GB

Operating instructions

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

AL4002

11425600 / 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	04 / 2022
01	• Removed: ifm IoT Core chapter • Added: Chapter IoT-Core Visualizer (→ 🗋 30)	11 / 2022
02	• Added: UL applications – Connection technology, Connection technology (→ 🗋 16) • Added: UL applications – Derating, Derating behaviour (→ 🗋 18)	10 / 2023
03	• Changed: Supported parameter setting software, Supported parameter setting software (→ 🗋 22) • 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 connection
- Status display of the voltage supply
- Status, error and short circuit/overload indication of the sensor ports

4.2 Visual indication

The device displays the following indications:

- Status and error indication of the PROFINET 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

4.3 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
- PROFINET
  - Projection software

4.4 Inputs

Ports X01...X08 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.

4.4.1 Sensor supply

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

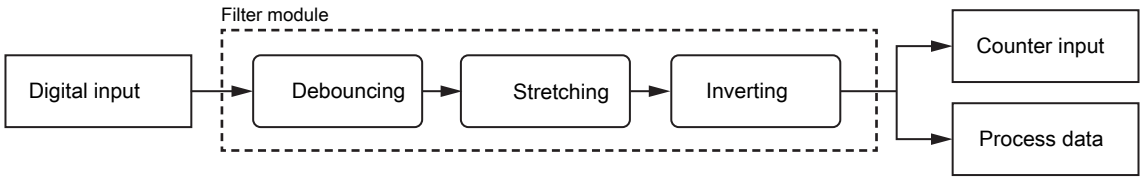
4.5 Digital input filters

The device pre-processes the digital input signals at ports X01...X08. 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



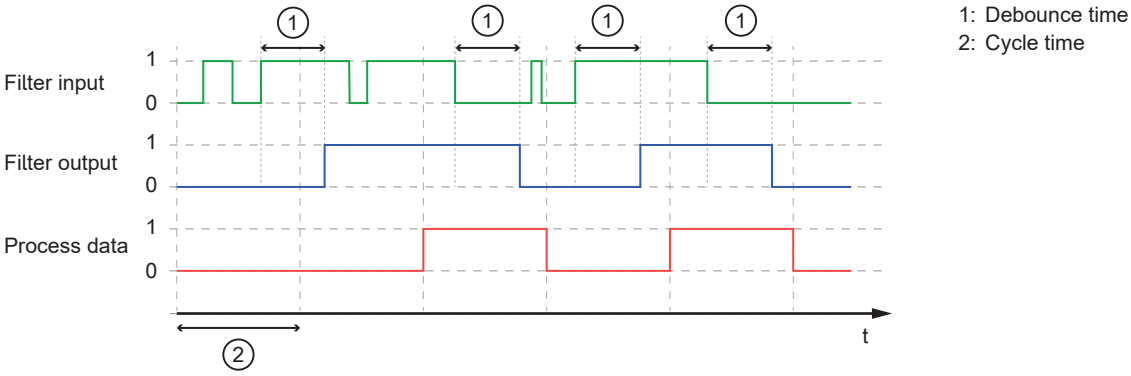
Each filter can be configured separately.

- 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)

4.5.1 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:

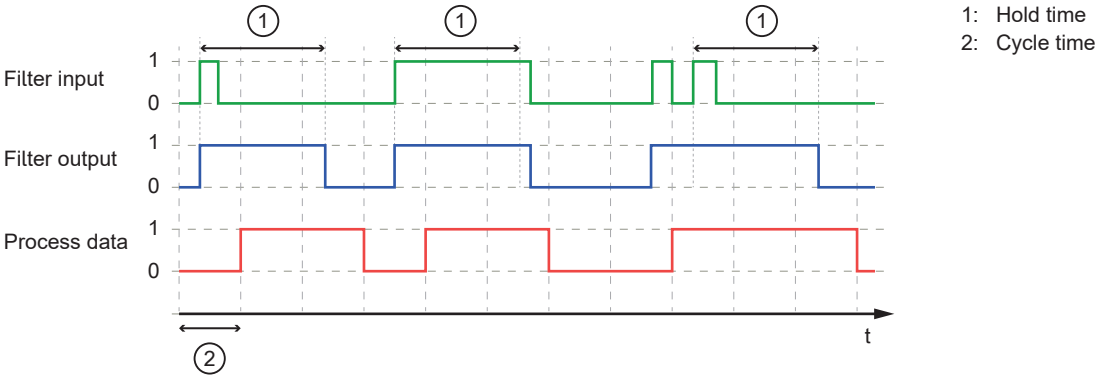


4.5.2 Stretching

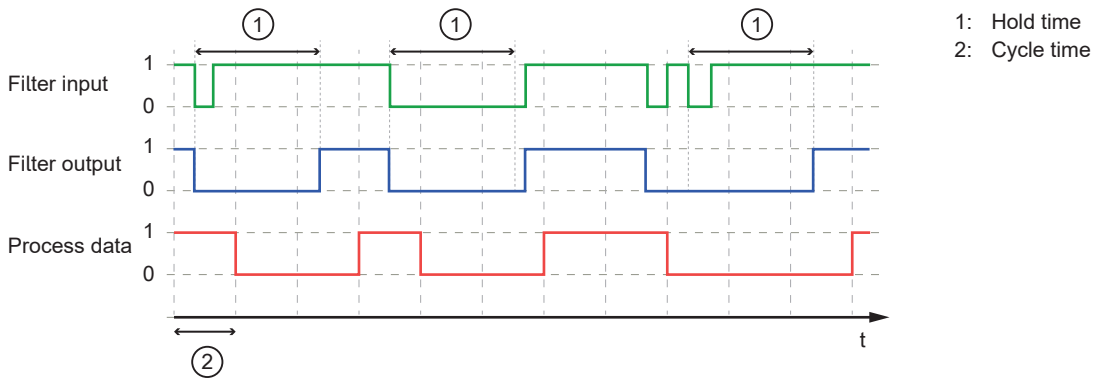
The filter stretches short input pulses. Level changes that occur during a stretching period are ignored. The filter is configured via the following parameters:

- 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):



4.5.3 Inverting

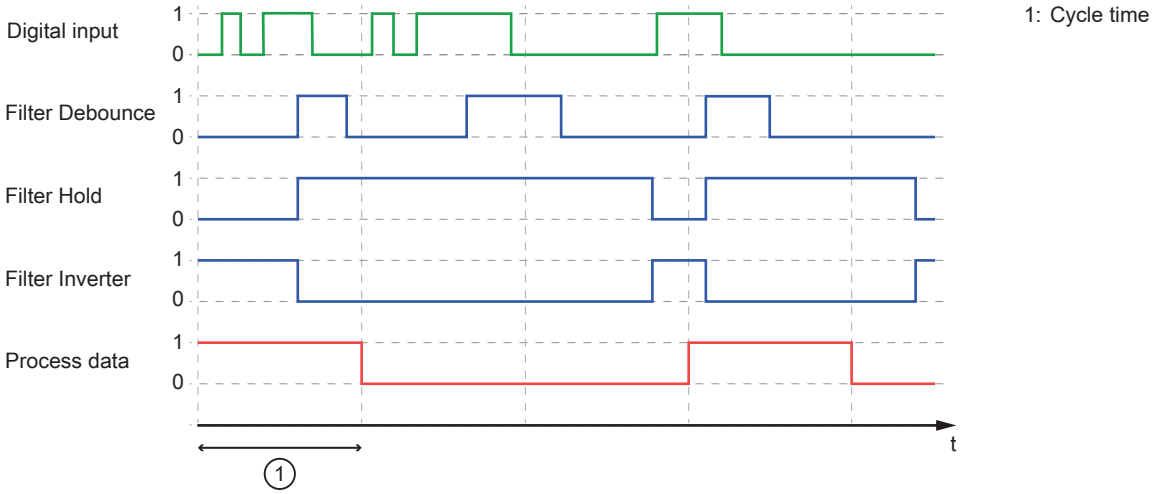
The filter inverts signals.

4.5.4 Filter combination

The filters can be combined.

