

# Remote I/O Boxes

## IO-Link Hub Type

## Analog Input Type



## ADIO Series

## PRODUCT MANUAL

**For your safety, read and follow the considerations written in the instruction manual, other manuals and Autonics website.**

The specifications, dimensions, etc. are subject to change without notice for product improvement. Some models may be discontinued without notice.

### Features

- Upper level communication protocol: IO-Link ver. 1.1 (port class: Class A)
- Housing material: Zinc die casting
- Protection rating: IP67, IP69K
- I/O port setting and status monitoring (cable short circuit and connection status, etc.)

### Safety Considerations

- Observe all 'Safety Considerations' for safe and proper operation to avoid hazards.
- ⚠ symbol indicates caution due to special circumstances in which hazards may occur.

**⚠ Warning** Failure to follow instructions may result in serious injury or death.

- 01. Fail-safe device must be installed when using the unit with machinery that may cause serious injury or substantial economic loss.**(e.g. nuclear power control, medical equipment, ships, vehicles, railways, aircraft, combustion apparatus, safety equipment, crime/disaster prevention devices, etc.)  
Failure to follow this instruction may result in personal injury, economic loss or fire.
- 02. Do not use the unit in the place where flammable/explosive/corrosive gas, high humidity, direct sunlight, radiant heat, vibration, impact or salinity may be present.**  
Failure to follow this instruction may result in explosion or fire.
- 03. Do not connect, repair, or inspect the unit while connected to a power source.**  
Failure to follow this instruction may result in fire.
- 04. Check 'Connections' before wiring.**  
Failure to follow this instruction may result in fire.
- 05. Do not disassemble or modify the unit.**  
Failure to follow this instruction may result in fire.
- 06. Do not touch the product during operation or for a certain period of time after stopping.**  
Failure to follow this instruction may result in burn.

**⚠ Caution** Failure to follow instructions may result in injury or product damage.

- 01. Use the unit within the rated specifications.**  
Failure to follow this instruction may result in fire or shortening the life cycle of the product.
- 02. Use a dry cloth to clean the unit, and do not use water or organic solvent.**  
Failure to follow this instruction may result in fire.
- 03. Keep the product away from metal chip, dust, and wire residue which flow into the unit.**  
Failure to follow this instruction may result in fire or product damage.
- 04. Connect the cable correctly and prevent poor contact.**  
Failure to follow this instruction may result in fire or product damage.
- 05. Do not connect or cut off the wire of the cable while operating the unit.**  
Failure to follow this instruction may result in fire or product damage.

### Cautions during Use

- Follow instructions in 'Cautions during Use'.  
Otherwise, it may cause unexpected accidents.
- The UA power (actuator power) and US power (sensor power) should be insulated by the individually isolated power device.
- Power supply should be insulated and limited voltage/current or Class 2, SELV power supply device.
- Use the rated standard cables and connectors. Do not apply excessive power when connecting or disconnecting the connectors of the product.
- Keep away from high voltage lines or power lines to prevent inductive noise.  
In case installing power line and input signal line closely, use line filter or varistor at power line and shielded wire at input signal line.  
For stable operation, use shield wire and ferrite core, when wiring communication wire, power wire, or signal wire.
- Do not use near the equipment which generates strong magnetic force or high frequency noise.
- Do not connect, or remove this unit while connected to a power source.
- This unit may be used in the following environments.
  - Indoors (in the environment condition rated in 'Specifications')
  - Altitude max. 2,000 m
  - Pollution degree 2
  - Installation category II

## Ordering Information

This is only for reference, the actual product does not support all combinations.  
For selecting the specified model, follow the Autonics website.

ADIO - ① - ② ③ ④ ⑤ ⑥ ⑦ ⑧ - ⑨

### ① Communication

IL: IO-Link

### ② Material

M: Zinc die casting

### ③ Port class

A: Class A

### ④ Ports

08: 8-port

### ⑤ I/O connector type

No mark: M12

### ⑥ I/O configuration

E: Analog input, 8-CH

### ⑦ Power connector type

A: Auxiliary power unsupported

### ⑧ I/O specification

A1: Voltage input (-10 to 10 VDC≐, 0 to 10 VDC≐)  
Current input (0 to 20 mA, 4 to 20 mA)



### ⑨ IO-Link product type

HUB3: IO-Link hub (transmission rate: COM3)

## Product Components

- Product × 1
- Name plates × 20
- M4×10 screw with washer × 1
- Instruction manual × 1
- Waterproof cover × 4

## Sold Separately

Sold separately	Appearance	Packaging unit
Name plates: NAMEP-1-10		× 10
Waterproof cover: P96-M12-2 <sup>01)</sup>		× 1

01) The protection rating of the product is guaranteed when using the waterproof cover.

## Software

Download the installation file and the manuals from the Autonics website.

### ■ atIOLink

The Port and Device Configuration Tool (PDCT) software, atIOLink, is designed for configuring, diagnosing, and maintaining IO-Link devices using an IODD file.

- IODD (IO-Link Device Description)

This file contains information such as manufacturer details, process data, diagnostic data, and parameter settings for a sensor using IO-Link communication.

By uploading the IODD file to the PDCT software, you can check the settings and communication data based on the user interface.

You can download the IODD file from the Autonics website.

