid":4714,
"adr":"/connections/mqttConnection/mqttCmdChannel/mqttCmdChannelSetup/cmdTopic/set
data"
"data":{"abc"}
}
```

► Set standard response topic.

- Request:

```
{
"code":"request",
"cid":4715,
"adr":"/connections/mqttConnection/mqttCmdChannel/mqttCmdChannelSetup/defaultReply
Topic/setdata"
"data":{"xyz"}
}
```

► Set the QoS.

- Request:

```
{
"code":"request",
"cid":4716,
"adr":"/connections/mqttConnection/MQTTSetup/QoS/setdata",
"data":{"QoS2"}
}
```

Example: Publish the temperature to an MQTT broker

54687

Task: Publish the temperature of the IO-Link master to an MQTT broker (IP address MQTT broker: 192.168.82.100, port: 1883, topic: abc)

Solution:

- Request:

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

- Response:

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

9.2.27 Using the IoT-Core Visualizer

Content

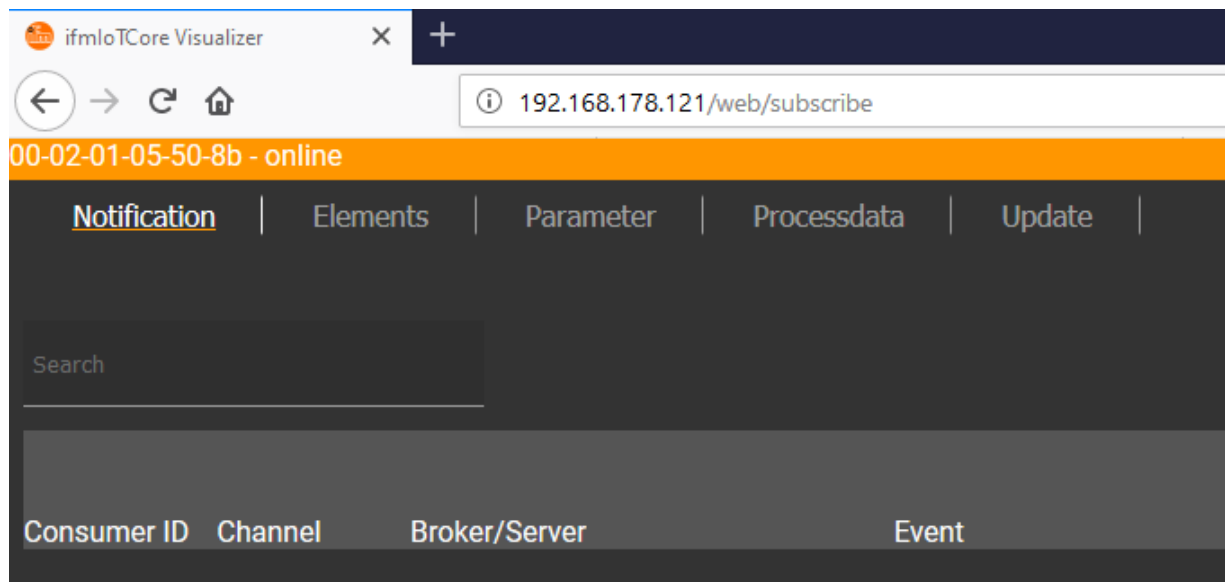
Managing notifications.....	72
Searching for elements in the device tree.....	74
Configuring IO-Link the master.....	75
Reading and writing process data.....	76
Updating the firmware.....	77

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:

- lot-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

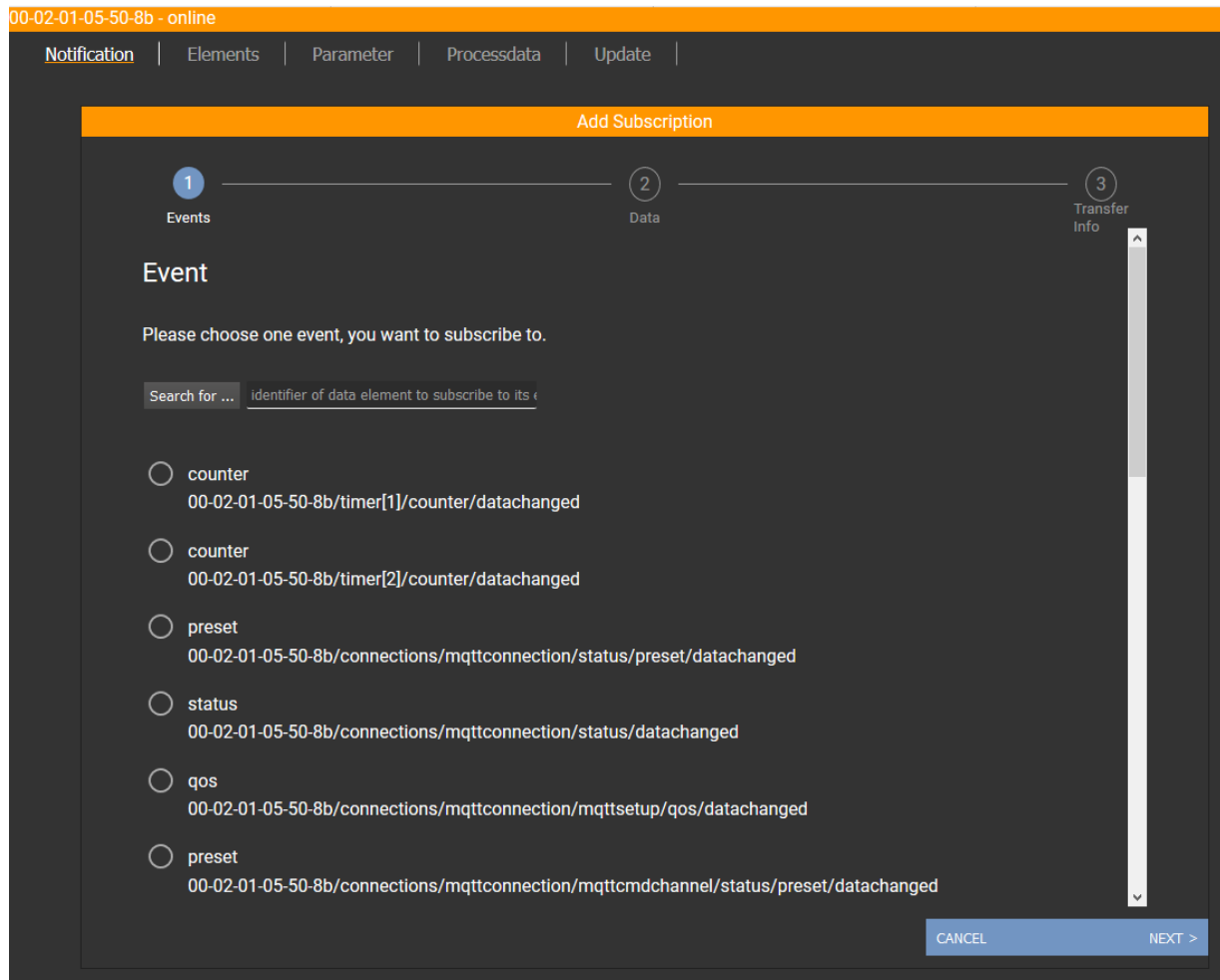
Creating a new notification

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.

00-02-01-05-50-8b - online

Notification | **Elements** | Parameter | Processdata | Update

Search for ...

identifier

profile

type

Processdatamaster Deviceinfo Timer[1] Timer[2] lotsetup Fieldbussetup Connections Iolinkmaster
Firmware Devicetag

^ 00-02-01-05-50-8b

getidentity	00-02-01-05-50-8b/getidentity	type: service profiles: undefined	Copy URL
gettree	00-02-01-05-50-8b/gettree	type: service profiles: undefined	Copy URL
querytree	00-02-01-05-50-8b/querytree	type: service profiles: undefined	Copy URL

- ▶ 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.

00-02-01-05-50-8b - online

Notification	Elements	Parameter	Processdata	Update				
Deviceinfo	Timer[1]	Timer[2]	iotsetup Network k	Fieldbussetup	Connections	Iolinkmaster	Firmware	Devicetag
^ iotsetup								
accessrights			iot only			Type:	enum	
						Namespace:	json	
						Encoding:	integer	
						Valuation:	valuelist:	
							0:	
							1:	
							3:	
v network								
smobip			192.168.82.2			Type:	string	
						Namespace:	json	
						Encoding:	utf-8	
						Valuation:	minlength:	

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:

- lot-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.

