Air Gap Sensor LK-DPA Series

Instruction Manual

LK-DPA-12S

LK-DPA-12L

Metrol Co., Ltd.

Symbols

The seriousness of risks and the level of danger are indicated as follows in this instruction manual.

⚠ CAUTION: This indicates a hazardous event with a low risk that could result in minor or moderate injury if not avoided.

⚠ WARNING: This indicates a hazardous event with a moderate risk that could result in death or serious injury if not avoided.

⚠ DANGER: This indicates a hazardous event with a high risk that could result in death or serious injury if not avoided.

For Safe Use

⚠ WARNING

a. The handling of this product, and the operation, maintenance and similar of all systems related to this product should be performed by a professional with sufficient knowledge and experience.
b. This product has been designed and manufactured as a general-purpose product to be used in general industrial applications. If using this product after embedding it into a machine, device or similar, check the compatibility of the application, and the related standards, laws and regulations. In particular, do not use this product in the following applications.
  (i) Applications in which the operating conditions and environment (e.g., in a heat resistant, vacuum or magnetic field environment) are outside of the range of the functions and performance of this product
  (ii) Applications likely to have an impact on human life or property (e.g., nuclear power facilities, transportation equipment or medical equipment), public facility applications (e.g., electricity, gas or water services) and applications equivalent to these
c. Never mount or remove this product or perform the operation or maintenance of any system relating to this product until checking it is safe.
d. Carefully read and understand the contents of this instruction manual to be able to use this product safely and correctly. There is a risk of death or injury if you do not follow the safety warnings, precautions or instructions in this instruction manual.

Guarantee Provisions

Understand the following guarantee provisions before using our products. In addition, correctly use our products upon fully understanding their functions and performance with catalogs, instruction manuals and our website. These provisions are intended only for transactions and use in Japan.

1) Applicable Products

The guarantee stipulated below applies to products manufactured and sold by our company (hereinafter referred to as "the Applicable Product")

2) Guarantee Period

The guarantee period of the Applicable Product is for one year and three months after purchase or after delivery to a location you have designated.

3) Guarantee Range

a. If the Applicable Product fails within the guarantee period due to the responsibility of our company, we will provide a replacement or repair it free of charge. However, the guarantee does not cover the failures applicable to below.

  i. When the Applicable Product has been used in deviation from the standards, ratings, environment, operating method and operating precautions described in the catalog, instruction manual or specifications

  ii. When the cause of the failure is not due to our products

  iii. When the Applicable Product has been disassembled, remodeled or repaired by a party other than our company

  iv. When the failure has been caused by a natural disaster, calamity or other force majeure

b. The guarantee range is limited to a guarantee of the Applicable Product alone. Secondary failures caused by the failure of the Applicable Product are not covered.

c. We do not perform on-site work (e.g., mounting, attended inspections or repairs)

Table of Contents

1. Overview

1-1. Overview of This Product

This product is a sensor that detects the gap by measuring pressure changes. The pressure to be measured will be higher when the gap between the air nozzle and the workpiece is narrow and lower when it is wide.

When you perform the master set with a gap (master value) you wish to detect, the pressure that will form the threshold value will be recorded. The pressure will be higher than the threshold value when the gap is narrower than the master value; the pressure will be lower than the threshold value when the gap is wider than the master value. These will be respectively judged as OK and NG.
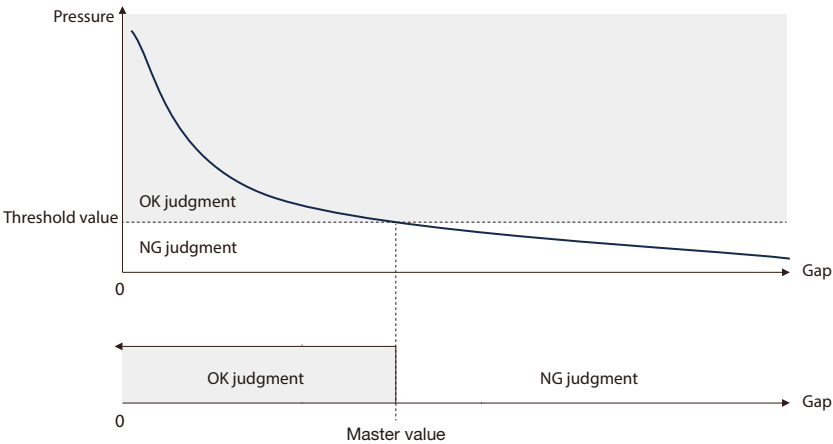
Below shows a schematic diagram of this product. The pressure used for the aforementioned judgment and threshold value is the value obtained by the sensor on the OUT port side. The sensor on the SUP port side is used to correct changes in the supply pressure.
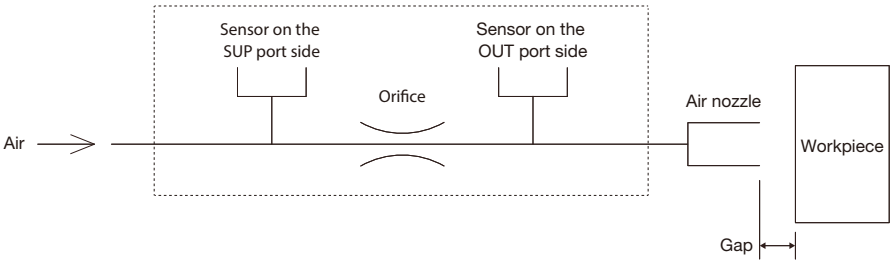
Perform the master set, various settings and monitoring of each value via the IO-Link.

This is a non-contact measurement by air. Therefore, it is possible to take measurements without leaving a measurement mark on the workpiece.

1-2. Features of This Product

(1) It is possible to take measurements with high repeatability.
(2) It is possible to control this product with IO-Link communications.
(3) This product has an IP67 dustproof and waterproof structure.

2. Specifications

2-1. Absolute Maximum Ratings

⚠ WARNING

Applying stress beyond the following absolute maximum ratings may lead to severe damage to the internal components.

Item	Value	Unit
Supply voltage	30	VDC
Output withstand voltage	26.4	V
Output withstand current	20	mA
Supply pressure	0.30	MPa

2. Specifications

2-2. Specifications Table

⚠ WARNING

a. The following specifications table is given after conducting tests based on our set conditions. It is not a guarantee of the performance under your operating environment.

b. This product is only for use with the following operating fluids. Use of other fluids may cause failures or malfunctions.

c. The second characteristic number (number on the right side) of the protective structure (IP) indicates the waterproofness with respect to the intrusion of water. Waterproofness with respect to coolant is different.

Product No.		LK-DPA-12S Series	LK-DPA-12L Series
Repeatability		±0.5 µm (master value: 1-60 µm) ±1 µm (master value: 60-100 µm) **Supply pressure variation falls within +/-1%**	±1 µm (master value: 80-150 µm) ±3 µm (master value: 150-250 µm) ±5 µm (master value: 250-350 µm) **Supply pressure variation falls within +/-1%**
Repeatability guarantee range		1-100 µm	80-350 µm
Fluid		Dry air (filtered to 5 µm)	
Supply pressure range		0.15-0.20 MPa	
Consumption flow rate		9 L/min (max)	24 L/min (max)
Connection port size		Rc 1/8	
Recommended tube	SUP port	ø6 × ø4 tube	
	OUT port	ø4 × ø2.5 tube and ø6 × ø4 tube	
Power supply voltage		DC 18-30 V	
Consumption current		100 mA or less	
Pin 2 output specifications		Open collector output Set the NPN/PNP from the IO-Link master	
Cable		Oil resistance, Standard length: 3 m, Diameter: ø5, Tensile strength: 30 N, Minimum bending radius – fixed: 7 mm, moveable: 20 mm, Number of core: 4, Conductor size: AWG26 equivalent	
Protective structure		IP67	
Operating temperature range		0-60℃ (no condensation)	

2. Specifications

2-3. Response Time Characteristics

The response time is the time from when the workpiece is brought close to the air nozzle with air supplied to this product and the workpiece movement is completed to when the judgment output switches to ON.