Example: All 3 filters are activated

Time diagram:

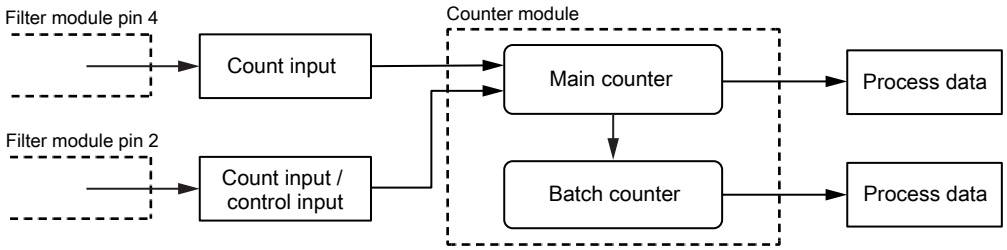


4.6 Counter

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.

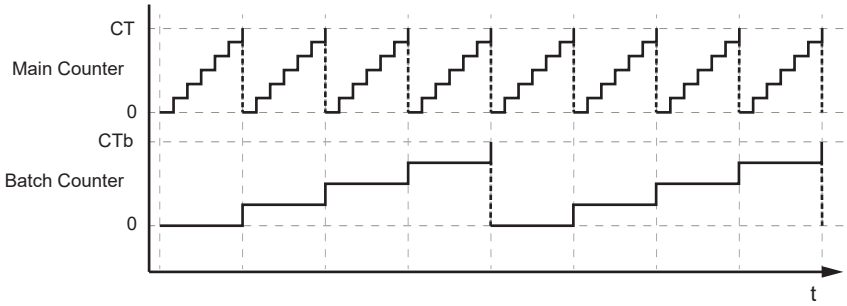
Maximum count frequency: 4500 Hz

4.6.1 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).

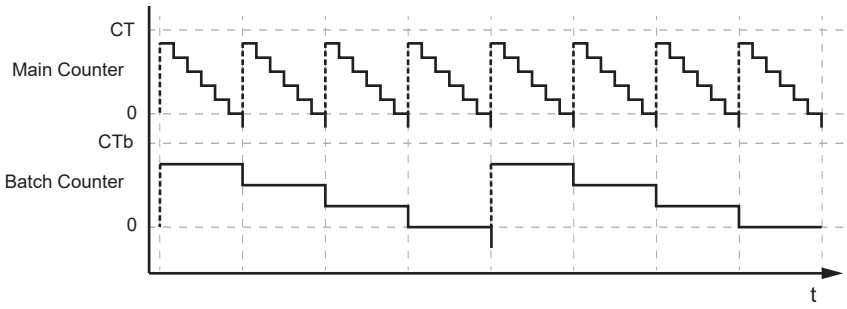


4.6.2 Counter mode CTD

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).

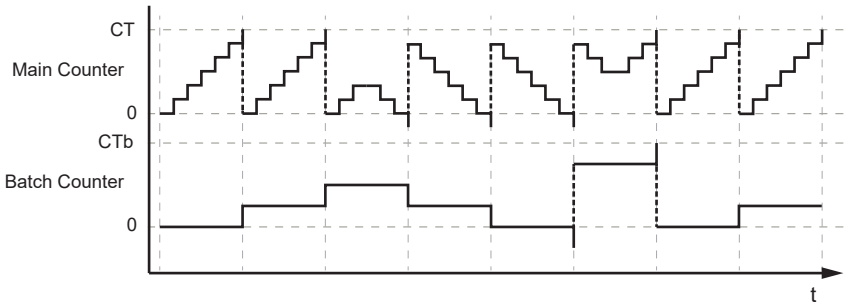


4.6.3 Counter mode CTUD

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).



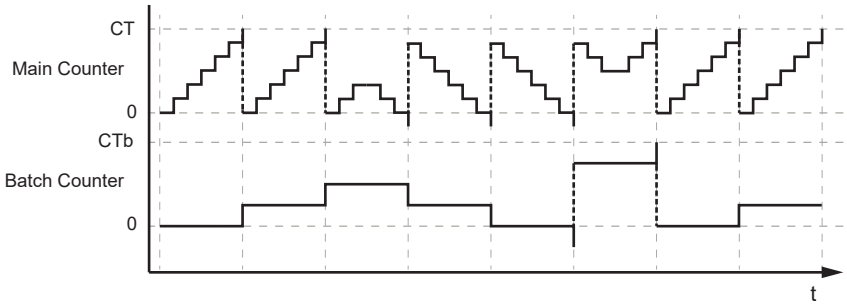
4.6.4 Counter mode CTDIR

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).



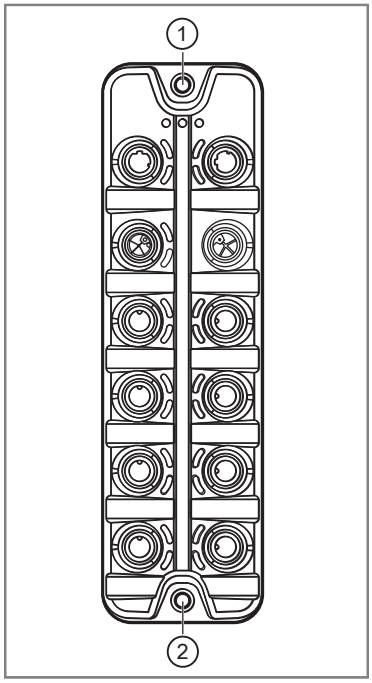
4.7 PROFINET

Supported PROFINET functions:

- Device profile: PROFINET IO device
- Fast Startup (FSU)
- Prioritized Startup
- Participation in network with activated IRT protocol
- System redundancy S2
- Dynamic reconfiguration
- Device description: GSD file

5 Installation

5.1 Overview



1: Upper mounting lug
2: Lower mounting lugs lug

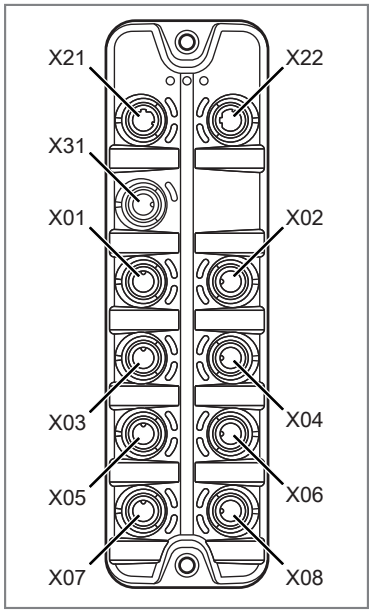
5.2 Install device

- ▶ 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



X21: Ethernet 1 (PROFINET)
X22: Ethernet 2 (PROFINET)
X31: Power IN
X01: Process connection 1 (sensor)
X02: Process connection 2 (sensor)
X03: Process connection 3 (sensor)
X04: Process connection 4 (sensor)
X05: Process connection 5 (sensor)
X06: Process connection 6 (sensor)
X07: Process connection 7 (sensor)
X08: 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 SELV/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 PROFINET network via Ethernet ports X21 / X22 (e. g. PROFINET control, additional PROFINET 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 PROFINET 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 X01...X08 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 X01...X08 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 ports X01...X08.

The X31 port is equipped with overvoltage protection (US).

The X31 port is equipped with reverse polarity protection (US).

The X31 port is equipped with an inrush current limitation.

Wiring:

1: L+ (US)
2: n.c.
3: L- (US)
4: n.c.

▶ Disconnect power.

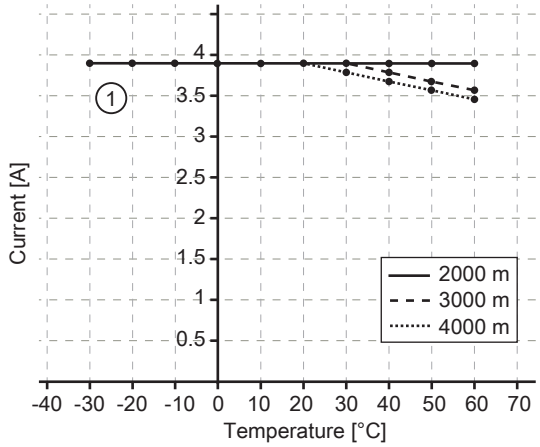
▶ Connect the device via the X31 port to 24 V DC (20...30 V SELV/PELV).

▶ For connection, use an A-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
- ▶ Observe the derating behaviour of the device (→ Derating behaviour 🗋 18).

