GB

Operating instructions
IO-Link input/output module
AL2305

11638505 / 00 03 / 2025

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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 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

1.2 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.

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.
- Store the product in its original packaging.

3 Intended use

The device has 8 ports that can be used as follows:

- Digital input
- Analogue input
  - 4...20 mA
  - 0...10 V
- Digital output

In addition to that, the following port modes are available in the [Acyclic Enhanced] operating mode:

- Analogue input
  - 0...20 mA
  - 0…5 V
- Frequency input 0…3 kHz
- PWM-I output 0...1800 mA
- PWM output 0...1000‰

[Acyclic Enhanced] mode is only available with device version BA or higher

The device must not be used in the food and beverage industry (use of cleaning agents under high pressure and at high temperatures).

4 Function

4.1 Operating modes

The following operating modes are available:

Operating mode	Device ID	Description	Application
Cyclic (default)	1315 d / 00 05 23 h	Setting the port modes using cyclical process data	Setting the port modes via the controller
Acyclic	1316 d / 00 05 24 h	Port modes and Parameter setting via acyclic communi-cation	Port modes and Parameter setting with IO-Link software
Acyclic_Enhanced	1448 d / 00 05 A8 h	Port modes and Parameter setting via acyclic communi-cation, additional functions available	Port modes and Parameter setting with IO-Link software

The operating mode can be changed by loading the corresponding IODD.

4.2 IO-Link

This unit has an IO-Link communication interface which enables direct access to process and diagnostic data. In addition it is possible to set the parameters of the unit while it is in operation. Operation of the unit via the IO-Link interface requires an IO-Link master.

With a PC, suitable IO-Link software and an IO-Link adapter cable, communication is possible while the system is not in operation.

The IODDs necessary for the configuration of the unit, detailed information about process data structure, diagnostic information, parameter addresses and the necessary information about the required IO-Link hardware and software can be found at www.ifm.com.

4.2.1 Response when the IO-Link communication is interrupted

The parameter [Output state COM lost / PD invalid] (index 15000) is used to set how the outputs are to respond when the IO-Link communication is interrupted. For every output it can be defined separately if it:

- 0: [OFF] is to be switched off
- 1: [ON] is to be switched on
- 2: [KEEP LAST] is to keep the last state

Parameter	Index	Subindex	Value	Incre-ments	Factory setting
Output COM lost / PD Invalid X1.0 - 1	15000	1	0 [OFF], 1 [ON], 2 [KEEP LAST]	1	0
Output COM lost / PD Invalid X1.0 - 2		2			
Output COM lost / PD Invalid X1.1 - 1		3			
Output COM lost / PD Invalid X1.1 - 2		4			
Output COM lost / PD Invalid X1.2 - 1		5			
Output COM lost / PD Invalid X1.2 – 2		6			
Output COM lost / PD Invalid X1.3 - 1		7			
Output COM lost / PD Invalid X1.3 - 2		8			
Output COM lost / PD Invalid X1.4 – 1		9			
Output COM lost / PD Invalid X1.4 - 2		10			
Output COM lost / PD Invalid X1.5 - 1		11			

Parameter	Index	Subindex	Value	Incre-ments	Factory setting
Output COM lost / PD Invalid X1.5 - 2	15000	12	0 [OFF], 1 [ON], 2 [KEEP LAST]	1	0
Output COM lost / PD Invalid X1.6 - 1		13			
Output COM lost / PD Invalid X1.6 - 2		14			
Output COM lost / PD Invalid X1.7 - 1		15			
Output COM lost / PD Invalid X1.7 - 2		16			

Subindex access: true

In the [Acyclic Enhanced] operating mode, the following options are also possible for each output:

- For the PWM output:
  - [OFF] = 0% duty cycle
  - [ON] = 100% duty cycle
  - [KEEP LAST] = last valid duty cycle
- For the PWM-I output:
  - [OFF] = 0 mA (0% duty cycle)
  - [ON] = I_{max} (PID control)
  - [KEEP LAST] = last valid requested current (PID control)

4.3 Electrical isolation of the voltage supply

The voltage supply of the ports (UA and UAi) is electrically isolated from the voltage supply of the IO-Link master (US).

An electrical connection between US and UA/UAi eliminates the electrical isolation. This can lead to increased interference in the IO-Link communication.

4.4 Parameter setting

IO Device Description (IODD) with all parameters and process data of the unit can be found at documentation.ifm.com.

4.5 Inputs / outputs

The device has 8 ports (X1.0...X1.7).

Each port has 2 inputs/outputs, which can operate in the following 9 modes:

Port mode	Pin 2	Pin 4
0 (default)	Digital input	Digital input
1	Digital input/output	Digital input/output
2	Analogue input (4...20 mA)	Digital input/output
3*	Analogue input (0...20 mA)	Digital input/output
4	Analogue input (0...10 V)	Digital input/output
5*	Analogue input (0...5 V)	Digital input/output
6* (only for ports X1.2 and X1.3)	Digital input	Frequency input 0…3 kHz
7* (only for ports X1.0 and X1.1)	Digital input	PWM-I output 0...1800 mA
8	Digital input	PWM output 0...1000‰

* only available in the [Acyclic Enhanced] operating mode

Parameter	Index	Subindex	Value	Increments	Factory setting
Port Mode X1.0	15105	1	0 – 5, 7, 8	1	0
Port Mode X1.1		3	0 – 5, 7, 8		
Port Mode X1.2		5	0 – 6, 8		
Port Mode X1.3		7	0 – 6, 8		
Port Mode X1.4		9	0 – 5, 8		
Port Mode X1.5		11	0 – 5, 8		
Port Mode X1.6		13	0 – 5, 8		
Port Mode X1.7		15	0 – 5, 8		

4.6 Voltage supply

4.6.1 Supply voltage US

The US supply voltage supplies the device and IO-Link with voltage.