This time changes depending on the tube length from the OUT port to the nozzle, the tube diameter, the seating state of the workpiece, the supply pressure and other factors.

The graphs on the next page show the response time if the workpiece is brought close to the air nozzle at 10 mm/sec from the state in which the air nozzle and workpiece are sufficiently separated until when the gap reaches the (master value −1) μm with air supplied to this product (example: If the master set is performed at 20 μm, the response time is measured with the workpiece moved up to 19 μm).

2-3-1. Shared Test Conditions

Air nozzle	ø1.5
Workpiece movement speed	10 mm/sec
Average number of times	4

2-3-2. Measurement System
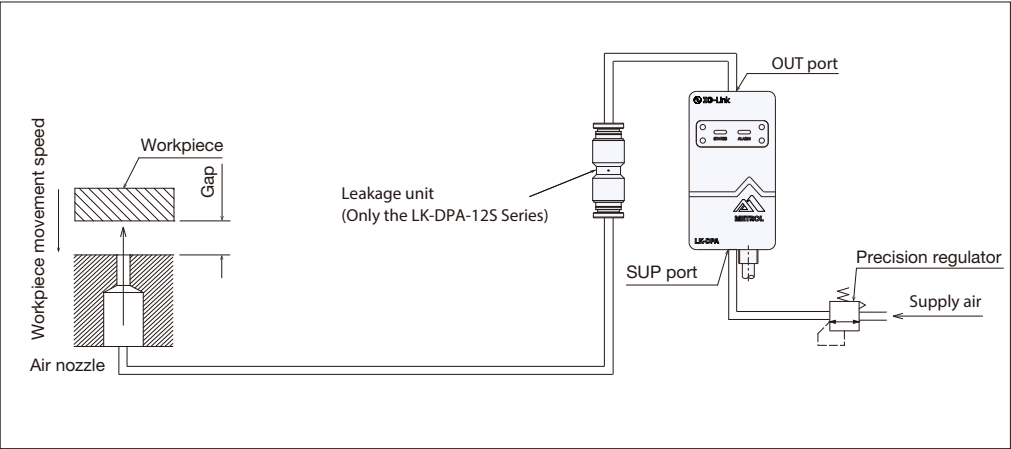
2. Specifications

2-3-3. LK-DPA-12S Series Response Time Characteristics Graphs

- Tube length from the OUT port to the air nozzle: 1.5 m
- Supply pressure: 0.15 MPa

- Tube length from the OUT port to the air nozzle: 1.5 m
- Supply pressure: 0.20 MPa

- Tube length from the OUT port to the air nozzle: 5 m
- Supply pressure: 0.15 MPa

- Tube length from the OUT port to the air nozzle: 5 m
- Supply pressure: 0.20 MPa
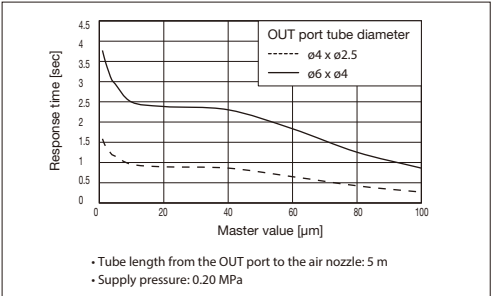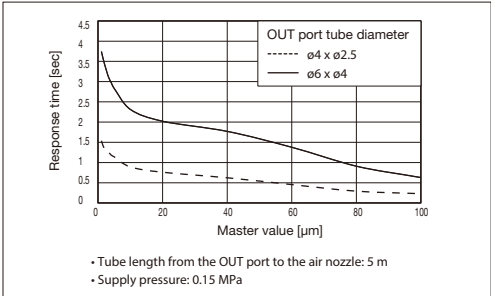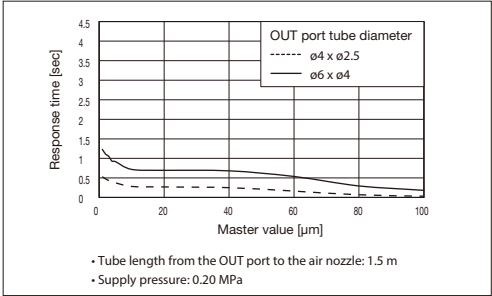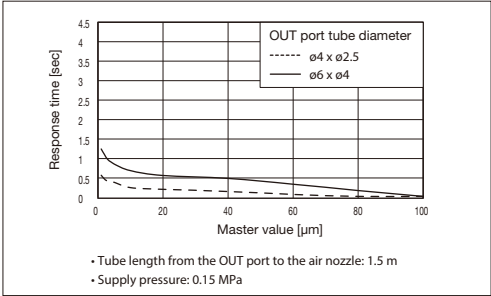
2-3-4. LK-DPA-12L Series Response Time Characteristics Graphs

- Tube length from the OUT port to the air nozzle: 1.5 m
- Supply pressure: 0.15 MPa

- Tube length from the OUT port to the air nozzle: 1.5 m
- Supply pressure: 0.20 MPa

- Tube length from the OUT port to the air nozzle: 5 m
- Supply pressure: 0.15 MPa

- Tube length from the OUT port to the air nozzle: 5 m
- Supply pressure: 0.20 MPa
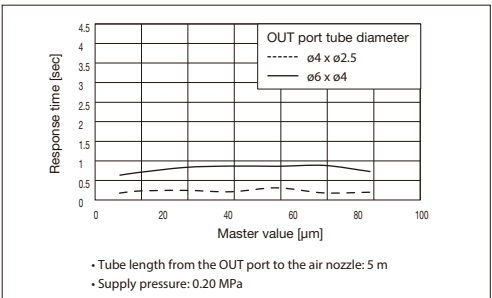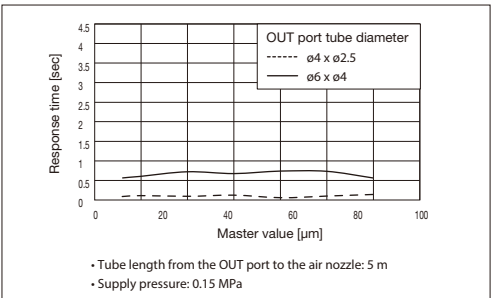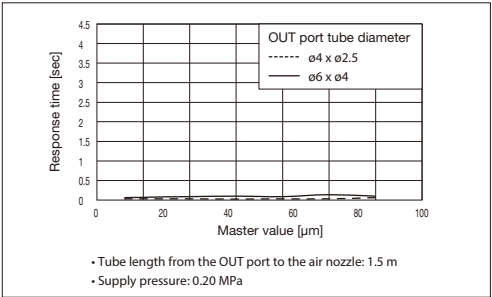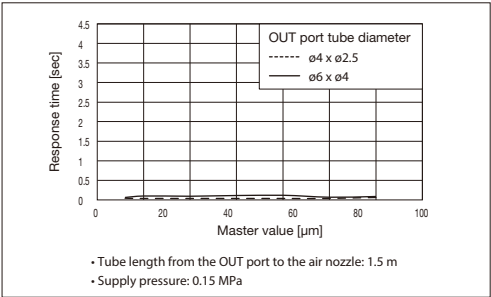
*1: The above graphs are given after conducting tests based on our set conditions. The results may differ depending on the operating environment.

*2: There is no difference in the response time due to the tube length from the regulator to the SUP port.

3. List of Included Items

Check that you have all the following included items before use.

No.	Name	LK-DPA-12S Series	LK-DPA-12L Series	Quantity
(1)	Product body	✓	✓	1
(2)	Leakage unit	✓	-	1
(3)	Instruction manual (this document)	✓	✓	1
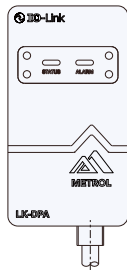
(1)　　　　　　　　　　　　　　(2)
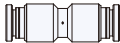
4. Items to Be Prepared by You

> ## ⚠ WARNING
>
> The "2-2. Specifications Table" (p. 6) is based on conditions using the recommended air nozzle. If you use an air nozzle with a different shape, the repeatability and consumption flow rate may differ. Judge the advisability of use upon verification in your actual environment.