00-02-01-05-50-8b - online

Notification | Elements | Parameter | **Processdata** | Update

Processdatamaster | Timer[1] | Timer[2] | Fieldbussetup | **iolinkmaster**
 Port[1] Port[2] Port[3]
 Port[4]

^ iolinkmaster

^ port[1]

portevent	FF0200	Type:	string
		Namespace:	json
		Encoding:	hexstring

^ iolinkdevice

vendorid	310	Type:	number
		Namespace:	json
		Encoding:	integer
		Valuation:	min: 0
			max: 65535

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:

- lot-Core Visualizer has been started.
- ▶ Click on [Update].
- > Menu page displays information about the current firmware version.

00-02-01-05-50-8b - online

Firmware	
00-02-01-05-50-8b/firmware	
Version:	AL1x2x_cn_ei_v3.1.44
Type:	firmware
Max size:	4194304
Chunk size:	4096
Size:	0

Buttons: Load software file (choose software package), Update

- ▶ 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 Modbus TCP

Content

Integrate the AL1341 into the Modbus project	78
Set IO-Link master.....	79
Set IO-Link ports.....	80
Read input data of several IO-Link ports.....	81
Read input data of individual IO-Link ports	82
Write output data of several IO-Link ports.....	83
Write output data of individual IO-Link ports	84
Read diagnostic information and events	85
Read device information.....	86
Control IO-Link master	86
Configure IO-Link devices	86
Modbus TCP: Programmers' notes	87

34455

On the field bus side, the device can be configured with any Modbus TCP compatible projection software.

9.3.1 Integrate the AL1341 into the Modbus project

34456

The AL1341 provides the functionality of a Modbus-TCP slave. The user can integrate the IO-Link master via the profile of a generic Modbus-TCP slave to a fieldbus project.

The IO-Link master, the IO-Link Ports and the process data are configured via the Modbus register of the AL1341.

Example: Integrate IO-Link master in a CODESYS project

34474



Familiarise yourself with the following CODESYS functions!

- Modbus master:
 - Online help > Fieldbus support > Modbus configurator > Modbus master
- Modbus slave device:
 - Online help > Fieldbus support > Modbus configurator > Modbus slave device

Task: Integrate IO-Link master in a CODESYS project

Hardware:

- AC14 DL as Modbus-TCP master
- AL1341 as Modbus-TCP slave

Solution:

Preparation:

▶ Create CODESYS project with AC14 DL.

1 Create Modbus-TCP master

- ▶ In the device tree: Right-click on [X8] node
 - > Context menu appears.
 - ▶ In the context menu: Select [Add Device...].
 - > Dialogue window appears.
 - ▶ Select the following settings:
 1. [Vendor]: Select [ifm electronic].
 2. [Device]: Select [Modbus_TCP_Master].
 3. [Name]: Enter a unique name.

- ▶ Click on [Add Device].
 - > Device tree shows Modbus-TCP master as sub-node of the interface X8.
- 2 Create Modbus-TCP slave (AL1341)**
- ▶ In the device tree: Right-click on the node of the added Modbus-TCP master
 - ▶ In the context menu: Select [Add Device...].
 - > Dialogue window appears.
 - ▶ Select the following settings:
 1. [Vendor]: Select [ifm electronic].
 2. [Device]: Select [Modbus_TCP_Slave].
 3. [Name]: Enter a unique name
 - ▶ Click on [Add Device].
 - > Device tree shows AL1341 as sub-node of the Modbus-TCP master.
- 3 Configure Modbus-TCP slave**
- ▶ In the following tabs, set the parameters as required:
 1. [General]: Set IP address and Unit ID
 2. [Modbus Slave Channel]: Add Modbus register
 2. [ModbusTCP Slave I/O Mapping]: Map Modbus register values to variables

9.3.2 Set IO-Link master

54624

Register area for the access to the configuration of the IO-Link master: → **Configuration Area**
 (→ p. [100](#))

The area contains the following data:

- Access rights to the IO-Link master
- Data length of the IO-Link input and output data of all IO-Link ports
- Alignment of the bytes in a data word



- ▶ Observe the general rules for access to the Modbus registers (→ **Rules for accessing the Modbus registers** (→ p. [87](#)))!
- ▶ When writing several registers at once, ensure that the transferred parameter data has the correct length!

Register	Content	Access
8998	Access Rights; Process Data Length	r/w
8999	Byte Swap	r/w

r/w ... read and write

9.3.3 Set IO-Link ports

Register area for the access to the configuration of the IO-Link ports: → **Configuration Area**
(→ p. [100](#))

The area contains the following data:

- Operating mode of IO-Link ports
- Device validation and Data storage settings
- Failsafe values of outputs



- ▶ Observe the general rules for access to the Modbus registers (→ **Rules for accessing the Modbus registers** (→ p. [87](#)))!
- ▶ When writing several registers at once, ensure that the transferred parameter data has the correct length!

Register	Contents	Access
9000	Port X01: Port Configuration	r/w
9006	Port X02: Port Configuration	r/w
9012	Port X03: Port Configuration	r/w
9018	Port X04: Port Configuration	r/w

r/w = read and write

In addition, the user can set the IO-Link ports of the AL1341 via the following acyclic commands:

- "Set Mode": → **Command 0x10 – Set mode** (→ p. [114](#))
- "Set Validation ID / Data Storage": → **Command 0x20 – Set validation ID / data storage**
(→ p. [116](#))
- "Set Fail-safe Data Pattern": → **Command 0x30 – Set fail-safe data pattern** (→ p. [118](#))

The commands use the process mechanisms of the acyclic command channel (→ **Use acyclic services** (→ p. [88](#))).

9.3.4 Read input data of several IO-Link ports

Register area for compact access to the input data of the IO-Link ports X01...X04: → **Input Data**
(→ p. [104](#))

The area contains the following data:

- Combined digital inputs - pin 2 / pin 4 (DI)
- Status information of the IO-Link ports
- Status information of the IO-Link devices
- Combined IO-Link input data



Observe the general rules for access to the Modbus registers (→ **Rules for accessing the Modbus registers** (→ p. [87](#)))!

The parameter "Invalid Data" indicates whether the read IO-Link input data is valid.

- ▶ Also read and evaluate the corresponding status information in addition to the input data of the ports!

Register	Contents	Access
197	Port X01...X04: Digital Input - pin 2 / pin 4 (DI)	r
198	Port X01...X04: Status Information IO-Link Ports	r
199	Port X01...X04: Status Information IO-Link Devices	r
200	Port X01...X04: Compact Input Data - IO-Link (4n Bytes)	r

r = read only

n = [2,4,8,16,32]; is determined by parameters [Process Data Length] (→ **Configuration Area** (→ p. [100](#)))

9.3.5 Read input data of individual IO-Link ports

Register area for separate access to input data of the individual IO-Link ports: → **Single Port Access** (→ p. [108](#))

The area contains the following data for each IO-Link port X01...X04:

- Digital input data at pin 2 / pin 4 (DI)
- Status information of IO-Link port
- Diagnostic and status information of the connected IO-Link devices
- Input data IO-Link



Observe the general rules for access to the Modbus registers (→ **Rules for accessing the Modbus registers** (→ p. [87](#)))!

The parameter "Invalid Data" indicates whether the read IO-Link input data is valid.

- ▶ Also read and evaluate the corresponding diagnostic information!

Register	Contents	Access
1000	Port X01: Digital Input - Pin 2 / Pin 4 (DI)	r
1001	Port X01: Diagnostic + Status Data	r
1002	Port X01: Input Data - IO-Link (n bytes)	r
2000	Port X02: Digital Input - Pin 2 / Pin 4 (DI)	r
2001	Port X02: Diagnostic + Status Data	r
2002	Port X02: Input Data - IO-Link (n bytes)	r
3000	Port X03: Digital Input - Pin 2 / Pin 4 (DI)	r
3001	Port X03: Diagnostic + Status Data	r
3002	Port X03: Input Data - IO-Link (n bytes)	r
4000	Port X04: Digital Input - Pin 2 / Pin 4 (DI)	r
4001	Port X04: Diagnostic + Status Data	r
4002	Port X04: Input Data - IO-Link (n bytes)	r

r ... read only

n = [2,4,8,16,32]; is determined by parameters [Process Data Length] (→ **Configuration Area** (→ p. [100](#)))

9.3.6 Write output data of several IO-Link ports

34472

Register area for compact access to the output data of the IO-Link ports X01...X04: → **Output Data** (→ p. [107](#))

The area contains the following data:

- Digital output data on pin 4 (DO)
- IO-Link output data of the IO-Link ports



- ▶ Observe the general rules for access to the Modbus registers (→ **Rules for accessing the Modbus registers** (→ p. [87](#)))!

Several connected register areas can be written with one write command.

The IO-Link master writes only the outputs in "Compact Output Data" that are completely covered by the transferred output data.