## ISDU Parameters and Functions

### ■ Process data input

- Port ☐ switch point 1 / 2
- Analog value port ☐
- Port ☐ pin 1 short
- Port ☐ analog value underflow
- Port ☐ analog value overflow
- Low supply voltage

### ■ Parameter configuration

- Process data alignment
- Analog mode
- Resolution
- Pin assignment
- Process data format
- Switch point 1, 2
- Switch point enable
- Operating hours alarm setting
- Data storage lock
- Restore factory settings

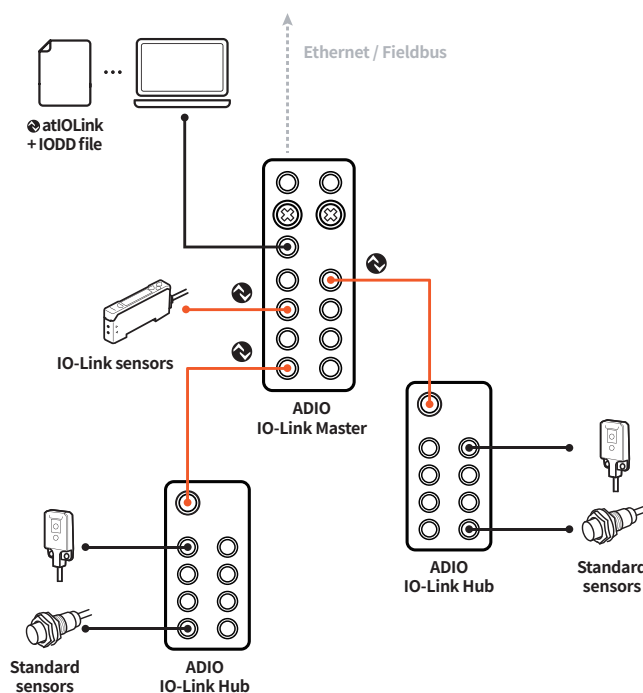
### ■ Diagnosis

- Operating hours

## Configuration of ADIO IO-Link Hub

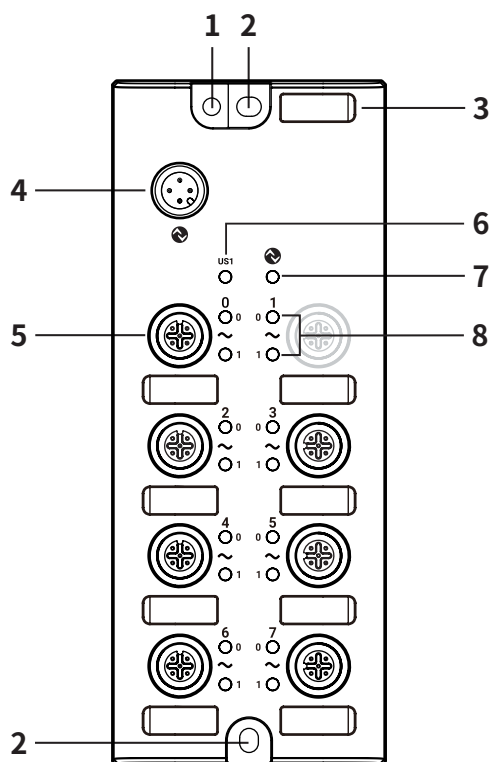
The figure below shows the ADIO IO-Link Hubs and the devices that make up the configuration. For proper use of the product, refer to the manuals and be sure to follow the safety precautions in the manuals.

You can download the relevant manuals from the Autonics website.



Step	Reference manual
<b>1. Hardware installation</b> Mounting and grounding, connecting the ports	→ ADIO IO-Link Master Product Manual, ADIO IO-Link Hub Product Manual
<b>2. Power supply</b> IO-Link master: Connecting the power ↓ IO-Link hub: Connecting the power (power supply through the IO-Link master)	→ ADIO IO-Link Master Product Manual, ADIO IO-Link Hub Product Manual
<b>3. Parameter configuration</b> IO-Link master: Configuring the communication mode of ports connected to the IO-Link hub • Pin 4 (C/Q): IO-Link mode ↓ IO-Link hub: Configuring the parameters and functions	→ ADIO IO-Link Hub Product Manual, atIOLink User Manual
<b>4. Verification of normal operation</b> Checking the indicators	→ ADIO IO-Link Master Product Manual, ADIO IO-Link Hub Product Manual

## Unit Descriptions



- 01. Grounding hole
- 02. Mounting hole
- 03. Insertion part for the name plate
- 04. IO-Link port
- 05. Standard I/O port
- 06. Power supply status indicator
- 07. IO-Link status indicator
- 08. Standard I/O port status indicator

## Port specifications

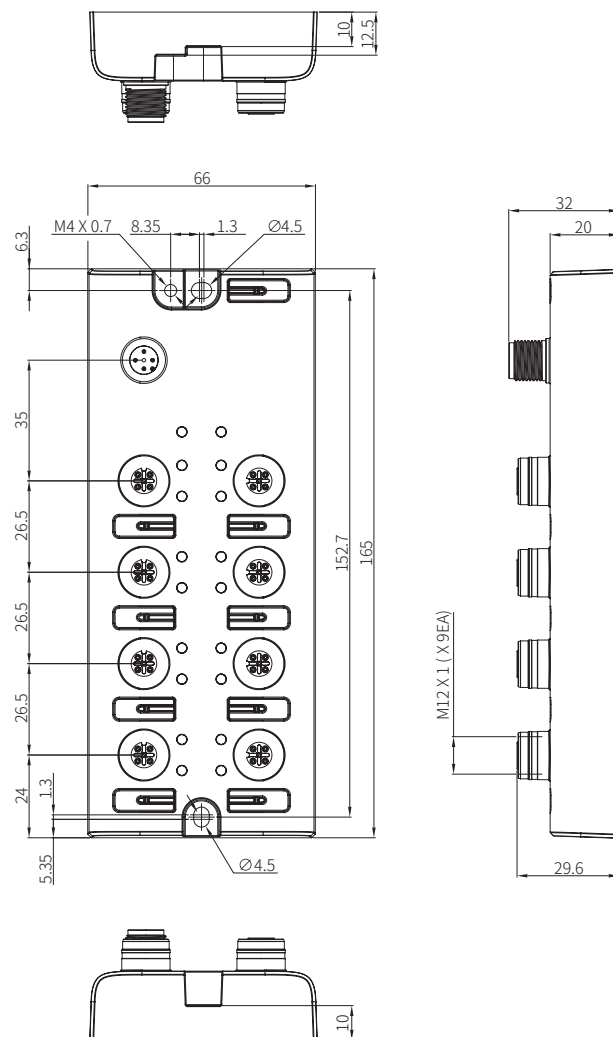
Before connecting the device, be sure to check the port specifications below and select the correct connector cable. We recommend that the selected connector cable comply with the protection ratings of IP67 or IP69K.