The following items are not included. Prepare them separately.

Name	Quantity	Remarks
Air filter	1	Recommended model: AF20-02(SMC), AF20-02-A(SMC)
Precision regulator	1	Recommended model: IR2000(SMC), IR2000-A(SMC)
SUP port connection fitting	1	Connection aperture: Rc1/8 (If the screw of the fitting is not sealed, jointly use thread seal tape)
OUT port connection fitting	1	
Air tube	-	SUP port recommended tube: ø6 × ø4 tube OUT port recommended tube: ø4 × ø2.5 tube and ø6 × ø4 tube *The outer diameter for the tube that can be connected to the attached leakage unit is ø6. If connecting a tube with an outer diameter of ø4, prepare a conversion fitting.
Air nozzle	-	Make with reference to the recommended air nozzle dimensions diagram.
IO-Link master	-	A connector between this product and IO-Link master is not included.

• Recommended Air Nozzle Dimensions Diagram
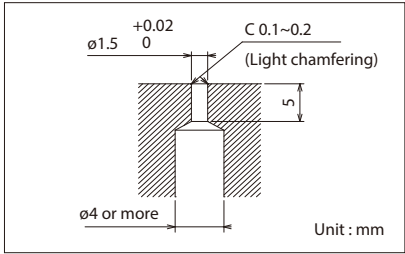
5. Names and Functions of Each Part

5-1. Product Body External Dimensions Diagram

Unit : mm

ALARM LED

STATUS LED

66

36

Cable

36

8

Rc1/8
OUT port

Rc1/8
SUP port

22

11.3

20

25

4-M4 depth 6
mounting hole
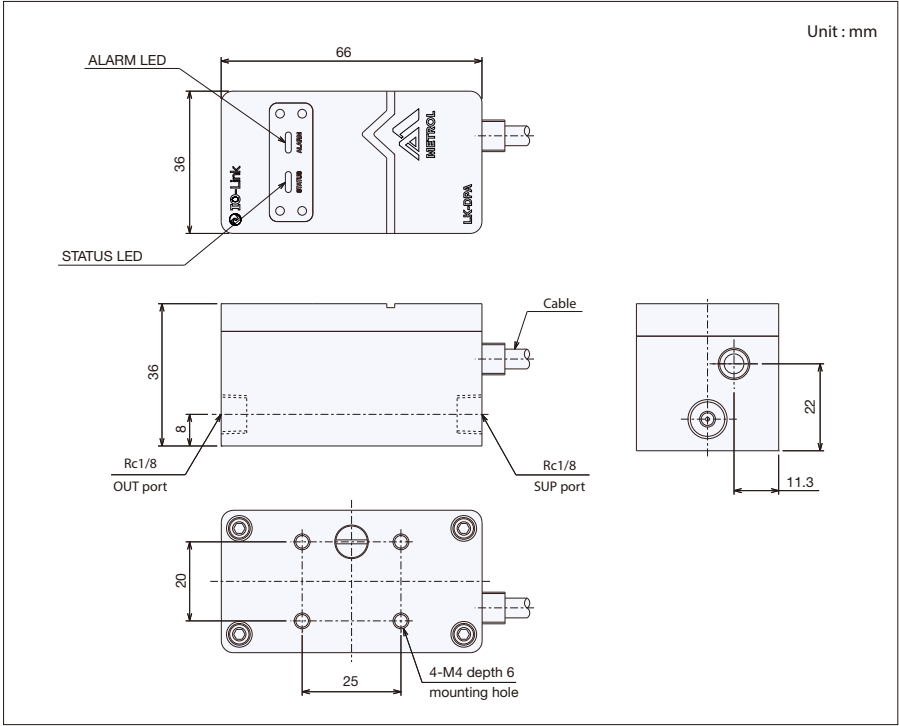
5-2. Leakage Unit (Standard accessory of LK-DPA-12S Series)

Connecting tube outer diameter
ø6

Connecting tube outer diameter
ø6
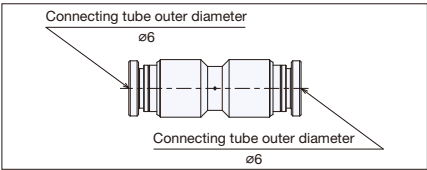
5-3. Names and Functions of Each Part

Name	Description
STATUS LED	Displays the judgment results.
ALARM LED	Displays the status of the pressure on the SUP port side.
SUP port	The port that supplies the pressure.
OUT port	The port that connects the air nozzle.
Mounting hole	Used when mounting the product body.
Leakage unit	Only the LK-DPA-12S Series. Connect with reference to p. 13.

*It is possible to set the LED lighting from the IO-Link master.

6. Installation and Connection Method

6-1. Fitting Mounting

Connect the fittings to the SUP port and the OUT port.

*1: Fittings are not included.

*2: If the screw of the fitting is not sealed, jointly use thread seal tape

6-2. Product Body Mounting

<table>
<tr><td colspan="2" align="center">⚠ WARNING</td></tr>
<tr><td>

a. Mount the product body at a higher position than the air nozzle to prevent the backflow of coolant from the air nozzle.
b. Keep the product body and the wiring away from electrical noise sources such as motor cables and other cables that carry large currents.
c. Use a cable of 20 m or less to reduce the effects of noise and surge.
d. Use a cable bending radius R of 7 mm or more when fixed and 20 mm or more when moveable.
e. Take care not to pull the cable. The tensile strength is 30 N.

</td></tr>
</table>

When mounting this product, use the mounting hole 4-M4 depth 6.

*Determine the position with consideration to ensure the tube between the OUT port and the air nozzle and the SUP port and the regulator is as short as possible.

6. Installation and Connection Method

6-3 Air Tube Mounting

⚠ WARNING

a. If the supply air contains drain, install an air dryer and drain catch in front of the air filter.
b. Make sure to install a filter (5 µm or less) and a mist separator on the supply side of the regulator.
c. Use a precision regulator (repeatability: within ±0.5%)
d. Do not use devices and fittings in the piping from the OUT port to the air nozzle so that there are no leaks other than the leakage unit or resistance.
e. The repeatability and the repeatability guarantee range of the LK-DPA-12S Series in "2-2. Specifications Table" (p. 6) is based on conditions using the included leakage unit (p. 11). If not using the included leakage unit, the repeatability may differ. Judge the advisability of use upon verification in your actual environment.
f. Arrange the leakage unit so that the holes are not blocked. Take care to ensure coolant and chips do not hit it when the product is not supplied with air.
g. The "2-2. Specifications Table" (p. 6) is based on conditions using one air nozzle per product body. If using multiple air nozzles, the repeatability and the consumption flow rate may differ. Judge the advisability of use upon verification in your actual environment.
h. The "2-2. Specifications Table" (p. 6) is based on conditions using the recommended tube. If using a different tube diameter, the repeatability and the consumption flow rate may differ. Judge the advisability of use upon verification in your actual environment.
i. Pipe after removing dirt and foreign matter remaining in the tube with an air blower or similar. If dirt or foreign matter remains in the tube, it may cause damage, failures or malfunctions.
j. If you supply air of 0.30 MPa or more to this product, there is a danger that the internal components may become damaged. Connect the tube after adjusting the supply pressure to a range of 0.15 to 0.20 MPa.
k. Check there are no air leakages and that the product is operating normally after piping. There is a danger that it may not be possible to secure safety due to malfunctions. If air is leaking, if the product is not operating normally or if there are other errors, turn off the power and stop the air supply.

Connect the SUP port tube, precision regulator and air filter to the SUP port and the OUT port tube, leakage unit (only the LK-DPA-12S Series) and air nozzle to the OUT port with reference to the piping example.