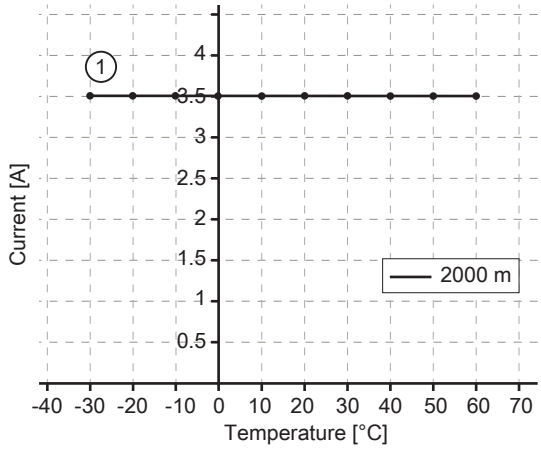
6.5.1 Derating behaviour

The current IUS available at ports X01...X08 depends on the ambient temperature of the device.



1: I_{US} at ports X01...X08

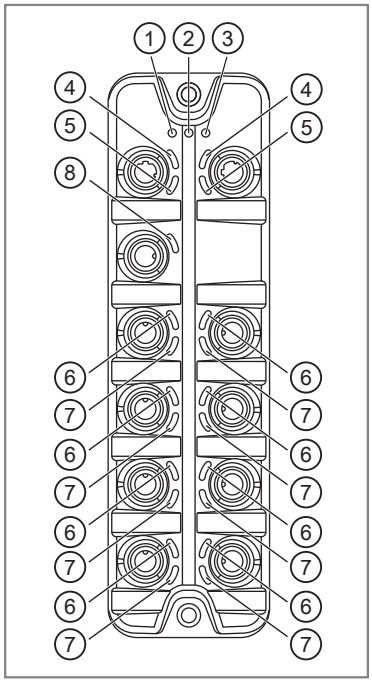
For UL applications:



1: I_{US} at ports X01...X08

7 Operating and display elements

7.1 LEDs



1: Status: RDY
2: Status: BF
3: Status: SF
4: PROFINET: LNK
5: PROFINET: 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)
BF	PROFINET connection status (bus failure)	-	Off	No error
		Red	Flashes (2 Hz)	No data transmission
			On	• No configuration or • physical connection with low speed or • no physical connection
SF	System status (system failure)	-	Off	No error
		Red	Flashes 3 s (1 Hz)	DCP signalling service initiated via fieldbus
			On	• Watchdog expired or • channel diagnosis, general or extended diagnosis available or • system error

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 transmis-sion	-	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.

! The configuration created with ifm moneo is overwritten when a connection is established between the device and the PROFINET PLC.

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: Configure the PROFINET interface (→ 🗋 22)

▶ Establish a connection to the device.

▷ The parameter setting software can access the device parameters.

9.1.2.1 Configure the PROFINET interface

The PROFINET interface of the device can only be set via DCP-capable parameter setting software, e.g. PROFINET projection software.

! With the parameter setting software ifm moneo or ifm moneo|configure (SA), the IP parameters of the PROFINET interface can only be set during the network scan. In the editor view of the device, the configuration of the PROFINET interface is read-only.

▶ Start the parameter setting software.

▶ Configure the PROFINET interface of the device.

▷ The device has a configured PROFINET interface.

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 Reading the interface configuration

▶ Observe the notes on the configuration of the PROFINET interface: Configure the PROFINET interface (→ 🗋 22)

Available parameters:

Name	Description	Value range	Access
[ipaddress]	IP address of the PROFINET interface	e.g. 192.100.0.10 0.0.0.0 (default)	ro [1]
[subnetmask]	Subnet mask of the network segment	e.g. 255.255.255.0 0.0.0.0 (default)	ro [1]
[ipdefaultgateway]	IP address of the network gateway	e.g. 192.100.0.1 0.0.0.0 (default)	ro [1]
[macaddress]	MAC address of the Ethernet interface	e.g. 00:02:01:0E:10:7F	ro [1]
[hostname]	Name of the device in the PROFINET network	e.g. al4x0x	ro [1]

[1] Read only

Requirements:

✓ The parameter setting software has been started.

✓ The detailed view of the device is active.

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

▷ The menu page displays the current configuration of the PROFINET interface.

9.1.3.2 Reading the connection status

Available information:

Name	Description	Value range	Access
[connectionstatus]	Status of the PROFINET connection	• Disconnected: Not connected • Connected: Connected	ro [1]
[fieldbusfirmware]	Firmware version of the PROFINET stack	e.g. 5.4.0.3 (PROFINET IO Device)	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 PROFINET 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 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]

Name	Description	Value range	Access
[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).

ℹ 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	AL4002	ro [1]
[devicefamily]	Device family	Ethernet modules	ro [1]
[vendor]	Manufacturer	ifm electronic gmbh	ro [1]
[swrevision]	Firmware revision	e.g. AL4x0x_fw_pn_v1.4.0.137	ro [1]
[hwrevision]	Hardware revision (status)	e.g. AA	ro [1]
[bootloaderrevision]	Bootloader version	e.g. AL4xxx_bl_v1.2.0.35	ro [1]
[serialnumber]	Serial number	e.g. 0002043100003	ro [1]
[fieldbustype]	Fieldbus	PROFINET	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. AL4x0x_fw_pn_1.4.0.137	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:

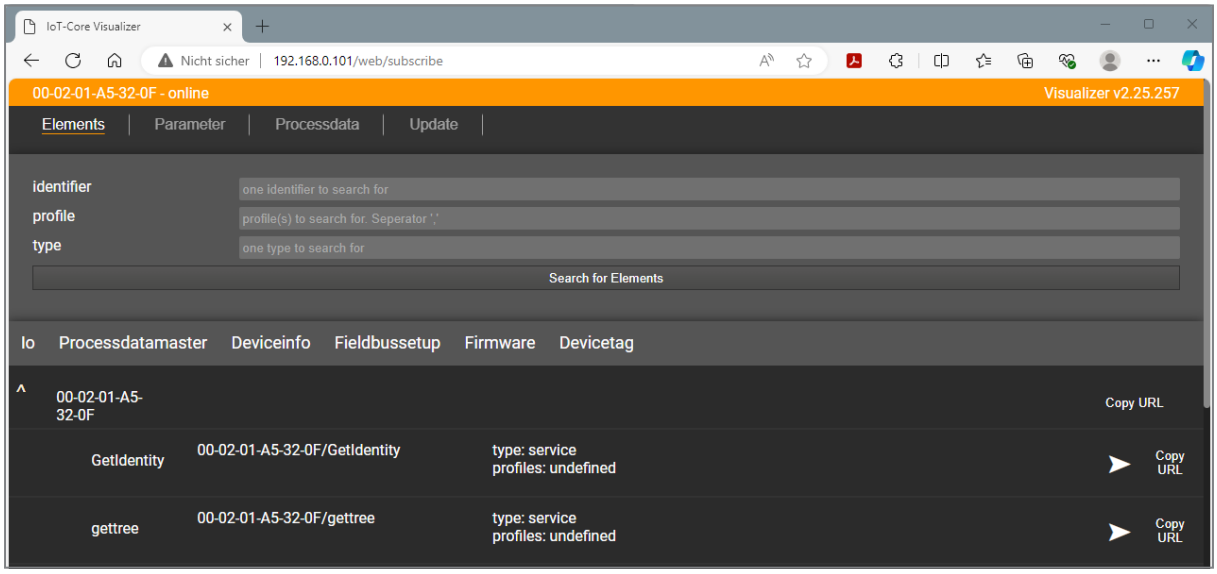
✓ The laptop / PC is connected directly or via a suitable network coupling element (e.g. switch) to a PROFINET port (X21 / X22) of the device.

✓ PROFINET 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 (→ 🗋 31)
- [Parameter]: Configuring the device (→ 🗋 32)
- [Processdata]: Accessing the process data (→ 🗋 35)
- [Update]: Update firmware (→ 🗋 38)

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.