- IO-Link port: We do not recommend using M12 connector cables manufactured by Autonics.
- Standard I/O port: If you are using a standard sensors, you can find the relevant connector cables in the 'M8/M12 Connector Cable Product Manual.'

	IO-Link port	Standard I/O port
Connector type	M12 (Plug-Male), A-coded	M12 (Socket-Female), A-coded
Number of pins	4-pin	4-pin
Number of ports	1	8
Tightening torque	0.6 N m	0.6 N m
Push-Pull	-	YES
Functions	IO-Link communication connection and power supply	External standard sensors connection

## Dimensions

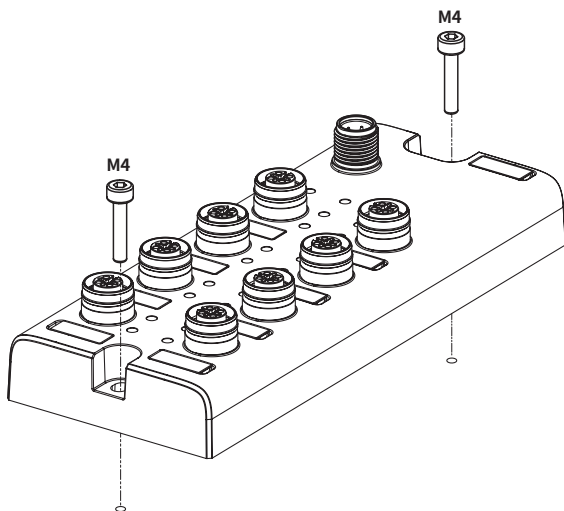
- Unit: mm, For the detailed dimensions of the product, follow the Autonics website.



## Installation and Grounding

### ■ Mounting

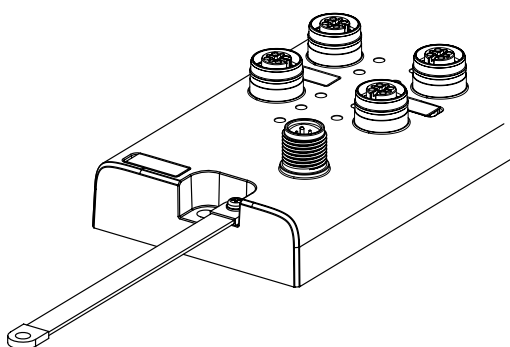
01. Prepare a flat or metal panel in the enclosure.
02. Drill a hole to mount and ground the product on the surface.
03. Turn off all power.
04. Fix the product using M4 screws in the mounting holes.  
Tightening torque: 1.5 N m



### ■ Grounding

⚠ Be sure to use a cable with low impedance and as short as possible for connecting the housing to the product.

01. Connect the grounding strap and M4×10 screw with washer.
02. Fix the screw in the grounding hole.  
Tightening torque: 1.2 N m

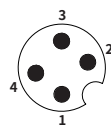


## Connections

⚠ Make sure that the total power consumption of the ADIO hub does not exceed a maximum of 4 A, and be sure to use the provided waterproof covers for any unused standard I/O ports.  
Otherwise, the protection rating of the product cannot be guaranteed.

### ■ IO-Link port

- The port type: M12 (Plug-Male), 4-pin, A-coded
- Connected to the I/O ports of the ADIO IO-Link master, it is possible to supply power and establish IO-Link communication for the ADIO IO-Link hub.



Pin	Function	Description
1	+24 VDC $\equiv$ , 4 A (US1)	Supply power from the IO-Link master
2	N.C.	Not connected
3	GND	Electrical grounding, 0 V
4	C/Q (IO-Link)	IO-Link data channel

### ■ Standard I/O port

- The port type: M12 (Socket-Female), 4-pin, A-coded
- Connected to the standard sensors.

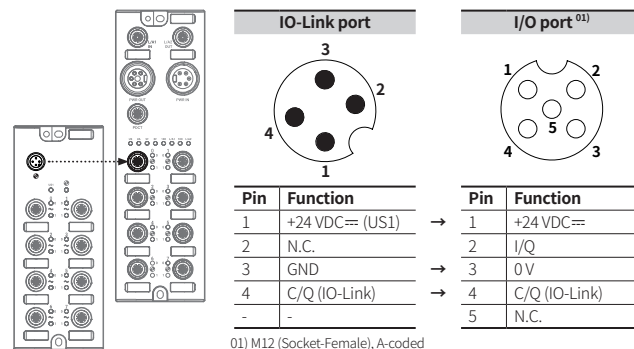


Pin	Function	Description
1	+24 VDC $\equiv$ , 150 mA (L+)	Supply power <sup>01)</sup>
2	Input (B)	Voltage / Current input
3	GND (L-)	Electrical grounding, 0 V
4	Input (A)	Voltage / Current input

01) A short circuit between Pins 1, 2, and 4 may result in product damage.

