

**Smart ESD Device
700 Series for Safety
Instrumented Systems**

Model AVP77_/78_/79_

User's Manual



Azbil Corporation

Important

- Make sure that this manual is delivered to the user of this product.
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 - The contents of this manual are subject to change without notice.
 - Although we have taken all possible measures to ensure the accuracy of this manual, please contact us if you find any errors or missing information.
 - Note that we cannot be held responsible for the results of device operation by the customer.
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Introduction

Thank you for purchasing our Smart emergency shutdown (ESD) device. Model AVP77_/78_/79_ supports the safety instrumented systems (SIS), and is a smart ESD Device that can connect to signal lines of 4-20 mA DC, 0-20 mA DC or 0/24 V DC.

The auto setup function makes it easy to set up the valve.

You can use the HART communication to conduct various adjustments and settings, and use the local user interface (LUI), which is composed of an LCD (liquid crystal display) and operation buttons, to easily monitor and conduct basic adjustments of the input signal, valve opening, pressure displays, as well as activate and verify the result of the PST (partial stroke test).

Furthermore, the built-in pressure sensor can be used to measure the supply air pressure and output air pressure. With this, you can not only use this equipment for self diagnosis, but can also combine with “Valstaff,” a valve maintenance support system, to monitor valve’s characteristics, operating condition, etc., which will contribute to the valve’s maintenance efficiency. This user manual explains how to handle the equipment. Please use this manual to optimize the characteristics of this product.

Scope of this manual and related documents

This manual describes functions, as well as the installation and adjustment procedures.

For handling that is subject to conditions that are in line with the functional safety standards of IEC 61508 or IEC 61511, please refer to the safety manual that is included in the package of this device.

For details on HART communication, please refer to “Safety Instrumented Systems (SIS) Specification - Communication Specification” (No. CM2-AVP772-2002 (T.B.D)*).

For details on valve diagnostic criteria, please refer to “Control Valve Diagnosis Function Manual” (No. CM2-AVP700-2003).

* For any questions regarding the detail, please contact the office listed at the end of this manual.

Safety precautions

■ Symbols

The purpose of the safety precautions listed here is to ensure the user uses the product safely and correctly, to prevent harm to the user and other people and damage to property. Make sure to observe the safety precautions.

Many different symbols are used in this manual.

Their appearance and meaning are described below. Thoroughly understand the explanation before starting to read the main text.



Warning Wrong handling may cause the death or severe injury of the user.



Caution Wrong handling may cause a minor injury to the user or damage to equipment.

■ Sample symbols





	This symbol indicates warnings and cautions for handling the device.
	This symbol indicates prohibited actions that must not be taken.
	This symbol indicates instructions for an action that must be taken.













■ Conventions used in this instruction manual





Handling Precautions : This symbol indicates a point to be noted when handling the device.

Precautions for safe work

 Warning	
	Do not perform wiring with wet hands or while the device is energized. This may lead to electric shock. Turn the power off before starting the work and work with dry hands or use gloves.
	Follow the work procedure defined in the explosion protection guidelines of countries when performing the power distribution work in an explosion-proof area.
	For devices equipped with the pressure-resistant, explosion-proof specifications, open/close the explosionproof enclosure and the cover according to "Chapter 7 Notes on the Explosion-Proof".

 Caution	
	Do not get on the installed device or use it as a step stool. This is dangerous because the device may tip over.
	Do not touch the device during operation without reason. This is dangerous because the surface may be hot or cold depending on the usage environment.
	Be careful not to touch the edge of the cover or the screw threads of the main unit when opening the cover of the terminal box. You may be injured by these parts.
	Use a DC power supply with overload protection. Overload may cause smoke or fire.
	If a tool or other item touches the glass part of the display, it may break, leading to an injury. Be careful. Wear safety glasses during work.
	This product is heavy. Be careful where you step and wear safety shoes during work.
	Do not touch the feedback lever or other moving parts while the device is operating. You may be injured by getting your hand or other body part caught in them.
	Properly use the power supply based on the specifications. Inputting a different power supply may damage the device.
	Use gloves and other protective equipment during work in a hot, cold, or other severe environment.
	Do not bring magnets or magnetic screwdrivers near the device. They may activate the valve.
	Supply appropriate air pressure according to the specifications. Too much pressure may cause abnormal valve function, damage to the pressure gauge, etc.

Precaution for disposal of Electrical and Electronic Equipment

<p>Disposal of Electrical and Electronic Equipment (for Environmental Protection) This is an industrial product subject to the WEEE Directive. Do not dispose of electrical and electronic equipment in the same way as household waste. Old products contain valuable raw materials and must be returned to an authorized collection point for correct disposal or recycling.</p>	 
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Unpacking, Verification, and Storage of Product

Unpacking



This device is precision measuring equipment. Carefully handle it to prevent accidents or damage. After unpacking, check that the items below are included.

- The device
- Feedback lever and hexagon socket bolts × 2
- (4 mm) hexagon wrench × 1 (for feedback lever).
(Included only when the device is shipped alone.)
- Regulator (optional)
- Mounting plate set (optional)
- Pressure-resistant packing cable adapter and pressure-resistant elbow
(option for explosion-proof specifications)
- Instruction manual (this document) (included if specified at the time of purchase.)
- Safety manual
- Extension lever and hexagon socket bolts × 2 (optional)

Specifications check

Specifications are written on the product nameplate. Furthermore, please verify that the phrase “Smart ESD Device for SIS” is printed on the front cover. Verify that all ordered items are present. Please especially take note of the following.

- Tag No.
- Model
- Production No. (PROD.)
- Input current range (INPUT)
- Supply air pressure (SUPPLY)
- Explosion protection certification seal (for explosion-proof specifications)
- Functional Safety Authorization FS Symbol

 Warning
 For use in an explosion-proof area, be sure to select a model that satisfies the necessary explosion-proof requirements. Non-explosion-proof products cannot be used in an explosion-proof area.

Contact

If any part of the specification is unclear, please contact our service representative. When contacting us, please always have your model number and production number ready.

Storage

When storing the device after purchase, observe the following precautions.

- When storing the device before it has been used
 1. Store the device as packed at shipment.
 2. Store the device at an indoor location with little vibration or shocks and at normal temperature and humidity (about 25 °C, 65 %RH).
- When storing the device after it has been used
 1. Tightly secure the terminal box cover and block the conduit connection port with tape to prevent humidity intrusion.
 2. Block the three pneumatic piping connection ports (SUP, OUT1 and OUT2) with tape to prevent humidity and dust intrusion.
 3. Pack the device in the same way as at shipment.
 4. Store the device at an indoor location with little vibration or shocks where it will not be exposed to rain or water and at normal temperature and humidity (about 25 °C, 65 %RH).

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Chapter 1 Structure of the Control System

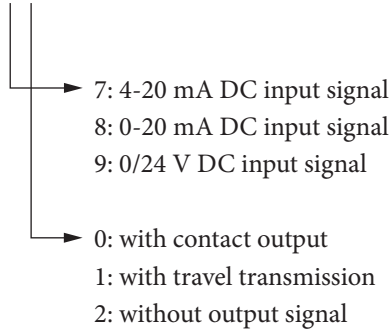
This chapter describes device configuration in a control system that uses the device.

- Description of the configuration of the input/output system of the device
- Description of the structure of the main unit of the device and the name and function of each part

1-1 Model Number Configuration

Smart ESD Device 700 Series for Safety Instrumented Systems

Model AVP7



1-2 System Configuration

This device is a smart ESD device that can be connected to 4-20 mA DC, 0-20 mA DC, or 0/24 V DC controller output signal lines. Various adjustments can be done electronically, so the relationship between input signals and valve travel can be set to any desired value. In addition, having a 4-line connection enables the output of the amount of valve travel to a host monitoring system via 4-20 mA DC analog signal, as well as the transmission of failure output to the monitoring system via burnout indication of the contact output signal or the travel transmission signal. (Model AVP7_1 have travel transmission, and Model AVP7_0 have contact output.)

The basic concept of a valve control system using this device is shown in the following diagram.

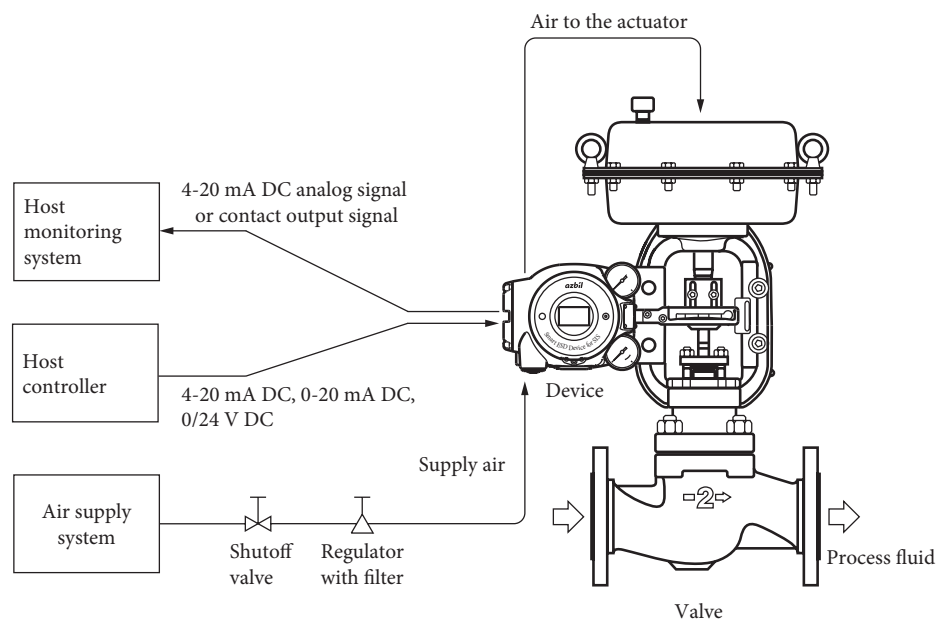


Figure 1-1. Concept Diagram of Control System

1-3 System Configuration (Model AVP7_2) without Output Signal

1-3-1 In the Case of Current Signal Input

Illustrates the system configuration for Model AVP772/782.

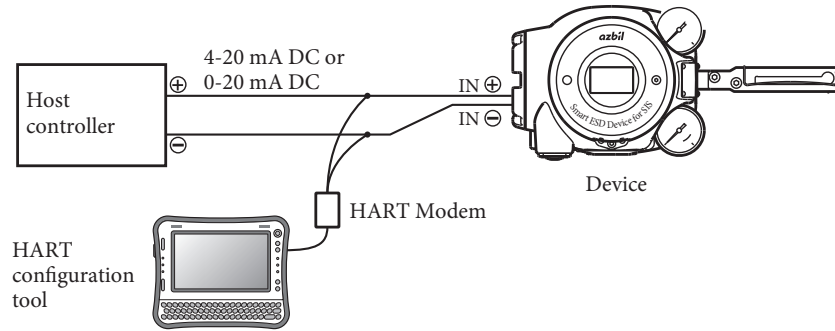


Figure 1-2. System Configuration with Current Signal Input without Output Signal (Model AVP772/782)

1-3-2 In the Case of Voltage Signal (0/24 V DC)

Illustrates the system configuration for Model AVP792.

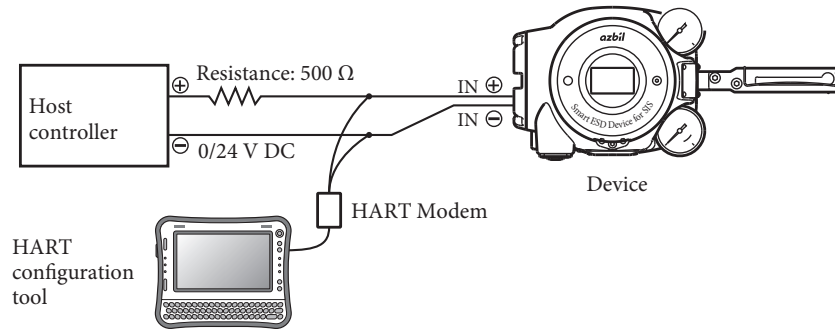


Figure 1-3. System Configuration With Voltage Signal Input without Output Signal (Model AVP792)

1-4 System Configuration with Travel Transmission (Model AVP7_1)

Model AVP7_1 has a function for transmitting the amount of valve travel.

This travel transmission signal will change to burnout indication (failure output) in the preset direction when an abnormality of this device or the valve is detected during self-diagnosis or in the PST (partial stroke test).

To output the travel signal to the host monitoring device using analog values, configure the system with travel transmission.

Normally, travel of 0 % and 100 % is output at 4 mA and 20 mA, respectively.

Failure output is

LO side: less than 3.6 mA

HI side: greater than 21 mA.

The following is an example of system configuration.

With this system configuration, analog signals are output directly to the host monitoring system from this device.

1-4-1 In the Case of Current Signal Input

Illustrates the system configuration for Model AVP771/781.

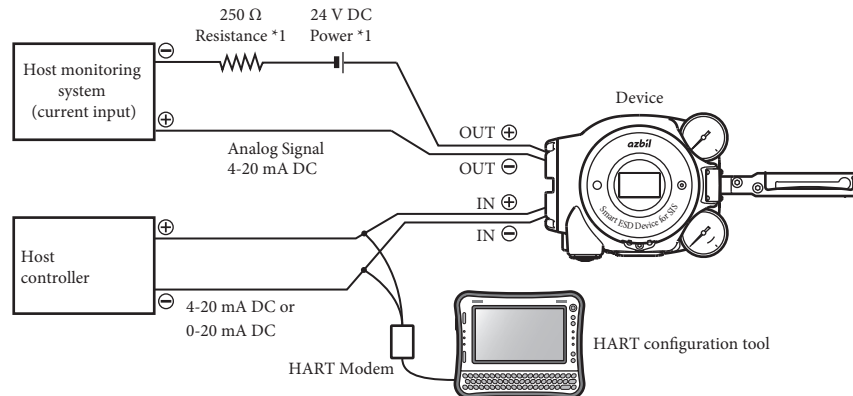


Figure 1-4. System Configuration with Current Signal Input and Travel Transmission Signal (Model AVP771/781)

1-4-2 In the Case of Voltage Signal (0/24 V DC)

Illustrates the system configuration for Model AVP791.

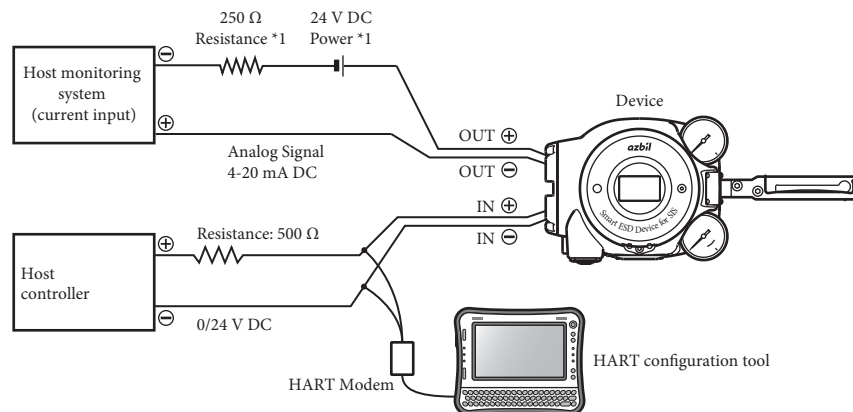


Figure 1-5. System Configuration with Voltage Signal Input and Travel Transmission Signal (Model AVP791)

*1. For details on power and resistance, please refer to section 2-3-4, "Input Signal and Output Signal Power"

1-5 System Configuration with Contact Output (Model AVP7_0)

Model AVP7_0 has a function for transmitting a contact output signal.