Example: The configured process data length is 4 bytes. If all in all 5 words have been transferred to register 600, the IO-Link master writes the outputs X01 (words 1+2) and X02 (words 3+4). The output X03 is not written.

- ▶ When writing the IO-Link outputs, ensure that the output data has the correct length!

The output data is invalid in the following situations:

- no Ethernet cable connected
- PLC has terminated the connection
- Connection to the PLC has a timeout

Register	Inhalt	Zugriff
599	Port X01...X04: Digital Output - Pin 4 (DO)	r/w
600	Port X01...X04: Compact Output Data IO-Link (4n bytes)	r/w

r/w = read and write

n = [2,4,8,16,32]; is determined by parameters [Process Data Length] (→ **Configuration Area** (→ p. [100](#)))

9.3.7 Write output data of individual IO-Link ports

Register area for separate access to output data of individual IO-Link ports: → **Single Port Access** (→ p. [108](#))

The area contains the following data for each IO-Link port X01...X04:

- Digital output data at pin 4 (DO)
- IO-Link output data



- ▶ Observe the general rules for access to the Modbus registers (→ **Rules for accessing the Modbus registers** (→ p. [87](#)))!

If the user tries to write more than 34 bytes of output data to a single port, the IO-Link master cancels the execution of the command and returns the error code "2 ILLIGEAL ADDRESS".

- ▶ When writing outputs, ensure that the length of the transferred output data corresponds with the configured process data length.

The output data is invalid in the following situations:

- No Ethernet cable connected
- PLC has terminated the connection
- Connection to the PLC has a timeout

Register	Contents	Access
1100	Port X01: Digital Output - Pin 4 (DO)	r/w
1101	Port X01: Output Data IO-Link (n bytes)	r/w
2100	Port X02: Digital Output - Pin 4 (DO)	r/w
2101	Port X02: Output Data IO-Link (n bytes)	r/w
3100	Port X03: Digital Output - Pin 4 (DO)	r/w
3101	Port X03: Output Data IO-Link (n bytes)	r/w
4100	Port X04: Digital Output - Pin 4 (DO)	r/w
4101	Port X04: Output Data IO-Link (n bytes)	r/w

r/w ... read and write

n = [2,4,8,16,32]; is determined by parameter [Process Data Length] (→ **Configuration Area** (→ p. [100](#)))

9.3.8 Read diagnostic information and events

Register area for the access to diagnostic information of the IO-Link ports X01...X04:→**Diagnostic data** (→ p. [102](#))

The area contains the following data:

- Status/error flags for port configuration
- Vendor ID / device ID of the connected IO-Link devices
- Events and corresponding event codes



► Observe the general rules for access to the Modbus registers (→**Rules for accessing the Modbus registers** (→ p. [87](#)))!



A maximum of 3 events per IO-Link port are displayed.

One-time events will be deleted after a minimum of 10 s (Event Single Shot).

Occurring events indicate the time of the error occurrence (event appears). If the error cause disappears, this is indicated by a further event (event disappears). Both event types always occur in pairs.

Register	Contents	Access
30	Port X01: Diagnostic Data	r
40	Port X02: Diagnostic Data	r
50	Port X03: Diagnostic Data	r
60	Port X04: Diagnostic Data	r

r = read only

Additional diagnostic and status details are provided in the following register areas:

- "Input Data" area: →**Read input data of several IO-Link ports** (→ p. [81](#))
- "Single Port Access" area: →**Read input data of several IO-Link ports** (→ p. [81](#))

9.3.9 Read device information

34451

The user can read device information using the FC43.

The AL1341 supports the following data records ("Read Device ID code"):

- Basic Device Identification (0x01): contained data objects: → Modbus TCP specification
- Regular Device Identification (0x02): contained data objects: → Modbus TCP specification
- Specific Device Identification (0x04): contained data objects:

Object ID	Object name / description	Data type	Possible values
0x00	VendorName	ASCII string	ifm electronic
0x01	ProductCode	ASCII string	1341
0x02	MajorMinorRevision	ASCII string	e.g. V1.001
0x03	VendorURL	ASCII string	www.ifm.com
0x04	ProductName	ASCII string	IO-Link Master DL MOD 4P IP69K
0x05	ModelName	ASCII string	1341
0x06	UserApplicationName	ASCII string	MODBUS IO-Link master

9.3.10 Control IO-Link master

34458

The user can control the IO-Link master using the following acyclic commands:

- "Reboot": → **Command 0x40 – Reboot** (→ p. [120](#))
- "Factory Reset": → **Command 0x50 – Factory Reset** (→ p. [121](#))

The commands use the process mechanisms of the acyclic command channel (→ **Use acyclic services** (→ p. [88](#))).

9.3.11 Configure IO-Link devices

33881

The IO-Link master supports the configuration of the connected IO-Link devices from the Modbus TCP projection software. The parameters of an IO-Link device are set via IO-Link index and subindex. The number of the configurable parameters depends on the connected IO-Link device.



Available parameters of the IO-Link devices: → IO Device Description (IODD) of the IO-Link device

The user can read and write IO-Link index and subindex using the following methods:

- Acyclic communication: → **Use acyclic services** (→ p. [88](#))

9.3.12 Modbus TCP: Programmers' notes

Content

Rules for accessing the Modbus registers	87
Supported function codes.....	87
Note: Exception Codes.....	88
Use acyclic services	88

33665

Rules for accessing the Modbus registers

54703

The following general rules apply for access to the Modbus registers:

- ▶ Only use the valid function codes to read or write Modbus registers (→ **Supported function codes** (→ p. [87](#))).
- ▶ After every read or write access check the validity of the transmitted data (→ **Mapping: PQI** (→ p. [109](#))).

Supported function codes

34440

The AL1341 supports the following function codes for read and/or write access to the Modbus register:

Function code	Function name / description
03 (0x03)	Read Multiple Registers
04 (0x04)	Read Input Register
06 (0x06)	Write Single Register
16 (0x10)	Write Multiple Registers
23 (0x17)	Read/Write Multiple Registers
43 (0x2B)	Read Device Identification



Detailed information about the function codes: → MODBUS-TCP specification

Note: Exception Codes

54689

If processing the function code request was without error, the response message will have the following content:

- Response Function Code: Request Function Code
- Response Data: Requested data

If an error occurs while accessing the registers, the AL1341 replies with an error code instead of the function code. The response message has the following content:

- Response Function Code: Error Code (= Request Function Code + 0x80)
- Response Data: Exception Code

The following exception codes are available:

Exception Code	Name	Description
0x1	ILLEGAL FUNCTION	Invalid function code (Modbus function not implemented)
0x2	ILLEGAL DATA ADDRESS	Invalid data address (wrong address or length)
0x3	ILLEGAL DATA VALUE	Invalid data value (invalid parameter; wrong number of register)
0x4	SERVER DEVICE FAILURE	Unrecoverable error in Modbus server while processing

Use acyclic services

34471

The AL1341 has a command interface to execute acyclic commands. A cyclic command consists of a request and a response.

Register	Contents	Access
500	Command Request Channel (Fieldbus PLC >>> IO-Link Master)	r/w
0	Command Response Channel (IO-Link Master >>> Fieldbus PLC)	r

Structure of the acyclic command channel: → **Acyclic Command Channel** (→ p. [110](#))

General procedure of the acyclic communication:

1 Write Command Request

- ▶ In the request channel: Write required data (except for [User ID]).
- > Write required [User ID].
- > Changed [User ID] signals a new command.
- > In the response channel: registers are reset to 0.
- > Acyclic command channel is blocked.
- > Processing of the command is started.

2 Check status

- ▶ In the response channel: Check [Command Status] register.
- > If [Command Status] <> 0: continue with step 3
- > If [Command Status] == 0: repeat step 2.

3 Read Command Response

- ▶ In the response channel: read returned user data.
- > Acyclic command channel is released.

10 Operation

Content

Using web-based management.....	89
---------------------------------	----

34061

10.1 Using web-based management

61181

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

- Status information of the ports
- Access to product page of connected IO-Link devices (only ifm devices)
- 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 to the laptop / PC via the IoT port.
- ▶ Optional: Check the IP settings of the IoT interface.
- ▶ Start web browser.
- ▶ In the address field of the web browser, enter the IP address of the IoT 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

Cleaning process.....	90
Updating the firmware	90
Replacing IO-Link device.....	90

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

61183

The firmware of the IO-Link master can be updated via the IoT Core Visualizer → **Updating the firmware** (→ p. [77](#), → p. [90](#)).

11.3 Replacing IO-Link device

34182

To replace an IO-Link device:

Requirement:

- > New IO-Link device is with factory settings.