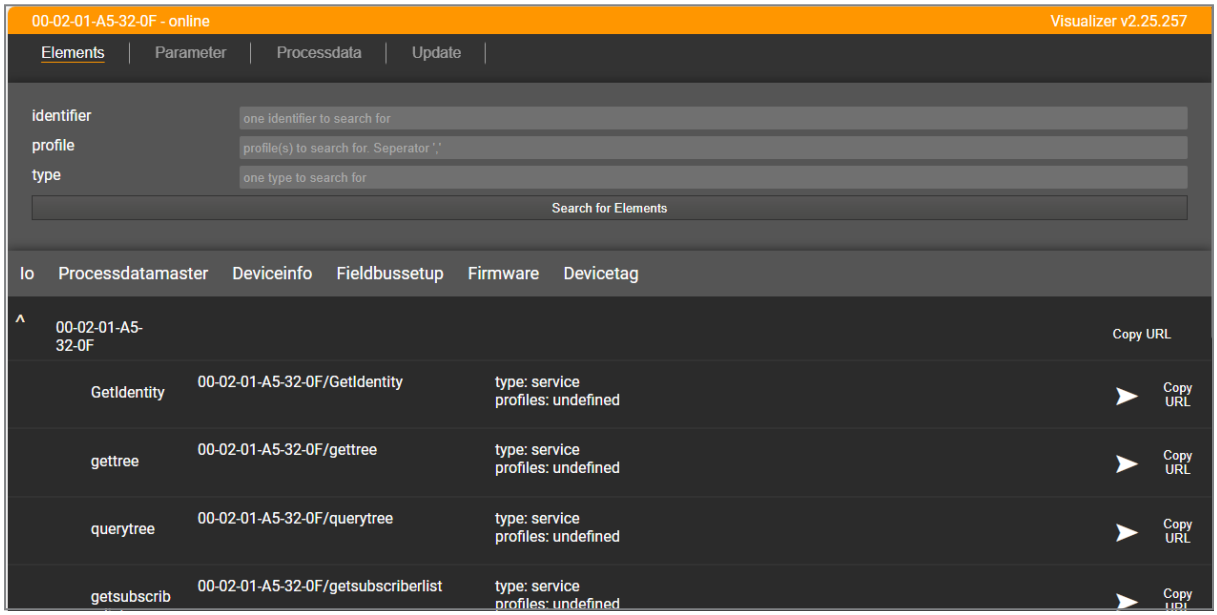
The following properties can be searched for:

- [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.

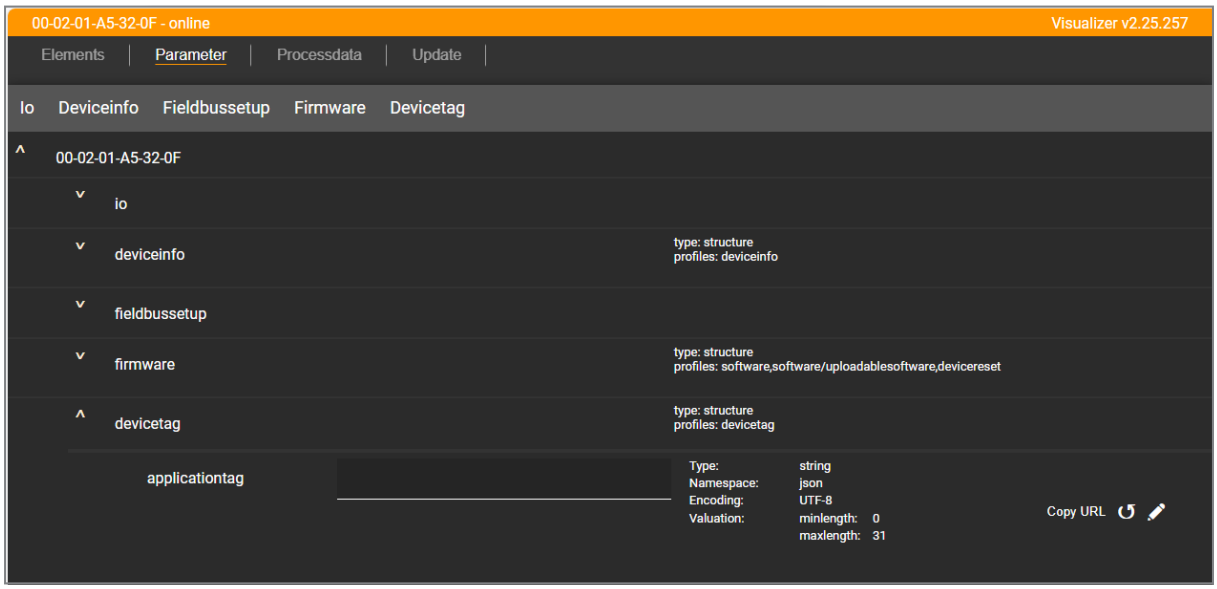
The configuration created via the IoT Core Visualizer is overwritten when a connection is established between the device and the PROFINET PLC.

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 Reading the configuration of the PROFINET interface

Available parameters:

Name	Description	Value range	Access
[network] > [ipaddress]	IP address of the Ethernet interface	e.g. 192.200.0.100 • 0.0.0.0 (default)	ro [1]
[network] > [subnetmask]	Subnet mask of the network segment	e.g. 255.255.192.0 • 0.0.0.0 (default)	ro [1]
[network] > [ipdefaultgateway]	IP address of the network gateway	e.g. 192.200.63.1 • 0.0.0.0 (default)	ro [1]
[network] > [macaddress]	MAC address of the Ethernet interface	e.g. 00:02:01:0E:10:7C	ro [1]

[1] Read only

Requirements:

✓ IoT Core Visualizer has been started.

✓ The [Parameter] menu is active.

▶ Select the [Fieldbussetup] submenu.

▷ The menu page displays the current configuration of the PROFINET interface.

9.2.3.2 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.

9.2.3.3 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.

9.2.3.4 Reading device information

Available information:

Name	Description	Value range	Access
[productcode]	Article number	AL4002	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. AL4x0x_fw_pn_v1.4.0.137	ro [1]
[bootloaderrevision]	Bootloader version	E.g. AL4xxx_bl_v1.2.0.35	ro [1]
[fieldbustype]	Fieldbus	PROFINET	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.

9.2.3.5 Reading the firmware version

Available information:

Name	Description	Value range	Access
[version]	Firmware version	AL4x0x_fw_pn_1.4.0.137	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.

9.2.3.6 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.

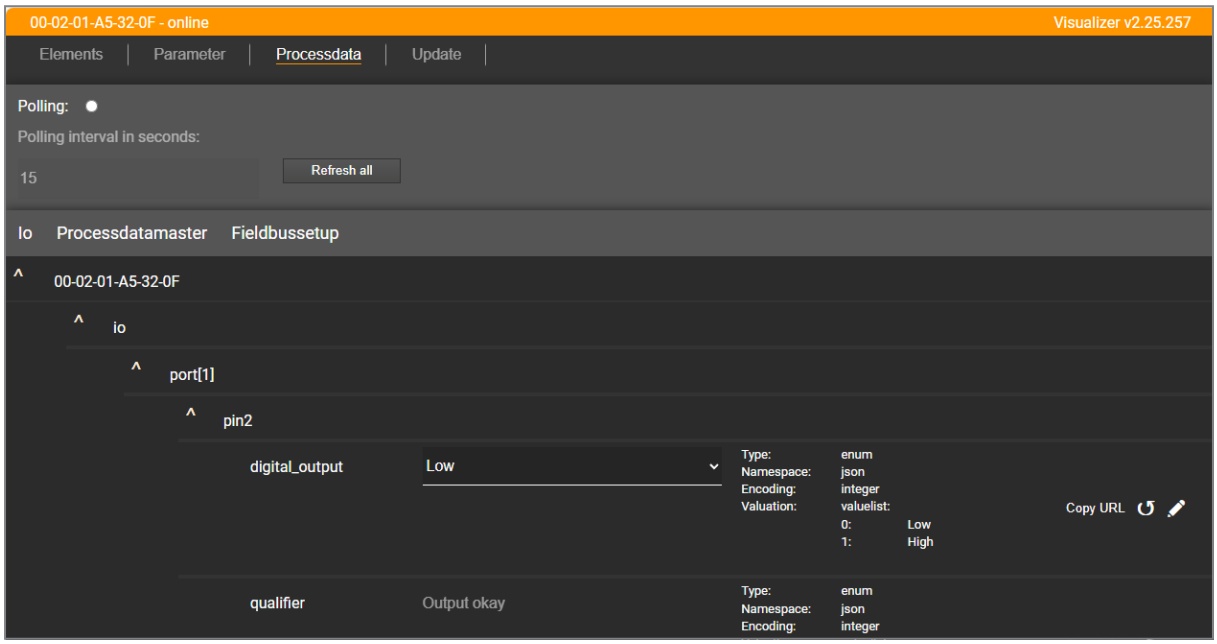
Requirements:

✓ 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]

[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.