This contact output is not related to valve travel, but rather transmits failure output when an abnormality of this device or of the valve is detected during self-diagnosis or in the PST (Partial Stroke Test).

Normal output: closed. Failure output: open.

The following is an example of system configuration.

With this system configuration, contact output is output directly to the host monitoring system from this device.

1-5-1 In the Case of Current Signal Input

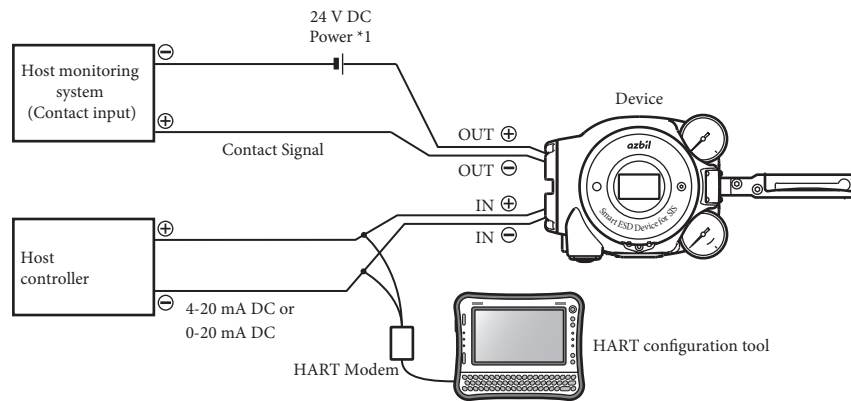


Figure 1-6. System Configuration with Current Signal Input and Contact Output Signal (Model AVP770/780)

1-5-2 In the Case of Voltage Signal (0/24 V DC)

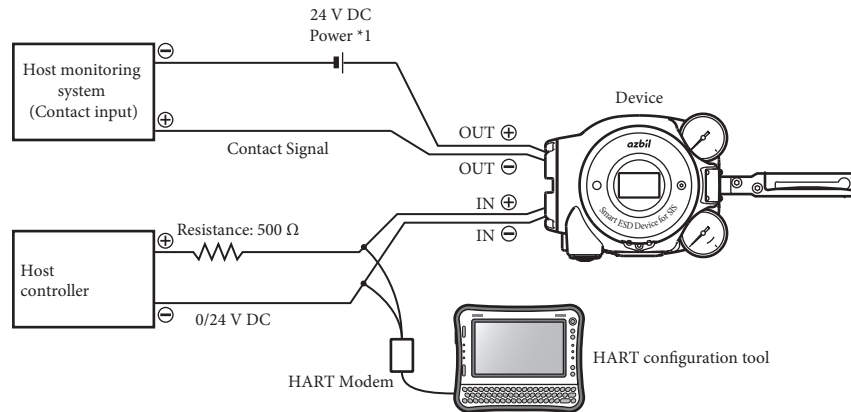


Figure 1-7. System Configuration with Voltage Signal Input and Contact Output Signal (Model AVP790)

*1. For details regarding the power, please refer to section 2-3-4, "Input Signal and Output Signal Power."

1-6 Structure of the Device and Description of Each Part

Structure of the Device

■ Major components

The structure of the main unit of the device is shown in the figure below.

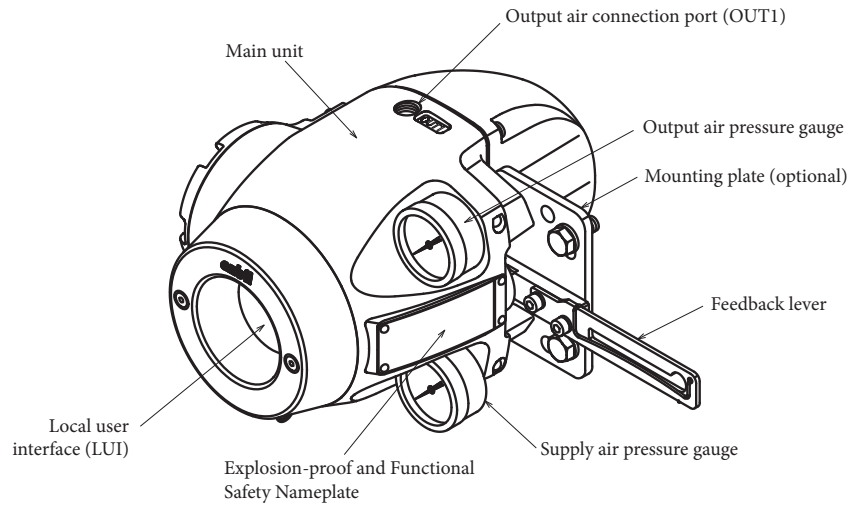


Figure 1-8. Structure of the Device (Top)

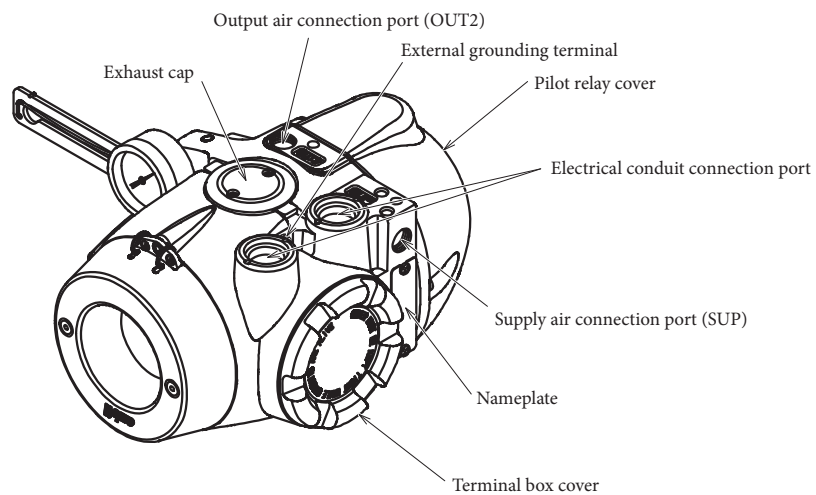


Figure 1-9. Structure of the Device (Bottom)

■ Name and description of each part

The table below describes each part.

Table 1-1. Description of Each Part

Name	Description
Main unit	<ul style="list-style-type: none"> Houses electronic circuits, an electro-pneumatic transducer (EPM), a position sensor (VTD), and a pressure sensor.
Pilot relay cover	<ul style="list-style-type: none"> Cover of the pilot relay that amplifies the air signal from the EPM (electro-pneumatic transducer) and transduces it into the air signal sent to the actuator. To adjust the balance pressure to switch between the pilot relay for the single-acting actuator and the pilot relay for the double-acting actuator, remove this cover.
Auto/Manual (A/M) switch	<ul style="list-style-type: none"> This switch is used to switch how the output air between the auto operation status and the manual operation status is controlled. This switch is built into the pilot relay. This switch can be seen by removing the pilot relay cover.
Feedback lever	<ul style="list-style-type: none"> Detects the valve lift and relays it to VTD (position sensor).
Local user interface (LUI)	<ul style="list-style-type: none"> The LUI allows you to adjust the zero / span, perform auto setup, and manually operate the device with the LCD (liquid crystal display) and operation buttons without using the communicator.
Supply air pressure gauge	<ul style="list-style-type: none"> Indicates the pressure of the supply air.
Output air pressure gauge	<ul style="list-style-type: none"> Indicates the pressure of the output air.
Supply air connection port (SUP)	<ul style="list-style-type: none"> Supply air is input to this port. “SUP” is displayed at this port.
Output air connection port (OUT1)	<ul style="list-style-type: none"> Output air is sent out of this port to the actuator. “OUT1” is displayed at this port.
Output air connection port (OUT2)	<ul style="list-style-type: none"> Output air is sent out of this port to the actuator. This port is blocked with a blind plug in the single-acting actuator. OUT2 is displayed at the output port for the double-acting actuator.
Mounting plate (optional)	<ul style="list-style-type: none"> The mounting plate is used to mount the device onto the actuator. The shape of the mounting plate differs depending on the specifications (actuator model).

Structure of the Terminal Box

■ Major components

This contains the input signal (controller output) terminal, output signal (travel transmission or contact output) terminal, and internal ground terminal.

The structure of the terminal box is as shown below.

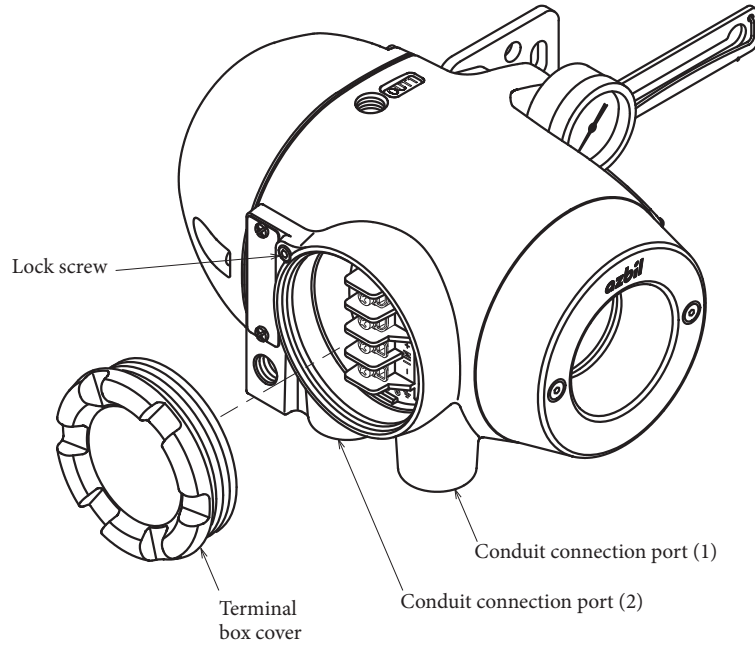


Figure 1-10. Structure of the Terminal Box

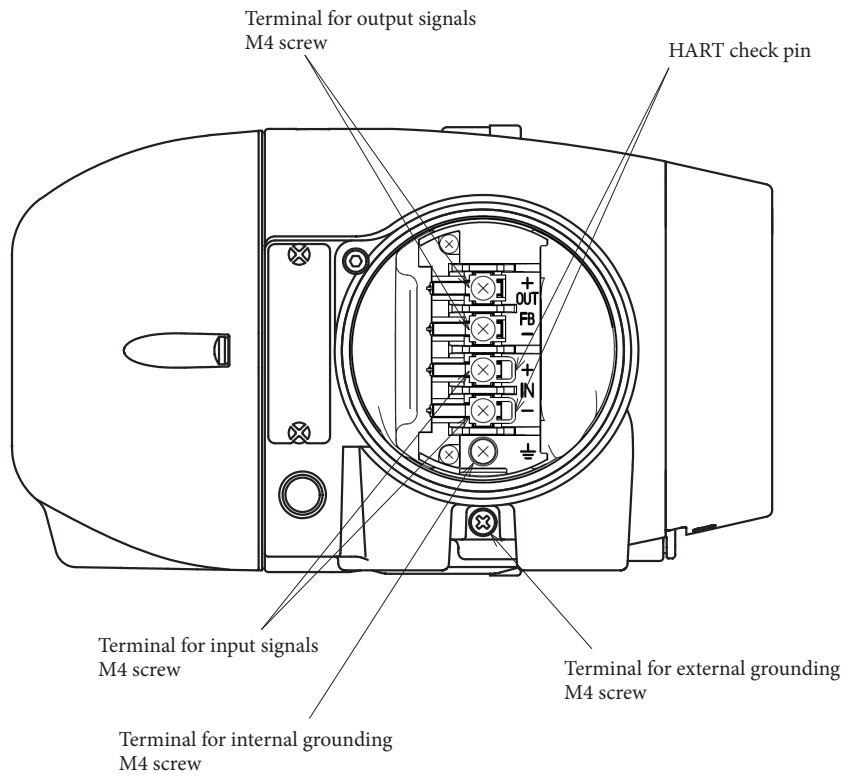




Figure 1-11. Terminal Block in the Terminal Box

■ Name and description of each part

The table below describes each part of the terminal box.

Name	Description
Terminal box cover	<ul style="list-style-type: none"> Lid of terminal box. This cover has a pressure-resistant explosion-proof structure.
Lock screw	<ul style="list-style-type: none"> Used to secure the terminal box cover.
Terminal for input signals	<ul style="list-style-type: none"> Labeled IN. Connects the signal cable from the host controller.
Terminal for output Signals	<ul style="list-style-type: none"> Labeled OUT. Connects the signal cable for output signal. The Model AVP7_2 (without output signal) does not have the terminal screws.
Internal grounding terminal	<ul style="list-style-type: none"> Internal terminal for grounding. The cable for grounding is connected to this terminal.
Conduit connection port (1)	<ul style="list-style-type: none"> Port for a cable.
Conduit connection port (2)	<ul style="list-style-type: none"> Port for a cable. This port is normally blocked with a blind plug.
Check pin for HART communication	<ul style="list-style-type: none"> By connecting the connection hook for the setting device communication cable to this pin, it is possible to communicate with this device.

 Warning
<div style="display: flex; align-items: flex-start;"> <div style="margin-right: 10px;"></div> <div> <p>When using a pressure-resistant explosion-proof model in a dangerous place, be sure to use the specified cable adapter for pressure-resistant packing for the conduit connection port. Securely close the terminal box cover all the way. Then, rotate the lock screw counterclockwise to secure the terminal box cover.</p> </div> </div>

! Handling Precautions:

Ground either the external or internal grounding terminal according to the specifications. Be careful not to ground the device at two points.

Local User Interface (LUI) Display

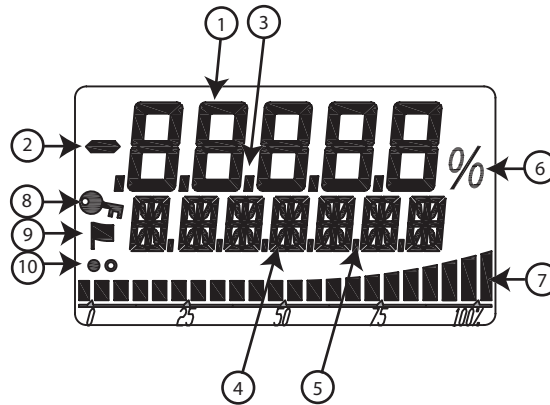


Figure 1-12. Segments of the LCD

Table 1-3. Description of Each Part

No.	Displayed element	Main display
(1)	7 segments (5 digits)	Main numerical values such as the specified opening.
(2)	Minus sign	Sign (+/-) for the 7-segment number.
(3)	Decimal point (five places)	Decimal point for the 7-segment number.
(4)	16 segments (7 digits)	The unit, status, or other data.
(5)	Dot (6 places)	Delimiter, etc., for 16-segment auxiliary display.
(6)	%	Percentage.
(7)	Bar graph (22 bars)	Bar graph showing percentage of set point, etc.
(8)	Key symbol	Displayed: LUI cannot be used Hidden: LUI is operable Flashing: LUI is busy
(9)	Flag symbol	The flag mark is displayed when the self diagnosis alarm is activated. For details on the alarm, please refer to the status monitor described on page 3-4.
(10)	Display refresh symbol	Display during operation White and black circles alternately blink while updating.