4.6.2 Supply voltage UA

UA supplies the outputs of the ports X1.0...X1.7 with voltage.

UA can also serve as a sensor supply for the ports if UAi is not connected. In this case, when UA is switched off, the power supply to the sensors is also switched off. If the sensors are still to be supplied with power despite UA being switched off, UAi must be connected to a separate power supply.

4.6.3 Sensor supply UAi

All sensor supplies have a common short-circuit monitoring. If a short circuit is detected, the sensor supply is switched to active short-circuit protection mode [Hiccup]. The output voltage of the sensor supplies is proportional to the operating voltage (18...30 V DC).

4.6.4 Behaviour in case of undervoltage

If the voltage supply of the outputs (UA) falls below 16 V, all outputs switch off.

4.6.5 Limit values, protection against excessive current

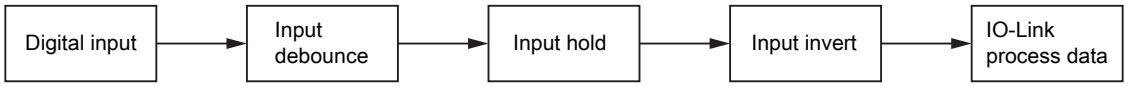
	AL2305
Total current	4 A
Power supply for sensors (pin1)	400 mA
Max. total current per port group	1.8 A
Max. current per port	1.8 A

The individual ports have no additional current limitation and can therefore be loaded variably. If the total current of a port group is too high, the device will switch off the overloaded port group until the current is within the permissible range again.

4.7 Digital input filters

The input signals can be changed via different filters before they are passed on via IO-Link. The following filters are available and are applied to the input signal in this order:

1. Debounce
2. Hold
3. Inverting



Each of these filters can be configured separately via IO-Link. More information is available in the IODD at documentation.ifm.com.

The device detects signals of a length of min. 2 ms. Shorter signals are not detected.

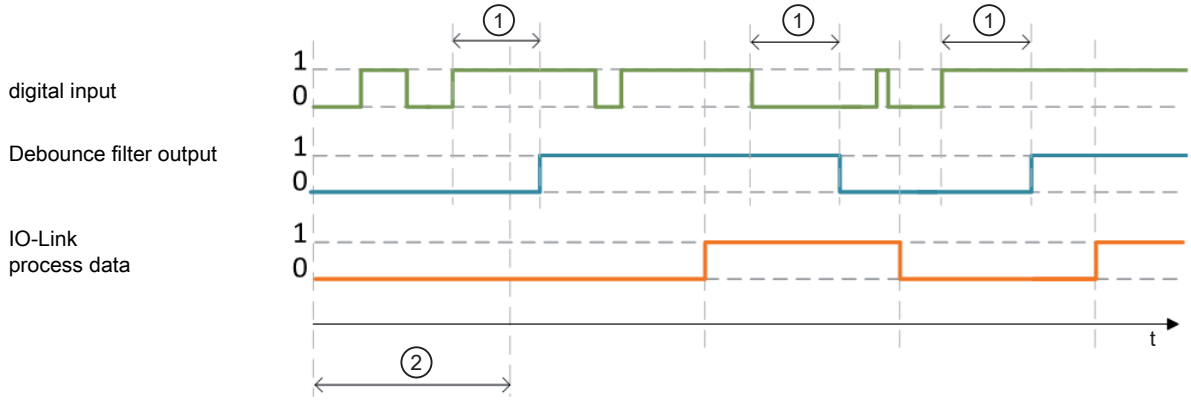
Periodic signals are only detected reliably if the signal period is at least twice as long as the cycle time.

The precision of the digital input filters is ± 1 ms.

4.7.1 Debouncing

The input debouncing filter suppresses noise signals caused by mechanical switches, contacts or relays. 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:



1: Debounce time
2: Cycle time

Parameter	Index	Subindex	Value (ms)	Increments	Factory setting
Input Debounce time X1.0 - 1	15100	1	0 – 50	1	0
Input Debounce time X1.0 - 2		2			
Input Debounce time X1.1 - 1		3			
Input Debounce time X1.1 - 2		4			
Input Debounce time X1.2 - 1		5			
Input Debounce time X1.2 – 2		6			
Input Debounce time X1.3 - 1		7			
Input Debounce time X1.3 - 2		8			
Input Debounce time X1.4 – 1		9			

Parameter	Index	Subindex	Value (ms)	Increments	Factory setting
Input Debounce time X1.4 - 2	15100	10	0 – 50	1	0
Input Debounce time X1.5 - 1		11			
Input Debounce time X1.5 - 2		12			
Input Debounce time X1.6 - 1		13			
Input Debounce time X1.6 - 2		14			
Input Debounce time X1.7 - 1		15			
Input Debounce time X1.7 - 2		16			