### ■ Example of wiring

(ADIO IO-Link hub to ADIO IO-Link master)



## Indicators

### ■ Status indicator



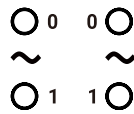
#### 01. ADIO IO-Link hub supply status

Indicator	LED status	Description
US1	● OFF	• Power supply is off.
	● Green ON	• Power supply: Operating normally.
	● Red ON	• Power supply: Operating at a low level. (< 18 VDC=)

#### 02. IO-Link communication status

Indicator	LED status	Description
	● OFF	• IO-Link communication error.
	● Flashing green	• IO-Link communication is running.
	● Green ON	• IO-Link communication is in standby. (pre-operate)

### ■ Standard I/O port status indicator



#### 01. Input status on Pin 4

Indicator	LED status	Description
0	● OFF	• When the analog mode is set to OFF. • No analog input signal.
	● Orange ON	• When the pin assignment is set to Pin 4, the input signal is within the rated range.
	● Red ON	• Short circuit between the L+ / L- (Pin 1, 3) • The analog input value is out of the allowable input range (underflow, overflow).

#### 02. Input status on Pin 2

Indicator	LED status	Description
1	● OFF	• When the analog mode is set to OFF. • No analog input signal.
	● Orange ON	• When the pin assignment is set to Pin 2, the input signal is within the rated range.
	● Red ON	• Short circuit between the L+ / L- (Pin 1, 3) • The analog input value is out of the allowable input range (underflow, overflow).

## Specifications

### ■ Electrical / Mechanical specifications

Type	Analog Input
Model	ADIO-IL-MA08EAA1-HUB3
Rated voltage / current	24 VDC=, ≤ 4 A (±10%)
Supply current	150 mA ±10%
Dimensions	W 66 × H 165 × D 32 (20) mm
Material	Zinc die casting
IO-Link port	M12 (Plug-Male), 4-pin, A-coded Number of ports: 1
Standard I/O port	M12 (Socket-Female), 4-pin, A-coded Push-Pull connector supported Number of ports: 8
Mounting method	Mounting hole: fixed with M4 screw
Grounding method	Grounding hole: fixed with M4 screw
Unit weight (packaged)	≈ 550 g (≈ 750 g)

### ■ Analog input specifications

Type	Analog Input
Number of input channels	8-CH (1 channel in each port)
Input type	Voltage input Current input
Input range	-10 to 10 VDC= (default value), 0 to 10 VDC= 0 to 20 mA, 4 to 20 mA
Input allowable range	±5% F.S. ±5% F.S.
Input impedance	≥ 500 kΩ ≤ 30 Ω
Resolution	10 / 12 / 14 / 16-bit (default value)
Accuracy <sup>01)</sup>	At room temperature: PV ±0.1% F.S. At out of room temperature: PV ±0.3% F.S.

01) The range of room temperature: 25 °C ±5 °C

### ■ Environmental conditions

Vibration	1.5 mm double amplitude at frequency of 10 to 55 Hz in each X, Y, Z direction for 2 hours
Shock	400 m/s <sup>2</sup> (≈ 40 G) in each X, Y, Z direction for 3 times
Ambient temperature <sup>01)</sup>	-5 to 70 °C, Storage: -25 to 70 °C (no freezing or condensation)
Ambient humidity	35 to 85%RH (no freezing or condensation)
Protection rating	IP67 (IEC standard), IP69K (DIN standard)

01) UL approved ambient temperature: 45 °C

### ■ Certification

Certification	CE UK
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## Communication Interface

### ■ IO-Link

IO-Link version	1.1
IO-Link port class	Class A
Minimum cycle time	5 ms
Transmission rate	COM3 (230.4 kbps)
IO-Link frame type	M-sequence TYPE_2_V
Cable length	≤ 20 m
Size of process data <sup>01)</sup>	Process data input (PD In.): 22-byte Process data output (PD Out.): N/A
Data storage	YES
IODD file	Download the IODD file from the Autonics website
Standard	IO-Link Interface and System Specification Version 1.1.2 IO-Link Test Specification Version 1.1.2

01) The process data input: IO-Link hub → IO-Link master  
The process data output: IO-Link master → IO-Link hub

### IO-Link: Identification information of ADIO IO-Link Hub

- atIOLink: Click the **IODD Catalog** or **Master PORT no. tab** > **Device information** tab

- | Index | Sub |  |  | Date | Date |  |
|-------|-----|--|--|------|------|--|
|-------|-----|--|--|------|------|--|

Index (dec.)	Sub index	Parameter	Access	Data length	Data type	Value / Range
0x00 (0)	8	Vendor ID 1 (MSB)	RO	2-byte	UINT8	0x0383 (899)
	9	Vendor ID 2 (LSB)				= Autronics Corporation
	10	Device ID 1 (MSB)	RO	3-byte	UINT8	0x30005 (196613)
	11	Device ID 2				= ADIO-IL-MA08EAA1-HUB3
	12	Device ID 3 (LSB)				

### ■ Read and write the identification data

You can read or change the vendor-specific parameters to identify the ADIO hubs.