For a display example, refer to “LUI Display List” in Appendix A.

! Handling Precautions:

The LUI buttons may not respond well near an electromagnetic inductor (such as a large transformer or high-frequency furnace).

Remove sand, dust, and other foreign objects from the rubber parts of the operation buttons before operating the LUI. Operating the LUI with foreign objects on it may damage the rubber parts.

Do not pull the rubber parts of the operation buttons. This may deteriorate the adhesive property, possibly causing malfunction.

Chapter 2 Installation

This chapter describes the usage conditions, installation, piping, and wiring of the device.

2-1 Usage Conditions

Install the device in a location that satisfies the following conditions.

Be sure to use it in accordance with the specifications.

Table 2-2. Range of Usage Conditions

		Units	Basic operating conditions	Normal operating conditions	Marginal operating conditions	Transportation conditions
Operating temperature range	General model	°C	23±2	-40 to +80	-40 to +80	-40 to +70
	TIIS flameproof model	°C	23±2	-20 to +55	-20 to +55	-40 to +70
	IECEX/FM/FMC/CCC/KCs flameproof model	°C	23±2	-30 to +75	-30 to +75	-40 to +70
	FM Intrinsically Safe Explosion-Proof Type (ic)/Non-incendive Type	°C	23±2	-24 to +75	-24 to +75	-40 to +70
	ATEX/IECEX Intrinsically Safe model	°C	23±2	-40 to +60	-40 to +60	-40 to +70
	LUI	°C	23±2	0 to 50	-40 to +80	-40 to +70
Vibration	Amplitude ^{*1}	mm _{p-p}	0	15 (5 to 8 Hz)	15 (5 to 10 Hz)	15 (5 to 10 Hz)
	Acceleration ^{*1,4}	m/s ²	0	20 (8 to 400 Hz)	40 (10 to 400 Hz)	40 (10 to 400 Hz)
Friction of the valve		%	3 to 20	3 to 20	0 to 3 20 to 100	—
Supply air pressure Ps (140 kPa ≤ Ps ≤ 700 kPa)		kPa	Ps±1%	140 to 700	0 to 710	—
Installation orientation ^{*3}		°	±1 ^{*2}	±180	±180	±180
Humidity range		%RH	50±10	5 to 100	5 to 100	5 to 100

The types of operating condition are defined as follows.

- Basic operating condition: Range in which the accuracy is guaranteed
- Normal operating condition: Range in which the device normally operates
- Marginal operating condition: Range in which performance is not guaranteed but the device can be used without being permanently damaged
- Transportation condition: Environment condition range in which the non-operating device will not be permanently damaged during transportation

*1. When the positioner cover is centered in front.

*2. The status where the drive shaft of the direct acting actuator is perpendicular to the ground and that is used as the reference.

*3. The tilt characteristics are not included.

*4. Not applicable to the pressure gauge.

2-2 Selection Criteria for Installation Location

The device is designed to withstand severe conditions, but the installation location should be selected according to the criteria described below to maximize performance.

1) Selection Criteria for Installation Location

Install the device in a location that satisfies all of the following conditions.

- Operating temperature range that conforms to the explosion protection rules
- Relative humidity: 5 to 100 %RH
- Ambient temperature change rate: ± 20 °C/h or slower
- Electromagnetic induction: 400 A/m or less (avoid places near a large transducer, high-frequency furnace, or other such equipment)
- Do not use a transceiver near the device.
- Vibration: 20 m/s² (8 to 400 Hz) or less
(The vibration conditions defined for the device are vibrations at the main unit of the device.)

2) Criteria for instrumentation air

The device employs a nozzle flapper structure in the electropneumatic transduction section. If instrumentation air is contaminated (includes oil, water, or other substance), the main unit function of the device may not function properly or an irrecoverable failure may occur. Therefore, the quality of instrumentation air supplied to the device is defined as follows.

- Solid material: No particles with a diameter larger than 3 μm .
- Oil: Less than 1 ppm.
- Supply air humidity: The dew point temperature is at least 10 °C lower than that of the device. (This criterion is based on the Japanese industrial standard JIS C 1805-1 (2001).)

Select a compressor and main line or terminal-installation type compressed air purifier by referring to the above specifications.

(1) Compressed air purifier for the main line

Select a compressed air purifier for the main line, such as a main line filter or micro-alescer, to satisfy the above specifications.

Japanese compressed air purifier manufacturers: SMC Corporation and CKD Corporation

(2) Compressed air purifier to be installed on the terminal

If you cannot install the air purifier in the main line due to problems with valve setup, please install a terminal-type compressed air cleaner, and make the above specification attainable.

<Example devices>

- Products from SMC Corporation
Mist Separator, AM150 or AM250 series
(Filtering level: 0.3 μm , Secondary oil mist concentration: 1.0 mg/m^3)

- CKD Corporation
Oil mist filter, M1000 or M3000 Series
Mantle S Type (Filtering level: 0.3 μm , Remaining oil: 1.0 mg/m^3)

 Handling Precautions:




Select a compressed air purifier with specifications suited to the usage conditions. Even when you install the above oil removal equipment, it is necessary to properly inspect and maintain the air circuit section for long-term stable operation. Install the oil removal equipment before use and perform periodic inspection and maintenance.

The warranty is void if the device fails because the quality of the instrumentation air was not sufficient.

2-3 Installation Procedure

2-3-1 Attaching the 700 Series to the Actuator

This device is a smart ESD device that is used together with a valve having a direct or rotary actuator. The weight of this device is about 4.2 kg. The basic installation procedure is the same as for a conventional electric/air positioner.

 Caution	
	<p>Be careful not to get injured by sharp parts such as the edge of the main unit or actuator or screw threads during mounting. The type of mounting plate, mounting method, and mounting procedure differ depending on the actuator model to be mounted in the device.</p>
	<p>If the device is not properly mounted, not only will it not be able to operate at its true performance but it may be damaged or fail. Pay attention to the following points.</p> <ul style="list-style-type: none">• The mounting plate and its accessories differ depending on the specifications (actuator model). Be sure to use the appropriate mounting plate and accessories for the actuator to be mounted.• When installing the valve, please consider ease of maintenance (piping, wiring, adjustments, etc.) and have as much space as possible surrounding it, and orient the equipment correctly.• Deliver the device to the installation location in the packaged state if possible.• Do not apply excessive force to the feedback lever during mounting.• Do not bend the feedback pin.• Do not block the exhaust port located underneath.• Install the device so that the electrical conduit connection port does not face upward.• Securely tighten bolts.• If the pressure regulator with filter is installed with the device, install with the drain of the pressure regulator with filter facing downward. If the pressure regulator with filter cannot be attached vertically (with the drain facing downward), remove it from the device.• In order to avoid the possibility of rainwater entering the pressure gauge, install the gauge such that it does not face upward or downward. In addition, the pressure gauge has a rainwater drain on its underside, so install the gauge with this hole facing downward.

1) Mounting the feedback lever

Assemble the feedback lever from the front of the main unit of the device using the two included hexagon socket bolts.

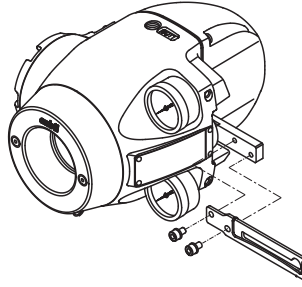


Figure 2-13. Mounting Procedure for Feedback Lever

Assemble the extension lever as shown in the figure below if necessary.

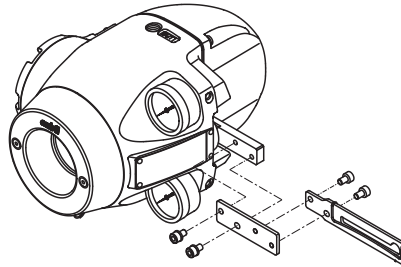


Figure 2-14. Mounting Procedure for Extension Lever

2) Mounting example

A typical mounting method is shown in the figure below. If your actuator is not shown in the figure below, refer to the assembly diagram included with the device.

[Direct-Acting Actuator HA2 to 4, PSA1 to 4, 6, VA1 to 6 from Azbil Corporation]

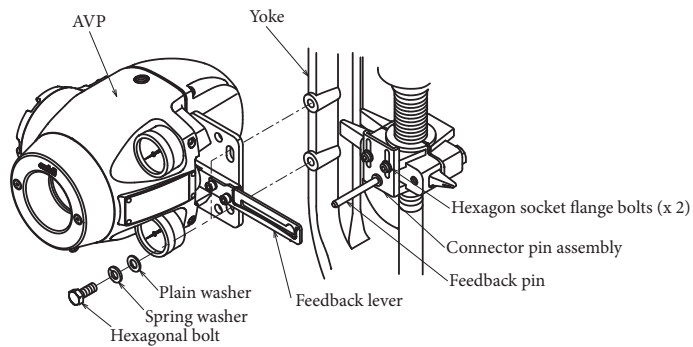


Figure 2-15. Mounting Procedure for Direct-Acting Actuator HA2 to 4, PSA1 to 4, 6, VA1 to 6 from Azbil Corporation

[RSA1, 2, VR3 actuator from Azbil Corporation]

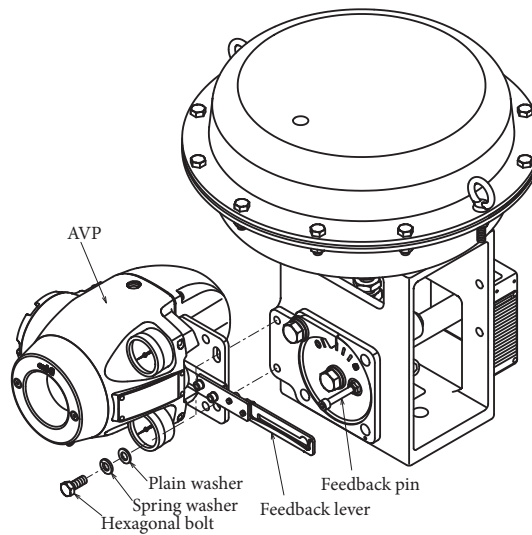


Figure 2-16. Mounting Procedure for RSA1, 2, VR3 Actuator from Azbil Corporation

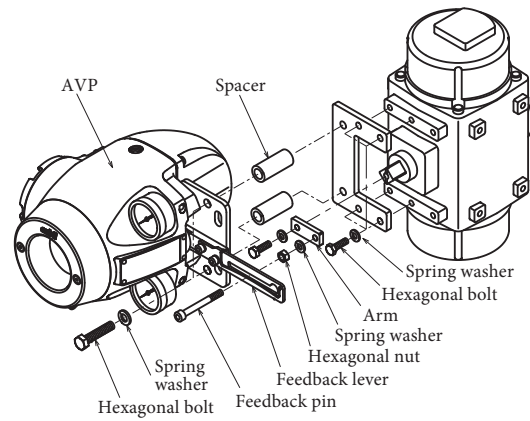
[Example of double-acting rotary cylinder actuator]

Figure 2-17. Mounting Procedure for Double-Acting Rotary Cylinder Actuator

3) Mounting procedure

The procedure for mounting the feedback lever onto the actuator is shown below.

Step	Procedure
1	Tightly secure the mounting plate by inserting hexagonal bolts (M8×20) with spring washers into the (two) screw holes at the rear of the device.
2	Tightly secure the device (mounting plate) onto the mounting seat of the actuator using bolts and washers. At this time, insert the actuator feedback pin into the slotted hole of the feedback lever in the device.

4) Connection of feedback pin and feedback lever

There are several points to be careful of when connecting the feedback lever to the device and the actuator feedback pin. Connect correctly.

- Only a pin with a diameter of 6 mm can be used.
- Insert the pin between the guide and the spring.

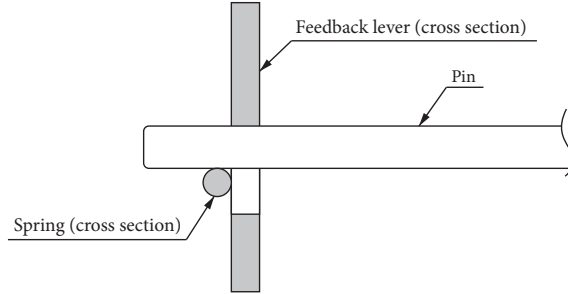


Figure 2-18. Connection of Feedback Lever and Feedback Pin

- Make the feedback lever perpendicular to the pin when viewed from the above.

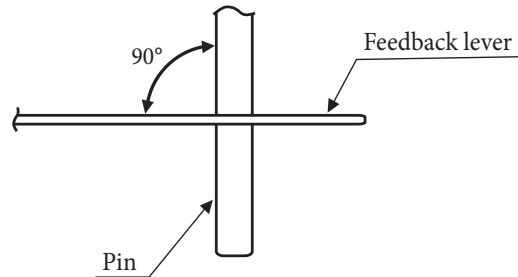


Figure 2-19. Angle between Feedback Lever and Pin

- Mount the lever so that it is horizontal when opened 50 %.

Contact us to find out how to mount the lever onto other actuators.

- The allowable rotation angle of the feedback lever is horizontal $\pm 30^\circ$. If the angle exceeds $\pm 30^\circ$, the self-diagnostic function detects VTD Travel Detector Out of Range and the device will not operate normally. (The accuracy is guaranteed when the rotation angle is between $\pm 4^\circ$ and $\pm 20^\circ$.)

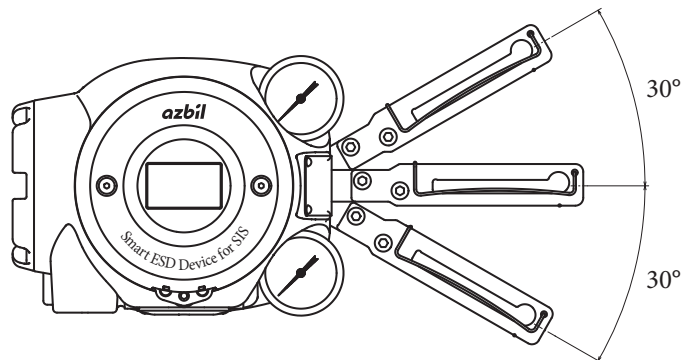


Figure 2-20. Operation Angle of Feedback Lever

- When attaching the lever to a rotary cylinder so that the shaft of the rotary cylinder is positioned between the feedback pin and the positioner as shown in the figure below, select Rotary/90° (for 90°) or Rotary/other (for angles other than 90°) as the Actuator Type according to the rotation angle.

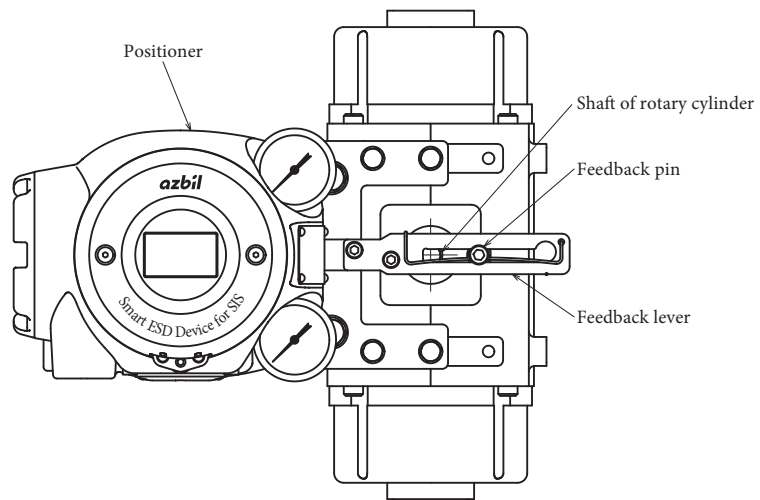


Figure 2-21. Connection of the Rotary Cylinder to the Feedback Pin and Feedback Lever

- When the rotary cylinder is large and the lever is assembled so that the feedback pin is positioned between the main unit and the shaft of the rotary cylinder as shown in the figure below, select Rotary (sub)/90° (for 90°) or Rotary (sub)/other (for angles other than 90°) as the Actuator Type according to the rotation angle.

