GB

Operating instructions

Remote I/O module 16 DI ModbusTCP IP65 / IP66 / IP67

AL4142

11489162 / 03 11 / 2024

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1 Preliminary note

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

1.1 Legal and copyright information

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

1.2 Symbols used

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

1.3 Warnings

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

WARNING

Warning of serious personal injury

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

CAUTION

Warning of minor to moderate personal injury

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

ATTENTION

Warning of damage to property

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

1.4 Safety symbol on the device

Safety symbol on the device:

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

1.5 Change history

Issue	Subject	Date
00	New creation of the document	11 / 2022
01	• Corrected: Chapter DI Channel Mapping (550) (→ 🗋 60)	04 / 2023
02	• Added: UL applications - Derating behaviour, Derating behaviour (→ 🗋 18) • Added: UL applications – Connection technology, Connection technology (→ 🗋 16) • Added: UL applications – Process connections, Process connections (→ 🗋 17) • Added: UL applications – Voltage output, Voltage output (→ 🗋 20)	10 / 2023
03	• Changed: Supported supply voltages, General wiring information (→ 🗋 16) • Changed: Supported parameter setting software, Supported parameter setting software (→ 🗋 24) • Changed: Screenshots IoT Core Visualizer	11 / 2024

2 Safety instructions

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

2.1 Cyber security

ATTENTION

Operating the machine in an unprotected network environment

▷ Unauthorised read or write access to data is possible.

▷ Unauthorised manipulation of the device function is possible.

▶ Check and restrict access options to the device.

3 Intended use

The device may only be used for the following purposes:

- Gateway between digital sensors and a higher-level control system

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

4 Function

4.1 Visual indication

The device displays the following indications:

- Status and error indication of the gateway and the system
- Status and activity indication of the Ethernet connections
- Status of the US voltage supply
- Status and error indication of the sensor ports

4.2 Parameter setting

The device can be configured using the following options:

- Parameter setting software
  - ifm moneo OS + ifm moneo|configure
  - ifm moneo|configure free
- ifm IoT Core
  - IoT-Core Visualizer
- ModbusTCP
  - Projection software

4.3 Inputs

Ports X1...X8 each have 2 digital inputs (type 2 according to EN 61131-3).

The digital inputs are connected to pins 2 and 4 of the ports.

4.3.1 Sensor supply

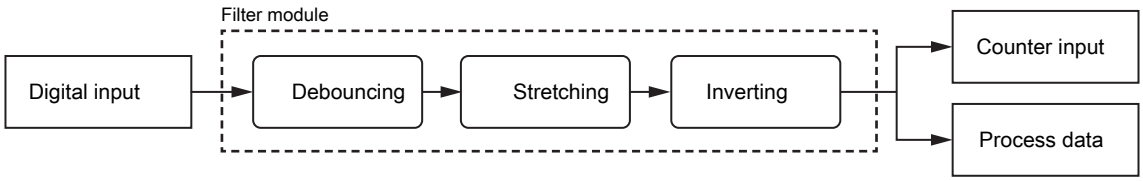
The device has a total of 8 sensor supplies (1 sensor supply per port).

4.4 Digital input filters

The device pre-processes the digital input signals at ports X1...X8. The filter result is forwarded as a process value and as an input signal for a counter module.

The following filters can be applied to the digital input signals in the sequence specified.

1. Debounce
2. Hold
3. Invert



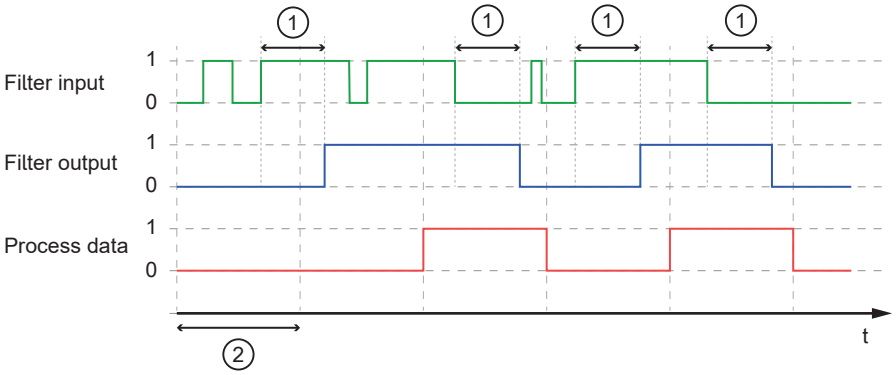
Each filter can be configured separately.

- Maximum input frequency: 4500 Hz
- Minimum detectable positive pulse width: 0.115 ms (+ positive edge)
- Minimum detectable negative pulse width: 0.115 ms (+ negative edge)

4.4.1 Debouncing

The filter suppresses noise signals. The filter provides the input signals at the filter output with a delay (debounce time). All signals shorter than the set debounce time are ignored by the filter.

Time diagram debounce filter:

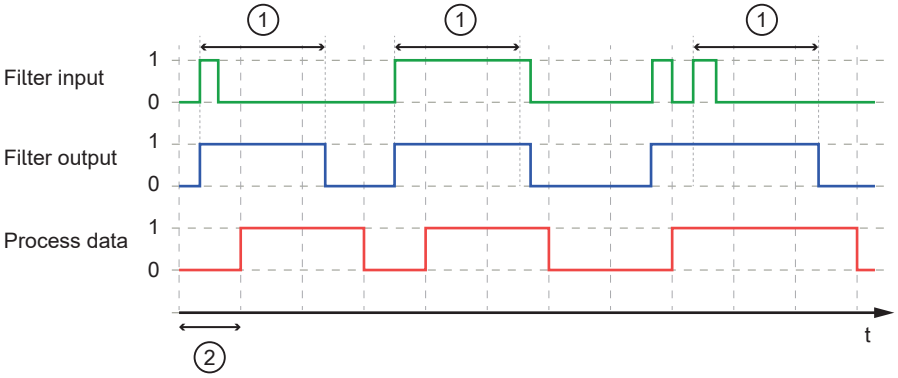


4.4.2 Stretching

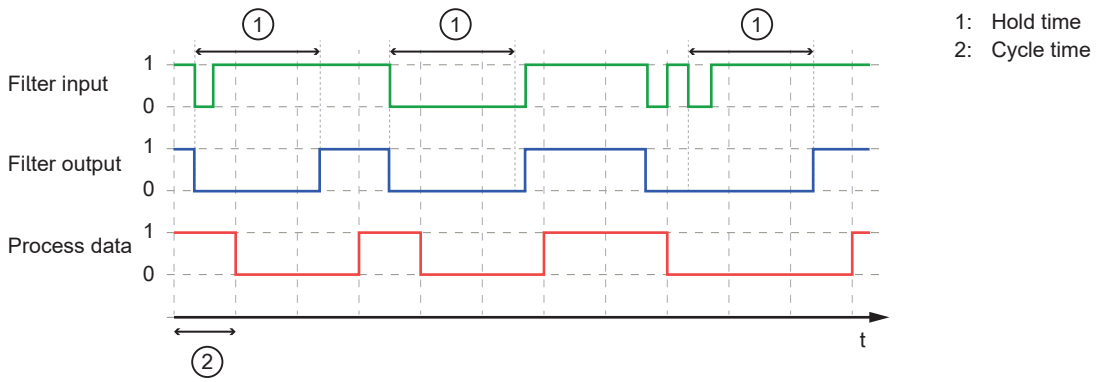
The filter stretches short input pulses. Level changes that occur during a stretching period are ignored. The filter is configured via the following parameters:

- Hold time: pulse duration to which short pulses are to be stretched. Pulses that are present for a longer time than the hold time are not stretched.
- Hold level: signal level to be stretched (HIGH or LOW)

Time diagram stretch filter (status HIGH):



Time diagram stretch filter (status LOW):



4.4.3 Inverting

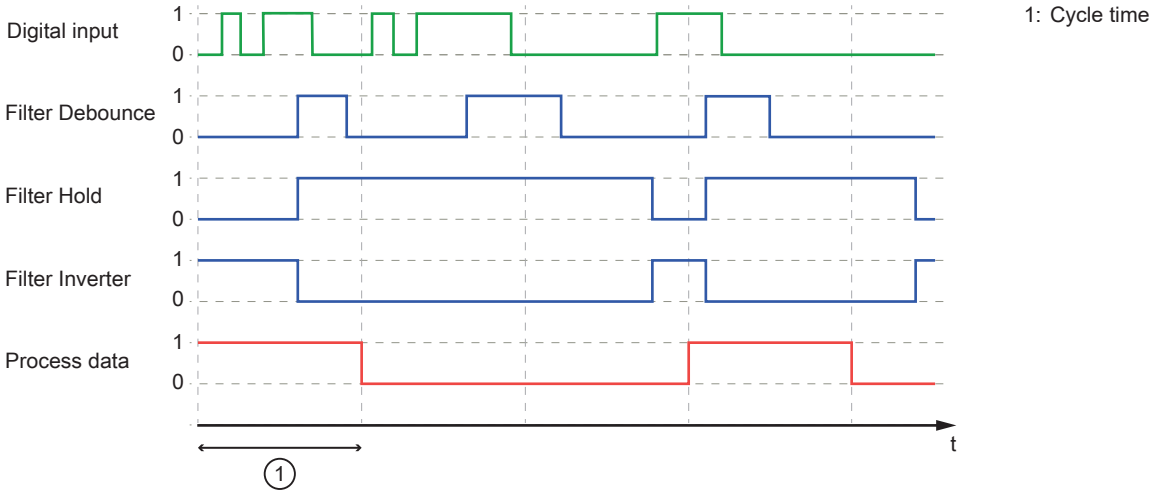
The filter inverts signals.

4.4.4 Filter combination

The filters can be combined.

Example: All 3 filters are activated

Time diagram:

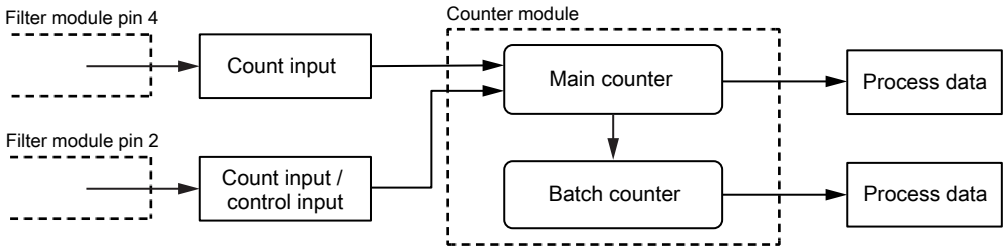


4.5 Counter

The device features one counter module per port.

A counter module consists of 2 separate counters:

- Main counter: The main counter counts the rising edges of the filtered digital input signals. The main counter has a value range that is defined by a threshold value. If the value range of the main counter is exceeded or not reached, an overflow or underflow signal is sent to the batch counter.
- Batch counter: The batch counter counts the overflow or underflow signals of the main counter.



A counter module can be operated in different operating modes. The following operating modes are available.

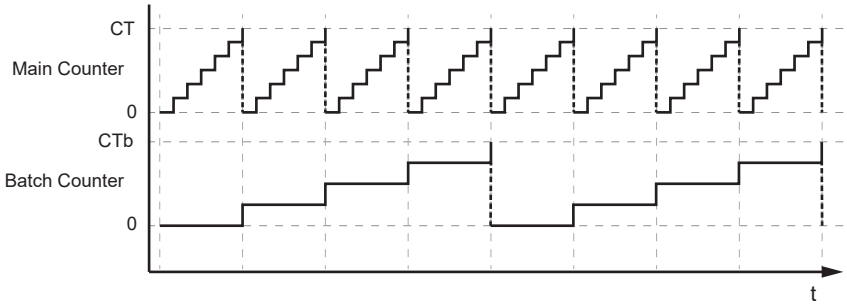
Maximum count frequency: 4500 Hz

4.5.1 Counter mode CTU

In CTU (Count Up) mode, the counter module operates as an up counter with overflow detection and overflow counter.

Behaviour:

- The initial value of the main counter is m = 0. The initial value of the batch counter is b = 0. The main counter has a threshold value CT. The batch counter has a threshold value CTb.
- If the counter module detects a positive edge at pin 4 of the port, the value of the main counter is incremented (m = m+1).
- If the main counter reaches the threshold value CT (m = CT), the counter value is reset (m = 0). Due to the overflow detection, the value of the batch counter is incremented (b = b+1).
- If the batch counter reaches the threshold value CTb (b = CTb), the counter value is reset (b = 0).