•Piping Example
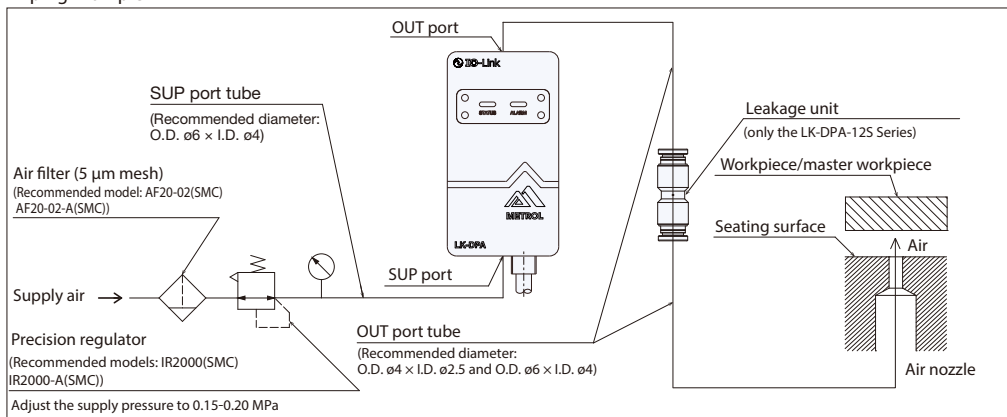
6. Installation and Connection Method

6-4. Connection to the IO-Link Master

⚠ WARNING

a. Connect to the IO-Link master when using this product.
b. Also make sure to check the instruction manual of the IO-Link master.
c. If connecting to the Class B port of the IO-Link master, do not connect the DO signal wire.

Connect to the IO-Link master you will use upon checking the following connection examples.

If connecting to the Class A port of the IO-Link master and not using the DO signal, you do not need to connect the DO signal wire. If connecting to the Class B port, do not connect the DO signal wire.

If not connecting the DO signal wire, appropriately treat the end upon setting the DO Setting (Index 109) (p. 26 and 31) to digital output disabled (0). The factory setting is digital output disabled (0).

When Connecting to Port Class A

LK-DPA-12		IO-Link master
Main circuit	Brown L+ → L+	Port Class A
	White DO → DI	
	Blue L − → L−	
	Black C/Q → C/Q	

When Connecting to Port Class B

LK-DPA-12		IO-Link master
Main circuit	Brown L+ → L+	Port Class B
	White DO → P24	
	Blue L − → L−	
	Black C/Q → C/Q	
	→ N24	
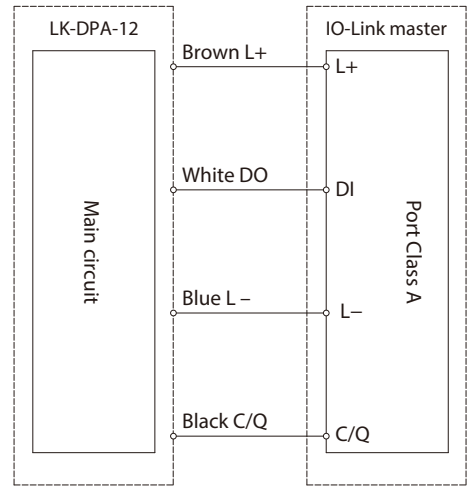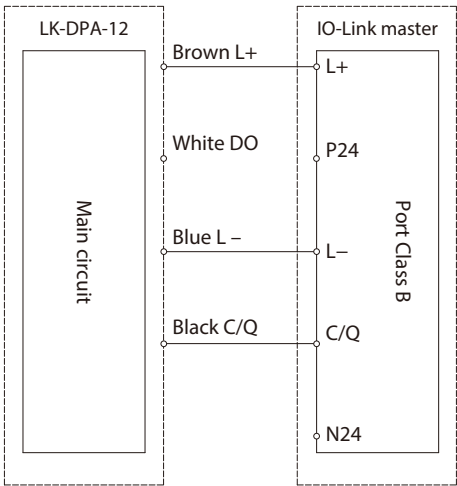
Wire color	Signal name	Description
Brown	L+	Power supply (+24 VDC)
White	DO	Digitally outputs the judgment with ON/OFF
Blue	L−	Power supply (0 VDC)
Black	C/Q	IO-Link communications wire

7. How to Operate

> ## ⚠ WARNING
>
> a. If you use this product for the first time and implement Restore factory settings, this product will operate with the settings from the factory. If using to control the device, use after setting as necessary upon checking the impact.
> b. If you use this product with a method other than that specified by our company, the protection performance and functions of this product may drop.

7-1. Display When Turning on the Power

When you turn on the power, all the LEDs will light up in purple and normal operation will then start after that.

7-2. Supply Pressure Alarm

A supply pressure alarm will occur if the supply pressure is outside the specification range. It is possible to check the supply pressure alarm with events (p. 17), process data (p. 19) and Detailed Device Status (Index 37) (p. 22) in addition to the ALARM LED. This product has the following supply pressure alarms.

Alarm name	Alarm LED display[*1]	Master set	Judgment	Details
100 kPA alarm	Lights up in red	-	-	Supply pressure: 100 kPa or less
205 kPa alarm	Blinks in red	-	-	Supply pressure: 205 kPa or more
+10 kPa alarm[*2]	Blinks in purple	✓	-	Pressure on the SUP port side is 10 kPa or more greater than at the time of the master set. Example: If performing the master set at a pressure of 150 kPa on the SUP port side, this alarm will occur when the pressure on the SUP port side is 160 kPa or more.
-10 kPa alarm[*2]	Blinks in purple	✓	-	Pressure on the SUP port side is 10 kPa or more lower than at the time of the master set. Example: If performing the master set at a pressure of 150 kPa on the SUP port side, this alarm will occur when the pressure on the SUP port side is 140 kPa or less.

*1: When the parameter Index 104 to 108 are the initial values (p. 25 and 30)

*2: The master set is performed at a supply pressure of 150 kPa under the factory settings. Therefore, a +10 kPa alarm or -10 kPa alarm will occur depending on your supply pressure. Use after performing the master set.

7. How to operate

7-3. Master Set Method

<div>

⚠ WARNING

If changing the measurement system (e.g., changing the piping), perform the master set again.

</div>

The master set is the setting of the master value that forms the threshold value of the judgment using the Master workpiece. Perform the master set from the IO-Link master. It is possible to set up to eight master values (Switches 1-8).

1) Make the gap that will serve as the master value with reference to the examples in the diagrams below when performing the master set.

(1) When Using a Shim
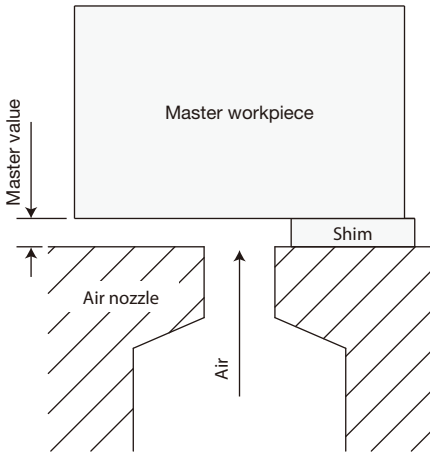
(2) When Preparing a Master workpiece with a Gap
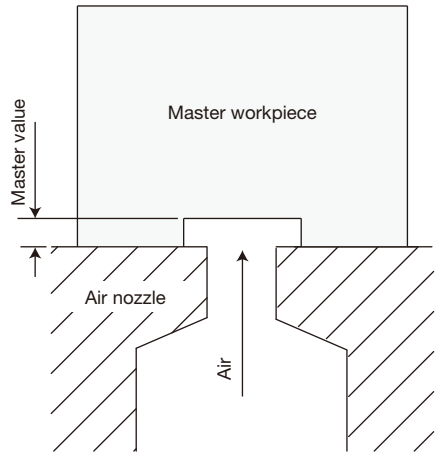
2) Enable the switch number to perform the master set with the on-request data. Set one of the Subindices 1~8 of Index 72 to true (1), which corresponds to the switch number. (p. 25 and 28)

3) Execute the master set command of the applicable switch number with the on-request data. The master set command is the Index 200 (p. 26 and 31).

4) The STATUS LED will blink for 1.5 seconds when the master set is complete. The ALARM LED will then turn off. The blinking of the STATUS LED follows the setting of the Judgment LED Setting OK (Index 102) (factory setting: blue).

*The master value is saved even when the power is turned off.