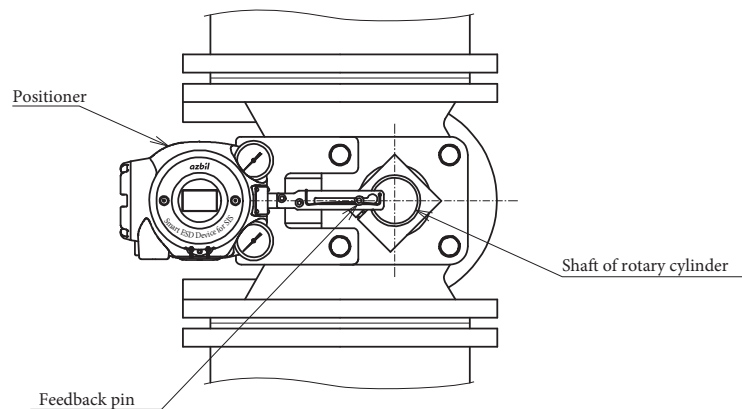


Figure 2-22. Feedback Pin and Feedback Lever Connection for Rotary Cylinder (Large Cylinder)

5) Maintenance space behind the device

The device has a nozzle flapper mechanism in the back of the main unit. When cleaning the flapper, you must remove the pilot relay cover secured to the back with three screws. Design the clamp and feedback mechanism to ensure maintenance space for cleaning.

2-3-2 Pneumatic Piping Connection

This section describes how to supply the air for the device to drive the actuator.

1) Air supply system

Supply air must be clean and dry for reliable use of the device for a long time. A typical example of an air supply system is shown in the figure below.

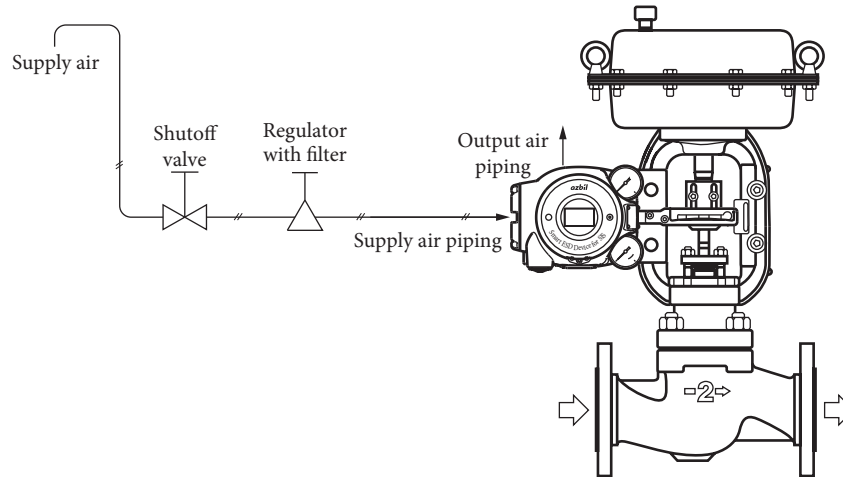


Figure 2-23. Air Supply System

2) Supply air

Use supply air that conforms to the instrumentation air standards (on page 2-3).

3) Regulator with filter

- The regulator with filter is used to adjust the pressure of the supply air to the device.
- Install the regulator as close to the main unit of the device as possible.
- The regulator can be manually operated by using the A/M switching function. (The double-acting actuator does not support manual operation.)
- Use a 3 μm or less filter.
- The filter removes solid materials from supply air.
- If the filter is not equipped, separately insert a (3 μm or less) filter immediately before the regulator.
- Install the regulator so that the drain faces downward.
- If you select the built-in Azbil regulator, the filter is built into the device before shipment.

4) Shutoff valve

- The shutoff valve is used to temporarily stop supplying air to the device.
- During maintenance, you can dismantle the equipment and valve without stopping the whole air supply system.

5) Piping

- Use piping with an inside diameter of 6 mm.
- When using the device in a corrosive atmosphere, select piping appropriate for the environment of the installation location. For example, you may use vinyl-coated copper pipe.
- To prevent air leaks, please always use plumbing coupling that fits the piping to be used.

6) Connection positions

The positions of the supply air connection port and output air connection port are shown in the figure below. Select the dimensions of the connection port screws according to the specifications.

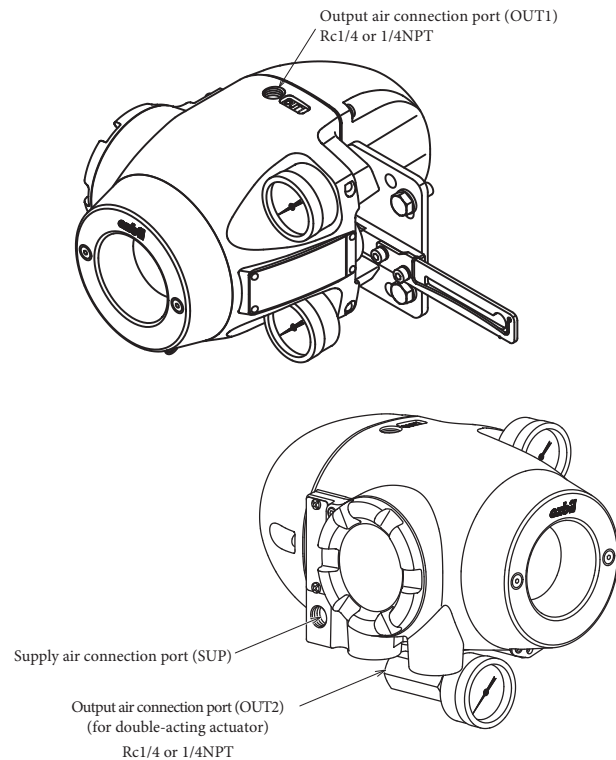


Figure 2-24. Pneumatic Piping Connection

! Handling Precautions:

When connecting the electromagnetic valve for emergency shutoff, air valve, or other part, install it between the output air connection and the actuator rather than the supply air connection side of the device.




7) Mounting procedure

The procedure for connecting pneumatic piping to operate the device is shown below.

Step	Procedure
1	<p>Connect the joint for piping to the connection port using seal tape.</p> <p>! Handling Precautions:</p> <ul style="list-style-type: none"> • Use seal tape as the seal material. Avoid using solid or liquid seal material if possible. • Do not let the seal tape get in the piping. • If you do use a liquid seal, make sure that no drops of the seal material get into the piping.
2	<p>Connect the supply and output pipes to each joint in consideration of the arrangement of the piping.</p> <p>! Handling Precautions:</p> <ul style="list-style-type: none"> • For the double-acting actuator, the connection between output air connection ports OUT1 and OUT2 and the actuator is determined by the valve operation. Check the valve operation before connecting pipes. • Sufficiently flush piping before connection to prevent burrs on the piping or other foreign objects from getting in the piping. • Keep the output air piping as short as possible.
3	<p>After all piping is complete, make sure that air does not leak.</p>

2-3-3 Electrical Wiring Connection

This section describes the methods for electrical wiring for signal input from the controller and signal output to the monitoring system.

Warning	
	Turn the power off before starting wiring work. Otherwise, electric shock may occur.
	When using the explosion-proof model in a dangerous place, be sure to connect the wiring while following Chapter 7, "Precautions for the Explosion-Proof Model."
Caution	
	Be sure to perform grounding work following the electrical work guidelines for the local region.

Handling Precautions:

Be sure to attach a blind plug to the unused conduit connection port so that it is completely covered.

1) Connection positions

The figure below shows the terminal block in the terminal box.

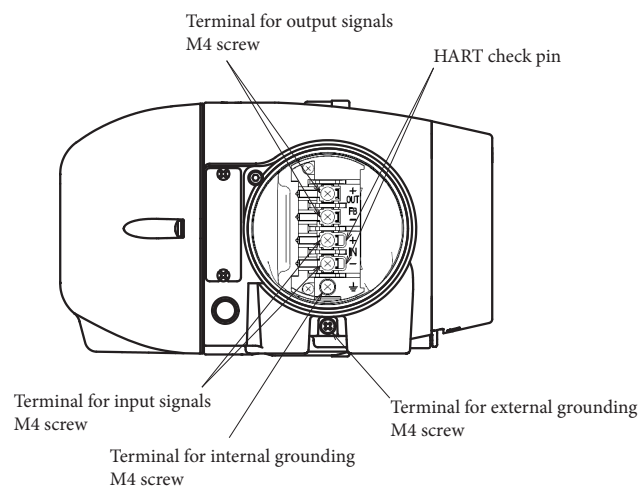


Figure 2-25. Terminal Block in the Terminal Box

2) Terminal for external grounding

Connect the external grounding terminal to the case with two washers as follows.

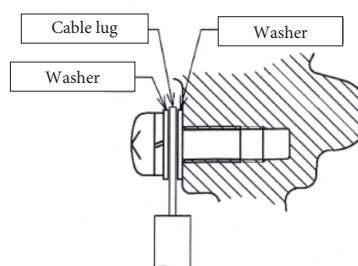
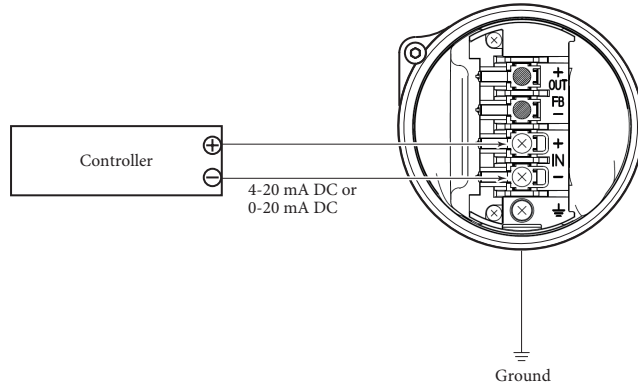


Figure 2-26. Connection of External Grounding Terminal

3) Electrical wiring of Model AVP7_2 without output signal

3-1) In the case of Model AVP772/782 with current signal input

Remove the terminal box cover and connect the wires as shown in the figure below.

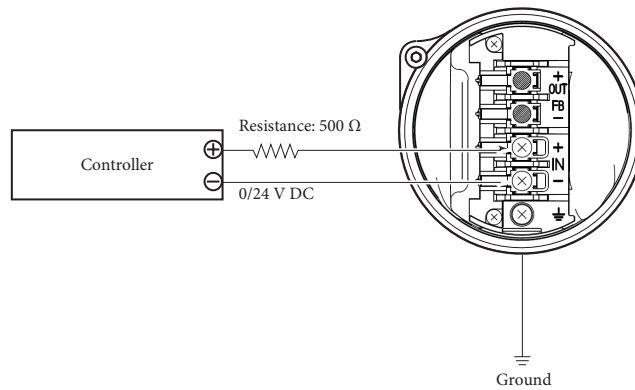


- Use only one of the two ground terminals (internal or external) and do the grounding work according to all local laws and ordinances governing electrical work.

Figure 2-27. Electrical Wiring with Current Signal Input without Output Signal (2-conductor Cable)

3-2) In the Case of Voltage Signal (0/24 V DC) (Model AVP792)

Remove the terminal box cover and connect the wires as shown in the figure below.



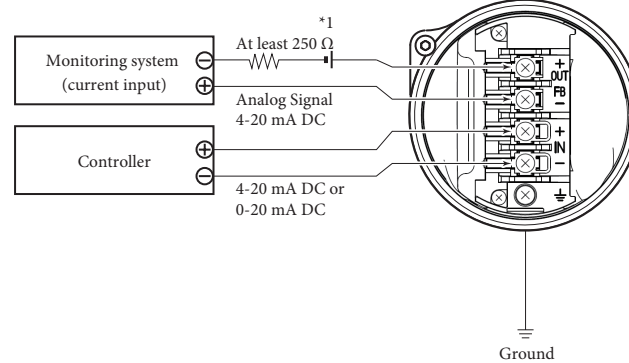
- Use only one of the two ground terminals (internal or external) and do the grounding work according to all local laws and ordinances governing electrical work.

Figure 2-28. Electrical Wiring with Voltage Signal Input without Output Signal (2-conductor Cable)

4) Electrical Wiring with Travel Transmission (Model AVP7_1)

4-1) In the case of Model AVP771/781 with current signal input

Remove the terminal box cover and connect the wires as shown in the figure below.

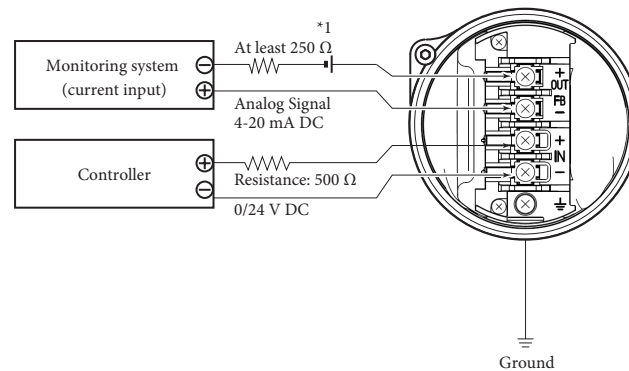


- Use only one of the two ground terminals (internal or external) and do the grounding work according to all local laws and ordinances governing electrical work.

Figure 2-29. Electrical Wiring with Current Signal Input and Travel Transmission (4-conductor Cable)

4-2) In the Case of Voltage Signal (0/24 V DC) Input (Model AVP791)

Remove the terminal box cover and connect the wires as shown in the figure below.



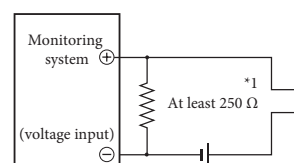
- Use only one of the two ground terminals (internal or external) and do the grounding work according to all local laws and ordinances governing electrical work.

Figure 2-30. Electrical Wiring with Voltage Signal Input and Travel Transmission (4-conductor Cable)

*1. For details on power and resistance, please refer to section 2-3-4, "Input Signal and Output Signal Power."

4-3) When the monitoring system is using voltage input (1-5 V)

Please conduct the wiring as follows.



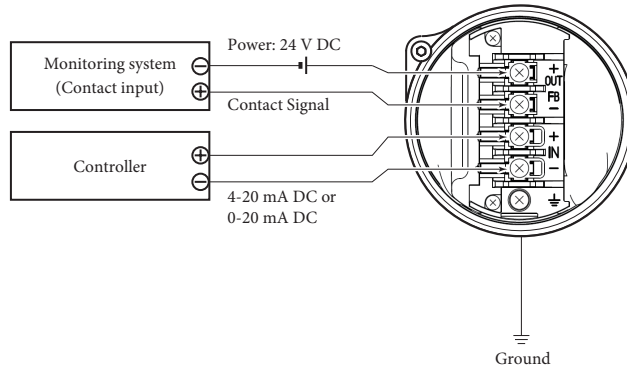
*1. reference Figures 2-22

Figure 2-31. Electrical wiring for monitoring system that uses a voltage input

5) Electrical wiring for contact output (Model AVP7_0)

5-1) In the case of Model AVP770/780 with current signal input

Remove the terminal box cover and connect the wires as shown in the figure below.