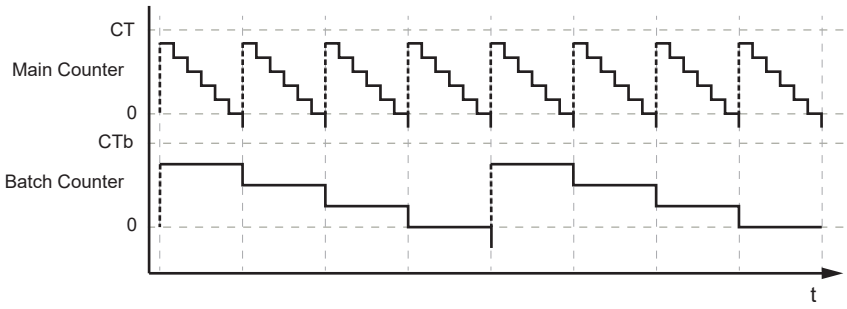


4.5.2 Counter mode CTD

In CTD (Count Down) mode, the counter module operates as a down counter with underflow detection and underflow counting.

Behaviour:

- The initial value of the main counter is m = 0. The initial value of the batch counter is b = 0. The main counter has a threshold value CT. The batch counter has a threshold value CTb.
- The first time a positive edge is detected at pin 4, the value of the main counter is set to the threshold value CT-1 (m = CT-1). At the same time, the value of the batch counter is set to the threshold value CTb-1 (b = CTb-1).
- If the counter module detects a positive edge at pin 4 of the port, the value of the main counter is decremented (m = m-1).
- If the main counter falls below 0, the counter value is reset to the threshold value (m = CT-1). Due to the underflow detection, the value of the batch counter is decremented (b = b-1).
- If the batch counter falls below 0, the counter value is reset to the threshold value (b = CTb-1).

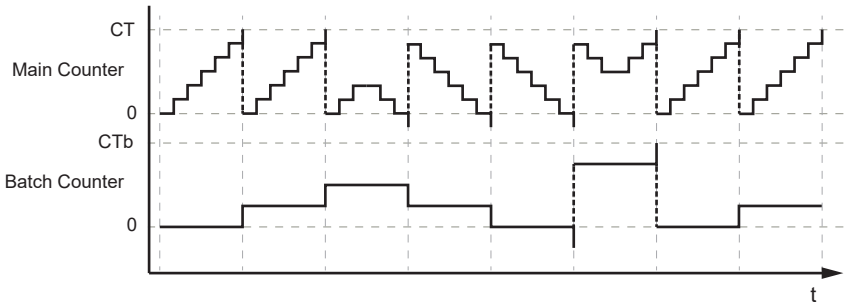


4.5.3 Counter mode CTUD

In CTUD (Count Up Down) mode, the counter operates as a simultaneous up and down counter with overflow and underflow detection.

Behaviour:

- The initial value of the main counter is m = 0. The initial value of the batch counter is b = 0. The main counter has a threshold value CT. The batch counter has a threshold value CTb.
- If the counter module detects a positive edge at pin 4 of the port, the value of the main counter is incremented (m = m+1).
- If the counter module detects a positive edge at pin 2 of the port, the value of the main counter is decremented (m = m-1).
- If the counter module simultaneously detects a positive edge at pin 4 and pin 2 of the port, the counter value of the main counter does not change.
- If the main counter reaches the threshold value CT (m = CT), the counter value is reset (m = 0). Due to the overflow detection, the value of the batch counter is incremented (b = b+1).
- If the main counter falls below 0, the counter value is reset to the threshold value (m = CT-1). Due to the underflow detection, the value of the batch counter is decremented (b = b-1).
- If the batch counter reaches the threshold value CTb (b = CTb), the counter value is reset (b = 0).
- If the batch counter falls below 0, the counter value is reset to the threshold value (b = CTb-1).



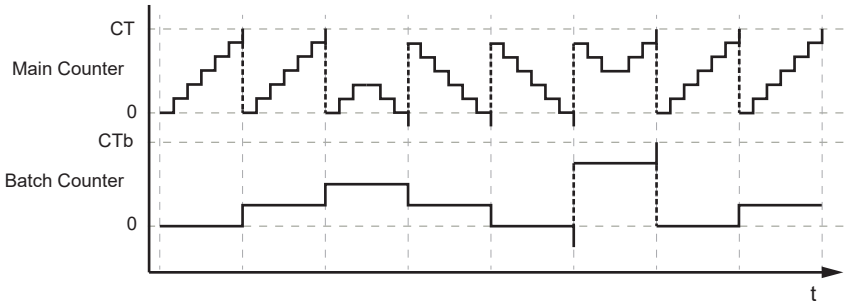
4.5.4 Counter mode CTDIR

In CTDIR (Count Direction) mode, the counter module operates either as an up counter with overflow detection or as a down counter with underflow detection. The counting direction can be set.

Behaviour:

- The initial value of the main counter is m = 0. The initial value of the batch counter is b = 0. The main counter has a threshold value CT. The batch counter has a threshold value CTb.
- The user can determine the counting direction. The counter module initially operates as an up counter with overflow detection.
- If the counter module detects a positive edge at pin 4 of the port and the counting direction of the port is set to “up”, the value of the main counter is incremented (m = m+1).

- If the main counter reaches the threshold value CT (m = CT), the counter value is reset (m = 0). Due to the overflow detection, the value of the batch counter is incremented (b = b+1).
- If the batch counter reaches the threshold value CTb (b = CTb), the counter value is reset (b = 0).
- If the counter module detects a positive edge at pin 4 of the port and the counting direction at pin 2 of the port is set to “down”, the value of the main counter is decremented (m = m-1).
- If the main counter falls below 0, the counter value is reset to the threshold value (m = CT-1). Due to the underflow detection, the value of the batch counter is decremented (b = b-1).
- If the batch counter falls below 0, the counter value is reset to the threshold value (b = CTb-1).



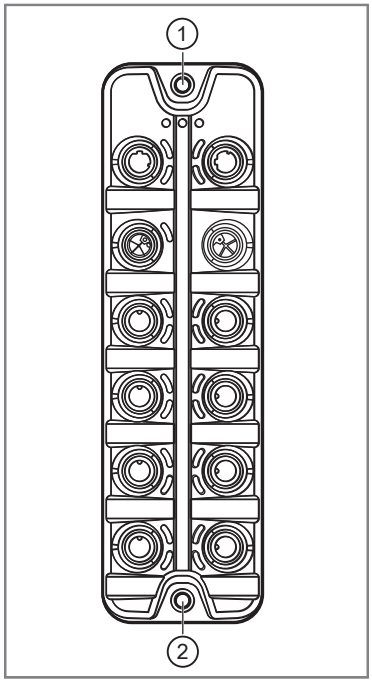
4.6 Modbus TCP

The device offers the following Modbus TCP functions:

- Device profile: Modbus TCP Server (message mode)
- 2-port switch for access to Modbus TCP interface (XF1 / XF2)

5 Installation

5.1 Overview



1: Upper mounting lug
2: Lower mounting lugs lug

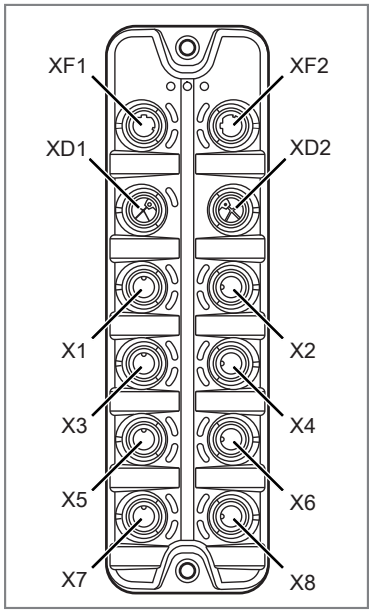
5.2 Install device

- ▶ Disconnect the power of the machine before installation.
- ▶ Use a flat mounting surface for installation.
- ▶ Please observe the maximum tightening torque.

Fasten the device onto the mounting surface using 2 M5 mounting screws and washers (tightening torque: 1.8 Nm).

6 Electrical connection

6.1 Overview



XF1: Ethernet 1 (ModbusTCP)
XF2: Ethernet 2 (ModbusTCP)
XD1: Power IN
XD2: Power OUT
X1: Process connection 1 (sensor)
X2: Process connection 2 (sensor)
X3: Process connection 3 (sensor)
X4: Process connection 4 (sensor)
X5: Process connection 5 (sensor)
X6: Process connection 6 (sensor)
X7: Process connection 7 (sensor)
X8: Process connection 8 (sensor)

6.2 General wiring information

The device must be connected by a qualified electrician.

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

The device is only suitable for operation on PELV voltages.

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

▶ Please observe the required precautions against electrostatic discharge!

The circuits are insulated from each other and from touchable surfaces of the device with basic insulation according to EN 61010-1.

The communication interfaces are insulated from each other and from touchable surfaces of the device with basic insulation according to EN 61010-1.

6.2.1 Connection technology

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

▶ Use connectors with gold-plated contacts.

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

▶ Observe the coding of the connectors during installation.

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

For UL applications:

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

6.3 Ethernet

The device is connected to the ModbusTCP network via Ethernet ports XF1 / XF2 (e. g. ModbusTCP control, additional ModbusTCP device). In addition, the device can be connected to an IT network via the Ethernet ports. The user can access functions of the ifm IoT Core via the IT network (parameter setting software, IoT Core Visualizer).

Wiring:

1: TX+
2: RX+
3: TX-
4: RX-
5: n.c.

▶ Connect the device to the ModbusTCP network via a free Ethernet port.

▶ Optional: Connect the device to the IT network via a free Ethernet port.

▶ For connection, use an M12 connector (minimum protection rating: IP65 / IP66 / IP67).

▶ Tighten the cable plug using 1.3 ± 0.1 Nm.

6.4 Process connections

The sensors are connected to the device via the X1...X8 ports.

Maximum current rating of the ports: 3.6 A (for UL applications: 3.2 A).

The ports feature short-circuit / overload detection.

▶ Connect the sensors to the X1...X8 ports.

▶ For connection, use M12 connectors (minimum protection rating: IP65 / IP66 / IP67; max. cable length: 30 m).

▶ Tighten the cable plug using 1.3 ± 0.1 Nm.

Wiring:

1: L+ (US)
2: IN2 DI2
3: L- (US)
4: IN1 DI1
5: FE

6.5 Voltage supply

The device is connected to the US supply voltage via the Power IN port.

The US supply voltage supplies the device and the sensors connected to the X1...X8 ports.

Optionally, an additional UA supply voltage can be fed to the device via the Power IN port. UA is looped through to the Power OUT port. UA is used exclusively to supply additional devices via the Power OUT port (daisy chain).

The XD1 port is equipped with overvoltage protection (US).

The XD1 port is equipped with reverse polarity protection (US).

The XD1 port is equipped with cross polarity protection (US, UA).

CAUTION

Exceeding the maximum input current of 16 A

▷ Risk of fire

▶ Dimension the I_U and I_A of the US and UA supply voltages accordingly, taking into account the derating behaviour of the device: Derating behaviour (→ 18)

Wiring:

1: L+ (US)
2: L- (UA)
3: L- (US)
4: L+ (UA)
5: FE

▶ Disconnect power.

▶ Connect the device via the XD1 port to the US supply voltage with 24 V DC (20...30 V PELV).

▶ Optional: Connect the device via the XD1 port to the UA supply voltage with 24 V DC (20...30 V PELV).

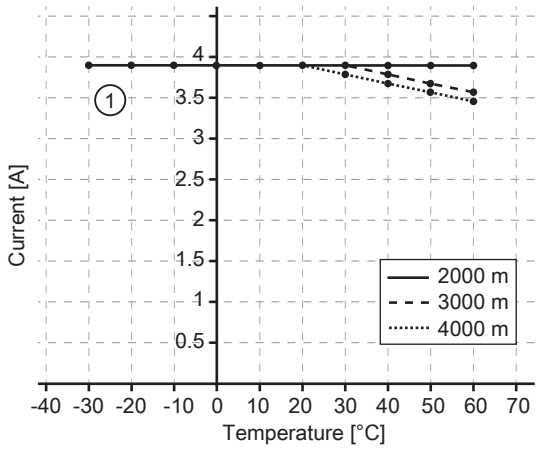
▶ For connection, use an L-coded M12 connector (with at least protection rating: IP65 / IP66 / IP67).