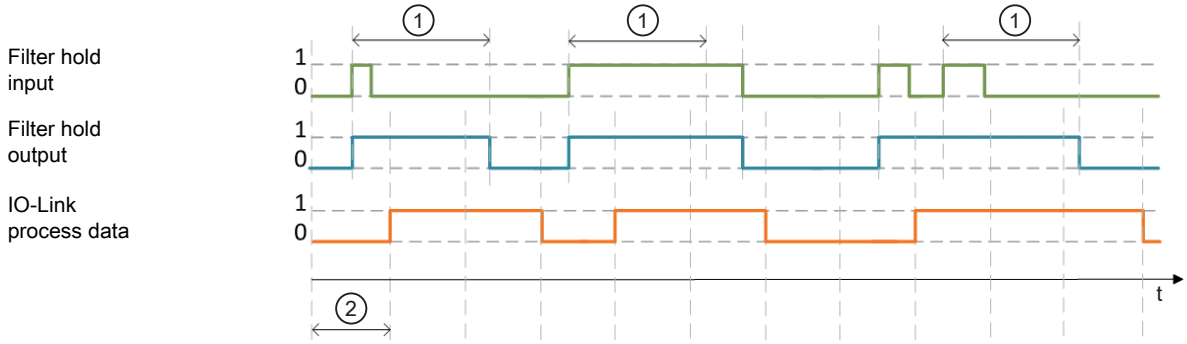
Subindex access: true

4.7.2 Hold

This filter stretches short input pulses. The filter is configured via the following parameters:

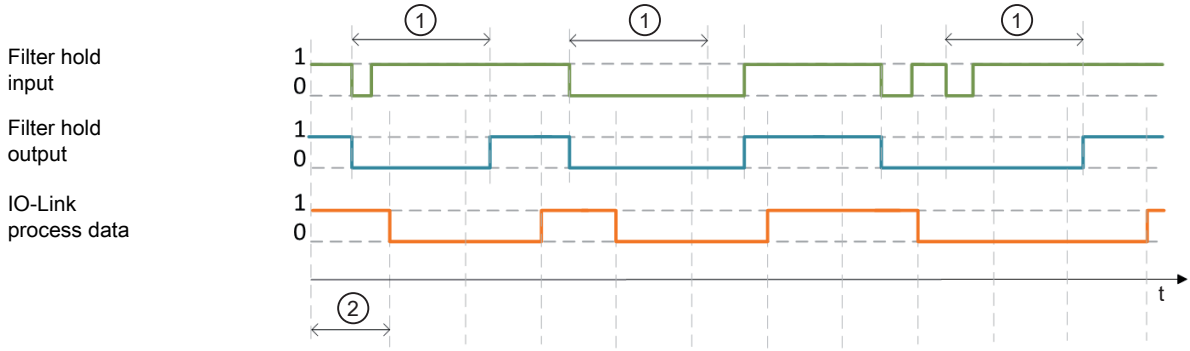
- Hold time: pulse duration to which short pulses are to be stretched. Pulses that are present for a longer time than the hold time are not stretched.
- Hold status: input level to be stretched (HIGH or LOW)

Time diagram hold filter with hold status HIGH:



1: Hold time
2: Cycle time

Time diagram for hold filter with hold status LOW:



1: Hold time
2: Cycle time

Input signals shorter than the cycle time are not reliably transmitted. To ensure a correct signal transmission via IO-Link the hold filter must be used.

Parameter	Index	Subindex	Value (ms)	Increments	Factory setting
Input hold time X1.0 - 1	15101	1	0 – 100	1	0
Input hold time X1.0 - 2		2			
Input hold time X1.1 - 1		3			
Input hold time X1.1 - 2		4			

Parameter	Index	Subindex	Value (ms)	Increments	Factory setting
Input hold time X1.2 - 1	15101	5	0 – 100	1	0
Input hold time X1.2 – 2		6			
Input hold time X1.3 - 1		7			
Input hold time X1.3 - 2		8			
Input hold time X1.4 – 1		9			
Input hold time X1.4 - 2		10			
Input hold time X1.5 - 1		11			
Input hold time X1.5 - 2		12			
Input hold time X1.6 - 1		13			
Input hold time X1.6 - 2		14			
Input hold time X1.7 - 1		15			
Input hold time X1.7 - 2		16			

Subindex access: true

Parameter	Index	Subindex	Value	Increments	Factory setting
Input hold state X1.0 - 1	15102	1	0 [LOW], 1 [HIGH]	-	1
Input hold state X1.0 - 2		2			
Input hold state X1.1 - 1		3			
Input hold state X1.1 - 2		4			
Input hold state X1.2 - 1		5			
Input hold state X1.2 – 2		6			
Input hold state X1.3 - 1		7			
Input hold state X1.3 - 2		8			
Input hold state X1.4 – 1		9			
Input hold state X1.4 - 2		10			
Input hold state X1.5 - 1		11			
Input hold state X1.5 - 2		12			
Input hold state X1.6 - 1		13			
Input hold state X1.6 - 2		14			
Input hold state X1.7 - 1		15			
Input hold state X1.7 - 2		16			

Subindex access: true

4.7.3 Inverting

This filter inverts incoming input signals.