9.2.4.5 Reading the connection status

Available information:

Name	Description	Value range	Access
[connectionstatus]	Status of the connection to the PROFINET network	• disconnected: not connected • Connected: connected	ro [1]

[1] Read only

Requirements:

✓ IoT Core Visualizer has been started.

✓ The [Processdata] menu is active.

▶ Select the [fieldbussetup] submenu.

▷ The menu page shows the connection status.

▷ The menu page shows the number of disconnections.

9.2.5 Update firmware

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

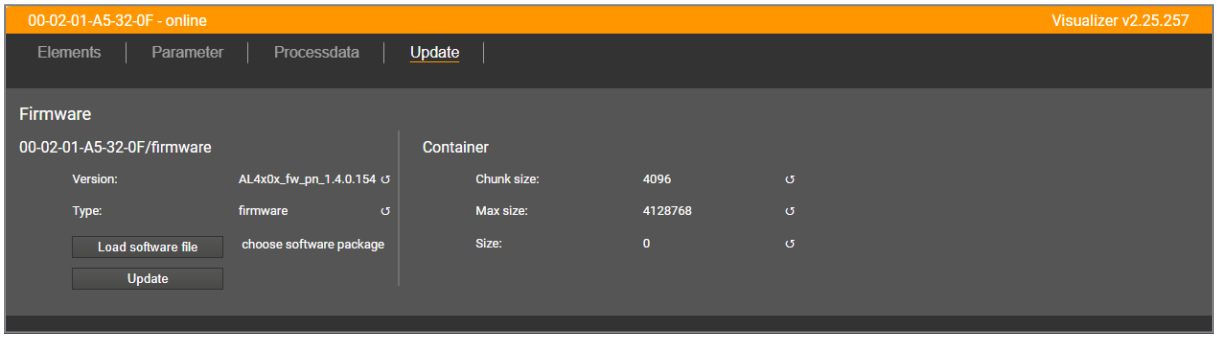
Requirements:

✓ 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 PROFINET

9.3.1 Install the GSD file

To map the device in a PROFINET projection software, ifm provides an GSD file. The device description file contains identification information, supported parameters and process data. The user can download the GSD file via documentation.ifm.com.

To add the device to the hardware catalogue of the PROFINET projection software:

▶ Download the GSD file of the device.

▶ Launch the PROFINET projection software.

▶ Install the GSD file.

▷ The device is added to the hardware catalogue of the PROFINET projection software.

▷ The PROFINET projection software can access the device functions and data.

9.3.2 Integrate the device into a PROFINET project

Using the installed device description in the hardware catalogue, the device can be added to a PROFINET project.

Requirements:

✓ The GSD file of the device is installed.

▶ Create a new project or open an existing one.

▶ Open the [Device & networks] view.

▶ Add necessary components of the automation network (e.g. PROFINET PLC).

▶ Select the device in the hardware catalogue and add it to the network using drag & drop.

▶ Establish a logical PROFINET IO connection between the device and the PROFINET PLC.

▶ Set the IP configuration of the device's PROFINET interface.

▷ The device has been integrated in the PROFINET project.

9.3.2.1 Use S2 redundancy

The device supports the S2 redundancy. S2 redundancy provides a solution to build a redundant system for implementation of fail-safe systems. The following constraints apply:

- Both Application Relations (SR-AR) use the same configuration (submodule settings, connection parameters).
- Only one AR can act as a primary SR-AR.
- Diagnostic messages and alarms are only reported to the primary SR-AR.
- Data records can be read via any SR-AR.
- Data records can only be written via the following SR-AR:
  - primary SR-AR
  - SR-AR that first accesses the device while establishing the connection

9.3.2.2 Use Configuration-in-Run

The device supports the Configuration-in-Run (CiR) function. CiR enables the user to load changes and extensions of the hardware configuration in the PROFINET configuration software to the PLC without needing to put the PLC into the "stop" state first.

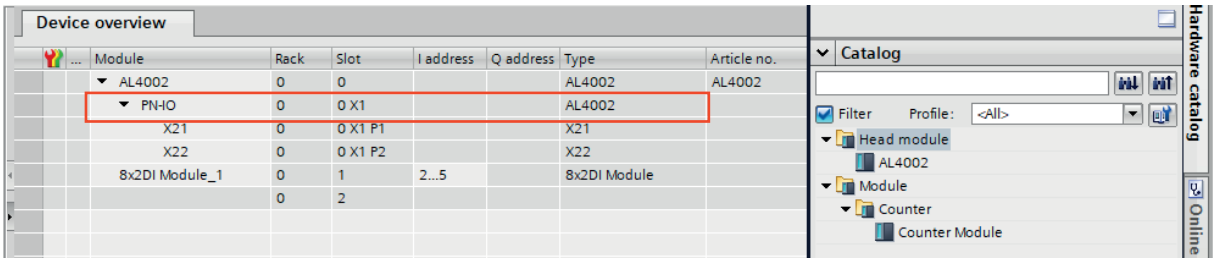
9.3.2.3 Use Isochronous Realtime (IRT)

The unit supports participation in a network with activated IRT protocol.

9.3.3 Configure the device

The device is configured via slot [0], subslot [X1].

The module [PN-IO] is permanently assigned to the slot. The assignment cannot be changed.



Requirements:

✓ Device is integrated in PROFINET project.

▶ Open the [Device view].

▷ The [Device overview] tab displays the device structure.

▶ Click on the module [PN_IO] in the slot [0 X1].

▷ The [Properties] view appears.

▷ The [General] tab displays the available configuration options of the device.

▶ Set the parameters.

▷ The device has been configured.

9.3.3.1 Use Prioritized Startup

The device supports the Prioritized Startup function.

To activate the Prioritized Startup function:

Requirements:

✓ Device is integrated in PROFINET project.

▶ Open the [Device view].

▶ Click on the module [PN_IO] (slot 1, subslot X1).

▷ The [General] tab displays general configuration options.

▶ Select [Advanced options] > [Interface options].

▶ Activate the [Prioritized startup] option.

▷ The Fast Startup function has been activated.

9.3.3.2 Use Fast Startup

The device supports the Fast Startup function (FSU).

Achieving the guaranteed fast startup time depends on the complexity and elements used in the PROFINET network.

To activate the Fast Startup function:

Requirements:

✓ Device is integrated in PROFINET project.

✓ The Fast Startup function has been activated.

▶ Open the [Device view].

▷ The [Device overview] tab displays the device structure.

▶ Click on the module [PN_IO] (slot 1, subslot X1).

▷ The [General] tab displays general configuration options.

▶ Select [Advanced options] > [X21 [X1 P1 R]] > [Port options].

▶ In the list [Transmission rate / duplex], select the value [TP 100Mbps full duplex]. The selected value must match the transmission rate of the network partner.

▶ Disable the option [Enable autonegotiation].

▷ The transmission rate of Ethernet port 1 is permanently set.

▶ Repeat steps for Ethernet port 2 ([X22 [X1 P2 R]]).

▷ The transmission rate of Ethernet port 2 is permanently set.

▷ The Fast Startup function is activated for PROFINET IO ports.

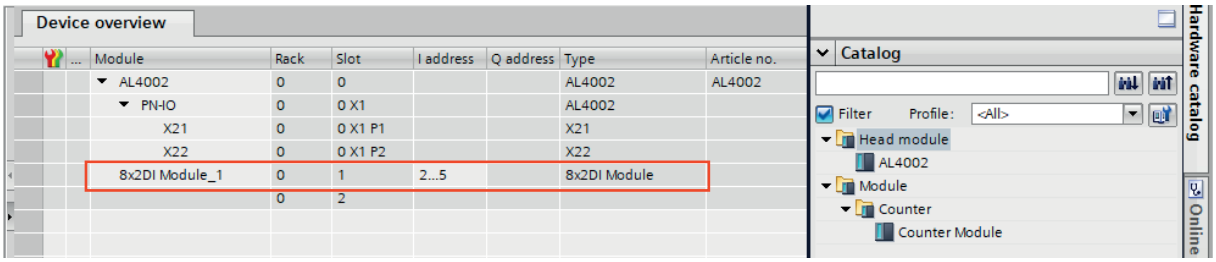
9.3.4 Configure input filters

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

The input filters are configured via the following module:

- Modules: 8x2DI + Qualifier (→ 🗋 47)

The module is permanently assigned to slot 1.



Each digital input on pin 2 and pin 4 of the ports has a filter. Each of these filters can be configured separately.