- > New IO-Link device supports IO-Link standard 1.1 or higher.

1 Set data storage

- ▶ Set the following parameters of the IO-Link port
 - Set Validation and Data Storage to [Type compatible V1.1 device with Restore] or [Type compatible V1.1. device with Backup + Restore]
 - Set correct values to [Vendor ID] and [Device ID] according to properties of the IO-Link device.
- ▶ Save changes.

2 Replace IO-Link device

- ▶ Disconnect old IO-Link device from IO-Link master.
- ▶ Connect new IO-Link device with the same IO-Link port of the AL1341.
- > IO-Link master copies parameter values from the data memory to the new IO-Link device.

12 Factory settings

34509

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

Parameter	Factory setting
[IP address] (Modbus TCP)	192.168.1.250
[Subnet mask] (Modbus TCP)	255.255.255.0
[IP gateway address] (Modbus TCP)	0.0.0.0
[IP address] (IoT interface)	169.254.X.X
[Subnet mask] (IoT interface)	255.255.0.0
[IP gateway address] (IoT interface)	0.0.0.0
[Modbus TCP name]	blank
Data memory (Data Storage)	empty

13 Accessories

33870

List of accessories of AL1341: → www.ifm.com > Product page > Accessories

14 Appendix

Content	
Technical data	94
Modbus TCP	98
ifm IoT Core	122

33879

14.1 Technical data

Content

Application	94
Electrical data	94
Inputs / outputs	94
Inputs	95
Outputs	95
Interfaces	95
Operating conditions.....	96
Approvals / tests	96
Mechanical data	96
Electrical connection.....	97

34188

14.1.1 Application

33878

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

14.1.2 Electrical data

33808

Electrical data	
Operating voltage [V]	20...28 DC; (US; to SELV/PELV)
Current Consumption [mA]	300...3900; (US)
Protection class	III
Sensor supply US	
Max. current load total [A]	3.6

14.1.3 Inputs / outputs

34068

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

14.1.4 Inputs

34069

Inputs	
Number of digital inputs	8; (IO-Link Port Class A: 4 x 2)
Switching level high [V]	11...28
Switching level low [V]	0...5
Digital inputs protected against short circuits	yes

14.1.5 Outputs

34053

Outputs	
Number of digital outputs	4; (IO-Link Port Class A: 4 x 1)
Max. current load per output [mA]	300
Short-circuit protection	yes

14.1.6 Interfaces

34389

Interfaces	
Communication interface	Ethernet; IO-Link
Communication interface	IO-Link; TCP/IP; Modbus TCP
Ethernet	
Transmission standard	10Base-T; 100Base-TX
Transmission rate [MBit/s]	10; 100
Protocol	TCP/IP; Modbus TCP
Factory settings	<ul style="list-style-type: none"> ▪ IP address: 192.168.1.250 ▪ Subnet mask: 255.255.255.0 ▪ Gateway IP address: 0.0.0.0 ▪ MAC address: see type label
IO-Link master	
Type of transmission	COM 1 / COM 2 / COM 3
IO-Link revision	V1.1
Number of ports Class A	4
IoT interface	
Transmission standard	10Base-T; 100Base-TX
Transmission rate [Mbits/s]	10; 100
Protocol	DHCP, DCHP, Auto IP
Factory settings	<ul style="list-style-type: none"> ▪ IP address: 169.254.X.X ▪ Subnet mask: 255.255.0.0 ▪ Gateway IP address: 0.0.0.0 ▪ MAC address: see type label

14.1.7 Operating conditions

34062

Operating conditions	
Applications	Indoor use
Ambient temperature [°C]	-25...60
Storage temperature [°C]	-25...85
Max. perm. relative air humidity [%]	90
Max. height above sea level [m]	2000
Protection rating	IP 65; IP 66; IP 67; IP 69K; (operation with stainless steel protective caps: IP 69K)
Pollution Degree	2

14.1.8 Approvals / tests

33877

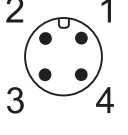
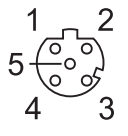
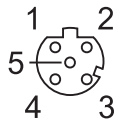
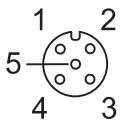
Approval / tests	
EMC	<ul style="list-style-type: none"> ▪ EN 61000-6-2 ▪ EN 61000-6-4
MTTF [Years]	90

14.1.9 Mechanical data

34050

Mechanical data	
Weight [g]	283,5
Materials	Housing: PA grey; socket: 1.4404 (stainless steel / 316L)

14.1.10 Electrical connection

Voltage supply IN X31											
Plug and socket connection	M12										
Wiring	 <table style="display: inline-table; vertical-align: middle;"> <tr> <td>1:</td> <td>+ 24 V DC (US)</td> </tr> <tr> <td>2:</td> <td>-</td> </tr> <tr> <td>3:</td> <td>GND (US)</td> </tr> <tr> <td>4:</td> <td>-</td> </tr> </table>	1:	+ 24 V DC (US)	2:	-	3:	GND (US)	4:	-		
1:	+ 24 V DC (US)										
2:	-										
3:	GND (US)										
4:	-										
Ethernet IN / OUT X21, X22											
Plug and socket connection	M12										
Wiring	 <table style="display: inline-table; vertical-align: middle;"> <tr> <td>1:</td> <td>TX +</td> </tr> <tr> <td>2:</td> <td>RX +</td> </tr> <tr> <td>3:</td> <td>TX -</td> </tr> <tr> <td>4:</td> <td>RX -</td> </tr> <tr> <td>5:</td> <td>-</td> </tr> </table>	1:	TX +	2:	RX +	3:	TX -	4:	RX -	5:	-
1:	TX +										
2:	RX +										
3:	TX -										
4:	RX -										
5:	-										
IoT X23											
Plug and socket connection	M12										
Wiring	 <table style="display: inline-table; vertical-align: middle;"> <tr> <td>1:</td> <td>TX +</td> </tr> <tr> <td>2:</td> <td>RX +</td> </tr> <tr> <td>3:</td> <td>TX -</td> </tr> <tr> <td>4:</td> <td>RX -</td> </tr> <tr> <td>5:</td> <td>-</td> </tr> </table>	1:	TX +	2:	RX +	3:	TX -	4:	RX -	5:	-
1:	TX +										
2:	RX +										
3:	TX -										
4:	RX -										
5:	-										
Process connection IO-Link ports Class A X01...X04											
Plug and socket connection	M12										
Wiring	 <table style="display: inline-table; vertical-align: middle;"> <tr> <td>1:</td> <td>Sensor supply (US) L+</td> </tr> <tr> <td>2:</td> <td>DI</td> </tr> <tr> <td>3:</td> <td>Sensor supply (US) L-</td> </tr> <tr> <td>4:</td> <td>C/Q IO-Link</td> </tr> <tr> <td>5:</td> <td>-</td> </tr> </table>	1:	Sensor supply (US) L+	2:	DI	3:	Sensor supply (US) L-	4:	C/Q IO-Link	5:	-
1:	Sensor supply (US) L+										
2:	DI										
3:	Sensor supply (US) L-										
4:	C/Q IO-Link										
5:	-										

14.2 Modbus TCP

Content

Register	99
Acyclic commands.....	113

33674

14.2.1 Register

Content	
Configuration Area.....	100
Diagnostic data.....	102
Input Data.....	104
Output Data.....	107
Single Port Access.....	108
Acyclic Command Channel.....	110

34442

The AL1341 saves the configuration data, process data and status/diagnostic data in Modbus registers.

Configuration Area

34470

Register	Contents	
	Bits 8-15	Bits 0-7
8998	Access Rights	Process Data Length
8999	reserved	Byte Swap
9000	Port X01: Port Configuration (→ Mapping: port configuration (→ p. 101))	
9006	Port X02: Port Configuration (→ Mapping: port configuration (→ p. 101))	
9012	Port X03: Port Configuration (→ Mapping: port configuration (→ p. 101))	
9018	Port X04: Port Configuration (→ Mapping: port configuration (→ p. 101))	

Legend:

- [Access Rights] The access rights to the parameter data, process data and the events/diagnostic messages of the IO-Link master as well as the connected IO-Link devices.