Parameter	Index	Subindex	Value	Increments	Factory setting
Input invert X1.0 - 1	15103	1	0 [NO], 1 [YES]	-	0
Input invert X1.0 – 2		2			
Input invert X1.1 - 1		3			
Input invert X1.1 - 2		4			
Input invert X1.2 - 1		5			
Input invert X1.2 – 2		6			
Input invert X1.3 - 1		7			
Input invert X1.3 - 2		8			

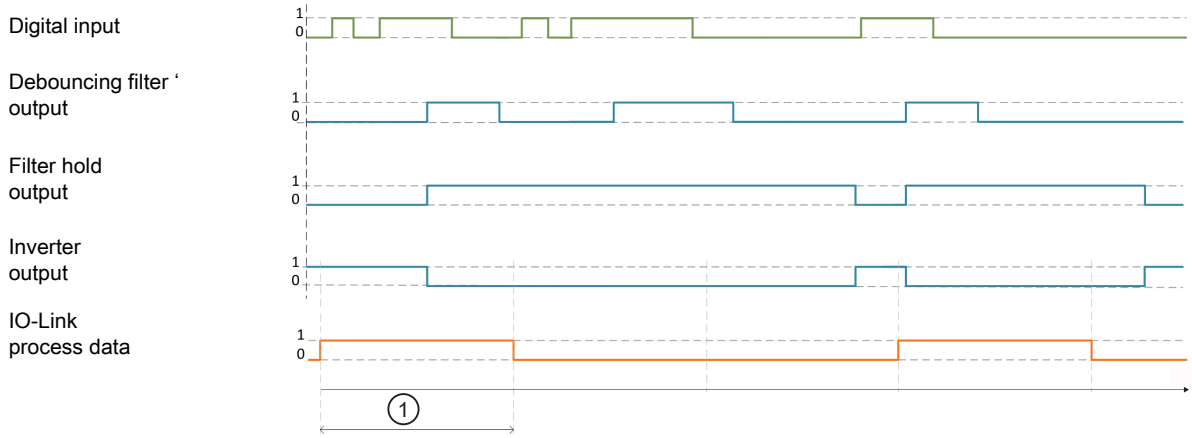
Parameter	Index	Subindex	Value	Increments	Factory setting
Input invert X1.4 – 1	15103	9	0 [NO], 1 [YES]	-	0
Input invert X1.4 - 2		10			
Input invert X1.5 - 1		11			
Input invert X1.5 - 2		12			
Input invert X1.6 - 1		13			
Input invert X1.6 - 2		14			
Input invert X1.7 - 1		15			
Input invert X1.7 - 2		16			

Subindex access: true

4.7.4 Combination of different input filters

The different input filters can be combined.

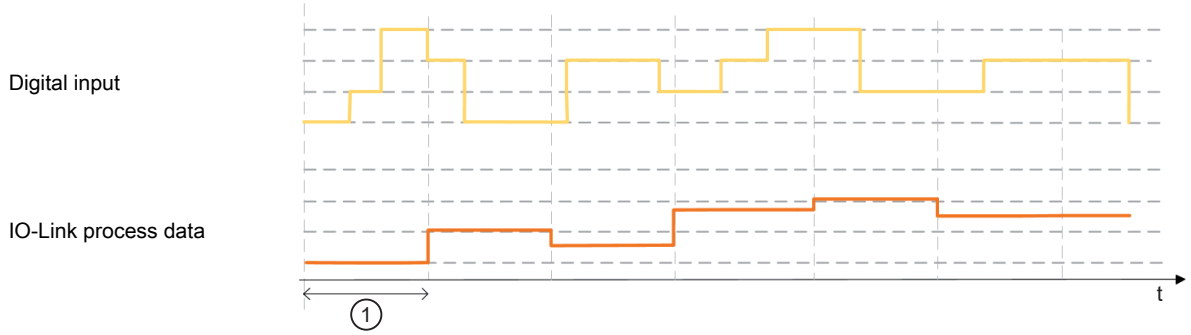
In the following example all 3 filters are used:



1: Cycle time

4.7.5 Analogue input signals

If the analogue input is activated, an average over the time specified in the parameter is calculated.



1: time period for averaging

Parameter	Index	Subindex	Value (ms)	Increments	Factory setting
Analog Input filter X1.0	15104	1	1 – 100	1	10
Analog Input filter X1.1		3			
Analog Input filter X1.2		5			
Analog Input filter X1.3		7			

Parameter	Index	Subindex	Value (ms)	Increments	Factory setting
Analog Input filter X1.4	15104	9	1 – 100	1	10
Analog Input filter X1.5		11			
Analog Input filter X1.6		13			
Analog Input filter X1.7		15			

Subindex access: true

4.8 Measurement of current consumption

This function is only available in operating mode [Acyclic Enhanced].

Current consumption measurement (mA) is active after the device is started, and is transmitted via the IO-Link parameter [Current] (index 15106). This function is available in all port modes.

The device determines the following measured values:

- Input current of all sensor supplies (total current at pin 1 of ports X1.0...X1.7)
- Output currents of the individual port groups X1.0…X1.3 and X1.4…X1.7 (total current at pin 2 and pin 4 of each port)

Parameter	Index	Subindex	Value (mA)	Increments	Factory setting
Input current X1.0...X1.7	15106	1	0 – 400	-	-
Output current X1.0…X1.3		2	0 – 1800		
Output current X1.4…X1.7		3	0 – 1800		

Tab. 1: Parameter [Current]

4.8.1 Configuration

To determine the current consumption, it is possible to set the averaging time separately for each current. This is done via the corresponding subindex of the parameter [Current avg time] (index 15107).

The measured current can be averaged over any value from 100...1000 ms.

Parameter	Index	Subindex	Value (ms)	Increments	Factory setting
Time X1.0...X1.7	15107	1	100 – 1000	1	100
Time X1.0...X1.3		2			
Time X1.4...X1.7		3			

Tab. 2: Parameter [Current avg Time]

4.9 Measurement of voltage values

This function is only available in operating mode [Acyclic Enhanced].

The device measures the voltage values (mV) of the individual supply voltages and transmits them via the IO-Link parameter [Power supply voltage] (index 15108). This function is active after the device is started, and is available in all port modes.