Available parameters per input filter:

- debounce time
- hold time
- hold level
- signal inversion

Requirements:

✓ Device is integrated in PROFINET project.

▶ Open the [Device view].

▷ The [Device overview] tab displays the device structure.

▶ Click on the module [8x2 DI + Qualifier] (slot [1]).

▷ The [Properties] view appears.

▷ The [General] tab displays the properties of the module.

▷ [Module parameters] provides access to parameters of the digital inputs.

▶ Set the parameters of the input filters.

▶ Save the project.

▷ The filters of the digital inputs are configured.

▷ The changed configuration will be activated the next time the application is downloaded to the device.

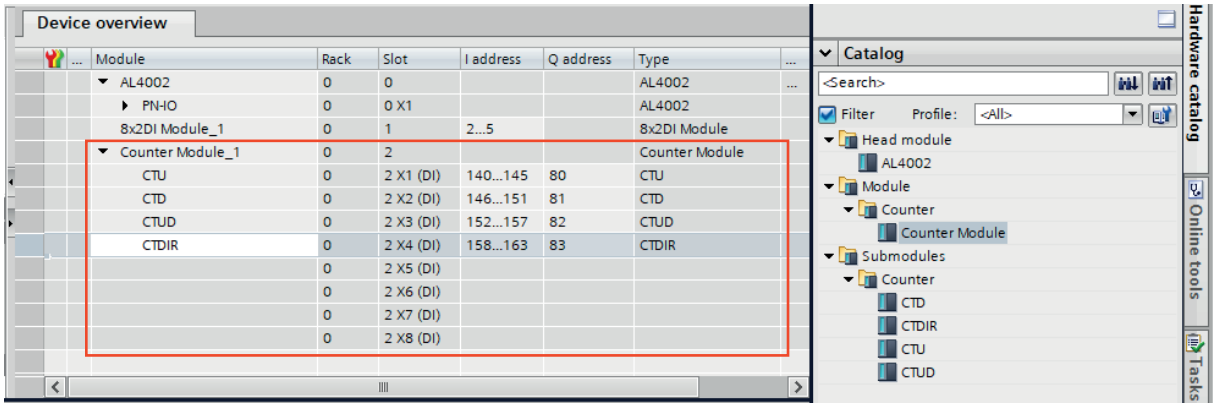
9.3.5 Configure counter modules

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

The counter modules are configured via the module [Counter Module] and its submodules:

- Submodule: CTU (→ 🗋 48)
- Submodule: CTD (→ 🗋 49)
- Submodule: CTUD (→ 🗋 50)
- Submodule: CTDIR (→ 🗋 51)

The module [Counter Module] needs to be assigned to slot 2 manually. Subsequently, a counter submodule can be assigned to each port via the respective subslot. The counter submodule determines the operating mode of the counter.



Each counter module can be configured separately.

Available parameters of the counter submodules:

- event messages of the main counter
- event messages of the batch counter
- threshold CT of the main counter
- threshold CTb of the batch counter
- function of pin 2 of the port
- instance for selecting the counting direction (only with CTDIR operating mode)

Requirements:

✓ Device is integrated in PROFINET project.

▶ Open the [Device view].

▷ The [Device overview] tab displays the device structure.

▶ In the hardware catalogue under [Modul] > [Counter], select the module [Counter Module] and move it to slot 2 using drag & drop.

▷ The counter module is assigned to the device.

▷ The device overview displays the port designations assigned to the slot.

▷ The hardware catalogue displays the available submodules.

▶ In the hardware catalogue under [Submodule] > [Counter], select the desired counter submodule and move it to a free subslot of the port using drag & drop.

▷ The counter submodule is assigned to the port.

▶ Click on the subslot with the assigned counter submodule.

▷ The [Properties] view appears.

▷ The [Properties] tab shows the properties of the counter submodule.

▷ [Module parameters] provides access to parameters of the counter submodule.

▶ Set the parameters.

▶ Optional: Repeat the procedure to assign and configure further counter submodules.

▷ Counter submodules are assigned to the ports and configured.

9.3.6 Read process data of the ports

The digital input data of the ports and the associated validity indicators are transmitted in the cyclic process data: Modules: 8x2DI + Qualifier (→ 🗋 52)

When the device is integrated into the PROFINET project, IEC addresses are generated automatically for the digital input data on pin 2 and pin 4 of the ports X01...X08.

Requirements:

✓ Device is integrated in PROFINET project.

▶ Connect the IEC addresses of the subslots with symbols in the global variable list.

▷ The user can access the digital input data of the ports via symbol names in the application.

9.3.7 Read counter values

The current counter values are accessed via the cyclical input data:

- Submodule: CTU (→ 🗋 53)
- Submodule: CTD (→ 🗋 54)
- Submodule: CTUD (→ 🗋 55)
- Submodule: CTDIR (→ 🗋 56)

When configuring the counter submodules, IEC addresses are generated automatically for the counter values of the main and batch counter.

Requirements:

✓ Device is integrated in PROFINET project.

✓ The counter submodules are configured.

▶ Connect the IEC addresses of the subslots with symbols in the global variable list.

▷ The user can access the counter values via symbol names in the application.

9.3.8 Control counters

The counter submodules assigned to the ports can be controlled separately. The following control signals are available per counter:

- Reset counter module
- Disable counter module
- Set counting direction (only for CTDIR counter operating mode)

The control signals are accessed via the cyclical output data:

- Submodule: CTU (→ 🗋 53)
- Submodule: CTD (→ 🗋 54)

- Submodule: CTUD (→ 🗋 55)
- Submodule: CTDIR (→ 🗋 56)

To control the counter modules:

Requirements:

✓ Device is integrated in PROFINET project.

✓ The counter submodules are configured.

✓ The IEC addresses of the cyclic process data are linked to variables.

▶ Set the control signals in the output data of the counter submodules.

▷ The control signals are sent to the counter submodule.

9.3.9 Accessing data records acyclically

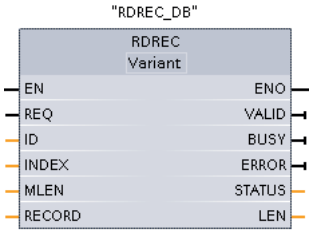
The user can access configuration and process data acyclically via data records.

The device supports the following data records:

- Data record: Filter configuration (→ 🗋 57)
- Data record: Counter configuration (→ 🗋 58)
- Data record: Counter values (→ 🗋 59)

Note: Read data record

▶ Read the data record with the function block RDREC.



Specific parameters:

- Input ID: HW_ID of the subslot (project-specific); properties of the subslot
- Input INDEX: index of the data record

9.3.10 Read counter events

The counter modules generate events when any of the following conditions occur:

- overflow main counter
- underflow main counter
- overflow batch counter
- underflow batch counter

The events triggered by the device are transmitted via the alarm mechanism of PROFINET IO. The overflow and underflow events of the counter modules are transmitted as process alarms. Process alarms are stored in an AINFO array. The relevant information is stored in bytes 16...35.

Structure of the AINFO array:

Bytes	Content	Description
16…19	Module ID	Module identification • 0x40000000: 8x2 DI Module • 0x41000000: Counter module
20…23	Submodule ID	Submodule identification • 0x41000010: CTU Submodule • 0x41000011: CTD Submodule • 0x41000012: CTUD Submodule • 0x41000013: CTDIR Submodule

Bytes	Content	Description
24…25	Alarm Specifier	Alarm • 0x0000: fixed
26…27	Format Identifier	Identification of the format • 0x8320: user-specific structure
28…29	Channel Number	Channel number • 0x8000: whole device
30…31	reserved	Reserved
32…33	Event Info	Event • 0x0100: overflow main counter • 0x0101: underflow main counter • 0x0110: overflow batch counter • 0x0111: underflow batch counter
34…35	reserved	Reserved

Requirements:

✓ The counter modules are configured.

✓ Events for main counter are activated.

✓ Events for batch counter are activated.

▶ Process the process alarms with OB40.

▶ Use the RALRM instruction to read the occurred event in the AINFO array.

9.3.11 Use I&M data records

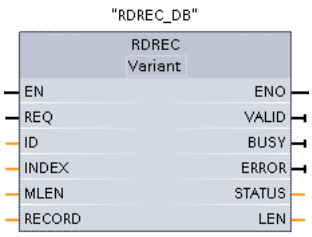
The unit supports the I&M data records I&M0 to I&M3 (→ I&M data 🗋 60).