1 byte	0x00	Modbus TCP + IoT
	0x01	Modbus TCP + IoT (ro)
	0x02	Modbus TCP only
	0x03	Keep setting (default)
- [Process Data Length] Length of the process input data and process output data

1 byte	0x00	2 bytes input / 2 bytes output data <ul style="list-style-type: none"> ▪ Input Data: 7 Words ▪ Output Data: 5 Words
	0x01	4 bytes input / 4 bytes output data <ul style="list-style-type: none"> ▪ Input Data: 11 Words ▪ Output Data: 9 Words
	0x02	8 bytes input / 8 bytes output data <ul style="list-style-type: none"> ▪ Input Data: 19 Words ▪ Output Data: 17 Words
	0x03	16 bytes input / 16 bytes output data <ul style="list-style-type: none"> ▪ Input Data: 35 Words ▪ Output Data: 33 Words
	0x04	32 bytes input / 32 bytes output data <ul style="list-style-type: none"> ▪ Input Data: 67 Words ▪ Output Data: 65 Words
- [Byte Swap] Sequence of bytes in the data word

1 byte	0x00	as Array of Bytes
	0x01	as integer16 value; when process data is updated, bytes will be exchanged (input data and output data).
- [Port Configuration] Configuration of the IO-Link port

12 bytes	→ Mapping: port configuration (→ p. 101)
----------	--

Mapping: port configuration

34478

Bits 8-15	Bits 0-7
Port Mode	Master Cycle Time
reserved	Validation ID
Vendor ID	
reserved	Device ID (MSB)
Device ID	Device ID (LSB)
Failsafe Mode -- IO-Link	Failsafe Mode -- Pin 4 (DO)

Legend:

▪ [Port Mode]	Operating mode of the IO-Link port	1 byte	0x00	deactivated
			0x01	Digital input (DI)
			0x02	Digital output (DO)
			0x03	IO-Link
▪ [Master Cycle Time]	Cycle time of the data transmission between the IO-Link master and the IO-Link device	1 byte	0x00	As fast as possible
			0x01	2 milliseconds
			0x02	4 milliseconds
			0x03	8 milliseconds
			0x04	16 milliseconds
			0x05	32 milliseconds
			0x06	64 milliseconds
			0x07	128 milliseconds
▪ [Validation ID]	Supported IO-Link standard and behaviour of the IO-Link master when connecting new IO-Link devices to the IO-Link port	1 byte	0x00	No validation
			0x01	V1.0 device
			0x02	V1.1 device
			0x03	V1.1 device with Backup + Restore
			0x04	V1.1 device with Backup
▪ [Vendor ID]	Vendor ID of the manufacturer of the device on the IO-Link port	2 bytes	0x0000...0xFFFF	
▪ [Device ID]	Device ID of the device on the IO-Link port Device ID = 0x123456	3 bytes	pro Byte: 0x00...0xFF	
	▪ Device ID (MSB) = 0x12			
	▪ Device ID = 0x34			
	▪ Device ID (LSB) = 0x56			
▪ [Failsafe Mode -- IO-Link]	Fail-safe mode for output data when the Modbus TCP connection is interrupted	1 byte	0x00	No Failsafe
			0x01	Failsafe Reset Value
			0x02	Failsafe Old Value
			0x03	Failsafe with Pattern
▪ [Failsafe Mode -- Pin 4 (DO)]	Fail-safe value for the operating mode "digital output (DO)"	1 byte	0x00	Failsafe Reset Value
			0x01	Failsafe Old Value
			0x02	Failsafe Set Value

Diagnostic data

SYS_OBJECTID>

Register	Contents	
	Bits 8-15	Bits 0-7
30	reserved	Port X01: → Mapping: Diagnostics (→ p. 102)
31	Port X01: Vendor ID	
32	reserved	Port X01: Device ID (MSB)
33	Port X01: Device ID	Port X01: Device ID (LSB)
34...39	Port X01: Events (→ Mapping: events (→ p. 103))	
40	Port X02: Diagnostic data (Mapping: → Port X01 - register 30...39)	
50	Port X03: Diagnostic data (Mapping: → Port X01 - register 30...39)	
60	Port X04: Diagnostic data (Mapping: → Port X01 - register 30...39)	

Legend:

- [Vendor ID] Vendor ID of the manufacturer of the device on the IO-Link port 2 bytes 0x0000...0xFFFF
- [Device ID] Device ID of the device on the IO-Link port 3 bytes per byte: 0x00...0xFF
 - Device ID = 0x123456
 - Device ID (MSB) = 0x12
 - Device ID = 0x34
 - Device ID (LSB) = 0x56

Mapping: Diagnostics

34504

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
reserved	Wrong Length PD OUT	Wrong Length PD IN	Cycle time	Wrong Vendor ID/ Device ID	reserved	reserved	IOL mode

Legend:

- [IOL Mode] Operating type of the IO-Link port 1 bit

0x0	Other
0x1	IO-Link
- [Wrong Vendor ID/ Device ID] Verification if the current and configured vendor ID and device ID are identical 1 bit

0x0	OK
0x1	No match
- [Wrong Cycle Time] Verification if the current and configured cycle time are identical 1 bit

0x0	OK
0x1	No match
- [Wrong Length PD IN] Verification if the size of the received input data are identical with the configured size 1 bit

0x0	OK
0x1	Configured size too small
- [Wrong Length PD OUT] Verification if the size of the sent output data is identical with the size expected by the IO-Link device 1 bit

0x0	OK
0x1	Configured size too small

Input Data

34447

Register	Contents
197	Port X01...X04: Digital Input - Pin 2 / Pin 4 (DI) (→ Mapping: digital input data (→ p. 105))
198	Port X01...X04: Diagnostic Information (→ Mapping: diagnostic information (→ p. 105))
199	Port X01...X04: Status Information IO-Link Ports (→ Mapping: Status information IO-Link ports (→ p. 106))
200	Port X01...X04: Compact Input Block (4n bytes) (→ Mapping: Compact Input Block (→ p. 106))

Legend:

- [Digital Input - Pin 2 / Pin 4 (DI)] Digital input data Pin 2 / Pin 4 (operating mode DO) of 4 IO-Link ports 2 bytes
- [Diagnostic Information] Diagnostic information 2 bytes
- [Status Information IO-Link Ports] Status information of the IO-Link ports 2 bytes
- [Compact Input Block (4n Bytes)] Input data (operating mode IO-Link) of 4 IO-Link ports 4n bytes per byte: 0x00...0xFF
n = [2,4,8,16,32]; is determined by parameters [Process Data Length] (→ **Configuration Area** (→ p. [100](#)))

Mapping: Status information IO-Link ports

34485

Bit															
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
res.	res.	res.	res.	X04: Data invalid	X03: Data invalid	X02: Data Invalid	X01: Data invalid	res.	res.	res.	res.	X04: Dev Not Conn	X03: Dev Not Conn	X02: Dev Not Conn	X01: Dev Not Conn

Legend:

- [Data invalid] indicates the status of the process input data on the IO-Link port 1 bit 0x0 data valid
0x1 data invalid
- [Dev Not Conn] Device Connected: indicates the connection to the device on the IO-Link port 1 bit 0x0 available
0x1 not available

Mapping: Compact Input Block

54567

IO-Link port	Register area				
	2 bytes/port (n = 2)	4 bytes/port (n = 4)	8 bytes/port (n = 8)	16 bytes/port (n = 16)	32 bytes/port (n = 32)
Port X01	200	200...201	200...203	200...207	200...215
Port X02	201	202...203	204...207	208...215	216...231
Port X03	202	204...205	208...211	216...223	232...247
Port X04	203	206...207	212...215	224...231	248...263

Output Data

34488

Register	Contents	
	Bits 8-15	Bits 0-7
599	Port X01...X04: Digital Output - Pin 4 (DO) (→ Mapping: Digital output data (→ p. 107))	
600	Port X01...X04: Compact Output Block (4n bytes) (→ Mapping: Compact Output Block (→ p. 107))	

Legend:

- [Digital Output - Pin 4 (DO)] Digital output data - pin 4 (operating mode DO) of 4 IO-Link ports 2 bytes
- [Compact Output Block (4n Bytes)] Output data (operating mode IO-Link) of 4 IO-Link ports 4n bytes per byte: 0x00...0xFF
n = [2,4,8,16,32]; is determined by parameters [Process Data Length] (→ **Configuration Area** (→ p. 100))

Mapping: Digital output data

34493

Bit															
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
res.	res.	res.	res.	res.	res.	res.	res.	res.	res.	res.	res.	X04: Pin 4	0X03: Pin 4	X02: Pin 4	X01: Pin 4

Legend:

- [Pin4] Signal level on pin 4 of the IO-Link port (DO) 1 bit 0x0 LOW
0x1 HIGH

Mapping: Compact Output Block

54568

IO-Link port	Register area				
	2 bytes/port (n = 2)	4 bytes/port (n = 4)	8 bytes/port (n = 8)	16 bytes/port (n = 16)	32 bytes/port (n = 32)
Port X01	600	600...601	600...603	600...607	600...615
Port X02	601	602...603	604...607	608...615	616...631
Port X03	602	604...605	608...611	616...623	632...647
Port X04	603	606...607	612...615	624...631	648...663

Mapping: PQI

34479

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
reserved	Wrong Length PD OUT	Wrong Length PD IN	Wrong Cycle Time	Wrong VID/DID	Invalid Data	Dev Not Conn	IOL Mode

Legend:

▪ [IOL Mode]	Operating type of the IO-Link port	1 bit	0x0	Other
			0x1	IO-Link
▪ [Dev Not Conn]	Connection between IO-Link Device and IO-Link port	1 bit	0x0	connected.