The device determines the following measured values:

Parameter	Index	Subindex	Value (mV)	Increments	Factory setting
US	15108	1	0 – 32000	-	-
UA		2			
UAi		3			

Tab. 3: Parameter Power supply voltage

4.10 Frequency input

This function is only available in operating mode [Acyclic Enhanced].

The device has digital type 3 inputs. Connected devices must be suitable for these inputs.

The duty cycle of the input frequency must be between 10% and 90%.

The pulse duration must be at least 21µs.

Port mode 06 must be set to activate the frequency input. In this mode, pin 4 of ports X1.2 and X1.3 functions as a frequency input: → Inputs / outputs

The parameters for the digital input do not apply to the frequency input.

The frequency input operates with SSC functionality according to the SSC parameters.

The frequency input has a measuring range of 0...3 kHz with a resolution of 0.1 Hz and an accuracy of 0.2% across the entire range.

If no input signal is detected for 10 s, the device sets the value of the corresponding process data to 0.

4.10.1 Configuration of the prescaler

The measured frequency can be divided by a value between 1 and 99. This value is set with the parameter [PrSC X1.2] for port X1.2 and with the parameter [PrSC X1.3] for port X1.3. The value can be changed in steps of 1 (default: 1).

If the input value is not to be changed, the prescaler must have the value 1.

When using the SSC functionality, it should be noted that the measured frequency is first scaled via the prescaler and then processed with the SSC logic.

Calculation:

The value displayed in the process data has not yet been calculated with the exponent. To obtain the corresponding frequency value in Hz, this value must be multiplied by 10^{-1}:

FI = *Process data in · Exponent [Hz]*

Example:

The measured value at both frequency inputs is 100 Hz. The frequency values are calculated as follows:

- PrSC X1.2 = 20
- PrSC X1.3 = 1 (no prescaler)

FI X1.2 = *measured value [X1.2] / PrSC X1.2 · exponent X1.2*

$= 1000 / 20 \cdot 10^{-1}$

$= 50 \cdot 10^{-1}$

= 5 [Hz]

FI X1.3 = *measured value [X1.3] / PrSC X1.3 · exponent X1.3*

$= 1000 / 1 \cdot 10^{-1}$

$= 1000 \cdot 10^{-1}$

= 100 [Hz]

Parameter	Index	Subindex	Value	Increments	Factory setting
PrSC X1.2	4007	0	1 - 99	1	1
PrSC X1.3	4017	0			

Tab. 4: Parameters PrSC X1.2 and PrSC X1.3

4.11 PWM output

This function is only available in operating mode [Acyclic Enhanced].

Pin 4 of all ports is the PWM output. The PWM output is activated as follows:

- Port mode = 08 in IO-Link parameter 15105
- PDOut [X1.x] (PWM Duty Cycle) > 0 in PDOut PLC-Out Word 6…20
- DO [X1.x-1] (pin 4) = 1 in PDOut PLC-Out Word 2 (1 activates the PWM output)

Inputs / outputs (→ 🗋 7)

4.11.1 Configuration

The following settings can be made for the PWM output:

- Duty cycle (setting via process data)
  A separate duty cycle can be set for each port. The value is written via [Process data out] (→ IODD).
- Frequency (setting via IO-Link parameters)
  The ports are divided into two groups, each with a common frequency value:
  – Group 1 for ports X1.0 – X1.3
  – Group 2 for ports X1.4 – X1.7

Parameter	Index	Subindex	Value (Hz)	Increments	Factory setting
PWM freq X1.0...X1.3	15010	0	20 – 1000	1	100
PWM freq X1.4...X1.7	15014	0			

- Optional: Dithering (setting via IO-Link parameters)
  Dithering is the PWM operation cycle that changes over time. The pulse/pause ratio can be changed at a specific frequency, which is related to the PWM frequency as follows:
- Dither frequency = PWM output frequency / (2 · [Count])
- Here, [Count] is the number of PWM pulses with a reduced pulse/pause ratio and then the same number of PWM pulses with an increased pulse/pause ratio in one single dither period. As [Count] is an integer, a dither period includes an integer number of PWM periods. It is also possible to define how much the pulse/pause ratio is to fluctuate in the [Level] part of the dither parameter. Example of PWM with dithering with the following PWM settings shown:
  – Duty cycle = 500‰
  – Dither [Level] = 200‰
  – Dither [Count] = 3