8. IO-Link Specifications

⚠ **WARNING**

It is possible to rewrite the data of this product 1 million times.

8-1. IO-Link Overview

It is possible to read the judgments, detected values, alarm information and other information from the IO-Link master in this product. It is also possible to perform the master set and various settings from the IO-Link master. The IO-Link has the following two types of data object.

a. Process data: Data sent and received periodically between the master and the device
b. On-request data: Data communicated non-periodically according to a request from the master

8-2. IODD Files

The IO device description (IODD) file is a definition file that describes the necessary device information to perform IO-Link communications.

8-3. Data Storage Function

The IO-Link master has a function to save the various set values. It is possible to transfer the set values saved in the IO-Link master to the device when replacing the device. Check the instruction manual of the IO-Link master you use for details of how to use it. The parameters corresponding to the data storage function are saved in the non-volatile memory of the device body. The data is saved even after you turn off the power.

8-4. DO Signals

The judgment of the switch number set with LED and DO Setting (Index 101) is digitally output. It is possible to switch between enabled/disabled and the output mode with the DO Setting (Index 109). If enabling, connect to the DI terminal of the Class A port of the IO-Link master.

8-5. EventCodes (Diagnosis Information)

These indicate the event information. Each event is assigned an EventQualifier that indicates the category of the event. The unique events are as follows.

EventQualifier [hex]	EventCode [hex]	Event type	Name	Description
E4	18 00	Warning	Pressure Alarm	Supply pressure alarm
F4	18 01	Error	EEPROM Error	Internal memory error

8. IO-Link Specifications

8-6 Device Specifications

Items	Details	
Device Name	LK-DPA-12S	LK-DPA-12L
Vendor ID	1213 (0x04bd)	
Vendor Name	Metrol	
Vendor Text	http://www.metrol.co.jp/	
Vendor URL	http://www.metrol.co.jp/	
Device ID	10003 (0x002713)	10004 (0x002714)

8-7. Support Functions

Items		Details
Block Parameter		yes
Data Storage		yes
Supported Access Locks	Parameter	no
	Data Storage	no
	Local Parameterization	no
	Local User Interface	no
SIO Mode Supported		no

8-8. Communication Specifications

Items	Details
IO-Link Revision	V1.1
Transmission Rate	230400 bit/s (COM3)
Minimum Cycle Time	5 ms
ISDU supported	yes

8. IO-Link Specifications

8-9. Process Data

Process data is data that is periodically sent and received via the process communications channel between the master and the device. Process data is only sent from the device in this product. Refer to the data with the same name in "8-10-2. Data Unique to the Product" (p. 23) for details of the data. There is no data with the same name for Subindices 19 to 28. Refer to Supply Alarm (Index 71) (p. 24 and 28).

*Some of the data types are given using the following codes in this section.
UI16: Unsigned 16-bit integer – Data type name = UInteger T / Length = 2-octet
Bool: Boolean value (1 or 0) – Data type name = BooleanT / Length = 1-bit

Sub-index [dec]	Bit offset [dec]	Data type*	Length [bit]	Name	Allowed value [dec]	Description
1	168	UI16	16	Current Sup Value	0~65535	Current pressure value on the SUP port side
2	152	UI16	16	Current Out Value	0~65535	Current pressure value on the OUT port side
3	136	UI16	16	Corrected Out Value 1		
4	120	UI16	16	Corrected Out Value 2		
5	104	UI16	16	Corrected Out Value 3		
6	88	UI16	16	Corrected Out Value 4	0~65535	Current corrected pressure value on the OUT port side
7	72	UI16	16	Corrected Out Value 5		
8	56	UI16	16	Corrected Out Value 6		
9	40	UI16	16	Corrected Out Value 7		
10	24	UI16	16	Corrected Out Value 8		
11	23	Bool	1	Judgment 1		
12	22	Bool	1	Judgment 2		
13	21	Bool	1	Judgment 3		
14	20	Bool	1	Judgment 4	*p.27	Judgement result
15	19	Bool	1	Judgment 5		
16	18	Bool	1	Judgment 6		
17	17	Bool	1	Judgment 7		
18	16	Bool	1	Judgment 8		
19	15	Bool	1	205kPa Alarm		205 kPa alarm – OFF: No / ON: Yes
20	14	Bool	1	100kPa Alarm		100 kPa alarm – OFF: No / ON: Yes
21	7	Bool	1	10kPa Alarm 1		
22	6	Bool	1	10kPa Alarm 2		
23	5	Bool	1	10kPa Alarm 3	0 : OFF	+10 kPa alarm or -10 kPa alarm 1~8 corresponds to Switches 1~8 respectively OFF: No / ON: Yes
24	4	Bool	1	10kPa Alarm 4	1 : ON	
25	3	Bool	1	10kPa Alarm 5		
26	2	Bool	1	10kPa Alarm 6		
27	1	Bool	1	10kPa Alarm 7		
28	0	Bool	1	10kPa Alarm 8		

8. IO-Link Specifications

8-10. On-request Data (1/12)

On-request data is data that is non-periodically communicated according to a request of the master. It is possible to read/write device parameters, read event information and execute commands.

  *Some of the data types are given using the following codes in this section.
   UI16: Unsigned 16-bit integer – Data type name = UInteger T / Length = 2-octet
   UI8: Unsigned 8-bit integer – Data type name = UInteger T / Length = 1-octet
   Bool: Boolean value (0 or 1) – Data type name = BooleanT / Length = 1-bit

8-10-1. IO-Link Data (1/3)

Index 0 (0x00) Direct Parameters 1

The data type is a 128-bit record. It is possible to read the following unsigned 8-bit integer data.

Sub-index [dec]	Bit offset [dec]	Data type*	Length [bit]	Name	R/W	Description
3	104	UI8	8	Min Cycle Time	R	Minimum cycle time: 5 ms
5	88	UI8	8	IO-Link Version ID	R	IO-Link Revision 1.1
8	64	UI8	8	Vendor ID 1	R	Vendor ID upper level byte 0x04
9	56	UI8	8	Vendor ID 2	R	Vendor ID lower level byte 0xBD
10	48	UI8	8	Device ID 1	R	Device ID upper level byte 0x00
11	40	UI8	8	Device ID 2	R	Device ID middle level byte 0x27
12	32	UI8	8	Device ID 3	R	Device ID lower level byte 12S: 0x13 / 12L:0x14

Index 2 (0x02) System Command

Only writing access is available. The data type is an unsigned 8-bit integer. Execute Restore factory settings by writing 130 (0x82) to be able to initialize the parameters to the factory settings.

Value [dec]	Name	R/W	Description
129	Application reset	W	Reset application settings
130	Restore factory settings	W	Reset all settings to factory defaults
131	Back-to-box	W	Reset all settings to factory defaults and stop communication

8. IO-Link Specifications

8-10. On-request Data (2/12)

8-10-1. IO-Link Data (2/3)

Index 16 (0x10)   Vendor Name
Only reading access is available. The data type is a 64-octet string.

Index 17 (0x11)   Vendor Text
Only reading access is available. The data type is a 64-octet string.

Index 18 (0x12)   Product Name
Only reading access is available. The data type is a 64-octet string.

Index 19 (0x13)   Product ID
Only reading access is available. The data type is a 64-octet string.

Index 20 (0x14)   Product Text
Only reading access is available. The data type is a 64-octet string.

Index 21 (0x15)   Serial Number
Only reading access is available. The data type is a 16-octet string.

Index 22 (0x16)   Hardware Revision
Only reading access is available. The data type is a 64-octet string.

Index 23 (0x17)   Firmware Revision
Only reading access is available. The data type is a 64-octet string.

Index 24 (0x18)   Application Specfic Tag
Reading and writing are possible with access. The data type is a 32-octet string. It supports the data storage function. It can be used as a free writing parameter. The factory setting is "***" (0x2A2A2A).

Index 25 (0x19) Function Tag
Reading and writing are possible with access. The data type is a 32-octet string. It supports the data storage function. It can be used as a parameter to write device functions. The factory setting is "***" (0x2A2A2A).