			0x1	not connected
▪ [Invalid Data]	Status of the process input data on the IO-Link port	1 bit	0x0	valid data
			0x1	invalid data
▪ [Wrong VID/DID]	Verification whether the current and configured vendor ID and device ID are identical	1 bit	0x0	OK
			0x1	no match
▪ [Wrong Cycle Time]	Verification whether the current and configured cycle time are identical	1 bit	0x0	OK
			0x1	no match
▪ [Wrong Length PD IN]	Verification whether the size of the received input data are identical with the configured size	1 bit	0x0	OK
			0x1	Configured size too small
▪ [Wrong Length PD OUT]	Verification whether the size of the sent output data is identical with the size expected by the IO-Link device	1 bit	0x0	OK
			0x1	Configured size too small

Acyclic Command Channel

34449

The following Modbus registers are available for acyclic data transmission:

Register	Contents	
	Bits 8-15	Bits 0-7
500	Command Request Channel (→ Request channel (→ p. 110))	
0	Command Response Channel (→ Response channel (→ p. 111))	

Legend:

- [Command Request Channel] Area for transmission of command request (fieldbus PLC >>> IO-Link master) 44 bytes
- [Command Response Channel] Area for transmission of command response (IO-Link master >>> fieldbus PLC) 44 bytes

Request channel

34450

Register	Contents	
	Bits 8-15	Bits 0-7
500	Port No.	
501	Index	
502	Subindex	
503	Command	User ID
504	Data Length (Number of Bytes)	
505	Data (byte 0)	Data (byte 1)
...
521	Data (byte 32)	Data (byte 33)

Legend:

- [Port No.] Number of the IO-Link port 1 Word 0x0001 Port X01
0x0002 Port X02
...
0x0004 Port X04
- [Index] Index of the IO-Link object 1 Word 0x0000...0xFFFF
- [Subindex] Subindex of the IO-Link object 1 Word 0x0000...0xFFFF
- [Command] Command number 1 byte 0x01 Read
0x02 Write
- [User ID] ID to identify the command 1 byte 0x00...0xFF
- [Data Length (Number of Bytes)] Number of bytes that contain relevant user data (is only evaluated for Command = 0x02) 1 Word 0x0000 0 bytes
...
0x0022 34 bytes
- [Data (Byte n)] user data n bytes per byte: 0x00 ... 0xFF

Error codes

34342

Error code	Description
0x71	Service not available (unknown command has been sent to the IO-Link port)
0x72	Port blocked (another cyclic process accesses the IO-Link port)
0x73	Forbidden (access rights don't allow command processing)
0x74	Invalid data (wrong parameter has been sent in the command)
0x76	Wrong port (wrong port number)
0x77	Wrong port function (wrong port function or wrong parameter has been sent to the device)
0x78	Invalid length (set length is > 0x20)
0x80	Error in the device application; observe additional code (→ Additional Codes (→ p. 112))

Additional Codes

54584

Code	Name	Description
0x00	APP_DEV	Device application error - no details
0x11	IDX_NOTAVAIL	Index not available
0x12	SUBIDX_NOTAVAIL	Subindex not available
0x20	SERV_NOTAVAIL	Service temporarily not available
0x21	SERV_NOTAVAIL_LOCCTRL	Service temporarily not available - local control
0x22	SERV_NOTAVAIL_DEVCTRL	Service temporarily not available - device control
0x23	IDX_NOT_WRITEABLE	Access denied
0x30	PAR_VALOUTOFRNG	Parameter value out of range
0x31	PAR_VALGLTIM	Parameter value above limit
0x32	PAR_VALLTLIM	Parameter value below limit
0x33	VAL_LENVERRUN	Parameter length overrun
0x34	VAL_LENUNDRUN	Parameter length underrun
0x35	FUNC_NOTAVAIL	Function not available
0x36	FUNC_UNAVAILTEMP	Function temporarily not available
0x40	PAR_SETINVALID	Invalid parameter set
0x41	PAR_SETINCONSIST	Inconsistent parameter set
0x82	APP_DEVNOTRDY	Application not ready



Additional Codes are only available, if Error Code = 0x80 (→ **Error codes** (→ p. [112](#)))

14.2.2 Acyclic commands

Content

Command 0x10 – Set mode.....	114
Command 0x20 – Set validation ID / data storage.....	116
Command 0x30 – Set fail-safe data pattern.....	118
Command 0x40 – Reboot.....	120
Command 0x50 – Factory Reset.....	121

34331

Command 0x40 – Reboot

34457

The command reboots the AL1341.

Command request

34494

Register	Contents	
	Bits 8-15	Bits 0-7
500	reserved	
501	reserved	
502	reserved	
503	0x40	User ID
504	reserved	
505	0x00AA	
506 ... 521	reserved	

Legend:

- [User ID] ID to identify the command 1 byte 0x00 .. 0xFF

Command response

34508

Register	Contents	
	Bits 8-15	Bits 0-7
0	reserved	
1	reserved	
2	reserved	
3	0x40	User ID
4	Result	
5	Data Length (Number of Bytes)	
6	reserved / Error Code	0xAA / Additional Code
7 ... 21	reserved	

Legend:

- [User ID] reflected User ID from request channel 1 byte 0x00 .. 0xFF
- [Result] Status of the command processing 1 word 0x0000 OK
0x00FF Error
- [Data Length (Number of Bytes)] Number of bytes that contain relevant user data 1 word 0x0001 1 byte
0x0002 2 bytes
- [Error Code] Error ID 1 byte → **Error codes** (→ p. [112](#))
- [Additional Code] Additional error codes 1 byte → **Additional Codes** (→ p. [112](#))

Command 0x50 – Factory Reset

34499

The command resets all parameters to the factory settings (→ **Factory settings** (→ p. [91](#))).