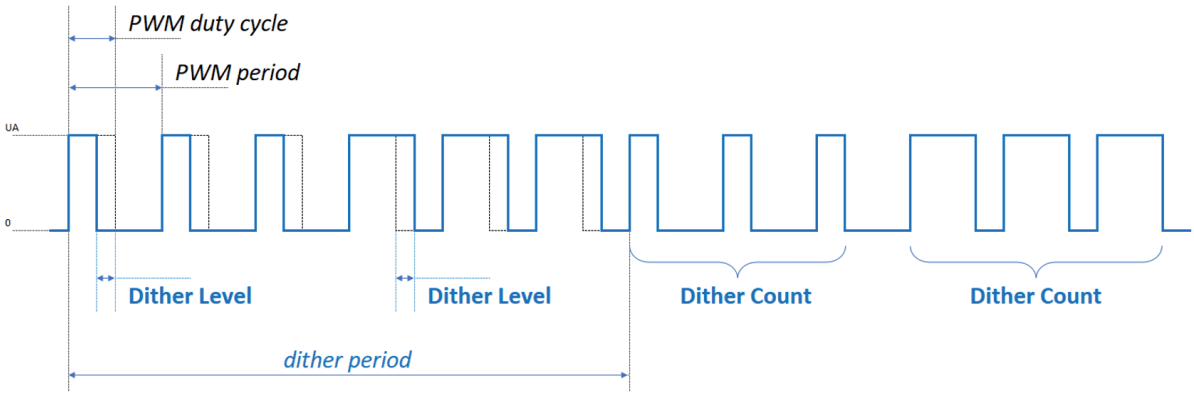


Fig. 1: Dithering_example

Parameter	Index	Subindex	Value	Increments	Factory setting
Level	15020 for X1.0 15021 for X1.1 15022 for X1.2 15023 for X1.3 15024 for X1.4 15025 for X1.5 15026 for X1.6 15027 for X1.7	1	0 – 250 (‰)	0.1	0
Count	15020 for X1.0 15021 for X1.1 15022 for X1.2 15023 for X1.3 15024 for X1.4 15025 for X1.5 15026 for X1.6 15027 for X1.7	2	0 - 20	1	

Tab. 5: Parameter PWM dither X1.x

[Level] = 0 deactivates dithering and/or
[Count] = 0 deactivates dithering.

4.12 PWM-I output

This function is only available in operating mode [Acyclic Enhanced].

Pin 4 of ports X1.0 and X1.1 is the PWM-I output. The PWM-I output is activated as follows:

- Port mode = 07 in IO-Link parameter 15105
- PDOut [X1.x] (PWM-I requested current) > 0 in PDOut PLC-Out Word 6/8
- DO [X1.x-1] (pin 4) = 1 in PDOut PLC-Out Word 2 (1 activates the PWM-I output)
- PID [X1.x] according to the connected load: Configuration example (→ 17)

Inputs / outputs (→ 7)

4.12.1 Configuration

The following settings can be made for the PWM-I output:

- Current (setting via process data)
  The output current can be set separately for both ports. The value is written via [Process data out] (→ IODD).
- Frequency (setting via IO-Link parameters)
  A common frequency value can be configured for both ports:

Parameter	Index	Subindex	Value (Hz)	Increments	Factory setting
PWM freq X1.0...X1.3	15010	0	20 – 1000	1	100

- PID controller
  The PWM-I functionality generates current by setting the corresponding duty cycle of the PWM signal. This means that the PWM-I output supplies more current at a constant frequency the more the duty cycle increases. The corresponding current is generated by a PID controller. The gain factor for the proportional component of the PID controller can be configured separately for both ports using the following parameters:

Parameter	Index	Subindex	Value	Incre-ments	Factory setting
Kp	15030 for X1.0 15031 for X1.1	1	0…2000000000	1	0
Ki	15030 for X1.0 15031 for X1.1	2			

Parameter	Index	Subindex	Value	Incre-ments	Factory setting
Kd	15030 for X1.0 15031 for X1.1	3	0…2000000000	1	0

Tab. 6: Parameter PWM-I PID for X1.x

The device can measure the generated current.
The value is read via [Process data in] (→ IODD).

4.12.2 Configuration example

The following table contains examples of settings that can be used as a starting point for optimising the PID controller (for a PWM-I frequency of 1000 Hz):

Connected load	Kp	Ki	Kd
Resistor 24Ω	1	10000	0
Resistor 240Ω	1	100000	0
DC motor 10 W	1	500	0

Values outside the configuration can lead to an incorrect indication of a short-circuit.

4.13 SSC functionality

This function is only available in operating mode [Acyclic Enhanced].

The SSC functionality can be used in the following port modes and on the following pins:

- port mode 02; pin 2 of all ports (analogue input 4...20 mA)
- port mode 03; pin 2 of all ports (analogue input 0...20 mA)
- port mode 04; pin 2 of all ports (analogue input 0...10 V)
- port mode 05; pin 2 of all ports (analogue input 0...5 V)
- port mode 06; pin 4 of ports X1.2 and X1.3 (frequency input 0...3 kHz)

4.13.1 Configuration

The following IO-Link parameters can be configured separately for all 8 ports:

Parameter	Index	Subindex	Value	Incre-ments	Factory setting
SP1	SSC X1.0 Param (60) SSC X1.1 Param (62) SSC X1.2 Param (16384) SSC X1.3 Param (16386) SSC X1.4 Param (16388) SSC X1.5 Param (16390) SSC X1.6 Param (16392) SSC X1.7 Param (16394)	1	-32000…32000	1	5000
SP2		2	-32000…32000	1	4000
Logic	SSC X1.0 Config (61) SSC X1.1 Config (63) SSC X1.2 Config (16385) SSC X1.3 Config (16387) SSC X1.4 Config (16389) SSC X1.5 Config (16391) SSC X1.6 Config (16393) SSC X1.7 Config (16395)	1	0 [High active] 1 [Low active]	-	[High active]
Mode		2	0 [Deactivated] 1 [Single point] 2 [Window] 3 [Two Point]	-	[Two point]
Hyst		3	0 - 3000	1	100

Tab. 7: SSC X1.x Param and SSC X1.x Config

4.13.2 Function diagrams

The device provides digital switching signals via switching signal channels (SSC = Switching Signal Channel).

The device has 8 digital switching signal channels, SSC1.0 to SSC1.7, which can be used to output the process value.

Explanation of the numbering of the switching signal channels SSCx.y:
x = process value; y = switching signal channel

The switching signal channels can only be evaluated via the IO-Link interface.

The parameters for each switching signal channel can be set individually.

The switch point mode, switch points and the switch point logic are set when the switching signal channel parameters are set.