Index 24 (0x18)   Application Specfic Tag
Reading and writing are possible with access. The data type is a 32-octet string. It supports the data storage function. It can be used as a parameter to installation location. The factory setting is "***" (0x2A2A2A).

Index 36 (0x24)   Device Status
Only reading access is available. The data type is an unsigned 8-bit integer. The following gives the readable device statuses

Value [dec]	Name	Description
0	Device is OK	Normal operation
1	Maintenance required	Not compatible
2	Out of specification	Outside the operating range
3	Functional check	Not compatible
4	Failure	Product failure

8. IO-Link Specifications

8-10. On-request Data (3/12)

8-10-1. IO-Link Data (3/3)

Index 37 (0x25)   Detailed Device Status

The upper level 1-octet represents the EventQualifier and the lower level 2-octet represents the EventCode. Events that have occurred are stored in the array in order. When an event disappears, the corresponding array is initialized (EventQualifier "0x00" and EventCode "0x0000"). Access is reading only. The data type is eight arrays of unsigned 3-octet strings. Check with "8-5. EventCodes (Diagnosis Information)" (p. 17) for events.

Octet	0	1	2	3	4	5	6	7
Bit offset	191~184	183~176	175~168	167~160	159~152	151~144	143~136	135~128
Subindex	1			2			3	
Parameter	Event Qualifier1	EventCode1		Event Qualifier2	EventCode2		Event Qualifier3	Event Code3

Octet	8	9	10	11	12	13	14	15
Bit offset	121~120	119~112	111~104	103~96	95~88	87~80	79~72	71~64
Subindex	3	4			5			6
Parameter	Event Code3	Event Qualifier4	EventCode4		Event Qualifier5	EventCode5		Event Qualifier6

Octet	16	17	18	19	20	21	22	23
Bit offset	63~56	55~48	47~40	39~32	31~24	23~16	15~8	7~0
Subindex	6		7			8		
Parameter	EventCode6		Event Qualifier7	EventCode7		Event Qualifier8	EventCode8	

Index 40 (0x28)   Process Data Input

It is possible to read the latest process data sent via the process communications channel. Access is reading only. Refer to "8-9. Process Data" (p. 19) for the data type and structure.

8. IO-Link Specifications

8-10. On-request Data (4/12)

8-10-2. Data Unique to the Product (1/9)

The following table gives the Index allocation of the data unique to the product. The details of the data are described later.

*DS: This indicates support for the data storage function.

Index [dec]	Name	Sub-index [dec]	Name	Data type	R/W	DS	Length [bit]	Allowed value [dec]	Default value	Description
64	Current Sup Value	0		UI16	R		16	0~65535	0	Current pressure value on the SUP port side
65	Current Sup Pressure	0		UI8	R		8	0~255	0	Current pressure value on the SUP port side [kPa]
66	Current Out Value	0		UI16	R		16	0~65535	0	Current pressure value on the OUT port side
67	Corrected Out Value	1	Switch 1	UI16	R		16	0~65535	0	Current pressure value on the OUT port side that has corrected the change in the pressure on the SUP port side using the Master Sup Value and the Current Sup Value
		2	Switch 2	UI16	R		16		0	
		3	Switch 3	UI16	R		16		0	
		4	Switch 4	UI16	R		16		0	
		5	Switch 5	UI16	R		16		0	
		6	Switch 6	UI16	R		16		0	
		7	Switch 7	UI16	R		16		0	
		8	Switch 8	UI16	R		16		0	
68	Judgment	1	Switch 1	UI8	R		8	*Described later	0	Judgment results
		2	Switch 2	UI8	R		8		0	
		3	Switch 3	UI8	R		8		0	
		4	Switch 4	UI8	R		8		0	
		5	Switch 5	UI8	R		8		0	
		6	Switch 6	UI8	R		8		0	
		7	Switch 7	UI8	R		8		0	
		8	Switch 8	UI8	R		8		0	

8. IO-Link Specifications

8-10. On-request Data (5/12)

8-10-2. Data Unique to the Product (2/9)

Index [dec]	Name	Sub-index [dec]	Name	Data type	R/W	DS	Length [bit]	Allowed value [dec]	Default value	Description
69	Master Sup Value	1	Switch 1	UI16	R	✓	16	0~65535	11879	Pressure value on the SUP port side at the time of the master set Used for correction
		2	Switch 2	UI16	R	✓	16		11879	
		3	Switch 3	UI16	R	✓	16		11879	
		4	Switch 4	UI16	R	✓	16		11879	
		5	Switch 5	UI16	R	✓	16		11879	
		6	Switch 6	UI16	R	✓	16		11879	
		7	Switch 7	UI16	R	✓	16		11879	
		8	Switch 8	UI16	R	✓	16		11879	
70	Master Out Value	1	Switch 1	UI16	R	✓	16	0~65535	0	Pressure value on the OUT port side at the time of the master set Judgment threshold value
		2	Switch 2	UI16	R	✓	16		0	
		3	Switch 3	UI16	R	✓	16		0	
		4	Switch 4	UI16	R	✓	16		0	
		5	Switch 5	UI16	R	✓	16		0	
		6	Switch 6	UI16	R	✓	16		0	
		7	Switch 7	UI16	R	✓	16		0	
		8	Switch 8	UI16	R	✓	16		0	
71	Supply Alarm	1	Switch 1	UI8	R		8	*Described later	0	Current status of the pressure on the SUP port side
		2	Switch 2	UI8	R		8		0	
		3	Switch 3	UI8	R		8		0	
		4	Switch 4	UI8	R		8		0	
		5	Switch 5	UI8	R		8		0	
		6	Switch 6	UI8	R		8		0	
		7	Switch 7	UI8	R		8		0	
		8	Switch 8	UI8	R		8		0	

8. IO-Link Specifications

8-10. On-request Data (6/12)

8-10-2. Data Unique to the Product (3/9)

Index [dec]	Name	Sub-index [dec]	Name	Data type	R/W	DS	Length [bit]	Allowed value [dec]	Default value	Description
72	Enable Judging	1	Switch 1	UI8	R/W	✓	8	*Described later	1	Each switch master set and judgment operation permission setting
		2	Switch 2	UI8	R/W	✓	8		0	
		3	Switch 3	UI8	R/W	✓	8		0	
		4	Switch 4	UI8	R/W	✓	8		0	
		5	Switch 5	UI8	R/W	✓	8		0	
		6	Switch 6	UI8	R/W	✓	8		0	
		7	Switch 7	UI8	R/W	✓	8		0	
		8	Switch 8	UI8	R/W	✓	8		0	
100	Average Setting	0		UI8	R/W	✓	8	*Described later	4	Average number of times setting of the Current SUP Value and the Current Out Value
101	LED and DO Setting	0		UI8	R/W	✓	8	*Described later	1	Sets the switch number allocated to the STATUS LED, ALARM Led and DO signal
102	Judgment LED Setting OK	0		UI8	R/W	✓	8	*Described later	1	STATUS LED display setting when the judgment is OK
103	Judgment LED Setting NG	0		UI8	R/W	✓	8	*Described later	2	STATUS LED display setting when the judgment is NG
104	Alarm LED Setting OK	0		UI8	R/W	✓	8	*Described later	1	ALARM LED display setting when the Supply Alarm is Supply OK
105	Alarm LED Setting 205kPa	0		UI8	R/W	✓	8	*Described later	130	ALARM LED display setting when the Supply Alarm is 205 kPa Alarm
106	Alarm LED Setting 100kPa	0		UI8	R/W	✓	8	*Described later	2	ALARM LED display setting when the Supply Alarm is 100 kPa Alarm
107	Alarm LED Setting +10kPa	0		UI8	R/W	✓	8	*Described later	131	ALARM LED display setting when the Supply Alarm is +10 kPa
108	Alarm LED Setting -10kPa	0		UI8	R/W	✓	8	*Described later	131	ALARM LED display setting when the Supply Alarm is -10 kPa