Command request

34501

Register	Contents	
	Bits 8-15	Bits 0-7
500	reserved	
501	reserved	
502	reserved	
503	0x50	User ID
504	reserved	
505	0x0055	
506 ... 520	reserved	

Legend:

- [User ID] ID to identify the command 1 byte 0x00 .. 0xFF

Command response

34507

Register	Contents	
	Bits 8-15	Bits 0-7
0	reserved	
1	reserved	
2	reserved	
3	0x50	User ID
4	Result	
5	Data Length (Number of Bytes)	
6	reserved / Error Code	0x55 / Additional Code
7 ... 21	reserved	

Legend:

- [User ID] reflected User ID from request channel 1 byte 0x00 .. 0xFF
- [Result] Status of the command processing 1 word 0x0000 OK
0x00FF Error
- [Data Length (Number of Bytes)] Number of bytes that contain relevant user data 1 word 0x0001 1 byte
0x0002 2 bytes
- [Error Code] Error ID 1 byte → **Error codes** (→ p. [112](#))
- [Additional Code] additional error codes 1 byte → **Additional Codes** (→ p. [112](#))

14.3 ifm IoT Core

Content

Overview: IoT profile.....	123
Overview: IoT types.....	130
Overview: IoT services	131

33803

14.3.1 Overview: IoT profile

Content

Profile: blob.....	123
Profile: deviceinfo	124
Profile: devicetag	124
Profile: iolinkdevice_full	125
Profile: iolinkmaster	125
Profile: mqttCmdChannel	126
Profile: mqttCmdChannelSetup	126
Profile: mqttConnection	126
Profile: mqttSetup	127
Profile: network.....	127
Profile: parameter	128
Profile: processdata	128
Profile: runcontrol	128
Profile: service	128
Profile: software.....	128
Profile: software/uploadedablessoftware	129
Profile: Timer	129

34054

Profile: blob

52264

Element (identifier)	Properties	Mandatory	Comment
blobname	<ul style="list-style-type: none"> ▪ 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	<ul style="list-style-type: none"> ▪ type = structure ▪ profile = deviceinfo 		characterises the element as device information
../devicename	type = data	optional	
../devicefamily	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	<ul style="list-style-type: none"> ▪ 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	<ul style="list-style-type: none"> ▪ 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	<ul style="list-style-type: none"> ▪ type = structure ▪ profile = iolinkmaster 		Executable service
../mode	<ul style="list-style-type: none"> ▪ type = data ▪ profile = parameter 	mandatory	
../comspeed	<ul style="list-style-type: none"> ▪ type = data ▪ profile = parameter 	mandatory	
../mastercycletime_actual	<ul style="list-style-type: none"> ▪ type = data ▪ profile = parameter 	mandatory	
../mastercycletime_preset	<ul style="list-style-type: none"> ▪ type = data ▪ profile = parameter 	mandatory	
../validation_datastorage_mode	<ul style="list-style-type: none"> ▪ type = data ▪ profile = parameter 	mandatory	
../validation_vendorid	<ul style="list-style-type: none"> ▪ type = data ▪ profile = parameter 	mandatory	
../validation_deviceid	<ul style="list-style-type: none"> ▪ type = data ▪ profile = parameter 	mandatory	
../additionalpins_in	<ul style="list-style-type: none"> ▪ type = data ▪ profile = processdata 	optional	
../additionalpins_out	<ul style="list-style-type: none"> ▪ type = data ▪ profile = processdata 	optional	
../portevent	<ul style="list-style-type: none"> ▪ type = data 	mandatory	
../iolinkdevice	<ul style="list-style-type: none"> ▪ type = structure ▪ profile = iolinkdevice_full 	mandatory	

Profile: mqttCmdChannel

61186

Element (identifier)	Properties	Mandatory	Comment
mqttCmdChannel	<ul style="list-style-type: none"> ▪ type = structure ▪ profile = commChannel 		Profile of the MQTT command channel
../type	<ul style="list-style-type: none"> ▪ type = data ▪ data type = STRING 	mandatory	Protocol type of the interface
../status	<ul style="list-style-type: none"> ▪ type = data ▪ data type = STRING 	mandatory	Status of the MQTT command channel (possible values: init, running, stopped, error)
../mqttCmdChannelSetup	type = profile		Sub-profile: Profile: mqttCmdChannelSetup (→ p. 126)

Profile: mqttCmdChannelSetup

61187

Element (identifier)	Properties	Mandatory	Comment
mqttCmdChannelSetup	<ul style="list-style-type: none"> ▪ type = structure ▪ profile = mqttCmdChannelSetup 		Settings of the MQTT command channel
../brokerIP	<ul style="list-style-type: none"> ▪ type = data ▪ data type = STRING 	optional	
../brokerPort	<ul style="list-style-type: none"> ▪ type = data ▪ data type = STRING 	optional	
../cmdTopic	<ul style="list-style-type: none"> ▪ type = data ▪ data type = STRING 	optional	
../defaultReplyTopic	<ul style="list-style-type: none"> ▪ type = data ▪ data type = STRING 	optional	

Profile: mqttConnection

61188

Element (identifier)	Properties	Mandatory	Comment
mqttConnection	<ul style="list-style-type: none"> ▪ type = structure ▪ profile = commInterface 		MQTT connection in the IoT Core
../type	<ul style="list-style-type: none"> ▪ type = data ▪ data type = STRING 	mandatory	Protocol type of the interface
../status	<ul style="list-style-type: none"> ▪ type = data ▪ data type = STRING 	mandatory	global status of the MQTT (possible values: init, running, stopped, error)
../mqttSetup	type = profile		Sub-profile: Profile: mqttSetup (→ p. 127)
../mqttCmdChannel	type = profile		Sub-profile: Profile: mqttCmdChannel (→ p. 126)

Profile: mqttSetup

61189

Element (identifier)	Properties	Mandatory	Comment
mqttSetup	<ul style="list-style-type: none"> ▪ type = structure ▪ profile = mqttSetup 		Settings of the MQTT command channel
../QoS	<ul style="list-style-type: none"> ▪ type = data ▪ data type = Number 	mandatory	Quality of Service of the MQTT connection
../version	<ul style="list-style-type: none"> ▪ type = data ▪ data type = STRING 	mandatory	

Profile: network

52266

Element (identifier)	Characteristics	Mandatory	Comments
network	<ul style="list-style-type: none"> ▪ type = structure ▪ profiles = deviceinfo 		Characterises the element as device information
../macaddress	<ul style="list-style-type: none"> ▪ type = data ▪ profile = parameter 	mandatory	
../ipaddress	<ul style="list-style-type: none"> ▪ type = data ▪ profile = parameter 	optional	
../ipv6address	<ul style="list-style-type: none"> ▪ type = data ▪ profile = parameter 	mandatory	
../subnetmask	<ul style="list-style-type: none"> ▪ type = data ▪ profile = parameter 	mandatory	
../ipdefaultgateway	<ul style="list-style-type: none"> ▪ type = data ▪ profile = parameter 	mandatory	
../dhcp	<ul style="list-style-type: none"> ▪ type = data ▪ profile = parameter 	optional	
../ipversion	<ul style="list-style-type: none"> ▪ type = data ▪ profile = parameter 	optional	
../hostname	<ul style="list-style-type: none"> ▪ type = data ▪ profile = parameter 	optional	
../autonegotiation	<ul style="list-style-type: none"> ▪ type = data ▪ profile = parameter 	optional	
../portspeed	<ul style="list-style-type: none"> ▪ 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: runcontrol

61190

Element (identifier)	Properties	Mandatory	Comment
runcontrol	<ul style="list-style-type: none"> ▪ type = profile ▪ profile = runcontrol 		Control of the MQTT command channel
../start	type = service	mandatory	Service: start (→ p. 142)
../stop	type = service	mandatory	Service: stop (→ p. 142)
../reset	type = service	mandatory	Service: Reset (→ p. 139)

Profile: service

34224

Element (identifier)	Properties	mandatory	Comments
service	<ul style="list-style-type: none"> ▪ type = service ▪ profile = service 		Executable service

Profile: software

34223

Element (identifier)	Properties	mandatory	Comments
software	<ul style="list-style-type: none"> ▪ 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	<ul style="list-style-type: none"> ▪ 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	<ul style="list-style-type: none"> ▪ 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	<ul style="list-style-type: none"> ▪ type = structure ▪ profile = timer 		
../counter	<ul style="list-style-type: none"> ▪ type = data ▪ profile = parameter 	mandatory	
../interval	<ul style="list-style-type: none"> ▪ 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

Content

Service: factoryreset.....	131
Service: getblobdata.....	132
Service: getdata.....	132
Service: getdatamulti.....	133
Service: getelementinfo.....	133
Service: getidentity.....	134
Service: getssubscriberlist.....	135
Service: getssubscriptioninfo.....	136
Service: gettree.....	137
Service: install.....	138
Service: iolreadacyclic.....	138
Service: iolwriteacyclic.....	138
Service: querytree.....	139
Service: reboot.....	139
Service: Reset.....	139
Service: setblock.....	140
Service: setdata.....	141
Service: signal.....	141
Service: start.....	142
Service: start_stream_set.....	142
Service: stop.....	142
Service: stream_set.....	143
Service: subscribe.....	143
Service: unsubscribe.....	144
Service: validation_useconnecteddevice.....	144

34056

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

54690

Name: getidentity**Description:** The service reads the device information of the AL1341 and issues it.**Request data ("data" field):** none**Return data ("data" field):**

Data field	Required field	Data type	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	optional	ARRAY OF OBJECTS		
device	optional		AL1341	
device.serialnumber	optional		Serial number	
device.hwrevision	optional		Hardware version	
device.swrevision	optional		Software version	
device.custom	optional			
Security	optional		Security options	
security.securitymode	optional	ENUM	shows if the security mode is activated	
security.authscheme	optional	ENUM	shows the active authentication scheme	
security.ispasswordset	optional	BOOL	shows whether a password has been set	
security.activeconnection	optional	ENUM	shows the currently used communication interface	
			▪ tcp_if	unencrypted http connection at the IoT interface, port 80
			▪ tls_if	encrypted https connection at the IoT interface, port 443
			▪ fb_if	unencrypted http connection at the fieldbus interface, port 80

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 <ul style="list-style-type: none"> ▪ 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: Reset

61195

Name: Reset**Description:** The service resets a connection to the initialisation state.**Request data ("data" field):** none**Return data ("data" field):** none**Example:**

```
{
  "code": "request",
  "cid": 4711,
  "adr": "/connections/mqttConnection/MQTTSetup/mqttCmdChannel/status/reset"
}
```

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 <ul style="list-style-type: none"> 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 AL1341.**Request data (field "data"):** none**Return data (field "data"):** none

Example:

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

Service: start

61196

Name: start**Description:** The service starts a connection.**Request data ("data" field):** none**Return data ("data" field):** none

Example:

```
{
  "code": "request",
  "cid": 4711,
  "adr": "/connections/mqttConnection/MQTTSetup/mqttCmdChannel/status/start"
}
```

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 transferred (number of bytes)

Return data (data): none**Service: stop**

61197

Name: stop**Description:** The service stops a connection.**Request data ("data" field):** none**Return data ("data" field):** none

Example:

```
{
  "code": "request",
  "cid": 4711,
  "adr": "/connections/mqttConnection/MQTTSetup/mqttCmdChannel/status/stop"
}
```

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**

61198

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.