- atIOLink: Click the **Master PORT no.** tab > **Parameters** tab > **Identification Menu**

Index (dec.)	Sub index	Parameter	Access	Data length	Data type	Value / Range
0x10 (16)	0	Vendor Name	RO	64-byte	String	Autonics Corporation
0x11 (17)	0	Vendor Text	RO	64-byte	String	Sensor & Controller, www.autonics.com
0x12 (18)	0	Product Name	RO	64-byte	String	ADIO-IL-MA08EAA1-HUB3
0x13 (19)	0	Product ID	RO	64-byte	String	ADIO-IL
0x14 (20)	0	Product Text	RO	64-byte	String	Analog Input 8 Channel A1
0x15 (21)	0	Serial Number	RO	16-byte	String	YYYYMMDDnn <sup>(01)</sup>
0x16 (22)	0	Hardware version	RO	4-byte	String	1.0
0x17 (23)	0	Firmware version	RO	4-byte	String	1.00.000r <sup>(02)</sup>
0x18 (24)	0	Application Specific Tag	RW	64-byte	String	*** <sup>(03)</sup>

01) Y = year / M = month / D = day / n = sequential number

02) major.minor.patch

03) You can write a product description such as its installation location or roles in the system.

### IO-Link: Configuration of Parameter Data

You can read or configure the parameter data for the ADIO hubs.

- atIOLink: click the **Master PORT no.** tab > **Parameters** tab > **Parameter Menu**

Index (dec.)	Sub index	Parameter	Access	Data length	Data type	Default value
0x59 (89)	0	Process data <sup>(2)</sup> alignment	RW	1-byte	-	1: Right
0xF0 (240)	0	Analog mode <sup>(1)</sup>	RW	8-byte	-	3: -10 to 10 V
	1 to 8			1-byte		
0xF1 (241)	0	Resolution <sup>(2)</sup>	RW	8-byte	-	0: 16-bit
	1 to 8			1-byte		
0xF2 (242)	0	Pin assignment <sup>(1)</sup>	RW	8-byte	-	1: Pin 4
	1 to 8			1-byte		
0xF5 (245)	0	Process data format <sup>(2)</sup>	RW	8-byte	-	2: Dimensioned (mV, µA)
	1 to 8			1-byte		
0xF6 (246)	0	Switch point 1 <sup>(3)</sup>	RW	16-byte	UINT8	-
	1 to 8			2-byte		
0xF7 (247)	0	Switch point 2 <sup>(3)</sup>	RW	16-byte	UINT8	-
	1 to 8			2-byte		
0xF8 (248)	0	Switch point enable <sup>(3)</sup>	RW	2-byte	Boolean	0: Disabled
	1 to 16			1-byte		
0x4A (74)	0	Operating hours alarm setting	RW	4-byte	UINT8	100000
0x0C (12)	2	Data storage lock	RW	2-byte	Boolean	0: False
0x82 (130)	0	Restore factory settings	WO	1-byte	-	-
0xFF (255)	0	Reset	WO	1-byte	-	-

01) The set of parameters for analog input configuration.

02) The set of parameters for setting the display format of analog input value.

03) The set of parameters for setting the switch point of analog input value.

### ■ Process data alignment

When you use the resolution of less than 16 bits, the process data alignment can be configured. In the case of resolutions such as 10, 12, and 14 bits, analog input data is filled with zeros in some bits and then transmitted as a 16-bit value.

- This process data alignment does not affect the 'dimensioned' data format.

Index (dec.)	Subindex	Bit size	Value / Range
0x59 (89)	0	16	0: Left (left-aligned) 1: Right (right-aligned)

0: Left-aligned

Byte 0								Byte 1							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Resolution 16-bit															
Resolution 14-bit														0	0
Resolution 12-bit												0	0	0	0
Resolution 10-bit										0	0	0	0	0	0

### 1: Right-aligned

Byte 0								Byte 1								
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0	
															Resolution 16-bit	
0	0														Resolution 14-bit	
0	0	0	0												Resolution 12-bit	
0	0	0	0	0	0	0										Resolution 10-bit

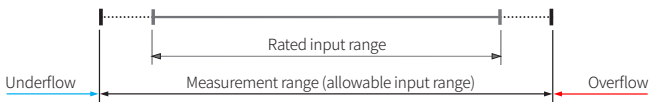
## ■ Analog mode

You can configure the analog input properties, such as input type and range, for each port. Subindex 0 allows you to access the analog mode for all ports, while the sub-indices from 1 to 8 allow you to read or change the analog mode for each corresponding port.

Index (dec.)	Subindex	Byte size	Port no.	Value / Range
0xF0 (240)	0	8	Port 0 to 7	0: Voltage input, 0 to 10 V
	1	1	Port 0	1: Current input, 4 to 20 mA
	2	1	Port 1	3: Voltage input, -10 to 10 V
	3	1	Port 2	5: Current input, 0 to 20 mA
	4	1	Port 3	255: Port OFF
	5	1	Port 4	
	6	1	Port 5	
	7	1	Port 6	
	8	1	Port 7	

## ■ Underflow and overflow

If the measured analog value exceeds the maximum and minimum values of the allowable input range, based on the configured analog mode for each port, the corresponding bits in the process data input (Byte 19 to 20) are set to 1.



Rated input range	Underflow range	Overflow range
0 to 10 V	< -0.5 V	> 10.5 V
-10 to 10 V	< -10.5 V	> 10.5 V
4 to 20 mA	< 3.8 mA	> 20.5 mA
0 to 20 mA	-	> 20.5 mA

## ■ Resolution

You can configure the resolution of analog signals for each port. Subindex 0 allows you to access the resolution for all ports, while sub-indices from 1 to 8 allow you to read or change the resolution for each corresponding port.

- This resolution does not affect the 'dimensioned' data format.