Switch point mode

You can choose between the following switch point modes:

- [Deactivated]
- [Single Point Mode]
- [Two Point Mode]
- [Window Mode]

The switching signal channel changes to the active state depending on the process data value (PDV).

The active state is above the switch point in [Single Point Mode] and [Two Point Mode] and within the window section in [Window Mode].

Switch point logic

By setting the switch point logic [High active] or [Low active], you can specify which value the switching signal channel has in the active state:

- [High active]: The switching signal channel is “high” in the active state (= ON = normally open = 1)
- [Low active]: The switching signal channel is “low” in the active state (= OFF = normally closed = 0)

The following figures show the status of the switching signal channels depending on the switch point mode, switch point logic and process data value (PDV).

Deactivated

If the [Deactivated] switch point mode is set for a switching signal channel, then the switching signal channel will permanently have the following value regardless of the process value:

- For switch point logic [High active]: permanently “low”.
- For switch point logic [Low active]: permanently “high”.

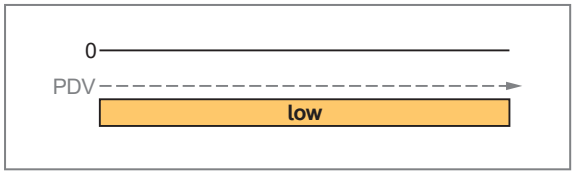


Fig. 2: [Deactivated] / [High active]

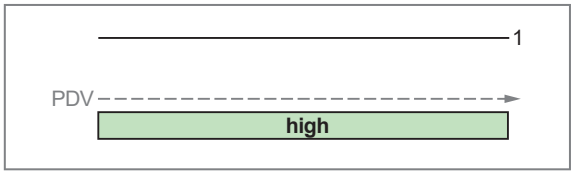


Fig. 3: [Deactivated] / [Low active]

Single Point Mode

Only one switch point (SP1) is manually set.

The reset point (SP1-H) results from the switch point and the set hysteresis.

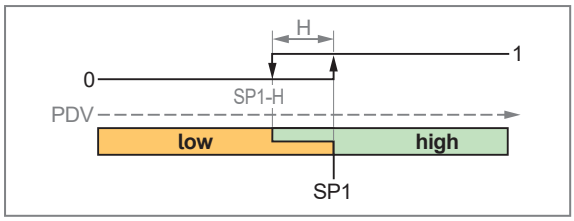


Fig. 4: [Single Point Mode] / [High active]

H: Hysteresis
SP1: Setpoint
SP1-H Reset point

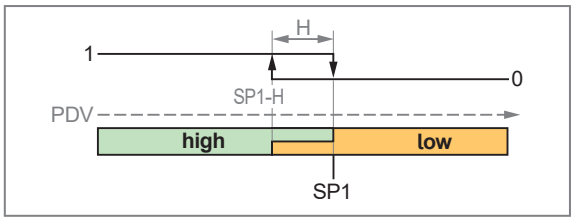


Fig. 5: [Single Point Mode] / [Low active]

H: Hysteresis
SP1: Setpoint
SP1-H Reset point

Two point mode

A switch point SP1 and a switch point SP2 are set manually.

SP1 must be greater than SP2. Thus, switch point 2 is always the reset point.

The hysteresis will be ignored in Two Point Mode.

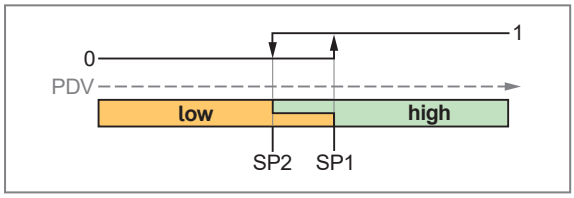


Fig. 6: [Two Point Mode] / [High active]

SP1: Switch point 1
SP2: Switch point 2

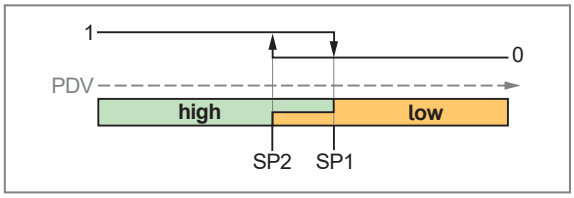


Fig. 7: [Two Point Mode] / [Low active]

SP1: Switch point 1
SP2: Switch point 2

Window mode

Two switch points (SP1) and (SP2) are set manually.

The two switch points define a window area.

SP1 must be greater than SP2. Thus, switch point 2 is always the reset point.

When the process data value enters the window area, the status of the switching signal channel changes immediately when the switch points are exceeded/not reached.

If the process data value leaves the window area, the status of the switching signal channel changes when the switch point plus hysteresis (SP1+H or SP2-H) is exceeded/not reached.

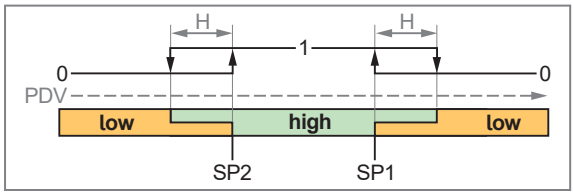


Fig. 8: [Window Mode] / [High active]

H: Hysteresis
SP1: Switch point 1
SP2: Switch point 2

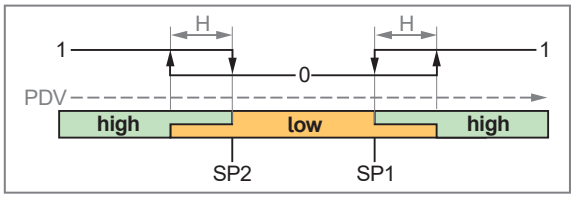


Fig. 9: [Window Mode] / [Low active]

H: Hysteresis
SP1: Switch point 1
SP2: Switch point 2

5 Installation

▶ Disconnect the power of the machine before installation.