▶ Tighten the cable sockets according to the torque specifications indicated by the cable vendor. Maximum permissible tightening torque: 0.8 Nm

6.5.1 Derating behaviour

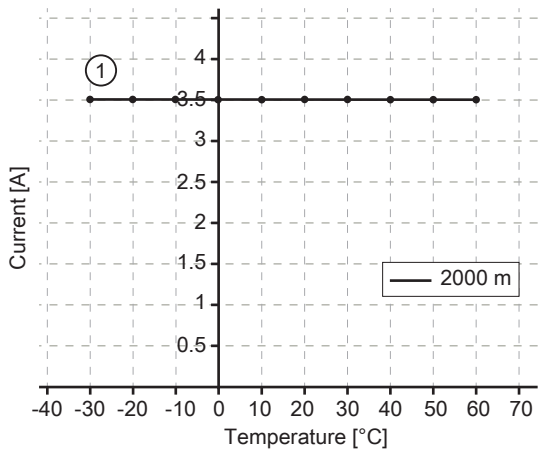
The current I_{US} available at ports X1...X8 and the currents $I_{US\text{-}daisy\text{-}chain}$ and $I_{UA\text{-}daisy\text{-}chain}$ available at port XD2 depend on the ambient temperature of the device.

6.5.1.1 Derating without daisy chain



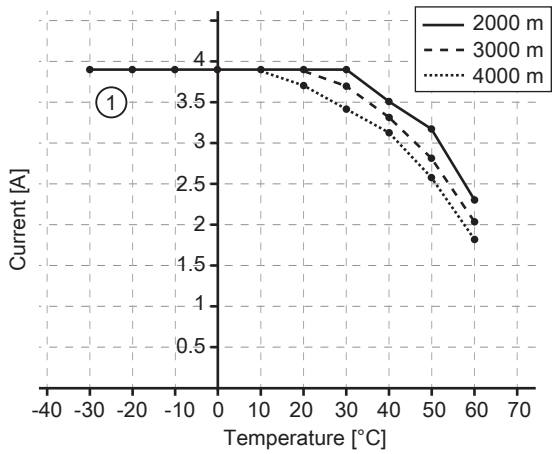
1: I_{US} at ports X1...X8

For UL applications:

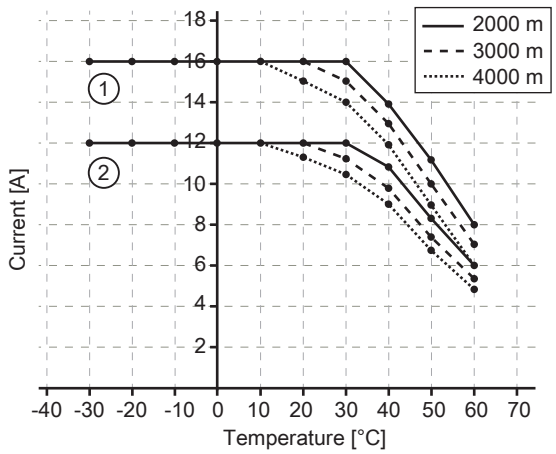


1: I_{US} at ports X1...X8

6.5.1.2 Derating with daisy chain



1: I_{US} at ports X1…X8



1: $I_{UA\text{-}daisy\text{-}chain}$ at port XD2
2: $I_{US\text{-}daisy\text{-}chain}$ at port XD2

Example: derating (2000 m)

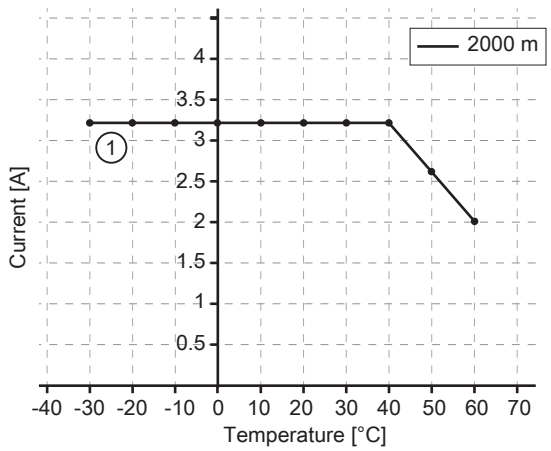
Temperature	$I_{UA\text{-}daisy\text{-}chain}$ (XD2)	I_{USmax} (XD1)	I_{US} (X1…X8)	$I_{US\text{-}daisy\text{-}chain}$ (XD2)
30 °C	16 A	15.9 A	3.9 A	12 A
30 °C			0 A	15.9 A
30 °C			1.8 A	14.1 A
60 °C	8 A	8 A	2 A	6 A
60 °C			0 A	8 A
60 °C			1 A	7 A

Explanation: The current I_{USmax} at port XD1 is the sum of the currents I_{US} taken from ports X1…X8 and the current $I_{US\text{-}daisy\text{-}chain}$ taken from port XD2 for the supply of further devices.

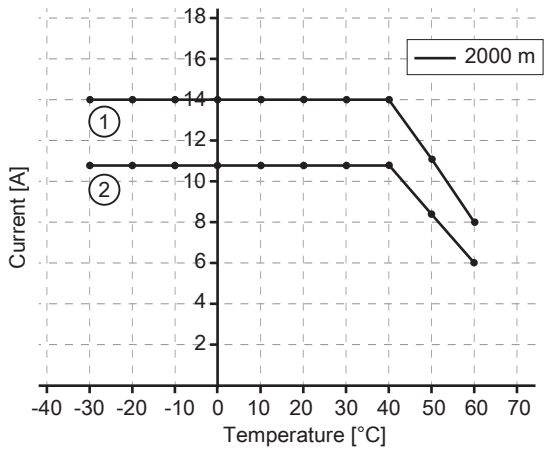
Formula: I_{USmax} (XD1) = I_{US} (X1…X8) + $I_{US\text{-}daisy\text{-}chain}$ (XD2)

The less current is consumed at ports X1...X8, the more current will be available to supply further devices via daisy chain through port XD2.

For UL applications:



1: I_{US} at ports X1…X8



1: $I_{UA\text{-}daisy\text{-}chain}$ at port XD2
2: $I_{US\text{-}daisy\text{-}chain}$ at port XD2

Example:

Temperature	$I_{UA\text{-}daisy\text{-}chain}$ (XD2)	I_{USmax} (XD1)	I_{US} (X1…X8)	$I_{US\text{-}daisy\text{-}chain}$ (XD2)
50°C	11.2 A	11.0 A	2.6 A	8.4 A

6.6 Voltage output

An additional device can be supplied via the power OUT port (daisy chain). The supply voltages US and UA are looped through from port XD1 to port XD2.

Max. current of US: 15.9 A (for UL applications: 10.8 A)

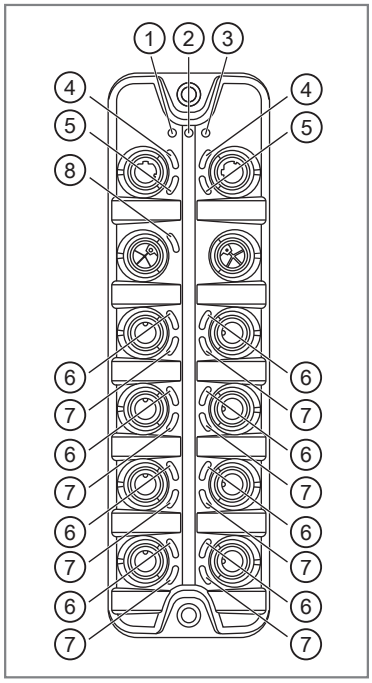
Max. current of UA: 16 A (for UL applications: 14 A)

Wiring:

- ▶ Optional: Connect an additional device to port XD2.
- ▶ For connection, use an L-coded M12 connector (with at least protection rating: IP65 / IP66 / IP67).
- ▶ Tighten the cable plug using 1.3 ± 0.1 Nm.
- ▶ Observe the derating behaviour of the device (→ Derating behaviour 🗋 18)!

7 Operating and display elements

7.1 LEDs



1: Status: RDY
2: Status: ERR
3: Status: RUN
4: Modbus TCP: LNK
5: Modbus TCP: ACT
6: Process connection: DI1
7: Process connection: DI2
8: Power supply: US

7.1.1 Status

LED	Description	Colour	State	Description
RDY	Gateway status	-	Off	Not active or reboots
		Green	Flashes 3 s (1 Hz)	DCP signalling service initiated via fieldbus
			Flashes (5 Hz)	Error
			Flashes (200 ms on, 800 ms off)	Firmware update running
			On	OK
		Red	On	Error during firmware update (e.g. firmware not compatible)
ERR	Error indication	-	Off	No error
		Red	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
			On	Communication error
RUN	Modbus TCP state (state machine)	-	Off	Not ready
		Green	Flashes (1 Hz)	Ready, but not yet configured
			Flashes (5 Hz)	Waiting for connection
			On	Connecting

7.1.2 Ethernet

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

7.1.3 Voltage supply

LED	Description	Colour	State	Description
US	Power supply US status	-	Off	No supply voltage is applied or the applied supply voltage is too low (<4.5 V)
		Green	On	Supply voltage applied
		Red	On	Overvoltage, undervoltage, short circuit at sensor supply

7.1.4 Process connections

LED	Description	Colour	State	Description
DI1	Digital input signal level (pin 4)	Yellow	Off	Digital input - pin 4: LOW
			On	Digital input - pin 4: HIGH
DI2	Digital input signal level (pin 2)	Yellow	Off	Digital input - pin 2: LOW
			On	Digital input - pin 2: HIGH

8 Set-up

▶ Install the unit correctly.

▶ Establish a correct electrical connection with the device.

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

▷ The LEDs show status and error conditions.

▷ The unit is ready for operation.

▷ The device can be configured.

9 Settings

9.1 Parameter setting software

9.1.1 Supported parameter setting software

Supported parameter setting options:

- ifm moneo|IIoT Core On-Premises (art no. QM9112)
- ifm moneo|IIoT Core Cloud (art no. QCM100)
- ifm moneo|configure free

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

▶ Install the desired parameter setting software.

▶ Activate the licences required for operation.

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

9.1.2 Establishing a connection to device

Requirements:

✓ The parameter setting software is correctly installed on the laptop / PC.

✓ The laptop / PC is connected to a free Ethernet port of the device.

▶ Start the parameter setting software.

▶ Scan the network for devices.

  ▷ The parameter setting software recognises the device.

▶ Optional:

▶ Establish a connection to the device.

▷ The parameter setting software can access the device parameters.

9.1.3 Fieldbus interface

The [fieldbus] menu provides access to the configuration of the fieldbus interface.

The fieldbus interface can only be configured via the fieldbus configuration software.

9.1.3.1 Configuring the ModbusTCP interface

The ModbusTCP interface of the device must be configured for communication with the ModbusTCP network.

Available parameters:

Name	Description	Value range	Access
[dhcp]	Status of 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 (default) • BOOTP: IP parameters are set via the Bootstrap Protocol	rw [1]
[ipaddress]	IP address of the ModbusTCP interface	e.g. 192.100.0.10 • 192.168.1.250 (default)	rw [1]
[subnetmask]	Subnet mask of the network segment	e.g. 255.255.255.0 • 255.255.255.0 (default)	rw [1]
[ipdefaultgateway]	IP address of the network gateway	e.g. 192.100.0.1 • 0.0.0.0 (default)	rw [1]
[macaddress]	MAC address of the Ethernet interface	e.g. 00:02:01:0E:10:7F	ro [2]
[hostname]	Name of the device in the ModbusTCP network	e.g. al4x4x	ro [2]

[1] Read and write

[2] Read only

To configure the ModbusTCP interface:

Requirements:

✓ The parameter setting software has been started.

✓ The connection to the device has been established.

▶ Select the [fieldbussetup] > [network] menu.

▷ The menu page shows the current settings.

▶ Set IP parameters of the interface.

▶ Write the changed values to the device.

▶ Restart the device.

▷ The ModbusTCP interface is configured

9.1.3.2 Setting ModbusTCP-specific parameters

Changes to the [byteswap] parameters will only take effect after the device has been restarted.