Index (dec.)	Subindex	Byte size	Port no.	Value / Range
0xF1 (241)	0	8	Port 0 to 7	0: 16-bit
	1	1	Port 0	1: 14-bit
	2	1	Port 1	2: 12-bit
	3	1	Port 2	3: 10-bitw
	4	1	Port 3	
	5	1	Port 4	
	6	1	Port 5	
	7	1	Port 6	
	8	1	Port 7	

## ■ Pin assignment

You can select the analog input pins (Pin 2 / Pin 4) for each port. Subindex 0 allows you to access the value of pin assignment for all ports, while sub-indices from 1 to 8 allow you to read or change the pin assignment for each corresponding port.

Index (dec.)	Subindex	Byte size	Port no.	Value / Range
0xF2 (242)	0	8	Port 0 to 7	0: Pin 2
	1	1	Port 0	1: Pin 4
	2	1	Port 1	
	3	1	Port 2	
	4	1	Port 3	
	5	1	Port 4	
	6	1	Port 5	
	7	1	Port 6	
	8	1	Port 7	

## ■ Process data format

The analog values are digitalized in the ADIO hubs. The format of the digitalized values is determined by the process data format, analog mode, resolution, and process data alignment. Each port is allocated 2 bytes of process input data for IO-Link data exchange, and the analog value is displayed based on the process data format.

You can configure the data format through this parameter.

Subindex 0 allows you to access the process data format for all ports, while sub-indices from 1 to 8 allow you to read or change the format for each corresponding port.

Index (dec.)	Subindex	Byte size	Port no.	Value / Range
0xF5 (245)	0	8	Port 0 to 7	0: Signed
	1	1	Port 0	1: Unsigned
	2	1	Port 1	2: Dimensioned (mV, µA)
	3	1	Port 2	
	4	1	Port 3	
	5	1	Port 4	
	6	1	Port 5	
	7	1	Port 6	
	8	1	Port 7	

### 0: Signed data format

The digitalized value is represented as a signed value (positive or negative) using the two's complement. Typically, the most significant bit (MSB) is used as the sign bit, and the analog input signal is calculated using the following formulas.

- For the voltage input

Analog mode		Data format	
Nominal range	Allowable range	Positive (MSB = 0)	Negative (MSB = 1)
-10 to 10 V	-10.5 to 10.5 V	$[V_{in}] = P_{in} \times \left( \frac{V_{max}}{2^{(R-1)} - 1} \right)$	$[V_{in}] = (P_{in} - 2^R) \times \left( \frac{V_{max}}{2^{(R-1)} - 1} \right)$
0 to 10 V	-0.5 to 10.5 V		

-  $P_{in}$  : Measured input value on each port

-  $R$  : Resolution (□-bit)

-  $V_{max}$  : Maximum allowable input voltage

- For the current input

Analog mode		Data format	
Nominal range	Allowable range	Positive (MSB = 0)	
0 to 20 mA	0 to 20.5 mA	$[I_{in}] = P_{in} \times \left( \frac{I_{max} - I_{min}}{2^{(R-1)} - 1} \right) + I_{min}$	
4 to 20 mA	3.8 to 20.5 mA		

-  $P_{in}$  : Measured input value on each port

-  $R$  : Resolution (□-bit)

-  $I_{max} / I_{min}$  : Maximum / minimum allowable input current

[Example] Calculate the digitalized value of a 9 V signal

- The applied voltage signal to the ADIO hub is 9 V and the parameters are configured as shown in the table below.

Parameter	Configured value
Process data alignment	1: Right
Analog mode	0: 0 to 10 V
Resolution	1: 14-bit
Process data format	0: Signed

- When monitoring the value of the process data input in atIOLink, it is represented as 7465 (0x1D, 0x29). Since the MSB of 7465 (0x1D, 0x29) is 0, it indicates that a positive number is being detected. (7465 = 0001 1101 0010 1001<sub>Bin</sub>)

- When deriving the result using the formula for converting positive voltage inputs, you can figure out that the original analog signal has been successfully digitalized.

$$\cdot \text{Input signal} = 7465 \times \left( \frac{10.5 \text{ V}}{2^{(14-1)} - 1} \right) = 9.5 \text{ V}$$

[Example] Calculate the digitalized value of a -5 V signal

- The applied voltage signal to the ADIO hub is -5 V and the parameters are configured as shown in the table below.

Parameter	Configured value
Process data alignment	0: Left
Analog mode	3: -10 to 10 V
Resolution	2: 12-bit
Process data format	0: Signed

- When monitoring the value of the process data input in atIOLink, it is represented as 49920 (0xC3, 0x00). This input value is left-aligned; therefore, the voltage input value with resolution is 0xC30 (3120). Since its MSB is 1, it indicates that a negative number is being detected. (49920 = 1100 0011 0000 0000<sub>Bin</sub>)

- When deriving the result using the formula for converting negative voltage inputs, you can figure out that the original analog signal has been successfully digitalized.

$$\cdot \text{Input signal} = (3120 - 2^{12}) \times \left( \frac{10.5 \text{ V}}{2^{(12-1)} - 1} \right) = -5.0 \text{ V}$$

### 1: Unsigned data format

The digitalized value is represented as a number ranging from 0x0000 to 0xFFFF, depending on the resolution.

The analog input signal is calculated using the following formulas.