CSV formatted notifications can only be transmitted using the TCP protocol via an activated and configured MQTT channel.

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: <ul style="list-style-type: none"> JSON: http://ipaddress:port/path JSON: ws://path JSON: mqtt://ipaddress:port/topic 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 <ul style="list-style-type: none"> 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 <ul style="list-style-type: none"> 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, user must unsubscribe immediately

Return data ("data" field): none**Notification:** JSON

```
{
"code": "event",
"cid": 4711,
"adr": "",
"data": {
```

```

"eventno": "EventNo",
"srcurl": "SrcURL",
"payload": {
  "eventurl": {"code": EventStatus, "data":EventData},
  "datapointurl_1": {"code":DataStatus_1, "data":DataValue_1},
  "datapointurl_2": {"code":DataStatus_2, "data":DataValue_2},
  ...}}
}

```

Notification: CSV

SrcURL, EventNo, EventStatus, EventData, DataStatus_1, DataValue_1, DataStatus_2, DataValue_2, ...

- SrcURL: Source of the event (data point on which subscribe command was listed)
- EventNo: Event number
- EventStatus: Status code of the event
- EventData: Event data
- DataStatus_1: Status code of the 1st element in list datatosend
- DataValue_1: Value of the 1st element in list datatosend
- DataStatus_2: Status code of the 2nd element in list datatosend
- DataValue_2: Value of the 2nd element in list datatosend
- ...

Service: unsubscribe

34197

Name: unsubscribe

Description: The service deletes an existing subscription. The service unsubscribe 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

15 Index

A

Access the ifm IoT Core	37
Accessories	92
Acyclic Command Channel	110
Acyclic commands	113
Additional Codes	112
Appendix	93
Application	94
Approvals / tests	96

C

Change history	6
Cleaning process	90
Command 0x10 – Set mode	114
Command 0x20 – Set validation ID / data storage	116
Command 0x30 – Set fail-safe data pattern	118
Command 0x40 – Reboot	120
Command 0x50 – Factory Reset	121
Command request	114, 116, 118, 120, 121
Command response	115, 117, 118, 120, 121
Communication, parameter setting, evaluation	11
Configuration	22
Configuration Area	100
Configure IO-Link devices	34, 86
Configuring IO-Link the master	75
Configuring the MQTT command channel	67
Connecting IO-Link devices for Class A operation	16
Connecting the device	17
Connecting the IoT port	15
Connecting the Modbus TCP ports	15
Control IO-Link master	86
Creating a new notification	72

D

Deleting a notification	73
Diagnostic data	102
Digital inputs	12

E

Electrical connection	14, 97
Electrical data	94
Error codes	112
Ethernet ports	19
Example	
Activate security mode	46
Browsing device description	42
Change name of the IO-Link master	60
Change the parameter value of an IO-Link device	56
Changing a subscription	62
Checking subscriptions	64
Clone the Data Storage of an IO-Link port	50
Configuring the MQTT command channel	68
GET request	37
Integrate IO-Link master in a CODESYS project	78
output subtree	41
POST request	38
Publish the temperature to an MQTT broker	70
Read IO-Link process data (operating mode)	52

Read several parameter values of the IO-Link master simultaneously	42
Read the parameter value of an IO-Link device	55
Reading digital input (operating mode)	53
Reading properties of an element	40
Request with authentication	46
reset password	47
Subscribing notifications via WebSocket	65
Subscribing to notifications	43, 61
Subscribing to notifications in CSV format	63
Unsubscribing from notifications	63
Update firmware	59
Writing digital output (operating mode)	53
Writing IO-Link value (operating mode)	52
Explanation of Symbols	5

F

Factory settings	91
Fieldbus	
Configuring the fieldbus interface	48
Configure IP settings	28
Configuring the IP settings	48
set the length of the process data	29
Setting fail-safe values	49
Firmware	
Reboot the device	33
Reset device to factory settings	33
First steps	40
Function	10
Functions and features	9

G

Gateway	
Reading device information	58
Reading status and diagnostic information	58
Resetting, rebooting and localising the device	57
Setting the application tag	60
Updating the firmware	59
General	7
General functions	40
GET request	37

I

ifm IoT Core	35, 122
Info	
Show device information	32
Input Data	104
Inputs	95
Inputs / outputs	94
Integrate the AL1341 into the Modbus project	78
Interfaces	95
Internet of Things (IoT)	11
IO-Link	11
IO-Link devices	
Accessing parameters	55
Indicating IO-Link events	57
Reading a writing device information	57
IO-Link ports	16
Activate data transfer to LR AGENT or LR SMARTOBSERVER	29
Configure operating mode	30
Configuring data transfer to LR AGENT or LR SMARTOBSERVER	52
Configuring device validation and data storage	50
Indicating port events	55
Reading / writing process data	52
set fail-safe values	32

Set the device validation and data storage.....	31
Setting the operating mode of pin 4 (US).....	49
IO-Link Ports (Class A).....	20
IO-Link supply.....	12
IoT	
Configure IP settings.....	24
Configure security mode.....	25
Configure the interface to LR AGENT or LR SMARTOBSERVER.....	27
Configuring access rights.....	26, 44
Configuring IP settings.....	44
Configuring security mode.....	45
Configuring the LR AGENT or LR SMARTOBSERVER interface.....	45
IoT Core	
Diagnostic codes.....	39
General information.....	36
IoT port.....	20
IT security.....	8
L	
LED indicators.....	19
Legal and copyright information.....	5
LR DEVICE.....	23
M	
Maintenance, repair and disposal.....	90
Managing notifications.....	72
Mapping	
Compact Input Block.....	106
Compact Output Block.....	107
diagnostic information.....	105
Diagnostics.....	102
digital input data.....	105
Digital output data.....	107
events.....	103
port configuration.....	101
PQI.....	109
Status information.....	108
Status information IO-Link ports.....	106
Mechanical data.....	96
Modbus TCP.....	11, 78, 98
Programmers' notes.....	87
Mount the device.....	13
Mounting.....	13
MQTT support.....	67
N	
Note	
Connection states.....	68
Exception Codes.....	88
Security mode.....	45
Notes.....	14
O	
Offline parameter setting.....	24
Operating and display elements.....	18
Operating conditions.....	96
Operation.....	89
Output Data.....	107
Outputs.....	95
Overview.....	18
IoT profile.....	123
IoT services.....	131
IoT types.....	130

P

Parameter setting.....	11
Parameter setting with LR DEVICE.....	24
POST request.....	38
Preliminary note.....	5
Profile	
blob.....	123
deviceinfo.....	124
devicetag.....	124
iolinkdevice_full.....	125
iolinkmaster.....	125
mqttCmdChannel.....	126
mqttCmdChannelSetup.....	126
mqttConnection.....	126
mqttSetup.....	127
network.....	127
parameter.....	128
processdata.....	128
runcontrol.....	128
service.....	128
software.....	128
software/uploadedablessoftware.....	129
Timer.....	129
Programmers' notes.....	36
Purpose of the document.....	5

R

Read device information.....	86
Read diagnostic information and events.....	85
Read input data of individual IO-Link ports.....	82
Read input data of several IO-Link ports.....	81
Reading and writing process data.....	76
Register.....	99
Remarks.....	24
Replacing IO-Link device.....	90
Request channel.....	110
Required background knowledge.....	7
Response channel.....	111
Rules for accessing the Modbus registers.....	87

S

Safety instructions.....	7
Safety symbols on the device.....	7
Searching for elements in the device tree.....	74
Security mode.....	11
Service	
factoryreset.....	131
getblobdata.....	132
getdata.....	132
getdatamulti.....	133
getelementinfo.....	133
getsubscriberlist.....	135
getsubscriptioninfo.....	136
gettree.....	137
install.....	138
iolreadacyclic.....	138
iolwriteacyclic.....	138
querytree.....	139
reboot.....	139
Reset.....	139
setblock.....	140
setdata.....	141
signal.....	141

start	142
start_stream_set.....	142
stop	142
stream_set	143
subscribe	143
unsubscribe.....	144
validation_useconnecteddevice.....	144
Servicet	
getidentity	134
Set IO-Link master.....	79
Set IO-Link ports.....	80
Setting the storage duration	43
Set-up	21
Single Port Access.....	108
Status LEDs.....	19
Subscribing to notifications.....	61
Supported function codes.....	87
T	
Technical data	94
U	
Updating the firmware	77, 90
Use acyclic services	88
Using the IoT-Core Visualizer.....	71
Using Web Socket	65
Using web-based management.....	89
V	
Visual indication.....	12
Voltage supply	20
W	
Write output data of individual IO-Link ports	84
Write output data of several IO-Link ports.....	83