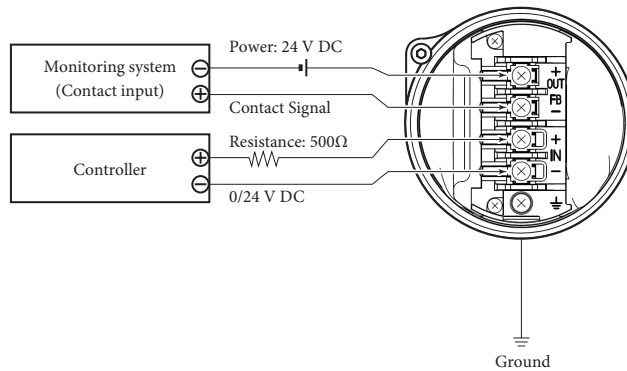


- Use only one of the two ground terminals (internal or external) and do the grounding work according to all local laws and ordinances governing electrical work.

Figure 2-32. Electrical Wiring with Current Signal Input and Contact Output (4-conductor Cable)

5-2) In the Case of Voltage Signal (0/24 V DC) Input (Model AVP790)

Remove the terminal box cover and connect the wires as shown in the figure below.



- Use only one of the two ground terminals (internal or external) and do the grounding work according to all local laws and ordinances governing electrical work.

Figure 2-33. Electrical Wiring with Voltage Signal Input and Contact Output (4-conductor Cable)

2-3-4 Input Signal and Output Signal Power

1) Input signal

There are the following three types of input signals to this device.

- 4-20 mA DC (Model AVP77_)
- 0-20 mA DC (Model AVP78_)
- 0/24 V DC (Model AVP79_)

These input signals are also used as the power source to drive the internal circuits.

The input signal specification of the device differs depending on the SIS positioner mode. The SIS positioner mode has a positioning mode that controls the valve travel, and an ON/OFF mode that fully closes or opens the valve.

When the device is used for an emergency shutdown valve (or the emergency open valve), please set the SIS positioner mode to an ON/OFF mode.

When the device is used for a control valve, please set the SIS positioner mode to a positioning mode. (For details regarding the modification of the settings of the SIS positioner mode, please refer to section 4-2-9, "SIS Positioner Mode")

Table 2-3. Input Signal Specification

When used for an emergency shut down valve (or the emergency open valve) (when the SIS positioner mode is set to ON/OFF mode)

Basic Model No.	Input Specification	Emergency Operation		Normal Operation		PST Execution (Feasibility)
		Input Signal	Output Air Pressure	Input Signal	Output Air Pressure	
Model AVP77_	4-20 mA DC	3.84-4.48 mA DC	0*	12-20 mA DC	Maximum Pressure	PST Executable
Model AVP78_	0-20 mA DC	Less than 0.5 mA DC		24±4.8 V DC		
Model AVP79_	0/24 V DC	Less than 0.5 V DC				

If used for a control valve (When the SIS positioner mode is in positioning mode)

Basic Model No.	Input Specification	Emergency Operation		Normal Operation		PST Execution (Feasibility)
		Input Signal	Output Air Pressure	Input Signal	Output Air Pressure	
Model AVP77_	4-20 mA DC	3.84-4.48 mA DC	0*	5.6-20 mA DC	Control Pressure	PST Not executable
Model AVP78_	0-20 mA DC	Less than 0.5 mA DC		4-20 mA DC		

*: For double-acting units, OUT1's pressure will be at 0, and OUT2's will be at supplied air pressure.

Operation cannot be guaranteed with an input signal outside of these ranges.

! Handling Precautions:

- When operating with current input, do not go over 24 mA DC.
- When operating with voltage input, do not apply more than 30 V DC.
- When Model AVP77_ are operated by the positioning mode, the output air pressure is 0 if the input signal falls to less than 5.6 mA. Accordingly, use Model AVP78_ if you need positioning with an input signal in the 4-20 mA range.

2) Travel Transmission Power

The travel transmission power is 17.9–45 V DC.

The load resistance for connections to the travel transmission loop should fall within the operating range shown below for the power voltage used.

! Handling Precautions:

Do not apply a travel transmission power greater than 45 V DC.

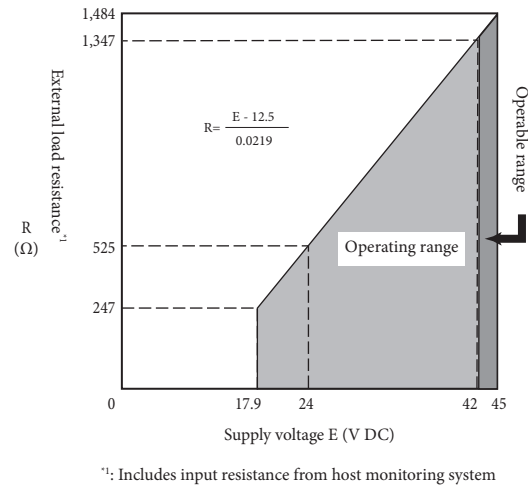


Figure 2-34. Voltage for the Travel Transmission vs. Load Resistance Characteristics

3) Power for contact output

- Contact capacity: 30 V DC max, 100 mA DC max
- Saturation voltage: 5 V DC max

2-3-5 Cables (For Input or Output Signal)

1) Selection and conditions of cables

The criteria for selection and the condition of cables for wiring are described below.

- We recommend using “CVV” 600 V PVC- insulated sheath control cable (Japanese industrial standard JIS C 3401) with a conductive cross-sectional area of 1.25 mm² or a stranded cable with equivalent or higher performance.
- When routing cable in a place subject to electromagnetic noise, use “CVVS” shielded wire (standard JCS 4258 of the Japanese Electric Wire & Cable Makers’ Association).
- Select a sheath material that withstands the cable installation environment (including the ambient temperature, corrosive gas, and corrosive liquid).
- Use cable with an outside diameter of 7 to 12 mm. When using a pressure-resistant packing cable adapter, be sure to use packing appropriate for the outside diameter of the cable.
- Crimp terminals with insulated sleeve (for M4 screw) are recommended for terminals.
- The maximum permissible cable length is 1500 m.

2) Cable installation

Comply with the following when installing cables between this device and the actuator.









- Avoid installing cables near devices that generate electrical noise such as large capacity transformers, motors, or power sources for motors.
- Do not install cables in the same tray or duct with other power cables for motors.
- We recommend the use of conduits and ducts to prevent water and mechanical damage to electrical lines. Also, always use water-tight glands at conduit connection ports.
- Use conduits and ducts for locations exposed to electromagnetic noise.
- When using shielded cable, the cable must be grounded at a single point on the DCS side.

Handling Precautions:

The device is intended for use in industrial locations defined in CE marking directive (EN 61326-1).

3) Wiring procedure

The procedure for electrical wiring to operate the device is shown below.

Step	Procedure
1	Loosen the locking bolts (M4) on the terminal box cover with a hex wrench (3). (Turn the bolts clockwise.)
2	Rotate the terminal box cover counterclockwise to remove it.  Handling Precautions: Be careful not to damage the paint with a tool or other object.
3	Remove the dust-proof plug from the conduit connection port.
4	Insert the cable into the conduit connection port.  Handling Precautions: Be careful not to damage the sheath of the cable.
5	Wire the cable to the relevant terminal in the terminal box.  Handling Precautions: <ul style="list-style-type: none"> • Be careful of the polarity. • Sufficiently tighten the terminal screw. The recommended tightening torque is 1.5 N·m.
6	Apply sufficient waterproofing treatment to the conduit to prevent rainwater or other liquid from entering inside.  Handling Precautions: We recommend using silicone non-hardening sealant.
7	Mount the terminal box cover, sufficiently tighten it with an appropriate tool, and then secure the cover by rotating the lock screw counterclockwise. <div style="border: 1px solid black; padding: 5px; margin: 5px 0;"><div style="text-align: center;"> Caution</div><div style="display: flex; justify-content: space-between;"><div style="text-align: center;"> Be careful not to get your finger caught in the clamp.</div><div style="text-align: center;"> Be careful not to hurt your finger with the edge of cover or the screw threads of the main unit.</div></div></div>  Handling Precautions: Be careful not to damage the paint of the device with a tool or other object.

Handling Precautions:

The input resistance of Model AVP77_/78_ is equivalent to 600 Ω . At 20 mA DC, it would require an inter-terminal voltage of at least 12 V. Check the controller's allowable load resistance and the output voltage. Note that when the controller's allowable load resistance is less than 600 Ω , an isolator or similar device should be used.

2-4 Cable gland and flameproof universal elbow for TIIS flameproof apparatus

The TIIS flameproof models are provided with a certified cable gland. The cable gland seals the cable entering the positioner's case to withstand an internal explosion and protects the cable from being damaged mechanically and electrically. Use the specially designed elbow if it is necessary to change the direction of the cable with these models.

! Handling Precautions:

Cable Entry Device other than the TIIS Explosion-proof Model

If this device received explosion-proof certification other than TIIS flameproof certification, and if you wish to use it, please connect the cable according to the regional electrical wiring work guidelines.

1) Structure of the flameproof cable gland

The flameproof cable gland is shown below in assembled and exploded views.

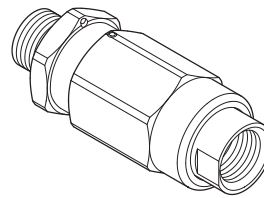


Figure 2-35. Flameproof Cable Gland

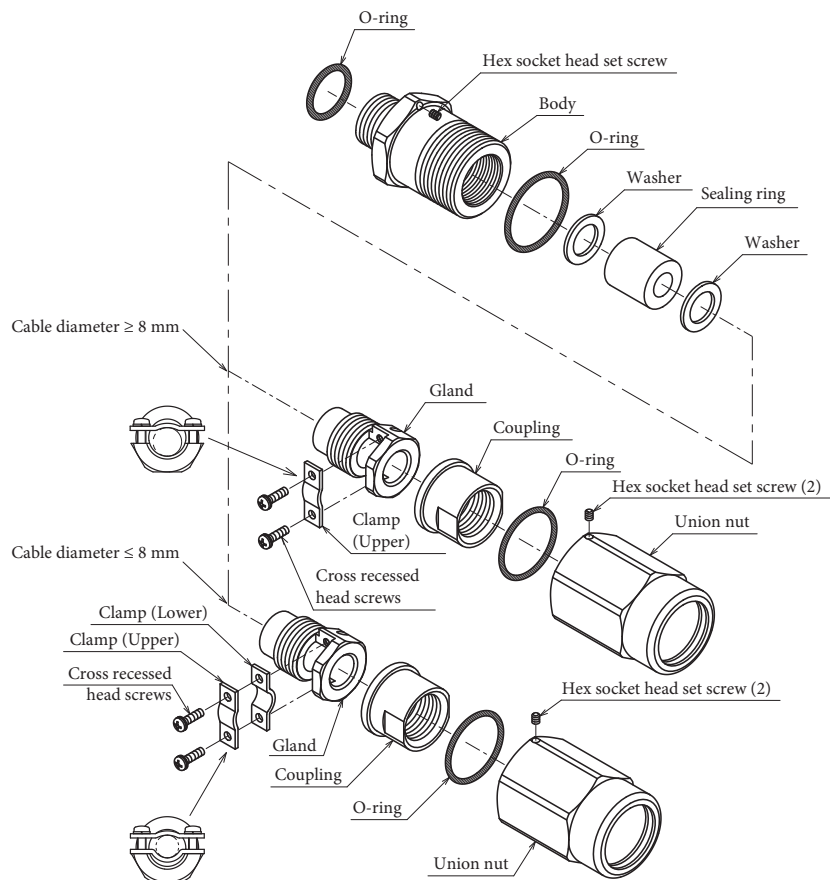


Figure 2-36. Constituent Elements of Flameproof Cable Gland

2) Structure of the flameproof universal elbow

The figure below shows the universal elbow.

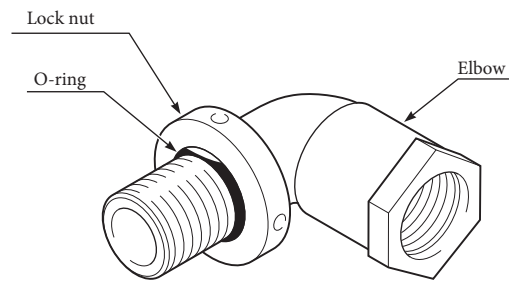
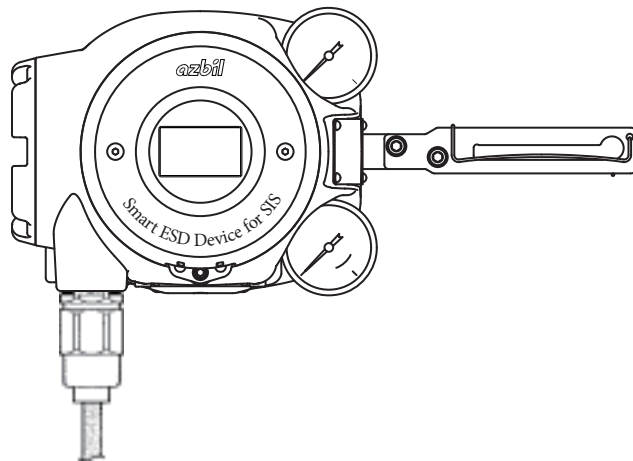


Figure 2-37. Flameproof Elbow

3) Mounting example

The flameproof cable gland and the universal elbow are used to connect the field wiring cable to the device enclosure, as shown below.

[Use of flameproof cable gland]



[Use of flameproof cable gland and elbow]

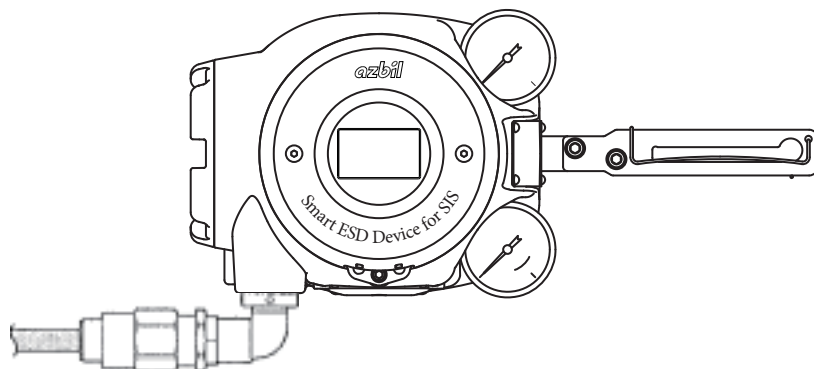











Figure 2-38. Mounting Example of Flameproof Cable Gland and Elbow

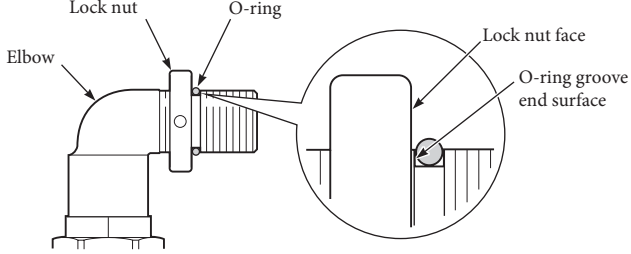
4) Mounting procedure for flameproof cable gland

The procedure for mounting the flameproof cable gland is shown below.