• For voltage input

Analog mode		Data format
Nominal range	Allowable range	
-10 to 10 V	-10.5 to 10.5 V	
0 to 10 V	-0.5 to 10.5 V	$[V_{in}] = P_{in} \times \left( \frac{V_{max} - V_{min}}{2^R - 1} \right) + V_{min}$

-  $P_{in}$  : Measured input value on each port

-  $R$  : Resolution (□-bit)

-  $V_{max}/V_{min}$  : Maximum / minimum allowable input voltage

• For current input

Analog mode		Data format
Nominal range	Allowable range	
0 to 20 mA	0 to 20.5 mA	
4 to 20 mA	3.8 to 20.5 mA	$[I_{in}] = P_{in} \times \left( \frac{I_{max} - I_{min}}{2^R - 1} \right) + I_{min}$

-  $P_{in}$  : Measured input value on each port

-  $R$  : Resolution (□-bit)

-  $I_{max}/I_{min}$  : Maximum / minimum allowable input current

[Example] Calculate the digitalized value of a 10 mA signal

01. The applied current signal to the ADIO hub is 10 mA and the parameters are configured as shown in the table below.

Parameter	Configured value
Process data alignment	0: Left
Analog mode	1: 4 to 20 mA
Resolution	2: 12-bit
Process data format	1: Unsigned

02. When monitoring the value of the process data input in atIOLink, it is represented as 31888 (0x7C, 0x90). This input value is left-aligned; therefore, the current input value with resolution is 0x7C9 (1993). (31888 = 0111 1100 1001 0000<sub>Bin</sub>)

03. When deriving the result using the formula for converting current inputs, you can figure out that the original analog signal has been successfully digitalized.

$$\cdot \text{Input signal} = 1993 \times \left( \frac{20.5 - 3.8}{2^{12} - 1} \right) + 3.8 = 11.92 \text{ mA}$$

### 2: Dimensioned data format

The values of input voltage and current are digitized with the unit of mV or  $\mu$ A and transmitted to the process data. When converting to the digital value, the resolution is 16-bit, and the data is right-aligned. Unlike the data format previously described, the configured resolution and process data alignment have no effect on the dimensioned data format. The analog input signal is calculated using the following formulas.

• For voltage input

Analog mode	Data format	
Nominal range	Positive (MSB = 0)	Negative (MSB = 1)
-10 to 10 V	$[V_{in}] = \frac{P_{in}}{1000}$	$[V_{in}] = \frac{P_{in} - 65536}{1000}$
0 to 10 V		

-  $P_{in}$  : Measured input value on each port

• For current input

Analog mode	Data format	
Nominal range	Positive (MSB = 0)	
0 to 20 mA	$[I_{in}] = \frac{P_{in}}{1000}$	
4 to 20 mA		

-  $P_{in}$  : Measured input value on each port

[Example] Calculate the digitalized value of a 9 V signal

01. The applied voltage signal to the ADIO hub is 9 V and the parameters are configured as shown in the table below.

Parameter	Configured value
Analog mode	0: 0 to 10 V
Process data format	2: Dimensioned

02. When monitoring the value of the process data input in atIOLink, it is represented as 9570 (0x25, 0x62). For voltage input, the value is digitized in mV units; therefore, it needs to be converted into V units.

03. When deriving the result using the formula for converting positive voltage inputs, you can figure out that the original analog signal has been successfully digitalized.

$$\cdot \text{Input signal} = \frac{9570}{1000} = 9.570 \text{ V}$$

[Example] Calculate the digitalized value of a -5 V signal

01. The applied voltage signal to the ADIO hub is -5 V and the parameters are configured as shown in the table below.

Parameter	Configured value
Analog mode	3: -10 to 10 V
Process data format	2: Dimensioned

02. When monitoring the value of the process data input in atIOLink, it is represented as 60533 (0xEC, 0x75). For voltage input, the value is digitized in mV units; therefore, it needs to be converted into V units.

03. When deriving the result using the formula for converting negative voltage inputs, you can figure out that the original analog signal has been successfully digitalized.

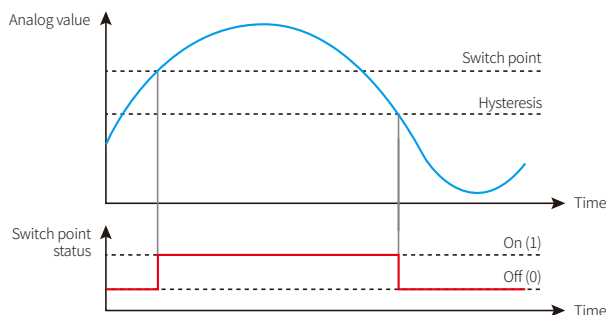
$$\cdot \text{Input signal} = \frac{60533 - 65536}{1000} = -5.003 \text{ V}$$



## ■ Switch point 1, 2

You can designate two switch points for each port. These switch points should be designated within the rated range of voltage or current input. If the measured input values exceed these switch points, the corresponding bits in the process data input (Byte 0 to 1) are set to 1.

- Hysteresis: Voltage input = 5 mV / Current input = 10  $\mu$ A
- The switch points are right-aligned. You need to consider these switch points when configuring the resolution and process data format.



Subindex 0 allows you to access the switch points for all ports, while sub-indices from 1 to 8 allow you to read or change the switch points for each corresponding port.

Index (dec.)	Subindex	Byte size	Port no.	Value / Range
0xF6 (246)	0	16	Port 0 to 7	Value for switch point 1 (e.g.: 50 <sub>dec</sub> → 0.050 V)
	1	2	Port 0	
	2	2	Port 1	
	3	2	Port 2	
	4	2	Port 3	
	5	2	Port 4	
	6	2	Port 5	
	7	2	Port 6	
	8	2	Port 7	
0xF7 (247)	0	16	Port 0 to 7	Value for switch point 2 (e.g.: 50 <sub>dec</sub> → 0.050 V)
	1	2	Port 0	
	2	2	Port 1	
	3	2	Port 2	
	4	2	Port 3	
	5	2	Port 4	
	6	2	Port 5	
	7	2	Port 6	
	8	2	Port 7	

## ■ Switch point enable

You can enable or disable the switch point 1 and 2 for each port. Subindex 0 allows you to access this parameter for all ports, while sub-indices from 1 to 16 allow you to read or change the setting of this parameter for each corresponding port.