- The data record I&M0 contains ID information. The I&M0 data record is available for each module / submodule of the device.
- In the data records I&M1...I&M3, the user can store application and device-specific information.

I&M data records can be accessed acyclically. Access to the I&M data records takes place index-based.

Note: Read data record

▶ Read the data record with the function block RDREC.



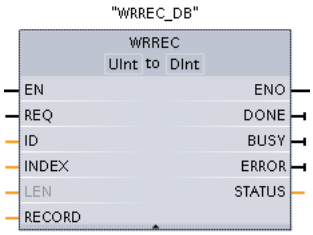
Specific parameters:

- Input ID: HW_ID of the subslot (project-specific); properties of the subslot
- Input INDEX: index of the data record

Note: Write data record

▶ Write the data record with the function block WRREC.

▶ Observe read and write permissions!



Specific parameters:

- Input ID: HW-ID of the slot (project-specific); properties of the slot
- Input INDEX: index of the data record

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 (→ 38)

11 Appendix

11.1 PROFINET

11.1.1 Parameters

11.1.1.1 Modules: 8x2DI + Qualifier

Parameter	Description	Values	Access
Debounce Time [* 0.1ms]	Debounce time (value * 0.1 ms)	• 0: 0 ms (default) … • 500: 50 ms	rw [1]
Hold time [* 0.1ms]	Hold time (value * 0.1 ms)	• 0: 0 ms (default) … • 60000: 6000 ms	rw [1]
Hold level	Hold level	• 0: Low: hold LOW • 1: High: hold HIGH (default)	rw [1]
Input Inverter	Signal inversion	• 0: Signal not inverted: do not invert signal (default) • 1: Signal inverted: signal inversion	rw [1]

[1] Read and write

11.1.1.2 Modules: Counter module

Submodule: CTU

Parameter	Description	Values	Access
Enable Main counter event	Notifications for main counter	• ☐: disable • ☑: enable (default)	rw [1]
Enable Main counter event	Notifications for batch counter	• ☐: disable • ☑: enable (default)	rw [1]
Pin 2 function	function of pin 2 of the port	• Not used: no function (default) • Reset main & batch counter: Reset main counter and batch counter • Disable main & batch counter: Disable main counter and batch counter	rw [1]
Main Threshold	Threshold CT of the main counter	• 1 … • 4294967295 (default)	rw [1]
Batch Threshold	Threshold CTb of the batch counter	• 1 … • 65535 (default)	rw [1]

[1] Read and write

Submodule: CTD

Parameter	Description	Values	Access
Enable Main counter event	Notifications for main counter	• ☐: disable • ☑: enable (default)	rw [1]
Enable Main counter event	Notifications for batch counter	• ☐: disable • ☑: enable (default)	rw [1]
Pin 2 function	function of pin 2 of the port	• Not used: no function (default) • Reset main & batch counter: Reset main counter and batch counter • Disable main & batch counter: Disable main counter and batch counter	rw [1]
Main Threshold	Threshold CT of the main counter	• 1 … • 4294967295 (default)	rw [1]
Batch Threshold	Threshold CTb of the batch counter	• 1 … • 65535 (default)	rw [1]

[1] Read and write

Submodule: CTUD

Parameter	Description	Values	Access
Enable Main counter event	Notifications for main counter	• ☐: disable • ☑: enable (default)	rw [1]
Enable Main counter event	Notifications for batch counter	• ☐: disable • ☑: enable (default)	rw [1]
Pin 2 function	function of pin 2 of the port	• Counter edge input 2: counting input (default)	rw [1]
Main Threshold	Threshold CT of the main counter	• 1 … • 4294967295 (default)	rw [1]
Batch Threshold	Threshold CTb of the batch counter	• 1 … • 65535 (default)	rw [1]

[1] Read and write

Submodule: CTDIR

Parameter	Description	Values	Access
Enable Main counter event	Notifications for main counter	• ☐: disable • ☑: enable (default)	rw [1]
Enable Main counter event	Notifications for batch counter	• ☐: disable • ☑: enable (default)	rw [1]
Pin2 function / Count direction selection	Pin 2 function of the port and selection of the control instance for selecting the counting direction	• Pin2 Count direction: signal at pin 2 controls counting direction • Pin2 Not used & Count Direction by PLC: pin 2 without function; selection of counting direction via PLC • Pin2 Reset Counter & Count Direction by PLC: signal at pin 2 resets main counter and batch counter; selection of counting direction via PLC • Pin2 Reset Counter & Count Direction by PLC: signal at pin 2 deactivates main counter and batch counter; selection of counting direction via PLC	rw [1]
Main Threshold	Threshold CT of the main counter	• 1 … • 4294967295 (default)	rw [1]
Batch Threshold	Threshold CTb of the batch counter	• 1 … • 65535 (default)	rw [1]

[1] Read and write

11.1.2 Cyclic data

11.1.2.1 Modules: 8x2DI + Qualifier

Input data: 4 byte

Byte (Offset)	Bit							
	7	6	5	4	3	2	1	0
n	Ch07: DI	Ch06: DI	Ch05: DI	Ch04: DI	Ch03: DI	Ch02: DI	Ch01: DI	Ch00: DI
n+1	Ch15: DI	Ch14: DI	Ch13: DI	Ch12: DI	Ch11: DI	Ch10: DI	Ch09: DI	Ch08: DI
n+2	Ch07: QDI	Ch06: QDI	Ch05: QDI	Ch04: QDI	Ch03: QDI	Ch02: QDI	Ch01: QDI	Ch00: QDI
n+3	Ch15: QDI	Ch14: QDI	Ch13: QDI	Ch12: QDI	Ch11: QDI	Ch10: QDI	Ch09: QDI	Ch08: QDI

Legend:

- DI — Signal level of the digital input — 1 BIT
  - 0: LOW
  - 1: HIGH
- QDI — Validity of the process value of the digital input — 1 BIT
  - 0: invalid
  - 1: valid

Output data: none

11.1.2.2 Submodule: CTU

Input data: 6 bytes

Byte (offset)	Bit							
	7	6	5	4	3	2	1	0
0…3	Main Counter Value							
4…5	Batch Counter Value							

Legend:

• Main Counter Value	Current main counter value Main Counter Value = 0x12345678 • Main Counter Value[0] = 0x12 • Main Counter Value[1] = 0x34 • Main Counter Value[2] = 0x56 • Main Counter Value[3] = 0x78	UINT32	• 0x00000000: 0 … • 0xFFFFFFFE: 4294967294
• Batch Counter Value	Current batch counter value Batch Counter Value = 0x1234 • Batch Counter Value[0] = 0x12 • Batch Counter Value[1] = 0x34	UINT16	• 0x0000: 0 … • 0xFFFE: 65534

Output data: 1 byte

Byte (offset)	Bit							
	7	6	5	4	3	2	1	0
0	Reserved						Disable Counter	Reset Counter

Legend:

• Reset Counter	Reset main counter and batch counter to initial value	1 bit	• 0x0: no action • 0x1: reset
• Disable Counter	Disable main counter and batch counter	1 bit	• 0x0: no action • 0x1: disable

11.1.2.3 Submodule: CTD

Input data: 6 bytes

Byte (offset)	Bit							
	7	6	5	4	3	2	1	0
0…3	Main Counter Value							
4…5	Batch Counter Value							

Legend:

• Main Counter Value	Current main counter value Main Counter Value = 0x12345678 • Main Counter Value[0] = 0x12 • Main Counter Value[1] = 0x34 • Main Counter Value[2] = 0x56 • Main Counter Value[3] = 0x78	UINT32	• 0x00000000: 0 … • 0xFFFFFFFE: 4294967294
• Batch Counter Value	Current batch counter value Batch Counter Value = 0x1234 • Batch Counter Value[0] = 0x12 • Batch Counter Value[1] = 0x34	UINT16	• 0x0000: 0 … • 0xFFFE: 65534

Output data: 1 byte

Byte (offset)	Bit							
	7	6	5	4	3	2	1	0
0	Reserved						Disable Counter	Reset Counter

Legend:

• Reset Counter	Reset main counter and batch counter to initial value	1 bit	• 0x0: no action • 0x1: reset
• Disable Counter	Disable main counter and batch counter	1 bit	• 0x0: no action • 0x1: disable

11.1.2.4 Submodule: CTUD

Input data: 6 bytes

Byte (offset)	Bit							
	7	6	5	4	3	2	1	0
0…3	Main Counter Value							
4…5	Batch Counter Value							