Step	Procedure												
1	<p>Firmly tighten the body of the cable gland to the conduit connection port on the terminal box or to the universal elbow to hold it in place.</p> <p> Handling Precautions: Apply adequate waterproofing to these parts. We recommend the use of silicone resin based non-hardening seal materials.</p>												
2	<p>Refer to the illustrations and insert the cable carefully.</p> <div style="border: 1px solid black; padding: 5px; margin: 5px 0;"> <p style="text-align: center;"> Warning</p> <p>If the diameters of the cable and the packing do not match each other, the flame propagation cannot be prevented. Refer to the table below and select packing with the correct internal diameter for the outer diameter of the cable.</p> <table border="1" data-bbox="683 790 1369 1016"> <thead> <tr> <th data-bbox="683 790 911 860"> Cable outer diameter (mm)</th> <th data-bbox="911 790 1139 860">Packing inner diameter (mm)</th> <th data-bbox="1139 790 1369 860">Notes</th> </tr> </thead> <tbody> <tr> <td data-bbox="683 860 911 909">7.0-8.0</td> <td data-bbox="911 860 1139 909">8</td> <td data-bbox="1139 860 1369 909">Provided</td> </tr> <tr> <td data-bbox="683 909 911 958">8.0-10.0</td> <td data-bbox="911 909 1139 958">10</td> <td data-bbox="1139 909 1369 958">Built in</td> </tr> <tr> <td data-bbox="683 958 911 1016">10.0-12.0</td> <td data-bbox="911 958 1139 1016">12</td> <td data-bbox="1139 958 1369 1016">Provided</td> </tr> </tbody> </table> </div> <p> If the cable outer diameter is 8 mm or less, use the lower clamp when attaching the cable gland.</p> <p> Handling Precautions: Be careful not to damage the coating of the device with a tool.</p>	 Cable outer diameter (mm)	Packing inner diameter (mm)	Notes	7.0-8.0	8	Provided	8.0-10.0	10	Built in	10.0-12.0	12	Provided
 Cable outer diameter (mm)	Packing inner diameter (mm)	Notes											
7.0-8.0	8	Provided											
8.0-10.0	10	Built in											
10.0-12.0	12	Provided											
3	<p>Clamp the cable gland with screwing and tightening it to the body.</p> <div style="border: 1px solid black; padding: 5px; margin: 5px 0;"> <p style="text-align: center;"> Warning</p> <p> To prevent injuries due to flame propagation, be sure to tighten the packing adequately.</p> </div>												
4	<p>Insert the cable end into the terminal box.</p>												
5	<p>Screw the union nut to the body and tighten it securely. Then, tighten the union nut's hex socket set screw in the union nut.</p>												

5) Mounting procedure for flameproof universal elbow

The procedure for mounting the flameproof universal elbow is shown below.

Step	Procedure
1	<p>Align the lock nut with the O-ring groove as shown below.</p>  <p>Figure 2-39. Arrangement of Lock Nut and O-ring</p>
2	<p>Screw the flameproof universal elbow into the terminal box conduit connection port until the lock nut end surface meets the connection port end surface.</p> <p>When two elbows are used, first screw the first elbow into the terminal box. Next, screw the second elbow into the terminal box in the reverse direction to the first elbow.</p> <p>! Handling Precautions: Apply adequate waterproofing to these parts.</p>
3	<p>Turn the flameproof universal elbow to loosen it in the desired direction.</p> <p>! Handling Precautions: Do not loosen it more than 1 turn.</p>
4	<p>Lock the flameproof universal elbow in place by tightening down the lock nut using the special tool.</p>

Chapter 3 Operation

This chapter describes how to start operating the device and adjust it using the local user interface (LUI). If you purchase the device as a separate item, be sure to read Chapter 2 before reading this chapter.

3-1 Local User Interface (LUI)

Four push buttons on the LUI (with , , , and  symbols) can be operated by removing two screws ((2.5 mm) hexagonal socket bolts) from the front cover of the device.

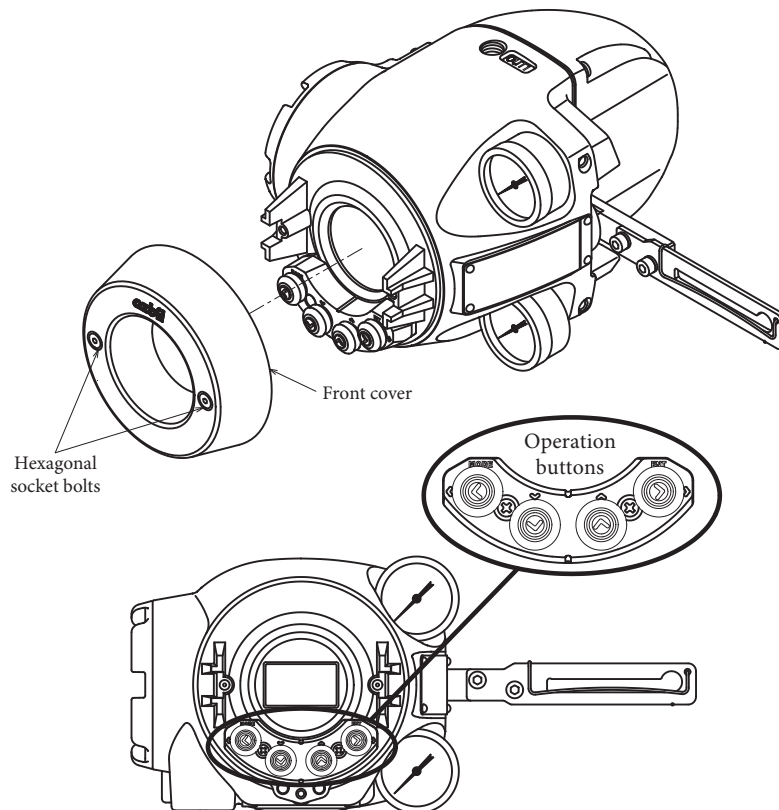









Figure 3-40. LUI Structure with the Front Cover Removed

Table 3-4.

Key input	Monitor mode	Setup mode
	Switches between display categories.	Goes to the next display.
	Selects the next item.	
	Selects the previous item.	
	Switches between display categories.	Goes back to the previous display.
 Hold down	Switches between setup mode and monitor mode.	
 Hold down	Executes the function.	

The LUI has monitor and setup modes.

In monitor mode, normal, detailed and status monitoring are available. The normal monitor can be used to monitor data such as opening and input signals and it displays alarm information if a self-diagnostic alarm is issued.

To change from monitor mode to setup mode, hold down the  button. In setup mode, operations such as auto setup and zero / span adjustment can be performed. Figure 3-2 shows a diagram of the LUI screen transition.

The LUI displays the dynamic values of the device and can be used to adjust and set up the following six functions.

- Auto setup function
- Zero/span adjustment
- Supply Bypass Function
- PST (Partial Stroke Test) Activation
- Control Parameter Configuration
- Valve System Configuration

This section describes the adjustment and setting procedure using the LUI.

Handling Precautions:

- Operation from a host unit is suspended while the LUI is being used to make adjustments or change settings.
- If there is an object near the operation button, remove it before operation.
- Return the display to the normal monitor when you want to display alarms, because you cannot display alarms while using a monitor other than the normal monitor.

Alarms and the present values are alternately displayed at that time of alarm outbreak.

- Switch to your desired screen when mounting the cover, as the screen does not automatically change from the screen that was displayed.
- The design of the front cover differs depending on whether you are following the SIS or general specification, so please pay attention to the difference when mounting.
- If automatic PST is already set, the PST is not executed while the LUI is in the setup mode. Please verify the execution time of the automatic PST before operating.
- If you have made adjustments, make sure to verify them by checking device operation. If you have also modified settings, make sure that they were modified correctly.

The LUI display differs depending on the software version.
 Check the software version on the LUI in details monitor mode
 with guide No. 2-1.

For software version 2.2 and earlier



If you use another host or communicator for communication during setup, this screen is displayed and the setup mode cannot be entered.

Enter the password if a password has been set.

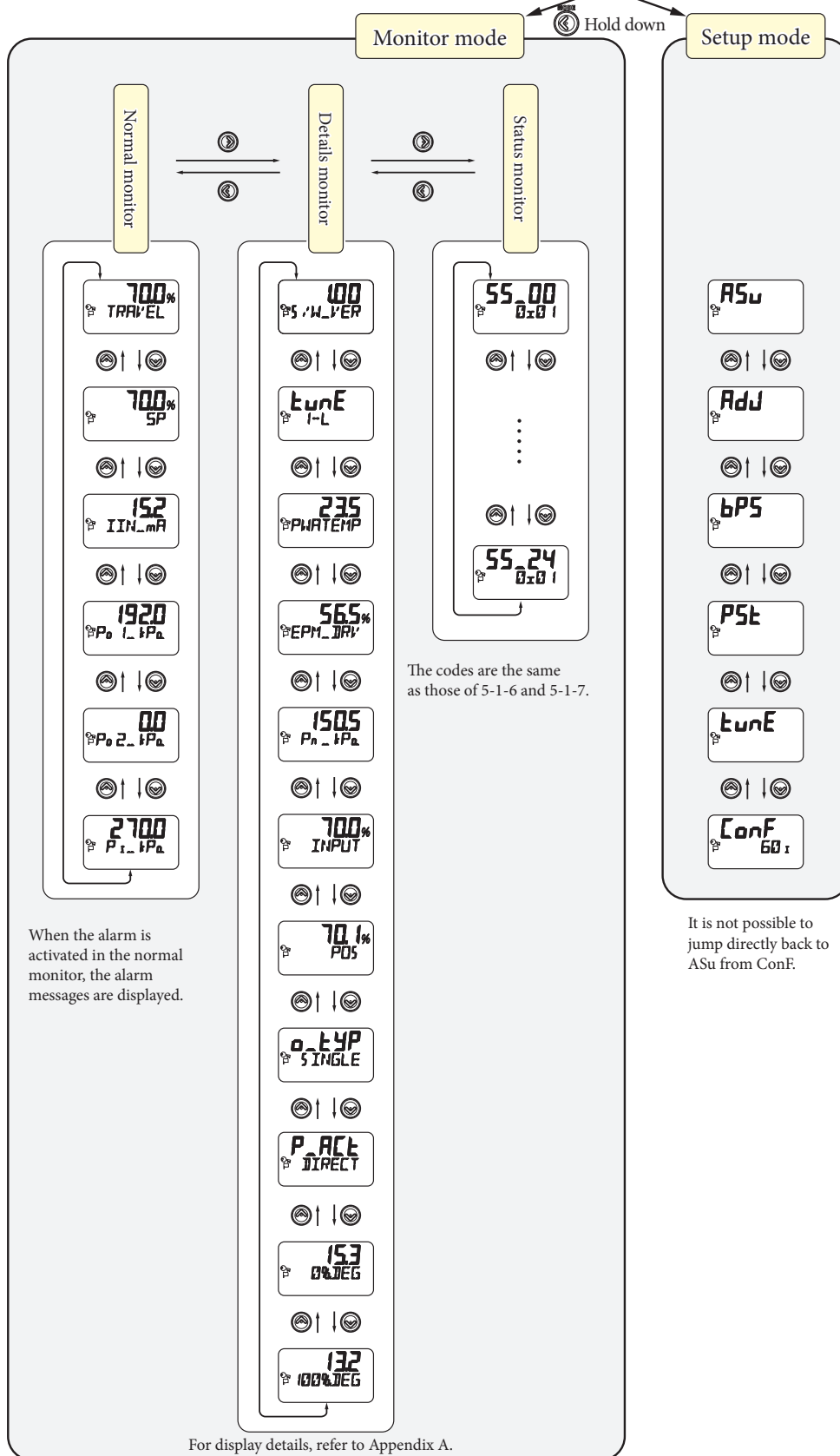


Figure 3-41.

For software version 2.3 and later

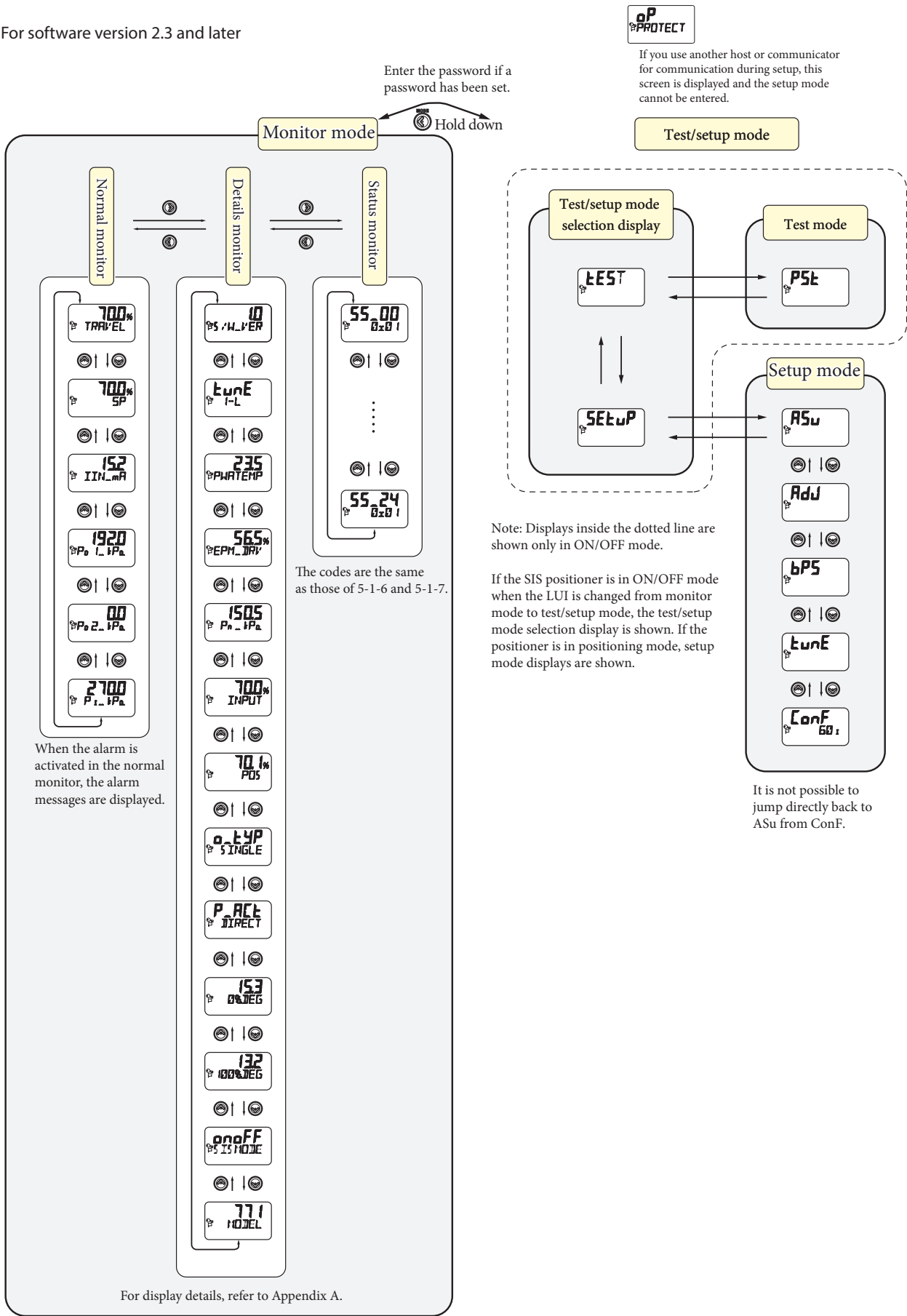


Figure 3-42.