- Disabled: The corresponding bits in the process data input are set to 0.
- Enabled: If the measured input value exceeds the switch points, the corresponding bits in the process data input are set to 1.

Index (dec.)	Subindex	Bit size	Port no.	Value / Range
0xF8 (248)	0	16	Port 0 to 7	0: Disabled
	1	1	Port 0 - switch point 1	1: Enabled
	2	1	Port 1 - switch point 1	
	3	1	Port 2 - switch point 1	
	4	1	Port 3 - switch point 1	
	5	1	Port 4 - switch point 1	
	6	1	Port 5 - switch point 1	
	7	1	Port 6 - switch point 1	
	8	1	Port 7 - switch point 1	
	9	1	Port 0 - switch point 2	
	10	1	Port 1 - switch point 2	
	11	1	Port 2 - switch point 2	
	12	1	Port 3 - switch point 2	
	13	1	Port 4 - switch point 2	
	14	1	Port 5 - switch point 2	
	15	1	Port 6 - switch point 2	
	16	1	Port 7 - switch point 2	

## ■ Operating hours alarm setting

You can configure the operating hours of the ADIO hub.

When the operating hour reaches the set value, an event will be triggered for notifications.

Index (dec.)	Subindex	Byte size	Value / Range
0x4A (74)	0	4	0 to 131071 hours

## ■ Data storage lock

You can prevent the upload of the ADIO hub's configuration when using Data Storage (DS) mode.

Index (dec.)	Subindex	Byte size	Value / Range
0x0C (12)	2	2	0: False (Unlocked) 1: True (Locked)

## ■ Restore factory settings

You can restore the parameter configuration of the ADIO hub to its factory default settings.

- atIOLink: Click the **Parameter Menu > RESTORE FACTORY SETTINGS**
- Commands: Activate the 'Restore factory settings' parameter. The index is 0x82, and the subindex is 0.

## ■ Reset

Restart the ADIO hub.

- Commands: Activate the 'Reset' parameter. The index is 0xFF, and the subindex is 0.

## IO-Link: Diagnostic Information

You can see the diagnostic information for the ADIO hub.

- atIOLink: Click the **Master PORT no. tab > Parameters tab > Diagnosis Menu**

## ■ Operating hours

You can see the total operating hours of the ADIO hub.

Index (dec.)	Subindex	Access	Data length	Data type	Value / Range
0x48 (72)	0	RO	4-byte	-	Operating hours

## IO-Link: Event and Error Monitoring

You can monitor the event and error history of the ADIO hub.

- atIOLink: Click the **Master PORT no. tab > Events tab**

## ■ Event code

Event code (dec.)	Description
0x1821 (6177)	Operating time alarm
0x5111 (20753)	Low sensor voltage (US)
0x7710 (30480)	Short circuit on Pin 1
0x8C20 (35872)	Measurement value is out of range

## ■ Error code

Error code (dec.)	Description
0x8011 (32785)	Index not available
0x8012 (32786)	Subindex not available
0x8023 (32803)	Access Denied
0x8030 (32816)	Parameter value out of range
0x8033 (32819)	Parameter length overrun
0x8034 (82820)	Parameter length underrun

## IO-Link: Process Data Input Monitoring

You can monitor the process data input status of the ADIO hub.

- atIOLink: Click the **Master PORT no.** tab > **Process data** tab

No.	Parameter	Description
1.	Switch point 1, 2	When the measured input value on a standard I/O port exceeds the switch point, the corresponding bits are set.
2.	Analog value	You can see the measured voltage or current input value for each standard I/O port.
3.	Pin 1 short	When a short circuit occurs between Pin 1 and Pin 3 on a standard I/O port, the corresponding bits are set.
4.	Analog value underflow	When the measured voltage or current input value is less than the minimum rated input range on a standard I/O port, the corresponding bits are set. [e.g.] When the rated input range is from 4 to 20 mA, the ADIO hub detects if the measured value has decreased to 3 mA.
5.	Analog value overflow	When the measured voltage or current input value is greater than the maximum rated input range on a standard I/O port, the corresponding bits are set. [e.g.] When the rated input range is from -10 to 10 V, the ADIO hub detects if the measured value has increased to 11 V.
6.	Low supply voltage	When the supply power (US1) of the ADIO hub is less than 18 VDC $\pm$ , the corresponding bit is set.

### ■ Process data input structure

Parameter	Byte no.	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Switch point 1	Byte 0	Port 7	Port 6	Port 5	Port 4	Port 3	Port 2	Port 1	Port 0
Switch point 2	Byte 1	Port 7	Port 6	Port 5	Port 4	Port 3	Port 2	Port 1	Port 0
Analog value	Byte 2 to 3	Port 0							
	Byte 4 to 5	Port 1							
	Byte 6 to 7	Port 2							
	Byte 8 to 9	Port 3							
	Byte 10 to 11	Port 4							
	Byte 12 to 13	Port 5							
	Byte 14 to 15	Port 6							
	Byte 16 to 17	Port 7							
Pin 1 short	Byte 18	Port 7	Port 6	Port 5	Port 4	Port 3	Port 2	Port 1	Port 0
Analog value underflow	Byte 19	Port 7	Port 6	Port 5	Port 4	Port 3	Port 2	Port 1	Port 0
Analog value overflow	Byte 20	Port 7	Port 6	Port 5	Port 4	Port 3	Port 2	Port 1	Port 0
Low supply voltage	Byte 21	-	-	-	-	-	-	-	US1 status