▶ For installation choose a flat mounting surface.

▶ Fasten the module onto the mounting surface using M5 mounting screws and washers. Tightening torque 1.8 Nm.

6 Electrical connection

The unit must be connected by a qualified electrician.

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

Voltage supply according to SELV, PELV.

Do not apply external voltage to the outputs.

The device has digital type 3 inputs. Connected devices must be suitable for these inputs.

▶ Protect the UA voltage supply according to the maximum load and the ambient temperature (maximum 4 A).
The characteristics of the fuse must correspond to the application.

▶ Use only UL-certified cables (CYJV or PVVA) with suitable data to connect the device.

6.1 Connecting the device

▶ Disconnect power.

▶ Connect the unit as follows:

M12 plug, A-coded, IO-Link (X1)

1: L+ (US)
2: not used
3: L- (US)
4: IO-Link

M12 connector, A-coded, voltage supply U_{AUX} (X31)

1: L+ (UAi)
2: L- (UA and UAi)
3: not used
4: L+ (UA)

M12 socket, A-coded, ports (X1.0...X1.7)

1: L+ (UA and UAi)
2: Multi-function port DI2, DO2, AI2
3: L- (UA and UAi)
4: Multi-function port DI1, DO1, FI*, PWM*, PWM-I*
5: Not used
* only available in the [Acyclic Enhanced] operating mode

6.1.1 IO-Link connection

The IO-Link port must be connected according to the IO-Link specification.

6.1.2 Mounting the connector

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.

If connector in the device:

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

If sockets in the device:

▶ Tighten the cable plug using 1.0 ± 0.1 Nm.

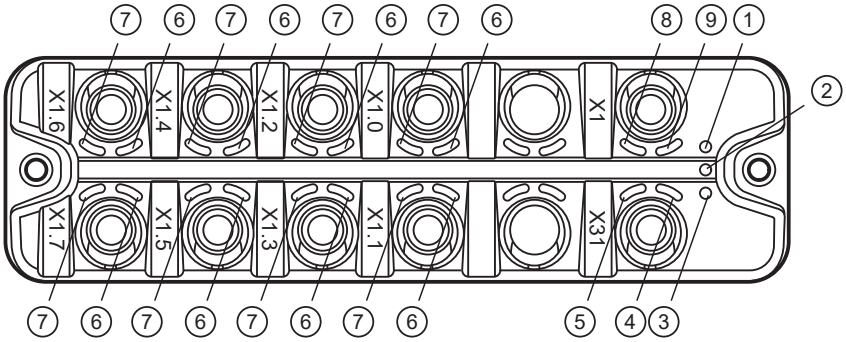
▶ Cover unused connections with protective covers. Tightening torque: 0.6...0.8 Nm

▶ Provide all outgoing cables with suitable strain relief after a maximum of 200 mm. Observe the minimum bending radius of the cables (→ information from the cable manufacturer).

6.1.2.1 Maximum cable length

- Without IO-Link communication: 30 m on each side
- With IO-Link communication: 20 m on the master side

7 Operating and display elements



1:	LED INT	Internal error
2:	LED 1	Port group 1 error
3:	LED 2	Port group 2 error
4:	LED UA	Supply voltage ports
5:	LED UAi	Supply voltage sensors
6:	LED I/O2	Status input/output I/O2
7:	LED I/O1	Status input/output I/O1
8:	LED	IO-Link communication
9:	LED US	Supply voltage

7.1 LEDs

LED	Colour	Input/output function	Status	Designation
INT	Red		On	Internal error
			Off	No internal error Device in operating mode
1	Red		On	Short circuit in port group 1 or undervoltage UA
			Off	No error in port group 1 Device in operating mode
2	Red		On	Short circuit in port group 2 or undervoltage UA
			Off	No error in port group 2 Device in operating mode
US	Green		On	Voltage supply ≥ 18 V
			Off	Voltage supply < 16 V
UA	Green		On	Voltage supply ≥ 18 V
			Off	Voltage supply < 16 V
UAi	Green		On	Voltage supply ≥ 18 V
			Off	Voltage supply < 16 V
	Green		On	IO-Link communication active
			Off	IO-Link communication not active
I/O1, I/O2	Yellow	Digital input	On	Input signal High
			Off	Input signal Low
			Flashing	Short circuit
		Digital output	On	Output signal High
			Off	Output signal Low
			Flashing	Short circuit
		Analogue input	On	Signal within measuring range

LED	Colour	Input/output function	Status	Designation
I/O1, I/O2	Yellow	Analogue input	Off	Signal outside measuring range
			Flashing	Short circuit
		Frequency input*	On	Signal within measuring range
			Off	Signal outside measuring range
			Flashing	Short circuit
		PWM output*	On	PWM signal present
			Off	No PWM signal available
			Flashing	Short circuit
		PWM-I output*	On	PWM-I signal present
			Off	No PWM-I signal present
			Flashing	Short circuit

* only available in the [Acyclic Enhanced] operating mode

8 Maintenance, repair and disposal

The unit is maintenance-free.

▶ After use, dispose of the unit in an environmentally friendly way in accordance with the applicable national regulations.

Cleaning the unit:

▶ Disconnect the unit from the voltage supply.

▶ Clean the unit from dirt using a soft, chemically untreated and dry micro-fibre cloth.