3-2 Adjustment before Operation

Perform auto setup before using the device. Then, adjust the zero/span if necessary.

The zero/span adjustment function in the device electrically sets the fully closed and fully open positions of the valve independently of each other. Therefore, you can adjust each of these positions without interfering with the other one.

3-2-1 Auto Setup

There are two auto setup methods.

- Using the LUI
- Using HART communication

This section describes the method using the LUI. For the method through HART communication and the details of auto setup, refer to Chapter 4.

Handling Precautions:

- Set the input signal to 5.6 mA or more when the SIS positioner mode is in positioning mode, and when it is in ON/OFF mode, set it to 12 mA or more or 19.2 V or more. You will not be able to execute auto setup if the signal falls below 5.6 mA when the SIS positioner mode is in positioning mode, or if it falls below 12 mA or 19.2 V in ON/OFF mode.
- In the self-diagnosis result, if there is a message with a check mark in the positioning mode field in table 4-6 in section 4-2-21, “Diagnostic Messages,” the auto setup will not function correctly.
- Once auto setup and zero/span adjustment are completed, always remember to change the input signal and to check the opening, valve travel, and other valve operations.
- Correctly set the actuator type and feedback lever position when fully closed before starting auto setup.
- The dynamic characteristics may not be properly set due to the operating unit capacity, operation stroke, inner diameter and length of the air piping, etc. When that happens, please refer to section 4-2-5, “Control Setting” and manually adjust the dynamic characteristics.
- If the size of the operating unit is set to “Custom,” then its size will not be modified even if the auto setup is conducted. When selecting the operating unit’s size via the auto setup, please set it to Param1-6, A-C.
- Even if the size of the operating unit and the valve is the same, there may be times when the factory default setting will differ depending on the equipment combination. After installation, please conduct an operation check, as well as appropriate adjustments and setting, if necessary.
- After executing auto-setup, the forced fully open value (see section 4-2-7, “Forced Fully Open/Closed Characteristics”) may be changed. If necessary, reconfigure the forced fully open value. However, if the SIS positioner mode is in ON/OFF mode, then the value will be fixed at 99 %.
- If the booster relay is incorporated, hunting may occur during auto-setup, so either adjust the booster’s sensitivity or refer to section 4-2-5, “Control Setting” and manually adjust the dynamic characteristics.
- If a speed controller is incorporated, set it to full open and execute auto-setup. Then, adjust the speed via speed controller.
- If the main unit is purchased separately, its initial settings are set by default to those in the list of default values in section 6-7, “List of Default Internal Data Values.” If it is connected to an operating unit with setting that differs from these default settings, it will not operate just by itself. Before operating, be sure to execute auto-setup and that it is configured appropriately.

 **Caution**



There is a danger during auto setup because the fully closed valve moves to fully open. Be prepared in advance to prevent injury and effects on the process when the valve moves.

If the factory default setting is not instructed at the time of shipment, then the operating unit type is set to Linear, and the feedback lever position during forced closure is set to Down. If the factory default setting was instructed, please refer to the section on the factory default setting. In addition, modify the setting if necessary.

If you can't properly close the auto setup, check the following.

- The supply air pressure is at an appropriate level
- A/M conversion switch is in auto drive mode
- Feedback pin and lever are properly connected.
- The output air pressure is properly connected to the operating unit
- The valve unit is not fixated by the manual handle, etc.

The reverse action actuator fully closes, fully opens, and fully closes the valve when auto setup starts. The direct operation actuator fully opens, fully closes, and fully opens the valve. Afterwards, it will operate near the aperture range of 20 % <=> 25 % and 80 % <=> 85 %.

When you exit auto setup, it will maintain an aperture suited to the input signal.

Check the following points before starting auto setup.

- Actuator Type

Linear (standard): Direct-acting actuator

Rotary/90°: When the distance between the feedback lever of the rotary actuator (90°) and the pin is longer than the distance from the valve shaft

Rotary/Other: When the distance between the feedback lever of the rotary actuator (around 60°) and the pin is longer than the distance from the valve shaft

Rotary(sub)/90°: When the distance between the feedback lever of the rotary actuator (90°) and the pin is shorter than the distance from the valve shaft











Rotary(sub)/Other: When the distance between the feedback lever of the rotary actuator (around 60°) and the pin is shorter than the distance from the valve shaft

- Valve Closed Position

DOWN (standard)

UP

(1) Procedure for performing auto setup

Step	Procedure	LUI display
1	Loosen two hexagonal socket bolts and remove the front cover.	
2	Press and hold the  button to enter Settings mode. Enter the password if prompted to do so. For details on setting up the password, please refer to section 3-2-6, "Password." To change Actuator Type or Valve Closed Position, refer to (3) below.	
3	Set the input signal to 5.6 mA or more if the SIS positioner mode is in positioning mode, and set it to 12 mA or more or to 19.2 V or more if it is in ON/OFF mode; then press the  button once, confirm that it switched to the screen on the right, then make a long press of the  button once more to execute the auto setup.	 
4	The valve, which is initially fully closed, will fully open and then fully close again. Then, it opens to between 20 % and 25 % and between 80 % and 85 %. After the valve operation ends, the LUI screen changes and the opening appropriate to the input signal is set.	
5	 will return to the initial screen of the auto setup.	

The meaning of the word FAIL that may occur during the execution of auto setup is as follows.







FAIL00: auto setup failed

FAIL01: input signal is low


















FAIL02: function other than auto setup is currently in progress

FAIL90: forced termination

(2) Procedure for aborting auto setup

Step	Procedure	LUI display
1	To abort auto setup during execution, press the  button.	
2	Holding down the  button aborts the execution.	
3	When you press the  button, the screen on the right is displayed again.	

(3) Procedure for specifying Actuator Type and Valve Closed Position

Step	Procedure	LUI display
1	Press the  or  button repeatedly to display the screen on the right.	
2	Press the  button.	
3	Select an appropriate actuator type with the  and  buttons and press the  button.	
4	Select an appropriate feedback lever position when the valve is fully closed with the  and  buttons and hold down the  button to set that position.	
5	The specified actuator type and feedback lever position when the valve is fully closed are displayed. Check the settings.	
6	Go back to the desired menu with the  and  buttons.	

3-2-2 Zero/Span Adjustment

After auto setup, check the 0 % and 100 % positions. If adjustment is required, adjust the zero/span.



The following two zero/span adjustment methods are available.

- Using the LUI
- Using HART communication (This method is further broken down into the following four methods.)
 - Auto Travel Calibration
 - Angle Correction
 - Manual Setting
 - Change Travel Angle

















This section describes the method using the LUI. For the method using HART communication, refer to Chapter 4.

! Handling Precautions:










- If you adjust the span after auto setup, the forced fully opening value is automatically changed to the value calculated by subtracting 1 % from the overstroke percentage.





 Caution
 There is a danger during auto setup because the fully closed valve moves to fully open. Be prepared in advance to prevent injury and effects on the process when the valve moves.

(1) Procedure for adjusting the zero/span









Step	Procedure	LUI display
1	Loosen two hex socket bolts (2.5 mm) to remove the front cover.	
2	Press and hold the  button to enter Settings mode. Enter the password if prompted to do so. For details on inputting the password, please refer to section 3-2-6, "Password."	
3	Press the  button to display the screen on the right (ADJ).	
4	Press the  button, select whether to adjust the angle for 100 % or 0 % opening with the  and  buttons, and press the  button. (Refer to (2) below, "Procedure for adjusting the angle.") To manually adjust the opening rather than using the angle adjustment function, select manual adjustment for 100 % opening (0 % opening) with the  and  buttons and press the  button. (Refer to (3) below, "Procedure for manual adjustment.")	 (100 % opening angle adjustment)  (0 % opening angle adjustment)  (100 % opening manual adjustment)  (0 % opening manual adjustment)

(2) Procedure for adjusting the angle

Step	Procedure	LUI display						
1	Select the angle (COARSE, MID, FINE) for 100 % opening adjustment (0 % opening adjustment) with the  and  buttons and press the  button. <div style="display: flex; align-items: center; justify-content: center;"> <div style="font-size: 3em; margin-right: 10px;">(</div> <table style="border: none;"> <tr> <td style="padding-right: 10px;">COARSE:</td> <td>Angle 1°</td> </tr> <tr> <td>MEDIUM:</td> <td>Angle 0.1°</td> </tr> <tr> <td>FINE:</td> <td>Angle 0.01°</td> </tr> </table> <div style="font-size: 3em; margin-left: 10px;">)</div> </div>	COARSE:	Angle 1°	MEDIUM:	Angle 0.1°	FINE:	Angle 0.01°	 
COARSE:	Angle 1°							
MEDIUM:	Angle 0.1°							
FINE:	Angle 0.01°							
2	Adjust the angle by pressing the  button to increase the angle and pressing the  button to decrease the angle.	 						

Step	Procedure	LUI display
3	<p>Pressing the  button displays the current opening and output air pressure (Pout1). Check that the angle is properly adjusted.</p> <p>If further adjustment is required, go back to the adjustment screen with the  button.</p>	 






(3) Procedure for manual adjustment














Step	Procedure	LUI display
1	Manually specify the desired position for 100 % opening (0 % opening).	 
2	Press the  button.	 
3	Check that the desired position is selected and then hold down the  button. This adjusts the 100 % opening (0 % opening).	 

3-2-3 Supply Bypass

Supply bypass allows the valve to be fully closed and opened and enables operation with the regulator. (For double-acting actuators, the valve can only be fully opened or closed.)

(1) Procedure for supply bypass

Step	Procedure	LUI display
1	Loosen two hexagonal socket bolts and remove the front cover.	
2	<p>Hold down the  button and set the current setting to the setup mode.</p> <p>If the password is required to change the mode, enter the password.</p> <p>For detailed information of the password, please refer to section 3-2-6, "Password".</p>	
3	Press the  button to display the screen shown on the right.	

Step	Procedure	LUI display
4	Set the input signal 5.6 mA or more if the SIS positioner mode is in positioning mode, or set it to 12 mA or more or to 19.2 V or more if it is in ON/OFF mode; then press the  button, confirm that it switched to the screen on the right, then make a long press of the  button if you wish to set the output air pressure to 0. (If the output air pressure is already 0 or it is set to the supply air pressure at the supply bypass, go to the screen of step 6 where the supply bypass can be operated.)	
5	To change the output air pressure to the supply air pressure, press the  button to display the screen on the right and hold down the  button.	
6	If the supply bypass requirements are not satisfied (if the input signal falls below 5.6 mA when the SIS positioner mode is in positioning mode, or if it falls below 12 mA or 19.2 V during ON/OFF mode), it will switch to the screen on the right.	
7	If supply bypass conditions are satisfied, the screen shows that the bypasses are operating.	 
8	To clear supply bypass operations, press the  button to display the screen shown on the right.	
9	Holding down the  button clears the supply bypass.	

The meaning of the word FAIL that may occur during the execution of the supply bypass is as follows.

FAIL01: input signal is low

FAIL02: function other than supply bypass is currently in progress

FAIL90: forced termination

Caution



There is a danger in using the supply bypass, as the valve will be moved. Also during the supply bypass setting, it is dangerous to not operate it for more than 10 minutes, as this will cancel out the setting, and the valve will start moving. Ensure ahead of time that there will be no injuries or effects on the process if the valve is moved.

3-2-4 Partial Stroke Test (PST)

Partial Stroke Test (PST) is a function that tests whether the valve can be operated correctly by partially moving the travel from 100 % (or 0 %).

Please verify whether the target travel, the ramp time until reaching that travel, etc., are set up correctly before activating the PST.














The default factory setting is as follows: target travel of 90 % (or 10 %), 15 seconds of ramp time until reaching the target travel, 15 seconds of wait time at the target travel, and 15 seconds of ramp time until reaching the initial travel. For details on the setting, please refer to section 4-2-23, “PST (Partial Stroke Test).”




Please set an automatic PST disabled via HART communication, as an error will show if the automatic PST is activated when the PST is being executed via the LUI.

For details on modifying the setting of the automatic PST, please refer to section 4-2-23, “PST (Partial Stroke Test).”

Activate it via the following procedure, and verify the test result.

PST Operation Procedure

Step	Procedure	LUI display
1	Loosen two hex socket bolts to remove the front cover.	
2	 Press and hold the button to enter the password and enter the settings mode. For details on inputting the password, please refer to section 3-2-6, “Password.”	
3	 Press the button to display the screen on the right.	
4	Set the input signal to to 12 mA or more or to 19.2 V or more, push the  button, move into the screen on the right, and then apply a long press to the  button once again.	
5	PST is activated, and the valve starts moving.	
6	 When you push the button, the travel and output air pressure are displayed as on the screen on the right.	
7	After the PST is complete and is successful, “SUCCESS” is displayed as on the screen on the right.	
8	If the PST fails, or verification of the result is required, then the screen on the right will display “FAIL,” where the cause of the failure will be displayed according to its designated number.	

Step	Procedure	LUI display
9	When you push the  button when the PST is being executed, it will switch into the screen on the right. The PST can be canceled by applying a long press to the  button.	

The meaning of the word FAIL that may occur during the execution of the PST is as follows.

FAIL00: An error was detected.*²

FAIL01: Input signal is below the low limit indicated in step 4 in “PST Operation Procedure” above in this section.

FAIL02: A function other than PST is running.

FAIL03: Starting a PST using the LUI is not enabled in [PST Enabled], or the SIS positioner is not in ON/OFF mode.

FAIL04: Self-diagnosis detected a problem.*³

FAIL10: One or more of the following PST errors were detected.*¹ *³

The valve travel does not change during the PST.

The target valve travel is not reached.

The valve travel at the end of the PST is abnormal.

Stick-slip occurred.

FAIL60: Excessive valve travel (the target travel was exceeded by 20 %)*³

FAIL70: The valve travel when the PST started was abnormal.*³

FAIL80: Pressure was abnormal.*³

FAIL90: The PST was aborted (canceled from the LUI)

WARN21: Restriction is clogged.*³

WARN22: Deposits on the nozzle-flapper*³

*1. Check [PST Detailed Result] using HART communication.

*2. This fail code is displayed only in software version 2.2 and earlier versions. FAIL_10, FAIL_70, and FAIL_80, which are displayed in software version 2.3, are all indicated as FAIL_00.

*3. Displayed only in software version 2.3 and later versions. Check the software version on the LUI in details monitor mode with guide No. 2-1.

Handling Precautions:

Please confirm that the following conditions that allow PST execution are met before actually executing it.

- The supply air pressure is input appropriately
- The travel during the start of PST is within ± 5 % of the PST Initial Travel (please refer to section 4-2-23, “PST (Partial Stroke Test)”
- None of the problems marked with the symbol “•” in the Positioning mode column of table 4-6 in section 4-2-21 (“Diagnostic Messages”) have occurred. Also, A/D Conversion Module 2 Failure, Temperature Sensor Failure, Internal Program Execution Error, and SIS RAM Data Failure listed in the same table have not occurred.
- SIS positioner mode is in ON/OFF mode
- PST Enable is not set to None

3-2-5 Control Parameters

Control parameters are determined by Actuator Size (Param 1 to 6, A, B, C) and Friction Level (Light (L), Medium (M), Heavy (H)).