Available parameters:

Name	Description	Value range	Access
[connectiontimeout]	Set timeout for interruption of the fieldbus connection (value in milliseconds)	• 20: 20 ms … • 30000: 30000 ms (default) … • 60000: 60000 ms	rw [1]
[byteswap]	Order of the bytes in data WORD	• 0: Big-Endian (default) • 65535: Little-Endian	rw [1]

[1] Read and write

To set the ModbusTCP-specific parameters:

Requirements:

✓ The parameter setting software has been started.

✓ The connection to the device is established (online).

▶ Select the [fieldbus] > [configuration] menu.

▷ The menu page shows the current settings.

▶ Setting ModbusTCP-specific parameters.

▶ Write the changed values to the device.

▷ ModbusTCP-specific parameters are set.

9.1.3.3 Reading the connection status

Available information:

Name	Description	Value range	Access
[connectionstatus]	Status of the ModbusTCP connection	• Disconnected: Not connected • Connected: Connected	ro [1]
[disconnectioncounter]	Connection interruption counter	• 0: no interruption … • 65535: 65535 interruptions	ro [1]
[fieldbusfirmware]	Firmware version of the ModbusTCP stack	e.g. 5.4.0.3 (ModbusTCP Server)	ro [1]

[1] Read only

Requirements:

✓ The parameter setting software has been started.

✓ The detailed view of the device is active.

▶ Select the [fieldbussetup] menu.

▷ The menu page displays the status of the ModbusTCP connection.

9.1.4 Process connections

The [io] menu provides access to the parameters of the process connections.

9.1.4.1 Configuring the input filters

▶ Observe the notes on input filters: Digital input filters (→ 🗋 9)

Available parameters:

Name	Description	Value range	Access
[debounce_time]	Debounce time (= value * 0.1 ms)	• 0: 0 ms (default) … • 500: 50 ms	rw [1]
[hold_time]	hold time (= value * 0.1 ms)	• 0: 0 ms (default) … • 60000: 6000 ms	rw [1]
[hold_level]	hold level	• 0: hold LOW • 1: hold HIGH (default)	rw [1]
[invert]	inversion	• 0: do not invert (default) • 1: invert	rw [1]

[1] Read and write; parameter can only be changed if no connection to fieldbus controller is established

▶ Select menu [io] > [port[n]] > [pin2] (n: 1...8).

▷ The menu page shows the available filter parameters for pin 2 of the port.

▶ Set the parameters.

▶ Select menu [io] > [port[n]] > [pin4] (n: 1...8).

▷ The menu page shows the available filter parameters for pin 4 of the port.

▶ Set the parameters.

▶ Write the changed values to the device.

▷ The digital input filters have been configured.

9.1.4.2 Setting the arrangement of the digital inputs

The arrangement of the digital input channels in Modbus registers 0, 400 and 401 is adjustable.

Available options:

- Pin-based:

Word	Bit															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
n	X8 pin 2	X7 pin 2	X6 pin 2	X5 pin 2	X4 pin 2	X3 pin 2	X2 pin 2	X1 pin 2	X8 pin 4	X7 pin 4	X6 pin 4	X5 pin 4	X4 pin 4	X3 pin 4	X2 pin 4	X1 pin 4

- Port-based:

Word	Bit															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
n	X8 pin 2	X8 pin 4	X7 pin 2	X7 pin 4	X6 pin 2	X6 pin 4	X5 pin 2	X5 pin 4	X4 pin 2	X4 pin 4	X3 pin 2	X3 pin 4	X2 pin 2	X2 pin 4	X1 pin 2	X1 pin 4

Available parameters:

Name	Description	Value range	Access
[di_channel_mapping]	Setting the arrangement of the digital inputs in the process data	• 0: Pin-based • 1: Port-based	rw [1]

[1] Read and write

To set the arrangement of the digital inputs in the process data:

Requirements:

✓ The parameter setting software has been started.

✓ The connection to the device has been established.

▶ Select [io] menu.

▷ The menu page shows the current settings.

▶ Set the parameters.

▶ Write the changed values to the device.

▷ Arrangement of the digital inputs in the process data is set.

9.1.4.3 Configuring the counter modules

▶ Observe the notes on counter modules: Counter (→ 🗋 11)

If the operating mode of a counter module is changed, the current counter values will be reset and any active events will be deleted.

Available parameters:

Name	Description	Value range	Access
[mode]	Operating mode of the counter module	• CTU (up counter): up counter (default) • CTD (down counter): Down counter • CTUD (up counter / down counter): up and down counter • CTDIR (direction counter): up or down counter	rw [1]
[pin2_function]	Pin 2 function of the port (→ Observe note!)	• N/C: no function (default) • Counter Edge Input 2: counting pulse (rising edge) • Count Direction: counting direction • Reset (Main & Batch Counter): reset main counter and batch counter • Disable (Main & Batch Counter): disable main counter and batch counter	rw [1]
[count_direction_selection]	Control instance for selecting the counting direction (→ Observe note!)	• Pin 2 Count Direction: pin 2 of the port (default) • IoT / PLC Count Direction: Fieldbus PLC	rw [1]
[main_threshold]	Main counter threshold (CT)	• 1 … • 4294967295 (default)	rw [1]
[batch_threshold]	Batch counter threshold (CTb)	• 1 … • 65535 (default)	rw [1]

[1] Read and write; parameter can only be changed if no connection to fieldbus controller is established

For the parameters [pin2_function] and [count_direction_selection] all shown parameter values can be selected. It is not checked whether these make sense. For each counter operating mode (parameter [mode]), the table below indicates the valid value ranges (✓: valid setting; ✕: invalid setting):

[mode]	[pin2_function]					[count_direction_selection]	
	N/C	Counter Edge Input Pin2	Count Direction	Reset (Main & Batch Counter)	Disable (Main & Batch Counter)	Pin 2 Count Direction	IoT / PLC Count Direction
CTU	✓	✕	✕	✓	✓	✕	✕
CTD	✓	✕	✕	✓	✓	✕	✕
CTUD	✕	✓	✕	✕	✕	✕	✕
CTDIR	✕	✕	✓	✕	✕	✓	✕
CTDIR	✓	✕	✕	✓	✓	✕	✓

Requirements:

✓ The parameter setting software has been started.
✓ The detailed view of the device is active.
▶ Select menu [io] > [counter[n]] (n: 1...8).
  ▷ The menu page displays the configuration options of the counter.
▶ Configure the counter module.
▶ Optional: Configure additional counter modules.
▶ Write the changed values to the device.
▷ The counter modules are configured.

9.1.5 Process data

The dashboard area provides access to the device's process data.

To display the dashboard area:

✓ The parameter value editor for the device is open.
▶ In the vertical bar at the right side of the screen: Click on .
▷ The dashboard view is displayed.

To hide the dashboard area:

✓ The dashboard area is displayed.
▶ Click on the vertical bar in the middle of the screen: Click on .
▷ The dashboard view is hidden.

9.1.5.1 Reading digital input data

Available information:

Name	Description	Value range	Access
[digital]	Signal level of the digital input channel (after filtering)	• LOW: off • HIGH: on	ro [1]

[1] Read only

Requirements:

✓ The parameter setting software has been started.
✓ The detailed view of the device is active.
▶ In the vertical bar at the right side of the screen: Click on .
  ▷ The dashboard view is displayed.
▷ The view shows the current signal levels of the digital outputs at pin 2 and pin 4 in substructure [io/port[n]] (n: 1...8).

The displayed signal levels are the filtered input data.

9.1.5.2 Reading counter values

Available parameters:

Name	Description	Value range	Access
[maincounter_value]	Main counter reading	0…4294967294	ro [1]
[batchcounter_value]	Batch counter value	0…65534	ro [1]

[1] Read only

Requirements:

✓ The parameter setting software has been started.

✓ The detailed view of the device is active.

▶ In the vertical bar at the right side of the screen: Click on ⏲.

▷ The dashboard view is displayed.

▷ In substructure [io/counter[n]] (n: 1...8), the current counter values of the main and batch counters are displayed.

9.1.5.3 Controlling counter modules

Available parameters:

Name	Description	Value range	Access
[disable]	Disable main counter and batch counter	• 0: counter module is active (default) • 1: counter module is not active	rw [1]
[reset]	Reset main counter, batch counter and CT and CTb thresholds to initial values	• 0: no action (default) • 1: reset	rw [1]
[direction] [2]	Set the counting direction for the main counter and the batch counter	• 0: up (default) • 1: down	rw [1]

[1] Read and write; parameter can only be changed if no connection to fieldbus controller is established

[2] only effective if operating mode of counter module = `CTDIR`

Requirements:

✓ The parameter setting software has been started.

✓ The detailed view of the device is active.

▶ In the vertical bar at the right side of the screen: Click on ⏲.

▷ The dashboard view is displayed.

▷ In substructure [io/counter[n]] (n: 1...8), the available control signals of the counter modules are displayed.

▶ Optional: Disable the counter module.

▶ Optional: Reset the counter module.

▶ Optional: Set the counting direction of the counter module.

▶ Write the changed parameter values to the device.

▷ The selected actions are executed.

9.1.5.4 Reading status and diagnostic information

Available information:

Parameter	Description	Value range	Access
[temperature]	Temperature of the device (value in °C)	-30…80	ro [1]
[voltage_us]	Present voltage value of the device supply US (value in mV)	0…40000	ro [1]
[supervisionstatus_us]	Status of the device supply US	• 0: No error • 1: Error	ro [1]
[current_us]	Present current value of the device supply US (value in mA)	0…40000	ro [1]

[1] Read only

Requirements:

✓ The parameter setting software has been started.

✓ The detailed view of the device is active.

▶ In the vertical bar at the right side of the screen: Click on ⏲.

▷ The dashboard view is displayed.

▷ The view shows the device's status and diagnostic information in the [processdatamaster] substructure.

9.1.6 Device information

The [deviceinfo] menu provides access to the device's identification information.

9.1.6.1 Reading identification information

Available information:

Name	Description	Value range	Access
[productcode]	Article number	AL4142	ro [1]
[devicefamily]	Device family	Ethernet modules	ro [1]
[vendor]	Manufacturer	ifm electronic gmbh	ro [1]
[swrevision]	Firmware revision	e.g. AL4x4x_fw_md_1.4.0.142	ro [1]
[hwrevision]	Hardware revision (status)	e.g. AA	ro [1]
[bootloaderrevision]	Bootloader version	e.g. AL4xxx_bl_1.4.0.39	ro [1]
[serialnumber]	Serial number	e.g. 0002043100003	ro [1]
[fieldbustype]	Fieldbus	ModbusTCP	ro [1]

[1] Read only

Requirements:

✓ The parameter setting software has been started.

✓ The detailed view of the device is active.

▶ Select the menu option [deviceinfo].

▷ The menu page displays the identification information of the device.

9.1.7 Device ID

Das Menü [devicetag] bietet Zugriff auf die Gerätekennung.

9.1.7.1 Setting the application tag

Available parameters:

Parameter	Description	Value range	Access
[applicationtag]	Application-specific identifier of the device in moneo	e.g. plant 1 machine 3	rw [1]

[1] Read and write

Requirements:

✓ The parameter setting software has been started.

✓ The detailed view of the device is active.

▶ Select [devicetag] menu.

▶ Enter the application identifier.

▶ Write the changed values to the device.

▷ The device can be identified by the selected application tag.

9.1.8 Device control

Das Menü [firmware] bietet Zugriff auf die Funktionen zur Steuerung des Geräts.

9.1.8.1 Resetting the device

Requirements:

✓ The parameter setting software has been started.

✓ The detailed view of the device is active.

▶ Select the [Firmware] menu.

▶ Click on [factoryreset].

▷ The device is reset to factory settings.

▷ All parameters are set to their default values.

9.1.8.2 Restarting the device

Requirements:

✓ The parameter setting software has been started.

✓ The detailed view of the device is active.

▶ Select the [Firmware] menu.

▶ Click on [Reboot].

▷ The device will be restarted.

▷ All set parameter values will be retained.

9.1.8.3 Reading the firmware version

Available information:

Parameter	Description	Value range	Access
[version]	Firmware version	e.g. AL4x4x_fw_md_1.4.0.142	ro [1]

[1] Read only

Requirements:

✓ The parameter setting software has been started.

✓ The detailed view of the device is active.

▶ Select the [Firmware] menu.

▷ The menu page displays the firmware version of the device.