Legend:

• Main Counter Value	Current main counter value Main Counter Value = 0x12345678 • Main Counter Value[0] = 0x12 • Main Counter Value[1] = 0x34 • Main Counter Value[2] = 0x56 • Main Counter Value[3] = 0x78	UINT32	• 0x00000000: 0 … • 0xFFFFFFFE: 4294967294
• Batch Counter Value	Current batch counter value Batch Counter Value = 0x1234 • Batch Counter Value[0] = 0x12 • Batch Counter Value[1] = 0x34	UINT16	• 0x0000: 0 … • 0xFFFE: 65534

Output data: 1 byte

Byte (offset)	Bit							
	7	6	5	4	3	2	1	0
0	Reserved						Disable Counter	Reset Counter

Legend:

• Reset Counter	Reset main counter and batch counter to initial value	1 bit	• 0x0: no action • 0x1: reset
• Disable Counter	Disable main counter and batch counter	1 bit	• 0x0: no action • 0x1: disable

11.1.2.5 Submodule: CTDIR

Input data: 6 bytes

Byte (offset)	Bit							
	7	6	5	4	3	2	1	0
0…3	Main Counter Value							
4…5	Batch Counter Value							

Legend:

• Main Counter Value	Current main counter value Main Counter Value = 0x12345678 • Main Counter Value[0] = 0x12 • Main Counter Value[1] = 0x34 • Main Counter Value[2] = 0x56 • Main Counter Value[3] = 0x78	UINT32	• 0x00000000: 0 … • 0xFFFFFFFE: 4294967294
• Batch Counter Value	Current batch counter value Batch Counter Value = 0x1234 • Batch Counter Value[0] = 0x12 • Batch Counter Value[1] = 0x34	UINT16	• 0x0000: 0 … • 0xFFFE: 65534

Output data: 1 byte

Byte (offset)	Bit							
	7	6	5	4	3	2	1	0
0	Reserved					Counter Direction	Disable Counter	Reset Counter

Legend:

• Reset Counter	Reset main counter and batch counter to initial value	1 bit	• 0x0: no action • 0x1: reset
• Disable Counter	Disable main counter and batch counter	1 bit	• 0x0: no action • 0x1: disable
• Counter Direction	Set counting direction (only effective if parameter [Count direction selection] = [PLC])	1 bit	• 0x0: up • 0x1: down

11.1.3 Acyclical data

11.1.3.1 Data record: Filter configuration

Index: 300…315

Assignment of input channels to data record indices:

Index	310	311	312	313	314	315	306	307	308	309	310	311	312	313	314	315
Input channel	Ch00	Ch01	Ch02	Ch03	Ch04	Ch05	Ch06	Ch07	Ch08	Ch09	Ch10	Ch11	Ch12	Ch13	Ch14	Ch15

Per index:

Byte (Offset)	**Bit**							
	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0…1	Debounce Time							
2…3	Hold Time							
4	res.	res.	res.	res.	res.	res.	Hold Level	Input Inverter

Legend:

- Debounce Time — Debounce time (= value * 0.1 ms)
  Debounce Time = 0x0123:
  - Debounce Time[0] = 0x01
  - Debounce Time[1] = 0x23

  UINT16 / rc
  - 0x0000: 0 ms
  …
  - 0x01F4: 50 ms
- Hold Time — Hold time (= value * 0.1 ms)
  Hold Time = 0x1234:
  - Hold Time[0] = 0x12
  - Hold Time[1] = 0x34

  UINT16 / rc
  - 0x0000: 0 ms
  …
  - 0xEA60: 6000 ms
- Input Inverter — inversion — 1 bit / rc
  - 0x0: do not invert
  - 0x1: invert
- Hold Level — hold level — 1 bit / rc
  - 0x0: hold LOW
  - 0x1: hold HIGH

11.1.3.2 Data record: Counter configuration

Index: 500

Byte (offset)	Bit							
	7	6	5	4	3	2	1	0
0	Counter mode							
1	Reserved		Batch Event enable	Main Event enable	Count direction [1] | Pin 2 function / Count direction [2]			
2..5	Main Treshold							
6…7	Batch Threshold							

[1] only available for operating modes [CTU], [CTD] and [CTUD]

[2] only available for operating mode [CTDIR]

Legend:

• Counter mode	Operating mode counter module	UINT8 / rc	• 0x0: CTU – up counter • 0x1: CTD – down counter • 0x2: CTUD – up and down counter • 0x3: CTDIR – up and down counter with selectable counting direction
• Pin 2 function	Pin 2 function of the port	4 bits / rc	For [CTU] and [CTD]: • 0x00: no function • 0x03: reset counter module • 0x04: disable counter module For [CTUD]: • 0x01: count input
• Pin 2 function / Count direction	Pin 2 function of the port and desired counting direction	4 bits / rc	• 0x02: pin 2 determines counting direction • 0x08: pin 2 not used & PLC determines counting direction • 0x0B: pin 2 resets counter module & PLC determines counting direction • 0x0C: pin 2 disables counter module & PLC determines counting direction
• Main Event enable	Enable overflow/underflow event of the main counter	1 bit / rc	• 0x0: disable • 0x1: activate
• Batch Event enable	Enable overflow/underflow event of the batch counter	1 bit / rc	• 0x0: disable • 0x1: activate
• Main Threshold	threshold CT of the main counter	UINT32 /rc	• 0x00000001:1 … • 0xFFFFFFF: 4294967295
• Batch Threshold	threshold CTb of the batch counter	UINT16 /rc	• 0x0001: 1 … • 0xFFFF: 65535

11.1.3.3 Data record: Counter values

Index: 501

Byte (offset)	Bit							
	7	6	5	4	3	2	1	0
0…3	Main Counter value							
4…5	Batch Counter value							

Legend:

- Main Counter value — Counter value of the main counter — UINT32 / rw — 0x00000000: 0 … 0xFFFFFFFE: 4294967294
- Batch Counter value — Counter value of the batch counter — UINT16 / rw — 0x0000: 0 … 0xFFFE: 65534

11.1.3.4 I&M data

I&M0 (Slot 0)

Index: 0xAFF0

Variable	Description	Value	Bytes
MANUFACTURER_ID	Manufacturer ID	0x136	2
ORDER_ID	Order ID (ASCII, separated by spaces)	AL4002	20
SERIAL_NUMBER	Serial number (ASCII, separated by spaces)		16
HARDWARE_REVISION	Hardware revision	e.g. AA	2
SOFTWARE_REVISION	Software revision • Byte 0: software type (V: release) • Byte 1: main version (uint8) • Byte 2: minor version (uint8) • byte 3: build version (uint8)	e.g. V1.0.3	4
REVISION_COUNTER	Revision counter; counter is incremented with every parameter change	0x0000 … 0xFFFF	2
PROFILE_ID	Profile ID • 0x0000: unspecific	0x0000	2
PROFILE_SPECIFIC_TYPE	Profile type • 0x0000: unused	0x0000	2
IM_VERSION	I&M version • 0x0101: V1.1	0x0101	2
IM_SUPPORTED	Supported I&M data records • 0x000: I&M0 is supported • 0x00E: I&M0-3 are supported	• DAP: 0x000E • Submodule: 0x0000	2

I&M1 (Slot 0)

Index: 0xAFF1

Variable	Description	Value	Bytes
TAG_FUNCTION	Identifier for function of the submodule • 0x20: empty	0x20	32
TAG_LOCATION	Identifier for location of the submodule • 0x20: empty	0x20	22

I&M2 (Slot 0)

Index: 0xAFF2

Variable	Description	Value	Bytes
INSTALLATION_DATE	Installation date of the submodule (ASCII, separated by spaces) • 0x20: empty	0x20	16
RESERVED	reserved	0x00	38

I&M3 (Slot 0)

Index: 0xAFF3

Variable	Description	Value	Bytes
DESCRIPTOR	Description of the submodule (ASCII, separated by spaces) • 0x20: empty	0x20	54

I&M0 (Slot 1)

Index: 0xAFF4

Variable	Description	Value	Bytes
API	API of the submodule		4
SLOT	Slot of the submodule		2
SUBSLOT	Subslot of the submodule		2
FLAGS	Flags: • 0x01: submodule has own I&M data • 0x02: I&M data of the submodule represent I&M data of the module • 0x04: I&M data of the submodule represent I&M data of the device		4