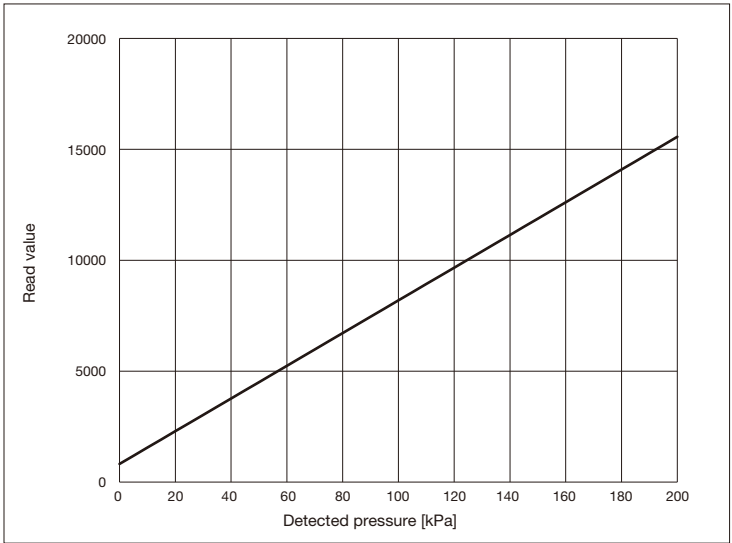# 8. IO-Link Specifications

8-10. On-request Data (7/12)

8-10-2. Data Unique to the Product (4/9)

Index [dec]	Name	Sub-index [dec]	Name	Data type	R/W	DS	Length [bit]	Allowed value [dec]	Default value	Description
109	DO Setting	0		UI8	R/W	✓	8	*Described later	0	DO Signal Setting. Outputs the allocation judgment with the LED and DO Setting.
200	Master Set Command	0		UI8	W		8	*Described later	-	Master Set Command Records the Current Out Value to the Master Value to set it as the threshold value.

The data details are as follows.

Index 64 (0x40)　Current Sup Value

This indicates the current pressure value on the SUP port side. Only reading access is available. The data type is an unsigned 16-bit integer. The readable values change roughly as in the graph below with respect to the detected pressure.

8. IO-Link Specifications

8-10. On-request Data (8/12)

8-10-2. Data Unique to the Product (5/9)

Index 65 (0x41)   Current Sup Pressure

This is the estimated value of the current detected pressure on the SUP port side. The Current Sup Value (Index 64) is converted to kPa. This may differ from the set pressure of the regulator due to the piping and other reasons.
Only reading access is available. The data type is an unsigned 8-bit integer.

Index 66 (0x42)   Current Out Value

This indicates the current pressure value on the OUT port side.
Only reading access is available. The data type is an unsigned 16-bit integer.
Refer to Current Sup Value (Index 64) for the readable values.

Index 67 (0x43)   Corrected Out Value

This is the current pressure value on the OUT port side for which the change of the pressure on the SUP port side from the time of the master set has been corrected. It is compared to the Master Out Value (Index 70) for the judgment. Subindices 1~8 correspond to Switches 1~8 respectively.
Only reading access is available. The data type is an unsigned 16-bit integer.

Index 68 (0x44)   Judgment

This is the parameter that indicates the judgment results. The Corrected Out Value (Index 67) and Master Out Value (Index 70) are compared to perform the judgment operation. Subindices 1~8 correspond to Switches 1~8 respectively.
Only reading access is available. The data type is an unsigned 8-bit integer. The readable values are as below.

Value[dec]	Name	Description
0	NG	Corrected Out Value < Master Out Value, a supply pressure alarm is generated or the judgment is set to disabled.
1	OK	Corrected Out Value > Master Out Value

Index 69 (0x45)   Master Sup Value

This is the parameter that indicates the pressure value on the SUP port side at the time of the master set. When a master set command is received, the value is updated. It is used to calculate the Corrected Out Value (Index 67).
Subindices 1~8 correspond to Switches 1~8 respectively.
Only reading access is available. The data type is an unsigned 16-bit integer. It supports the data storage function.
Refer to Current Sup Value (Index 64) for the readable values.

Index 70 (0x46)   Master Out Value

This is the parameter that indicates the pressure value on the OUT port side at the time of the master set. It serves as the threshold value of the judgment. Subindices 1~8 corresponds to Switches 1~8 respectively.
Only reading access is available. The data type is an unsigned 16-bit integer. It supports the data storage function.
Refer to Current Sup Value (Index 64) for the readable values.

8. IO-Link Specifications

8-10. On-request Data (9/12)

8-10-2. Data Unique to the Product (6/9)

Index 71 (0x47)   Supply Alarm

This indicates the status of the pressure on the SUP port side. No judgment is made at times other than Supply OK and the Judgment (Index 68) is NG. In addition, the master set is not executed at the time of a 205kPa Alarm or 100kPa Alarm. Subindices 1~8 correspond to Switches 1~8 respectively.

Only reading access is available. The data type is an unsigned 8-bit integer. The readable values are as below.

Value [dec]	Name	Description
0	Supply OK	The pressure on the SUP port side is normal. Alternatively, Enable Judging has been set to disabled.
1	205kPa Alarm	The pressure on the SUP port side is abnormal. The pressure on the SUP port side is 205 kPa or more.
2	100kPa Alarm	The pressure on the SUP port side is abnormal. The pressure on the OUT port side is 100 kPa or less.
3	+10kPa Alarm	The pressure on the SUP port side is abnormal. The pressure on the SUP port side is 10 kPa or more higher than the pressure at master set.
4	-10kPa Alarm	The pressure on the SUP port side is abnormal. The pressure on the SUP port side is 10 kPa or more lower than the pressure at master set.

Index 72 (0x48) Enable Judging

This enables or disables the master set and judgment operation. The master set and judgment are not performed when the parameter is false. Meanwhile, the Judgment (Index 68) is NG and the Supply Alarm (Index 71) is Supply OK. Subindices 1~8 correspond to Switches 1~8 respectively.

Reading and writing are possible with access. The data type is an unsigned 8-bit integer. It supports the data storage function.

The readable and writable values are as below. The factory setting is judgment operation enabled only for Switch 1 (1).

Value[dec]	Name	Description
0	false	Disables the master set and judgment operation
1	true	Enables the master set and judgment operation

⚠ WARNING

The "2-2. Specifications Table" (p. 6) is based on the condition of an average of four times. If three times or less, the repeatability may differ. Judge the advisability of use upon verification in your actual environment.

Index 100 (0x64)   Average Setting

This determines the number of times the pressure sensor value is averaged. In addition, the averaged value will be used for Current Sup Value (Index 64) and Current Out Value (Index 66). The internal update cycle of averaged value is roughly as below.

$$\text{Average Setting} \times 1.2 \text{ (ms)}$$

Reading and writing are possible with access. The data type is an unsigned 8-bit integer. It supports the data storage function. The readable and writeable values are from 1~255. The factory setting is 4.

8. IO-Link Specifications

8-10. On-request Data (10/12)

8-10-2. Data Unique to the Product (7/9)

Index 101 (0x65)　LED and DO Setting

STATUS LED, DO signal, and ALARM LED reflect the pressure status and the judgment of the switch number set with this parameter. Refer to DO Setting (Index 109) for the DO signal output settings.
Reading and writing are possible with access. The data type is an unsigned 8-bit integer. It supports the data storage function. The readable and writable values are as below.
The factory setting is Switch 1 (1).

Value [dec]	Name	Description
0	NONE	Not allocated. STATUS LED: Follows the setting (Judgment LED Setting OK (Index 102)) when the judgment is OK. ALARM LED: Follows the setting (Alarm LED Setting OK (Index 104)) when it is SUPPLY OK. DO signal: Follows the setting when the judgment is OK (output setting: DO Setting (Index 109)).
1~8	Switch 1~8	Reflects the judgment results of Switches 1~8 and the status of the pressure on the SUP side.

Index 102 (0x66)　Judgment LED Setting OK

It is possible to set the display of the STATUS LED when the judgment of the switch set with the LED and DO Setting (Index 101) is OK.
Reading and writing are possible with access. The data type is an unsigned 8-bit integer. It supports the data storage function. The readable and writable values are as below.
The factory setting is to light up in blue (1).