9.2 IoT-Core Visualizer

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

9.2.1 Starting the ifm IoT Core Visualizer

To start the IoT Core Visualizer:

Requirements:

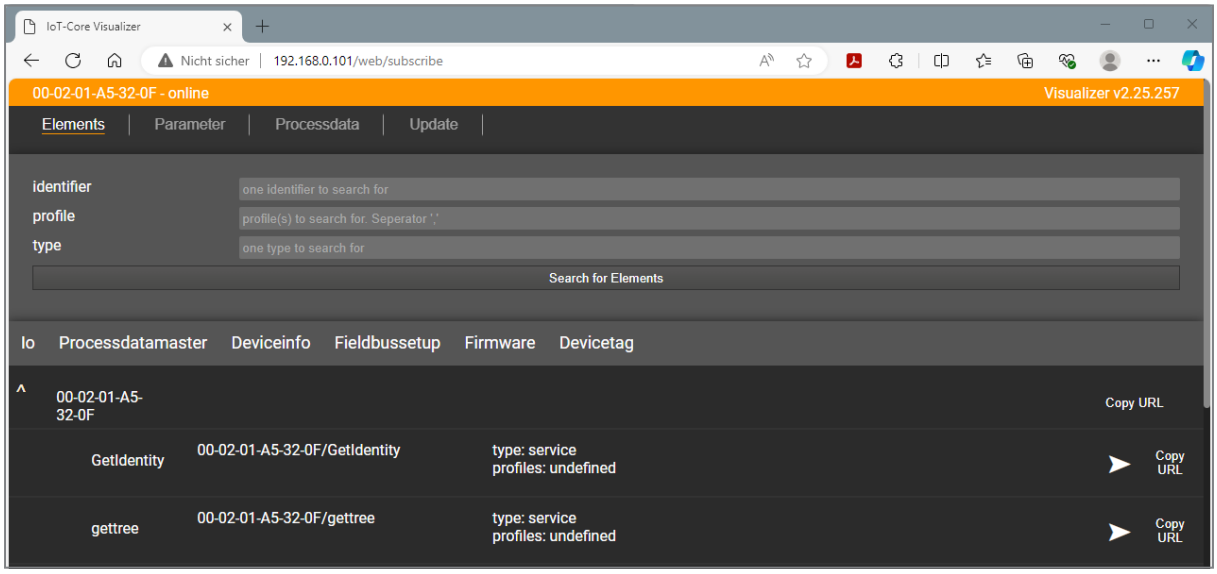
✓ The laptop / PC is connected directly or via a suitable network coupling element (e.g. switch) to a ModbusTCP port (XF1 / XF2) of the device.

✓ ModbusTCP interface has been configured.

▶ Start web browser.

▶ Go to the following URL: http://<ip-address> (e.g. `http://192.168.0.10`)

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



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

- [Elements]: Searching for elements of the IoT Core (→ 🗋 34)
- [Parameter]: Configuring the device (→ 🗋 35)
- [Processdata]: Accessing the process data (→ 🗋 39)
- [Update]: Update firmware (→ 🗋 41)

9.2.2 Searching for elements of the IoT Core

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

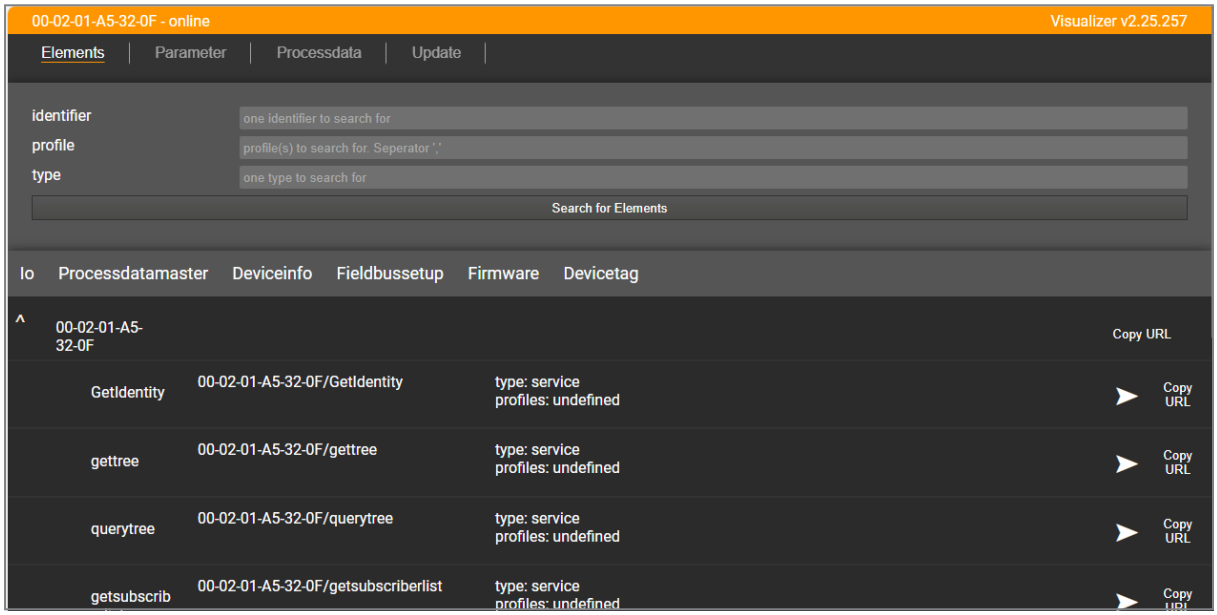
The following properties can be searched for:

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

Requirements:

✓ IoT Core Visualizer has been started.

✓ The [Elements] menu is active.



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

▶ Click on [Search for…].

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

▷ The result list shows all the elements found.

9.2.3 Configuring the device

The [Parameter] menu page provides access to the configuration options of the device.

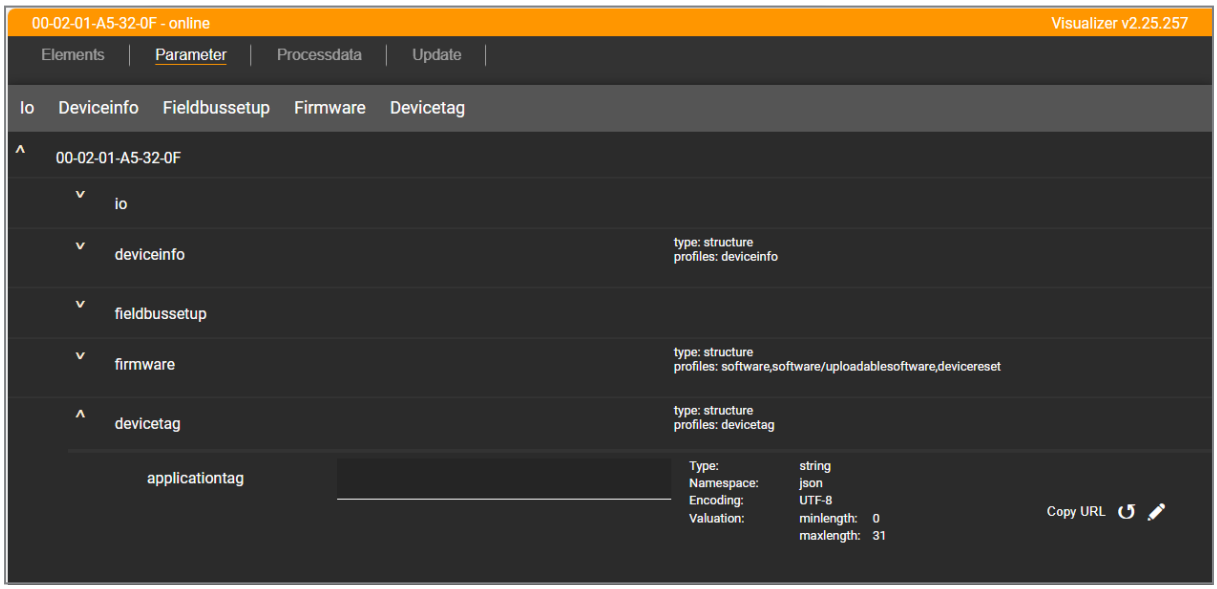
The configuration created via the IoT Core Visualizer is overwritten when a connection is established between the device and the ModbusTCP PLC.

Requirements:

✓ IoT Core Visualizer has been started.

▶ Select the [Parameter] menu.

▷ The menu page shows the available parameters of the device.



9.2.3.1 Configuring a ModbusTCP interface

Changes to the `byteswap` data point will only take effect after the device has been restarted.

Available parameters:

Name	Description	Value range	Access
[network] > [dhcp]	Status of the DHCP client	• Static IP: Static IP address • DHCP: DHCP (Dynamic Host Configuration protocol) • BOOTP: BOOTP (Bootstrap Protocol)	rw [1]
[network] > [ipaddress]	IP address of the Ethernet interface	e.g. 192.200.0.100 • 192.168.1.250 (default)	rw [1]
[network] > [subnetmask]	Subnet mask of the network segment	e.g. 255.255.192.0 • 255.255.255.0 (default)	rw [1]
[network] > [ipdefaultgateway]	IP address of the network gateway	e.g. 192.200.63.1 • 0.0.0.0 (default)	rw [1]
[network] > [macaddress]	MAC address of the Ethernet interface	e.g. 00:02:01:0E:10:7C	ro [2]
[configuration] > [connection-timeout]	Set timeout for interruption of the fieldbus connection (value in milliseconds)	• 20: 20 ms … • 31000: 31000 ms … • 60000: 60000 ms	rw [1]

Name	Description	Value range	Access
[configuration] > [byteswap]	Arrangement of the bytes in a data word	• big-endian: Big-endian format • little-endian: Little-endian format	rw [1]

[1] Read and write
[2] Read only

Requirements:

✓ IoT Core Visualizer has been started.

✓ The [Parameter] menu is active.

▶ Select the [fieldbussetup] > [configuration] submenu.

▶ Select the [fieldbussetup] > [network] submenu.

▷ The menu page shows the current settings.

▶ Set the parameters.

▶ Click on ✎ to save the changes to the device.

▶ If necessary, restart the device.

▷ The ModbusTCP interface is configured.

9.2.3.2 Setting the arrangement of the digital inputs

The arrangement of the digital input channels in Modbus registers 0, 400 and 401 is adjustable.

Available options:

- Pin-based:

Word	Bit															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
n	X8 pin 2	X7 pin 2	X6 pin 2	X5 pin 2	X4 pin 2	X3 pin 2	X2 pin 2	X1 pin 2	X8 pin 4	X7 pin 4	X6 pin 4	X5 pin 4	X4 pin 4	X3 pin 4	X2 pin 4	X1 pin 4

- Port-based:

Word	Bit															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
n	X8 pin 2	X8 pin 4	X7 pin 2	X7 pin 4	X6 pin 2	X6 pin 4	X5 pin 2	X5 pin 4	X4 pin 2	X4 pin 4	X3 pin 2	X3 pin 4	X2 pin 2	X2 pin 4	X1 pin 2	X1 pin 4

Available parameters:

Name	Description	Value range	Access
[di_channel_mapping]	Setting the arrangement of the digital inputs in the process data	• 0: Pin-based • 1: Port-based	rw [1]

[1] Read and write

Requirements:

✓ IoT Core Visualizer has been started.

✓ The [Parameter] menu is active.

▶ Select the [io] submenu.

▷ The menu page shows the current settings.

▶ Set the parameters.

▶ Click on ✎ to save the changes to the device.

▷ The arrangement of the digital input channels is configured.

9.2.3.3 Configuring input filters

▶ Observe the notes on input filters: Digital input filters (→ 🗋 9)

Available parameters:

Name	Description	Value range	Access
[debounce_time]	Debounce time (= value * 0.1 milliseconds)	• 0: 0 ms (default) … • 500: 50 ms	rw [1]
[hold_time]	Hold time (= value * 0.1 milliseconds)	• 0: 0 ms (default) … • 60000: 6000 ms	rw [1]
[hold_level]	Hold level	• low: hold LOW • high: hold HIGH (default)	rw [1]
[invert]	Inversion	• signal not inverted: do not invert (default) • signal inverted: invert	rw [1]

[1] Read and write; parameter can only be changed if no connection to fieldbus controller is established

Requirements:

✓ IoT Core Visualizer has been started.

✓ The [Parameter] menu is active.

▶ Select submenu [io] > [port[n]] (n: 1...8).

▷ The menu page shows the current settings of the digital input filters on pin 2 and pin 4 of the port.

▶ Set the parameters.

▶ Click on ✎ to save the changes to the device.

▷ The filters of the digital inputs are configured.

9.2.3.4 Configuring counter modules

▶ Observe the notes on counter modules: Counter (→ 🗋 11)

If the operating mode of a counter module is changed, the current counter values will be reset and any active events will be deleted.

For the parameters [pin2_function] and [count_direction_selection] all shown parameter values can be selected. It is not checked whether these make sense. For each counter operating mode (parameter [mode]), the table below indicates the valid value ranges (✓: valid setting; ✕: invalid setting):

[mode]	[pin2_function]					[count_direction_selection]	
	No function	Counting pulse	Counting direction	Reset main counter and batch counter	Disable main counter and batch counter	Pin 2	IoT Core / Fieldbus PLC
CTU	✓	✕	✕	✓	✓	✕	✕
CTD	✓	✕	✕	✓	✓	✕	✕
CTUD	✕	✓	✕	✕	✕	✕	✕
CTDIR	✕	✕	✓	✕	✕	✓	✕
CTDIR	✓	✕	✕	✓	✓	✕	✓

Available parameters:

Name	Description	Value range	Access
[mode]	Operating mode of the counter module	• CTU (up counter): up counter (default) • CTD (down counter): down counter • CTUD (up counter / down counter): up and down counter • CTDIR (direction counter): up and down counter with selectable counting direction	rw [1]
[pin2_function]	Pin 2 function of the port (→ Observe note!)	• N/C: no function (default) • Counter edge input 2: counting pulse (rising edge) • Count direction: counting direction • Reset (main & batch counter): reset main counter and batch counter • Disable (main & batch counter): disable main counter and batch counter	rw [1]
[count_direction_selection]	Control instance for selecting the counting direction (→ Observe note!)	• Pin 2 count direction: pin 2 (default) • IoT / PLC count direction: IoT Core / Fieldbus PLC	rw [1]
[main_threshold]	Main counter threshold (CT)	• 1 … • 4294967295 (default)	rw [1]
[batch_threshold]	Batch counter threshold (CTb)	• 1 … • 65535 (default)	rw [1]

[1] Read and write; parameter can only be changed if no connection to fieldbus controller is established

Requirements:

✓ IoT Core Visualizer has been started.

✓ The [Parameter] menu is active.

▶ Select submenu [io] > [port[n]] > [counter] (n: 1...8).

▷ The menu page shows the current settings.

▶ Set the parameters.

▶ Click on ✎ to save the changes.

▷ The counter modules are configured.

9.2.3.5 Reading device information

Available information:

Name	Description	Value range	Access
[productcode]	Article number	AL4142	ro [1]
[vendor]	Vendor	ifm electronic	ro [1]
[devicefamily]	Device family	Ethernet modules	ro [1]
[serialnumber]	Serial number (12 digits)	e.g. 000174210161	ro [1]
[hwrevision]	Hardware revision	E.g. AA	ro [1]
[swrevision]	Firmware version	E.g. AL4x4x_fw_md_1.4.0.142	ro [1]
[bootloaderrevision]	Bootloader version	E.g. AL4xxx_bl_1.4.0.39	ro [1]
[fieldbustype]	Fieldbus	ModbusTCP	ro [1]

[1] Read only

Requirements:

✓ IoT Core Visualizer has been started.

✓ The [Parameter] menu is active.

▶ Select the [deviceinfo] submenu.

▷ The menu page shows device information.

9.2.3.6 Reading the firmware version

Available information:

Name	Description	Value range	Access
[version]	Firmware version	AL4x4x_fw_md_1.4.0.142	ro [1]
[type]	Type	• firmware: Firmware type	ro [1]

[1] Read only

Requirements:

✓ IoT Core Visualizer has been started.

✓ The [Parameter] menu is active.

▶ Select the [firmware] submenu.

▷ The menu page shows the available information.

9.2.3.7 Setting the application tag

Available parameters:

Name	Description	Value range	Access
[applicationtag]	Device designation in monitoring software	E.g. “factory 2 plant 1”	rw [1]

[1] Read and write

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

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

Requirements:

✓ IoT Core Visualizer has been started.

✓ The [Parameter] menu is active.

▶ Select the [devicetag] submenu.

▷ The menu page shows the current settings.

▶ Enter the application tag.

▶ Click on ✎ to save the changes to the device.

▷ The new application tag is set.

9.2.4 Accessing the process data

The [Processdata] menu page provides access to the process data of the device.

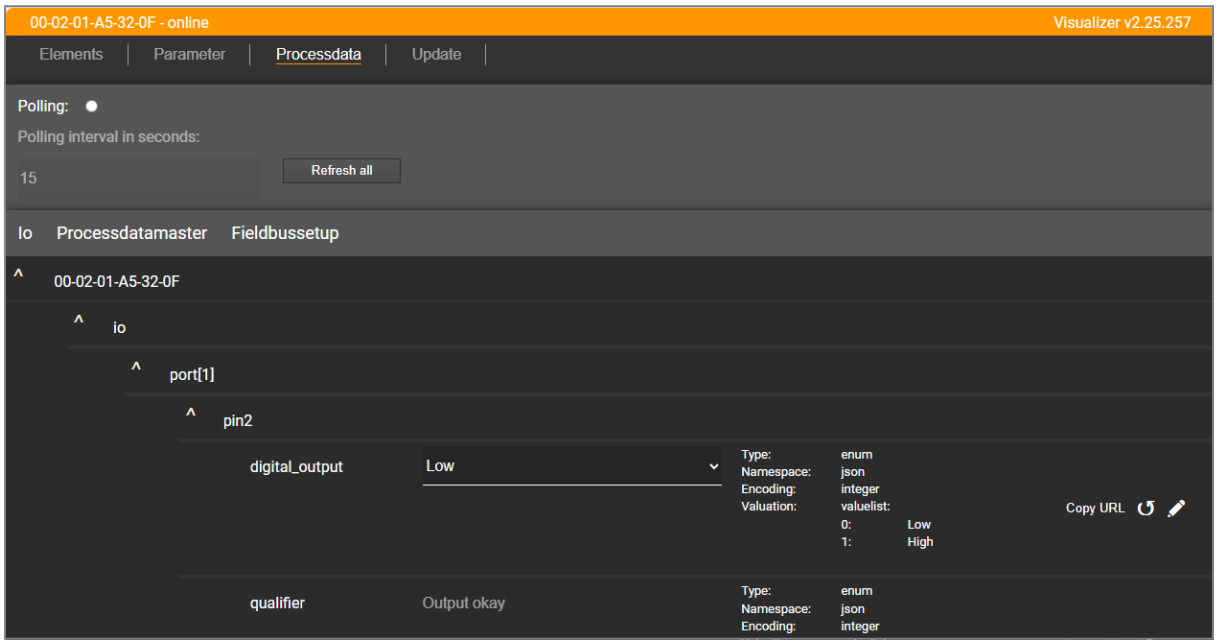
Requirements:

✓ IoT Core Visualizer has been started.

▶ Select the [Processdata] menu.

▷ The menu page shows the substructures of the device description that contains the process data.

▷ The current process values are displayed.



▶ Optional: In the header, activate the [Polling] option and set the polling interval.

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

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

9.2.4.1 Reading digital input data

Available information:

Name	Description	Value range	Access
[digital_input]	Process value digital input (after filtering)	• Low: LOW • High: HIGH	ro [1]

[1] Read only

Requirements:

✓ IoT Core Visualizer has been started.

✓ The [Processdata] menu is active.

▶ Select submenu [io] > [port[n]] (n: 1...8).

▷ The menu page shows the digital input data on pin 2 and pin 4 of the port.

9.2.4.2 Reading counter values

Available information:

Name	Description	Value range	Access
[maincounter_value]	Current main counter value	0…4294967295	ro [1]
[batchcounter_value]	Current batch counter value	0…65535	ro [1]

[1] Read only

Requirements:

✓ IoT Core Visualizer has been started.

✓ The [Processdata] menu is active.

▶ Select submenu [io] > [port[n]] > [counter] (n: 1...8).

▷ The menu page shows current counter values of the counter module.

9.2.4.3 Controlling counter modules

Available control signals:

Name	Description	Values	Access
[reset]	Reset counter module (reset counter and threshold values to default values)	• inactive: no action (default) • active: reset	rw [1]
[disable]	Disable counter module	• inactive: enable counter (default) • active: disable counter	rw [1]
[direction] [2]	Set counting direction for main counter and batch counter	• up: up (default) • down: down	rw [1]

[1] Read and write; parameter can only be changed if no connection to fieldbus controller is established

[2] only effective if operating mode of counter module = `CTDIR`

Requirements:

✓ IoT Core Visualizer has been started.

✓ The [Processdata] menu is active.

▶ Select submenu [io] > [port[n]] > [counter] (n: 1...8).

▷ The menu page shows the available services.

▶ Set the control signals.

▶ Click on ✎ to send the control signals to the device.

▷ The control signals are executed.

9.2.4.4 Reading status and diagnostic information

Available information:

Name	Description	Value range	Access
[temperature]	Device temperature (value in °C)	E.g. 52: 52 °C	ro [1]
[voltage_us]	Present voltage value of device supply US (value in mV)	E.g. 25236: 25236 mV	ro [1]
[current_us]	Present current value of device supply US (value in mA)	E.g. 82: 82 mA	ro [1]
[supervisionstatus_us]	Status of device supply US	• OK: no error • Fault: error	ro [1]
[uptime]	Time since the last start of the device (value in minutes)	• 0x0000: 0 min … • 0xFFFF: 65535 min	ro [1]

[1] Read only

Requirements:

✓ IoT Core Visualizer has been started.

✓ The [Processdata] menu is active.

▶ Select the [processdatamaster] submenu.

▷ The menu page shows status and diagnostic information.

9.2.5 Update firmware

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

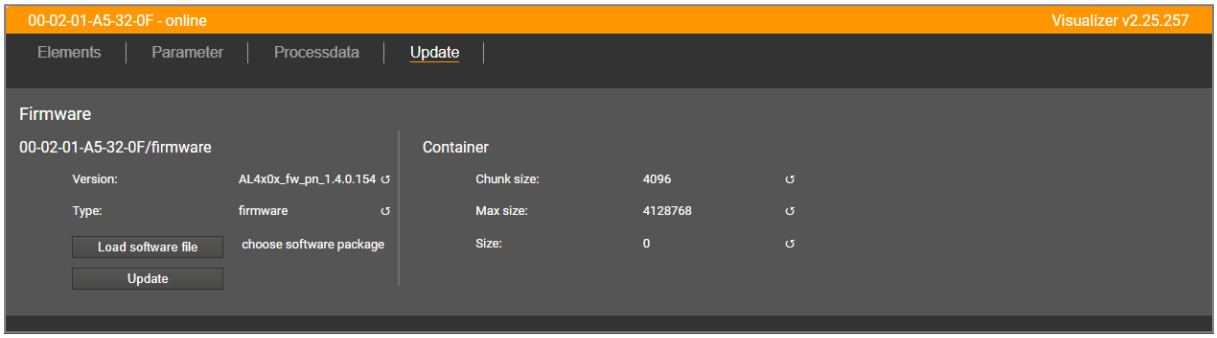
Requirements:

✓ IoT Core Visualizer has been started.

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

▶ Select the [Update] menu.

▷ Menu page shows information about the current firmware version.



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

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

▷ The firmware of the device is updated.

▷ The progress of the update process is displayed.

▷ After successful update: The device reboots automatically.

9.3 ModbusTCP

9.3.1 Integrating a device into a Modbus TCP project

The device offers the functionality of a Modbus TCP server (independent mode). The user can integrate the device into a Modbus TCP project via the profile of a generic Modbus TCP slave.

The device can be configured via the Modbus registers.

9.3.1.1 Example: Integrating a device into a CODESYS project

▶ Familiarise yourself with the Modbus Configurator function in the CODESYS help.

Task: Integrate the device into a CODESYS project.

Available hardware:

- SmartPLC AC14 DL (Modbus TCP Master)
- Device AL4142(Modbus TCP Slave)

Solution:

Create a Modbus TCP master

Requirements:

✓ CODESYS project with AC14 DL was created.

▶ In the device tree: Right click on the [X8 (Ethernet)] node.

▷ The context menu appears.

▶ Select the menu item [Add device…].

▷ A dialogue window appears.

▶ Select the device profile [Modbus_TCP_Master].

▶ Click on [Add device].