Value [dec]	Name	Description
0	OFF	Turns off
1	BLUE	Lights up in blue
2	RED	Lights up in red
3	PURPLE	Lights up in purple
129	BLINK BLUE	Blinks in blue
130	BLINK RED	Blinks in red
131	BLINK PURPLE	Blinks in purple

Index 103 (0x67)　Judgment LED Setting NG

It is possible to set the display of the STATUS LED when the judgment of the switch set with the LED and DO Setting (Index 101) is NG.
Reading and writing are possible with access. The data type is an unsigned 8-bit integer. It supports the data storage function.
Refer to Judgment LED Setting OK (Index 102) for the readable and writable values. The factory setting is to light up in red (2).

8. IO-Link Specifications

8-10. On-request Data (11/12)

8-10-2. Data Unique to the Product (8/9)

Index 104 (0x68)   Alarm LED Setting OK

It is possible to set the display of the ALARM LED when the switch set with the LED and DO Setting (Index 101) is Supply OK.

Reading and writing are possible with access. The data type is an unsigned 8-bit integer. It supports the data storage function.

Refer to Judgment LED Setting OK (Index 102) for the readable and writable values. The factory setting is to light up in blue (1).

Index 105 (0x69)   Alarm LED Setting 205kPa

It is possible to set the display of the ALARM LED when the switch set with the LED and DO Setting (Index 101) is the 205 kPa Alarm.

Reading and writing are possible with access. The data type is an unsigned 8-bit integer. It supports the data storage function.

Refer to Judgment LED Setting OK (Index 102) for the readable and writable values. The factory setting is to blink in red (130).

Index 106 (0x6A)   Alarm LED Setting 100kPa

It is possible to set the display of the ALARM LED when the switch set with the LED and DO Setting (Index 101) is the 100 kPa Alarm.

Reading and writing are possible with access. The data type is an unsigned 8-bit integer. It supports the data storage function.

Refer to Judgment LED Setting OK (Index 102) for the readable and writable values. The factory setting is to light up in red (2).

Index 107 (0x6B)   Alarm LED Setting +10kPa

It is possible to set the display of the ALARM LED when the switch set with the LED and DO Setting (Index 101) is the +10 kPa Alarm.

Reading and writing are possible with access. The data type is an unsigned 8-bit integer. It supports the data storage function.

Refer to Judgment LED Setting OK (Index 102) for the readable and writable values. The factory setting is to blink in purple (131).

Index 108 (0x6C)   Alarm LED Setting -10kPa

It is possible to set the display of the ALARM LED when the switch set with the LED and DO Setting (Index 101) is the -10 kPa Alarm.

Reading and writing are possible with access. The data type is an unsigned 8-bit integer. It supports the data storage function.

Refer to Judgment LED Setting OK (Index 102) for the readable and writable values. The factory setting is to blink in purple (131).

8. IO-Link Specifications

8-10. On-request Data (12/12)

8-10-2. Data Unique to the Product (9/9)

Index 109 (0x6D) DO Setting

It is possible to set the DO signal digital output format. Reading and writing are possible with access. The data type is an unsigned 8-bit integer. It supports the data storage function.
The readable and writable values are as below. The factory setting is digital output disabled (0).

Value [dec]	Name	Description
0	Disable	Digital output disabled
1	NPN NO	NPN open collector and normal open output
2	NPN NC	NPN open collector and normal close output
3	PNP NO	PNP open collector and normal open output
4	PNP NC	PNP open collector and normal close output

Index 200 (0xC8) Master Set Command

This is the command to execute the master set of the specified switch number. The master set will not be performed when the Supply Alarm (Index 71) is either the 205kPa Alarm or 100kPa Alarm and when the Enable Judging (Index 72) is false. When the master set is completed, the STATUS LED will blink for 1.5 seconds, the ALARM LED will turn off, and the Master Sup Value (Index 69) and the Master Out Value (Index 70) will be updated. The color of the blinking STATUS LED follows the setting of Judgment LED Setting OK (Index 102). Only writing access is available. The data type is an unsigned 8-bit integer.
The readable values are as below. Specify the switch number to perform the master set according to the value to be written.

| Value [dec]	Name	Description
1~8	Switch 1~8	Performs the master set on Switches 1~8

9. Orifice Cleaning Method

(1) You will be able to see the thread groove of the orifice in the inside of the OUT port. Then, turn it in the direction shown in the diagram using a flathead screwdriver with a width of 7 mm or less.
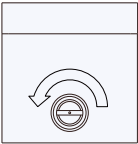
(2) If you rotate it five times or more and point the OUT port downward, the orifice and the gasket will come off. If the gasket stays inside and does not come off, remove only the orifice. Take care not to lose the orifice and the gasket when removing them.

OUT port
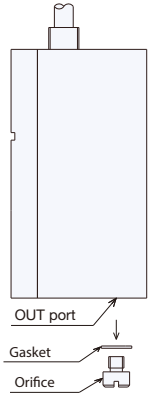
Gasket

Orifice

(3) Clean the orifice with an air blower.

Orifice
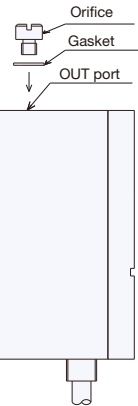
Gasket

OUT port

(4) Drop the gasket and the orifice to the inside from the OUT port.
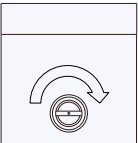
(5) Rotate and tighten in the direction shown in the diagram using a flathead screwdriver with a width of 7 mm or less (tightening torque: 3.9 N m)

10. Frequently Asked Questions (FAQ)

10-1. Specifications

Q. 1-1: Is the distance output as an absolute value.

A. 1-1: No. The identification of whether the gap is narrower or wider than the master value and each pressure value is output (p.19).

10-2. Wiring

Q. 2-1: Does the DO (white) output wire have polarity?

A. 2-1: Yes. It is open collector output of the transistor, so it has polarity. It is possible to switch the setting of the NPN and PNP from the IO-Link master. Refer to the connection examples in "6-4. Connection to the IO-Link Master" (p. 14) for the connection method.

10-3. Pressure Alarm

Q. 3-1: The ALARM LED is blinking in purple and a supply pressure alarm is occurring despite air being supplied at the time of the first startup. Is this a failure?

A. 3-1: The master set is performed at a supply pressure of 150 kPa under the factory setting. Therefore, a ±10 kPa alarm may occur according to your supply pressure. Use this product after performing the master set (p. 15 and 16).

Q. 3-2: A supply pressure alarm occurs regardless of the fact the pressure gauge indicates it is within the rated pressure range. Is this a failure?

A. 3-2: Check there are no air leaks or blockages from the pressure gauge to this product and that there are no connections of the equipment that would interfere with air flow.

10-4. Master Set

Q. 4-1: The master set is not performed even though a master set command has been sent. Is this a failure?

A. 4-1: Check that a supply pressure alarm is not occurring (P. 15). Check the Enable Judging (Index 72) (p. 25 and p. 28) of the switch number you want to perform the master set.

10. Frequently Asked Questions (FAQ)

10-5. Judgments

Q. 5-1: The LED display and the judgment output does not switch. Is this a failure?

A. 5-1: Check that a supply pressure alarm is not occurring (P. 15). There is a possibility that the master set has not been performed correctly. Check the conditions and then perform the master set again (p. 16). If there is no problem with the above points, check there is no air nozzle, leakage unit or tube blockage, that there is no air leak outside of the leakage unit from the sensor to the air nozzle, and that there is no connection of the equipment that would interfere with air flow.

Q. 5-2: The LED display switches normally, but the DO signal does not change. Is this a failure?

A. 5-2: It is possible that the output cable is not connected properly. In addition, if the output is always OFF, it is possible that it is disconnected. Refer to "6-4. Connection to the IO-Link Master" (p. 14) for the connection method.

Q. 5-3: The repeatability stated in the specifications table is not produced? Why?

A. 5-3: The repeatability stated in the specifications is a guaranteed value under the recommended conditions. Refer to the recommended values for the gap, tube and air nozzle shape. If you wish to use values other than those, judge the advisability of use upon verification in your actual environment.

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