▷ CODESYS adds the Modbus TCP master as a sub-node of the interface [X8 (Ethernet)] to the project.

▷ SmartPLC AC14 DL can be configured as TCP Master mode.

Add the device as a Modbus TCP slave

▶ In the device tree: Right click on the node [X8 (Ethernet)] > [Modbus_TCP_Master].

▷ The context menu appears.

▶ Select the menu item [Add device…].

▷ A dialogue window appears.

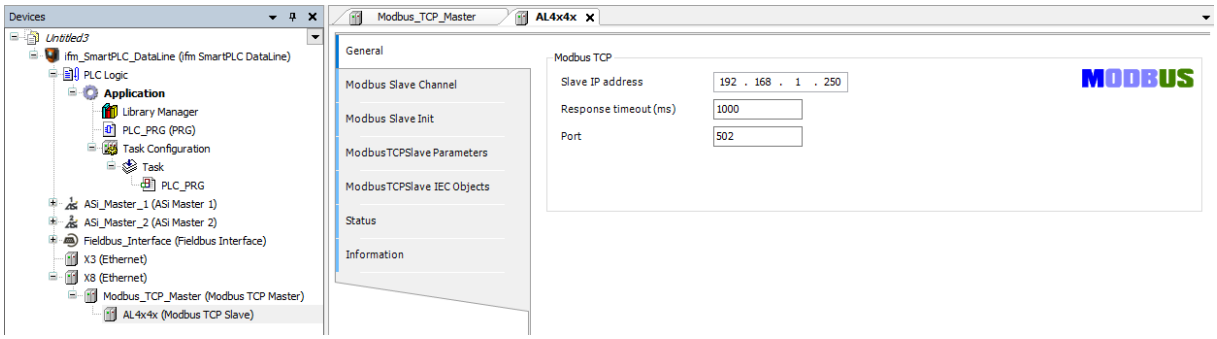
▶ Select the device profile [Modbus_TCP_Slave].

▶ Enter AL4142 as the name.

▶ Click on [Add device].

▷ CODESYS adds the device to the project as a sub-node of [Modbus TCP Master].

▷ The device can be configured as a Modbus TCP slave.



9.3.2 Device-specific notes

9.3.2.1 Rules for accessing the Modbus register

The following rules apply for access to the Modbus registers:

▶ To read or write Modbus registers, only use the valid Function Codes (→ Supported function codes 🗋 44).

9.3.2.2 Supported function codes

The device supports the following function codes for accessing the Modbus registers:

Function code	Name	Description
FC2 (0x02)	Read Input Discretes	Read individual digital inputs
FC3 (0x03)	Read Multiple Registers	Read several contiguous registers
FC4 (0x04)	Read input register	Read input register
FC6 (0x06)	Write Single Register	Writing a single register
FC16 (0x10)	Write Multiple Registers	Writing several contiguous registers
FC23 (0x17)	Read / Write Multiple Registers	Read / write several contiguous registers
FC43 (0x2B)	Read Device Identification	Reading device information

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

9.3.2.3 Exception codes

A Modbus TCP request has the following structure:

Function Code	Request Data

A Modbus TCP response has the following structure:

Function Code	Response Data

When a request is processed without errors, the response message contains the following information:

- Function code (1 byte): Function code of the request message
- Response data (n bytes): Requested data

If an error occurs during the processing of a request, the response message contains the following information:

- Function code (1 byte): Error Code (= Request Function Code + 0x80)
- Response data (1 byte): Exception codes

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 (invalid address or length)
0x3	ILLEGAL DATA VALUE	Invalid data value (invalid parameters; wrong number of registers)
0x4	SERVER DEVICE FAILURE	Unrecoverable error in the Modbus server during processing

9.3.3 Configuring the device

Register areas for the basic settings of the device:

- Set the byte order in the data registers: Byte Swap (500) (→ 🗋 58)
- Set the max. connection interruption time: Connection Timeout (510) (→ 🗋 59)
- Set the arrangement of the process data in registers 0, 400 and 401: DI Channel Mapping (550) (→ 🗋 60)

9.3.4 Configuring digital inputs

Register range for the configuration of the digital input channels: Digital Input Configuration (100 - 163) (→ 🗋 51)

Available parameters for each digital input channel:

- Inversion
- Hold level
- Debounce time
- Hold time

9.3.5 Configuring counter modules

The register area 200...271 provides access to the settings of the counter modules of the ports: Counter Configuration (200 - 271) (→ 🗋 53)

Available parameters per counter module:

- Operating mode of the counter module
- Pin 2 function of the port
- Instance for selecting the counting direction
- Threshold CT of the main counter
- Threshold CTb of the batch counter
- Set counter value of the main counter
- Set the counter value of the batch counter

9.3.6 Reading process data

Registers 0...34 provide access to the unit's process data: Input data (0 - 34) (→ 🗋 49)

The register range 0..2 contains the following process data:

- Digital inputs of all ports
- Overflow and underflow events of the main counter and batch counter of all ports

The register area 3...34 contains the following process data for each port separately:

- Counter values of the Main Counter and Batch Counter
- Overflow and underflow events of the main counter and batch counter

9.3.7 Controlling counter modules

The register range 300...355 provides access to the control signals of the individual counter modules: Counter Control (300 - 355) (→ 🗋 55)

There is a separate register area for each counter module. The following control signals are available in each register area:

- Disable counter module
- Set the direction
- Reset overflow/underflow event of the main counter
- Reset overflow/underflow event of the batch counter
- Counter and overflow/underflow events Reset counter events

The register range 400...408 provides compact access to the control signals of all counter modules: Block Configuration (400 - 408) (→ 🗋 57)

The following control signals are available for each counter module:

- Signal inversion (pin 2 / pin 4)
- Signal level (pin 2 / pin 4)
- Disable counter module
- Set the direction
- Reset overflow/underflow event of the main counter
- Reset overflow/underflow event of the batch counter
- Counter and overflow/underflow events Reset counter events

9.3.8 Controlling the device

System commands can be executed on the device.

Register area for accessing the system commands: System Command (600) (→ 🗋 61)

Available system commands:

- Restart the device.
- Resetting the device

9.3.9 Reading diagnostic data

The registers 2000…2002 provide access to the diagnostic data of the device: Diagnostic Data (2000 - 2002) (→ 🗋 62)

Available diagnostic data:

- Status of the voltage supply
- Time since last device start
- Connection interruption counter

9.3.10 Reading identification information

The user can read identification information of the device with the function code FC43.

The machine supports the following categories of the Read Device ID Code function:

- Basic Device Identification (0x01):

Object ID	Name	Data type	Value range
0x00	Vendor name	ASCII string	ifm electronic
0x01	Product Code	ASCII string	AL4142
0x02	Major Minor Revision	ASCII string	e.g. 1,001

- Regular Device Identification (0x02):

Object ID	Name	Data type	Value range
0x00	Vendor name	ASCII string	ifm electronic
0x01	Product Code	ASCII string	AL4142
0x02	Major Minor Revision	ASCII string	e.g. 1,001
0x03	Vendor Url	ASCII string	www.ifm.com
0x04	Product Name	ASCII string	ETH Module PFL MB 16DI IP67
0x05	Model Name	ASCII string	AL4142
0x06	User Application Name	ASCII string	Ethernet Module 16DI

10 Maintenance, repair and disposal

The operation of the device is maintenance-free.

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

10.1 Cleaning

▶ Disconnect the device from the voltage supply.

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

▶ In case of severe soiling, use a damp cloth.

▶ Do not use any caustic cleaning agents for cleaning!

10.2 Update firmware

The system software of the device can be updated using the following options:

- IoT-Core Visualizer: Update firmware (→ 41)

11 Appendix

11.1 ModbusTCP

11.1.1 Register

11.1.1.1 Input data (0 - 34)

Register	Bit															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	DI Ch15	DI Ch14	DI Ch14	DI Ch13	DI Ch12	DI Ch11	DI Ch10	DI Ch09	DI Ch08	DI Ch07	DI Ch06	DI Ch05	DI Ch04	DI Ch03	DI Ch02	DI Ch01
1	MC8 OF	MC7 OF	MC6 OF	MC5 OF	MC4 OF	MC3 OF	MC2 OF	MC1 OF	MC8 UF	MC7 UF	MC6 UF	MC5 UF	MC4 UF	MC3 UF	MC2 UF	MC1 UF
2	MC8 OF	MC7 OF	MC6 OF	MC5 OF	MC4 OF	MC3 OF	MC2 OF	MC1 OF	BC8 UF	BC7 UF	BC6 UF	BC5 UF	BC4 UF	BC3 UF	BC2 UF	BC1 UF
3…6	Counter 1: Mapping: Counter Data and Status (→ 50)															
7…10	Counter 2: Mapping: Counter Data and Status (→ 50)															
11…14	Counter 3: Mapping: Counter Data and Status (→ 50)															
15…18	Counter 4: Mapping: Counter Data and Status (→ 50)															
19…22	Counter 5: Mapping: Counter Data and Status (→ 50)															
23…26	Counter 6: Mapping: Counter Data and Status (→ 50)															
27…30	Counter 7: Mapping: Counter Data and Status (→ 50)															
31…34	Counter 8: Mapping: Counter Data and Status (→ 50)															

Legend:

• DI Chx	Signal level of the digital input channel Chx (x: 01...16) after filtering	1 BIT / ro	• 0x0: LOW • 0x1: HIGH
• MCx OF	Main Counter x Overflow: Overflow event at the main counter x (x: 1...8)	1 BIT / ro	• 0x0: no event • 0x1: overflow event
• MCx UF	Main Counter x Underflow: Underflow event at the main counter x (x: 1...8)	1 BIT / ro	• 0x0: no event • 0x1: underflow event
• BCx OF	Main Counter x Overflow: Overflow event at the batch counter x (x: 1...8)	1 BIT / ro	• 0x0: no event • 0x1: overflow event
• BCx UF	Batch Counter x Underflow: Underflow event at the batch counter x (x: 1...8)	1 BIT / ro	• 0x0: no event • 0x1: underflow event

Mapping: Counter Data and Status

Register	Bit															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
n	Main Counter Value (Word 0)															
n+1	Main Counter Value (Word 1)															
n+2	Batch Counter Value															
n+3	res.	res.	res.	res.	res.	res.	MC OF	MC UF	res.	res.	res.	res.	res.	res.	BC OF	BC UF

Legend:

• Main Counter Value	Current counter value of the main counter	2 WORD / ro	• 0x0000 0000: 0 … • 0xFFFF FFFE: 4294967294
• Batch Counter Value	Current counter value of the batch counter	1 WORD / ro	• 0x0000: 0 … • 0xFFFE: 65534
• MC OF	Main Counter Overflow: Overflow event at the main counter	1 BIT / ro	• 0x0: no event • 0x1: Overflow event
• MC UF	Main Counter Underflow: Underflow event at the main counter	1 BIT / ro	• 0x0: no event • 0x1: Underflow event
• BC OF	Main Counter Overflow: Overflow event at the batch counter	1 BIT / ro	• 0x0: no event • 0x1: Overflow event
• BC UF	Batch Counter Underflow: Underflow event at the batch counter	1 BIT / ro	• 0x0: no event • 0x1: Underflow event

11.1.1.2 Digital Input Configuration (100 - 163)

Register	Bit															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
100…103	DI Ch01 Configuration															
104…107	DI Ch02 Configuration															
108…111	DI Ch03 Configuration															
112…115	DI Ch04 Configuration															
116…119	DI Ch05 Configuration															
120…123	DI Ch06 Configuration															
124…127	DI Ch07 Configuration															
128…131	DI Ch08 Configuration															
132…135	DI Ch09 Configuration															
136…139	DI Ch10 Configuration															
140…143	DI Ch11 Configuration															
144…147	DI Ch12 Configuration															
148…151	DI Ch13 Configuration															
152…155	DI Ch14 Configuration															
156…159	DI Ch15 Configuration															
160…163	DI Ch16 Configuration															

Legend:

- DI Chx Configuration — Configuration of the digital input channel Chx (x: 01...16) — 4 WORD / rw — Per digital input channel: Mapping: Filter Settings (→ 52)

Mapping: Filter Settings

Word (offset)	Bit															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
n	reserved								res.	res.	res.	res.	res.	res.	res.	In-vert
n+1	reserved								res.	res.	res.	res.	res.	res.	res.	Hold Level
n+2	Debounce Time															
n+3	Hold Time															

Legend:

- Invert — signal inversion — 1 BIT / rw
  - 0x0: do not invert (default)
  - 0x1: invert
- Hold Level — Signal level to be maintained — 1 BIT / rw
  - 0x0: LOW
  - 0x1: HIGH (default)
- Debounce Time — Debounce time (value in *0.1 milliseconds) — 1 WORD / rw
  - 0x0000: 0 ms (default)

  …
  - 0x01F4: 50 ms
- Hold Time — Hold time (value in *0.1 milliseconds) — 1 WORD / rw
  - 0x0000: 0 ms (default)

  …
  - 0xEA60: 600 ms

11.1.1.3 Counter Configuration (200 - 271)

Register	Bit															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
200…208	Counter 1 Port X1: Counter Configuration (→ Mapping: Counter Configuration 54)															
209…217	Counter 2 Port X2: Counter Configuration (→ Mapping: Counter Configuration 54)															
218…226	Counter 3 Port X3: Counter Configuration (→ Mapping: Counter Configuration 54)															
227…235	Counter 4 Port X4: Counter Configuration (→ Mapping: Counter Configuration 54)															
236…244	Counter 5 Port X5: Counter Configuration (→ Mapping: Counter Configuration 54)															
245…253	Counter 6 Port X6: Counter Configuration (→ Mapping: Counter Configuration 54)															
254…262	Counter 7 Port X7: Counter Configuration (→ Mapping: Counter Configuration 54)															
263…271	Counter 8 Port X8: Counter Configuration (→ Mapping: Counter Configuration 54)															

Mapping: Counter Configuration

Register	Bit															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
n	Counter Mode															
n+1	Pin 2 Function															
n+2	Counter Direction Select															
n+3	Main Threshold (Word 0)															
n+4	Main Threshold (Word 1)															
n+5	Batch Threshold															
n+6	Force Main Counter (Word 0)															
n+7	Force Main Counter (Word 1)															
n+8	Force Batch Counter															

Legend:

• Counter Mode	Operating mode of the counter module	1 WORD	• 0x0000: CTU – Up Counter (default) • 0x0001:CTD – Down counter • 0x0002: CTUD – Up and down counter • 0x0003: CTDIR – Up or down counter
• Pin 2 Function	Pin 2 function of the port	1 WORD	• 0x0000: N/C - No function (default) • 0x0001: counter edge input 2 – counting input • 0x0002: count direction – select counting direction • 0x0003: reset main + batch counter - reset counter module • 0x0004: disable main + batch counter – disable counter module
• Counter Direction Select	Instance for selecting the counting direction	1 WORD	• 0x0000: pin 2 (default) • 0x0001: PLC
• Main Threshold	Threshold CT of the main counter MainThreshold = 0x01234567 • MainThreshold[0] = 0x0123 • MainThreshold[1] = 0x4567	2 WORD	• 0x0000 0001: 1 … • 0xFFFF FFFF: 4294967295 (default)
• Batch Threshold	Threshold CTb of the batch counter	1 WORD	• 0x0001: 1 … • 0xFFFF: 65535 (default)
• Force Main Counter	Set counter value of the main counter ForceMainCounter = 0x01234567 • ForceMainCounter[0] = 0x0123 • ForceMainCounter[1] = 0x4567	2 WORD	• 0x0000 0000: 0 … • 0xFFFF FFFE: 4294967294 (default)
• Force Batch Counter	Set counter value of the batch counter	1 WORD	• 0x0000: 0 … • 0xFFFE: 65534 (default)

11.1.1.4 Counter Control (300 - 355)

Register	Bit															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
300…306	Port X1: Output Counter (→ Mapping: Counter Control 56)															
307…313	Port X2: Output Counter (→ Mapping: Counter Control 56)															
314…320	Port X3: Output Counter (→ Mapping: Counter Control 56)															
321…327	Port X4: Output Counter (→ Mapping: Counter Control 56)															
328…334	Port X5: Output Counter (→ Mapping: Counter Control 56)															
335…341	Port X6: Output Counter (→ Mapping: Counter Control 56)															
342…348	Port X7: Output Counter (→ Mapping: Counter Control 56)															
349…355	Port X8: Output Counter (→ Mapping: Counter Control 56)															

Mapping: Counter Control

Register	Bit															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
n	reserved								res.	res.	res.	res.	res.	res.	res.	DIS
n+1	reserved								res.	res.	res.	res.	res.	res.	res.	DIR
n+2	reserved								res.	res.	res.	res.	res.	res.	res.	RST MC OV
n+3	reserved								res.	res.	res.	res.	res.	res.	res.	RST MC UV
n+4	reserved								res.	res.	res.	res.	res.	res.	res.	RST BC OV
n+5	reserved								res.	res.	res.	res.	res.	res.	res.	RST BC UV
n+6	reserved								res.	res.	res.	res.	res.	res.	res.	RST CT

Legend:

- DIS — Disable Counter: disable main counter + batch counter — 1 BIT
  - 0x0: no action
  - 0x1: disable main and batch counter
- DIR — Counter Direction: Set counting direction (valid only for counter mode CTDIR) — 1 BIT
  - 0x0: up
  - 0x1: down
- RST MC OV — Reset Main Counter Overflow: Reset counter event overflow of the main counter — 1 BIT
  - 0x0: no action
  - 0x1: Rest overflow event
- RST MC UV — Reset Main Counter Underflow: Reset counter event underflow of the main counter — 1 BIT
  - 0x0: no action
  - 0x1: Reset underflow event
- RST BC OV — Reset Batch Counter Overflow: Reset counter event overflow of the batch counter — 1 BIT
  - 0x0: no action
  - 0x1: Rest overflow event
- RST BC UV — Reset Batch Counter Underflow: Reset counter event underflow of the batch counter — 1 BIT
  - 0x0: no action
  - 0x1: Reset underflow event
- RST CT — Reset Counter Module: Reset main counter and batch counter to initial value — 1 BIT
  - 0x0: no action
  - 0x1: reset main + batch counter and counter events to overflow/underflow

11.1.1.5 Block Configuration (400 - 408)

Register	Bit															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
400	X8: DI2 INV	X8: DI1 INV	X7: DI2 INV	X7: DI1 INV	X6: DI2 INV	X6: DI1 INV	X5: DI2 INV	X5: DI1 INV	X4: DI2 INV	X4: DI1 INV	X3: DI2 INV	X3: DI1 INV	X2: DI2 INV	X2: DI1 INV	X1: DI2 INV	X1: DI1 INV
401	X8: DI2 HL	X8: DI1 HL	X7: DI2 HL	X7: DI1 HL	X6: DI2 HL	X6: DI1 HL	X5: DI2 HL	X5: DI1 HL	X4: DI2 HL	X4: DI1 HL	X3: DI2 HL	X3: DI1 HL	X2: DI2 HL	X2: DI1 HL	X1: DI2 HL	X1: DI1 HL
402	reserved								X8: DIS	X7: DIS	X6: DIS	X5: DIS	X4: DIS	X3: DIS	X2: DIS	X1: DIS
403	reserved								X8: DIR	X7: DIR	X6: DIR	X5: DIR	X4: DIR	X3: DIR	X2: DIR	X1: DIR
404	reserved								X8: RST MC OV	X7: RST MC OV	X6: RST MC OV	X5: RST MC OV	X4: RST MC OV	X3: RST MC OV	X2: RST MC OV	X1: RST MC OV
405	reserved								X8: RST MC UV	X7: RST MC UV	X6: RST MC UV	X5: RST MC UV	X4: RST MC UV	X3: RST MC UV	X2: RST MC UV	X1: RST MC UV
406	reserved								X8: RST BC OV	X7: RST BC OV	X6: RST BC OV	X5: RST BC OV	X4: RST BC OV	X3: RST BC OV	X2: RST BC OV	X1: RST BC OV
407	reserved								X8: RST BC UV	X7: RST BC UV	X6: RST BC UV	X5: RST BC UV	X4: RST BC UV	X3: RST BC UV	X2: RST BC UV	X1: RST BC UV
408	reserved								X8: RST CT	X7: RST CT	X6: RST CT	X5: RST CT	X4: RST CT	X3: RST CT	X2: RST CT	X1: RST CT

Legend:

- DI1 INV — Pin 4: signal inversion — 1 BIT
  - 0x0: do not invert (default)
  - 0x1: invert
- DI2 INV — Pin 2: signal inversion — 1 BIT
  - 0x0: do not invert (default)
  - 0x1: invert
- DI1 HL — Pin 4: Signal level to be maintained — 1 BIT
  - 0x0: LOW
  - 0x1: HIGH (default)
- DI2 HL — Pin 2: Signal level to be maintained — 1 BIT
  - 0x0: LOW
  - 0x1: HIGH (default)
- DIS — Disable Counter: disable main counter + batch counter — 1 BIT
  - 0x0: no action (default)
  - 0x1: disable main and batch counter
- DIR — Counter Direction: Set counting direction (valid only for counter mode CTDIR) — 1 BIT
  - 0x0: up (default)
  - 0x1: down
- RST MC OV — Reset Main Counter Overflow: Reset counter event overflow of the main counter — 1 BIT
  - 0x0: no action (default)
  - 0x1: Rest overflow event
- RST MC UV — Reset Main Counter Underflow: Reset counter event underflow of the main counter — 1 BIT
  - 0x0: no action (default)
  - 0x1: Reset underflow event
- RST BC OV — Reset Batch Counter Overflow: Reset counter event overflow of the batch counter — 1 BIT
  - 0x0: no action (default)
  - 0x1: Rest overflow event
- RST BC UV — Reset Batch Counter Underflow: Reset counter event underflow of the batch counter — 1 BIT
  - 0x0: no action (default)
  - 0x1: Reset underflow event
- RST CT — Reset main counter and batch counter to initial value — 1 BIT
  - 0x0: no action (default)
  - 0x1: reset main + batch counter and counter events to overflow/underflow

11.1.1.6 Byte Swap (500)

Register	Bit															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
500	Byte Swap															

Legend:

• Byte Swap	Arrangement of the bytes in the data tables	1 WORD / rw	• 0x0000: Big endian (default) • 0xFFFF: Little endian

11.1.1.7 Connection Timeout (510)

Register	Bit															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
510	Connection Timeout															

Legend:

• Connection Timeout	Max. value for connection timeouts (value in ms)	1 WORD / rw	• 20: 20 ms … • 30000: 30000 ms (default) … • 60000: 60000 ms

11.1.1.8 DI Channel Mapping (550)

Register	Bit															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
550	reserved								res.	res.	res.	res.	res.	res.	res.	DI-CO

Legend:

- DICO — DI channel order: Arrangement of the process data in registers 0, 400 and 401 — 1 BIT
  - 0x0: pin-based (default)
  - 0x1: port-based

Mapping: pin-based

Register	Bit															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
n	X8: Pin 2	X7: Pin 2	X6: Pin 2	X5: Pin 2	X4: Pin 2	X3: Pin 2	X2: Pin 2	X1: Pin 2	X8: Pin 4	X7: Pin 4	X6: Pin 4	X5: Pin 4	X4: Pin 4	X3: Pin 4	X2: Pin 4	X1: Pin 4

Mapping: port-based

Register	Bit															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
n	X8: Pin 2	X8: Pin 4	X7: Pin 2	X7: Pin 4	X6: Pin 2	X6: Pin 4	X5: Pin 2	X5: Pin 4	X4: Pin 2	X4: Pin 4	X3: Pin 2	X3: Pin 4	X2: Pin 2	X2: Pin 4	X1: Pin 2	X1: Pin 4

11.1.1.9 System Command (600)

Register	Bit															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
600	Command ID															

Legend:

• Command ID	Identifier of the command	1 WORD / wo	• 0x0040: Restart the device. • 0x0050: Resetting the device

11.1.1.10 Diagnostic Data (2000 - 2002)

Register	Bit															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
2000	reserved								res.	res.	res.	res.	res.	res.	res.	PSE
2001	Uptime															
2002	Disconnection Counter															

Legend:

• PSE	Power Status Error: status of the voltage supply	1 BIT / ro	• 0x0: No error • 0x1: Error
• Uptime	Time since the last start of the device (value in minutes)	1 WORD / ro	• 0x0000: 0 min … • 0xFFFF: 65535 min
• Disconnection Counter	The counter for connection interruptions (by user or by connection timeout) since the last start of the device; The counter is reset when the device is restarted	1 WORD / ro	• 0x0000: 0 interruptions … • 0xFFFF: 65535 interruptions