Table 3-5. Actuator size

Actuator Size	Stroke Speed [s]	Actuator Model	Actuator Diaphragm Capacity [cm ³]
PARAM A	0.25 max.	—	200
PARAM B	0.35 max.	—	300
PARAM C	0.45 max.	—	400
PARAM 1	0.75 max.	PSA1, PSK1	600
PARAM 2	2.0 max.	PSA2, HA2	1400
PARAM 3	5.5 max.	PSA3, HA3	2700
PARAM 4	8.15 max.	PSA4, HA4	6600
PARAM 5	12 max.	PSA6	8100
PARAM 6	99 max.	VA5	25300
Custom	—	—	Individual setting*















* Consult an Azbil Corp. service representative.

Table 3-6. Friction Level

Friction Level*	Gland packing material example
HEAVY	Graphite packing
MEDIUM	Yarn packing
LIGHT	Type V PTFE packing

* This is not determined by the material, but rather changes depending on the frictional force on the gland packing.

(1) Procedure for specifying control parameters

Step	Procedure	LUI display
1	Loosen two hexagonal socket bolts and remove the front cover.	
2	Hold down the  button to start the setup mode. Enter the password if prompted to do so. For details on inputting the password, please refer to section 3-2-6, "Password."	
3	Press the  button to display the screen shown on the right (tune).	
4	Press the  button to display the screen on the right and select Param 1 to 6, A, B, or C for Actuator Size using the  button, and press the  button.	
5	Select L (Light), M (Medium), or H (Heavy) for Friction Level and set it by holding down the  button. To return the setting to its original value, reset the value with  before holding down the  button.	
6	Check the specification result when it is displayed.	

⚠ Caution

The valve moves when control parameters are changed. Be prepared in advance to prevent injury and effects on the process when the valve moves.










3-2-6 Password

The password consists of four alphanumeric characters.

The default factory password function is set to “Enabled.”

The default factory password is “0000.”

How to enter the password

Step	Procedure	LUI display
1	Check that the password screen (screen on the right) is displayed and that the leftmost digit is blinking. Select the alphanumeric character of the password with the  or  button and press the  button.	
2	The second digit from the right starts blinking. Specify all four digits in the same way. To return to and specify a digit to the right of the current digit, use the  button.	
3	After specifying the fourth digit, press and hold the  button.	
4	If the password matches, it changes to Settings mode. If not, the error screen shown on the right is displayed. In this case, enter the password again.	

! Handling Precautions:

- When changing the password function to “Enabled,” you must input a new password.
- While the device is operating, set the password function to “Enabled.”

3-3 Starting Operation

3-3-1 Preoperation Check

Check the following points before starting operation.

- The device is properly installed and the feedback lever, feedback pin and other parts are not damaged or fractured.
- The pneumatic piping is completely connected and an appropriate supply air pressure is supplied. (Air is not leaking.)
- Appropriate input signal is applied.

1) Procedure for checking the device operation

The procedure for checking the device operation is shown below.

Step	Procedure
1	Check that the valve travel changes to match the preset characteristics by changing the input signal from the controller (constant current source). If operation is not normal, refer to chapter 5, "Troubleshooting."
2	After confirming normal operation, tightly secure the terminal box cover.

Handling Precautions:

- The travel transmission output or the contact output will change to failure output right after applying the input signal.
It will return to normal several seconds later.
- Confirm all other settings using the HART communication tool by going to [Device] → [Review.]

Caution



There is a danger if the automatic PST is enabled, as PST is automatically activated, which might result in unexpected movement of the valve. Take extra precautions when coming near the valve so that no injuries will occur if the valve starts moving.

Chapter 4 Operation with HART Communication

■ Summary

This chapter describes the operations performed using HART communication.

For details on the basics of operation, relationship between the SIS positioner mode and data setting, data setting and modification, storage of various data, etc., please refer to this chapter.

4-1 Operation with HART Communication

4-1-1 HART Communication

This section describes the menu configuration and functions for adjustment and settings using HART communication. The HART communication tool is used to adjust, set, and read the data of this device. For details, see the operation manual for the HART communication tool.

■ HART communication tool and wiring

Wire as shown in the following diagram.

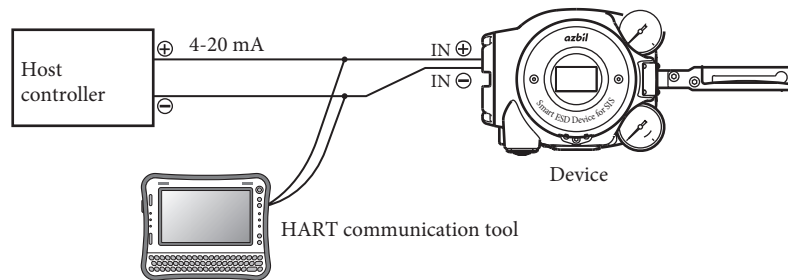


Figure 4-43.

■ Before starting HART communication

Check the following before starting communication.

- The wiring connections with this device are complete.
- The input signal from the controller is correctly applied.

! Handling Precautions:

- If there is no input signal from the controller, connect the appropriate input signal to the input signal terminal (IN). The lines from the controller must be removed in this case.
- Please download the latest DD (Device Description) when using the HART communication tool.
(Download from <http://www.azbil.com/products/bi/iap/index.html>)

4-2 Setup and Adjustment of Device

Set up and adjust the functions required for the device to operate properly.

The explanations in this section are based on the menu of the 475 communicator.

To change settings and make adjustments, select [Device] → [Configuration] → [Operator Action Setting] → [Allow operator action].

This allows you to change settings and make adjustments, and also restricts settings changes and adjustments from LUI and the other HART master*.

* HART communication master stations are configured for either the primary or secondary. In most cases, the host system is the primary and the 475 communicator is the secondary.

Once the settings and adjustments are complete, select [Device] → [Configuration] → [Operator Action Setting] → [Forbid operator action]. The LUI becomes inoperable if you do not perform this operation. (When there has been no HART communication for more than 10 minutes, this operation will be performed automatically and the LUI becomes operable.)

Handling Precautions:

- If the automatic PST is enabled, the PST is not executed while you are selecting “Allow operator action” and making adjustments and conducting settings. Please verify the execution time of the automatic PST before operating.
- If you have made adjustments, make sure to verify them by checking how the device operates. If you also modified settings, make sure that they were modified correctly.

4-2-1 Process Variables

The measurement value data present when the device is operating can be viewed.

Select [Process Variables].

- Checking measured values

Selecting [Process Variables] allows the following items to be checked.

Item	What is Displayed
Input (mA)	Current input value.
Input (%) ^{*1}	Input signal (%).
Set Point (SP) ^{*2}	Input signal (%) following flow type conversion.
Travel	Valve travel (%).
Position ^{*1}	Valve travel following flow type conversion.
Drive Signal	EPM (electric-pneumatic converter) drive signal (%).
Po1	Output air pressure (OUT1).
Po2	Output air pressure (OUT2).
Ps	Supply air pressure (SUP).
Pn	Nozzle back pressure.
Temperature	Temperature inside the main unit.

*1. This is not displayed if flow type conversion was not performed.

*2. The set point during forced closure is fixed at 0 %.

The set point during forced opening is equal to the travel cutoff high +1 %.

4-2-2 Auto Setup

Auto setup is a function that automatically performs basic adjustments and setup after the device is mounted on the actuator.

Select [Device] → [Basic Setup] → [Auto Setup].

Caution



There is a danger during auto setup because the fully closed valve moves to fully open. Be prepared in advance to prevent injury and effects on the process when the valve moves.

Handling Precautions:

- Set the input signal at 5.6 mA or more when the SIS positioner mode is in positioning mode, and when it is in ON/OFF mode, set it to 12 mA or more or 19.2 V or more. You will not be able to execute auto setup if it falls below 5.6 mA when the SIS positioner mode is in positioning mode, or if it falls below 12 mA or 19.2 V during ON/OFF mode.
- In the self-diagnosis result, if there is a message with a check mark in the positioning mode field in table 4-6 in section 4-2-21, “Diagnostic Messages,” the auto setup will not function correctly.
- Check that an appropriate supply air pressure is supplied to the device before starting auto setup.
- When auto setup and zero/span adjustment are complete, change the input signal and be sure to check valve operations such as opening and shutoff.
- In some cases, configuration may not be properly performed due to the actuator’s diaphragm capacity (if lower than with Azbil Corporation’s PSA1 type actuator, which has a diaphragm capacity of 850 cm³) or operation stroke (if less than 14.3 mm). If this occurs, refer to section 4-2-5, “Control Setting” and manually adjust the dynamic characteristics.
- After executing auto-setup, the forced fully open value (see section 4-2-7, “Forced Fully Open/Closed Characteristics”) may be changed. If necessary, reconfigure the forced fully open value. However, if the SIS positioner mode is in ON/OFF mode, then the value will be fixed at 99 %.
- If the booster relay is incorporated, hunting may occur during auto-setup, so either adjust the booster’s sensitivity or refer to section 4-2-5, “Control Setting” and manually adjust the dynamic characteristics.
- If a speed controller is incorporated, set it to full open and execute auto-setup. Then, adjust the speed via speed controller.
- If the main unit is purchased separately, its initial settings are set by default to those in the list of default values in section 6-7, “List of Default Internal Data Values.” If it is connected to an operating unit with setting that differs from these default settings, it will not operate just by itself. Before operating, be sure to execute auto-setup and that it is configured appropriately.

Check the actuator type and feedback lever position before starting auto setup.

The actuator type is set to Linear and the feedback lever position is set to Down when the valve is fully closed at the time of shipment unless there are other shipment setup instructions. If factory setting (initial setup) is requested, check the settings at the time of shipment. Configure settings as needed.

If auto setup is not successful, check the following points.

- The supply air pressure is appropriate.
- The A/M switch is in auto operation mode.

- The feedback pin and feedback lever are correctly connected.
- The output air pressure is correctly connected to the actuator.
- The valve is not fixed in place because of the manual handle or other part.

The reverse action actuator fully closes, fully opens, and fully closes the valve when auto setup starts. The direct action actuator fully opens, fully closes, and fully opens the valve. Then, it is opened to between 20 % and 25 % and between 80 % and 85 %.

After auto setup, the valve moves to the opening appropriate to the input signal.

The following items are automatically adjusted and set during auto setup.

(1) Zero/span adjustment

The zero point is set to the position of the feedback lever when the valve is fully closed. The span point (100 % opening) is set to the position, which is the opening of forced fully open value +1 %, when the valve is fully opened. (When the forced fully open value is 99 %, the opening position is the span point.) When the span is adjusted after auto setup, the forced fully open value is changed and stored.

(2) Input signal range (Input Range), PV LRV (Close) and PV URV (Open) settings

Interchange the range settings (PV LRV and PV URV) so that the power-off operation is identical to the fully close operation.

Example: The feedback lever position is in the DOWN direction when the valve is fully closed.

When the actuator action is reversed:

$$\text{PV LRV (Close)} = 4 \text{ mA}, \text{PV URV (Open)} = 20 \text{ mA}$$

When the actuator action is forwarded:

$$\text{PV LRV (Close)} = 20 \text{ mA}, \text{PV URV (Open)} = 4 \text{ mA}$$

(3) Specification of Actuator Size

Select the actuator size from among Param 1 to Param 6, Param A, B, and C.

(4) Specification of Friction Level

Select the friction level of the gland packing from among LIGHT, MEDIUM, and HEAVY.

(5) Specification of Feedback Lever Motion

Specify UP or DOWN as the operation of the feedback lever when output air pressure OUT1 increases.

(6) Specification of Positioner Action

When the input signal is “Disconnected,” the positioner action is forward operation (Direct) if the output air pressure is 0.

When the input signal is “Disconnected,” the positioner action is reverse operation (Reverse) if the output air pressure is the supply air pressure. The main unit cannot be set to conduct reverse operation.

(7) Specification of Pilot Relay Type

Select Single Acting or Double Acting as the operation of the actuator.

4-2-3 Input Signal Range (Input Range) (Model AVP77_/78_ Current Signal Input)

Sets the current input value when the valve travel is at 0 % (PV LRV (Close)) and the current input value when the valve travel is at 100 % (PV URV (Open)). An input in the 4-20 mA range can be used.

Select [Device] → [Configuration] → [Input Range].

PV URV (Open/100 %): Set the input signal at 100 % travel.

PV LRV (Closed/0 %): Set the input signal at 0 % travel.

Caution

Changing the input signal range will move the valve, which is dangerous. Ensure ahead of time that there will be no injuries or effects on process if the valve is moved.

Handling Precautions:

- Set the current input span to exceed 4 mA for (PV URV (Open) - PV LRV (Close)). If the current input span is less than 8 mA, the precision will be $\pm 1.5\%$ of full scale.
- Set the value so that the operation direction is the same when the input signal is 0 mA and 4 mA.

4-2-4 Valve System

Set the operation of the valve (actuator/valve) and main unit.

Select [Device] → [Configuration] → [Valve System].

Caution

There is danger because the valve moves when the settings are changed. Be prepared in advance to prevent injury and effects on the process when the valve moves.

- Actuator Type

Linear	Linear motion valve
Rotary/90°	When the distance between the feedback lever of the rotary actuator (90°) and the pin is longer than the distance from the valve shaft
Rotary/Other	When the distance between the feedback lever of the rotary actuator (around 60°) and the pin is longer than the distance from the valve shaft
Rotary sub/90°	When the distance between the feedback lever of the rotary actuator (90°) and the pin is shorter than the distance from the valve shaft
Rotary sub/Other	When the distance between the feedback lever of the rotary actuator (around 60°) and the pin is shorter than the distance from the valve shaft
- Fully closed feedback lever position (Valve Closed Position)
 - DOWN (standard)
 - UP
- Feedback Lever Motion

Specify UP or DOWN as the operation of the feedback lever when output air pressure OUT1 increases. This setting is automatically set by auto setup.
- Pilot Relay Type

The single acting or double acting of actuator action setting is automatically set by auto setup.
- Positioner Action

Positioner Action means the EPM operation direction, which is judged by auto setup. The device surely has the direct action. If the reverse action is judged by auto setup, the auto setup results in 09, which means the failure with Invalid Positioner Action.

! Handling Precautions:

The positioner's operational direction is determined by the device's hardware. The operational direction cannot be switched using this function.

- **Electrical Fail To**
Open or Closed is automatically set as the fail safe direction when the electrical signal is "Disconnected" based on the settings for Valve Closed Position, Feedback Lever Motion, and Positioner Action.
- **Air Fail To**
Open or Closed is automatically set as the fail safe direction when the supply air pressure is "Disconnected" based on the settings for Valve Closed Position and Feedback Lever Motion. This item is not displayed when Pilot Relay Type is Double Acting.

4-2-5 Control Configuration

The control parameters are the PID calculation parameters for controlling the valve, and the parameters are selected based on the actuator size and friction level.

Select [Device] → [Configuration] → [Control Configuration].

- **Actuator Size**
Specify Param 1 to 6 or Param A to C depending on the operation speed and capacity of the actuator.
To specify every PID operation parameter, select Custom. (For details, consult with one of our service representatives.)

Table 4-2. Actuator Size

Actuator Size	Stroke speed [s]	Actuator Model	Actuator Diaphragm Capacity [cm ³]
PARAM A	0.25 max.	—	200
PARAM B	0.35 max.	—	300
PARAM C	0.45 max.	—	400
PARAM 1	0.75 max.	PSA1, PSK1	600
PARAM 2	2.0 max.	PSA2, HA2	1400
PARAM 3	5.5 max.	PSA3, HA3	2700
PARAM 4	8.15 max.	PSA4, HA4	6600
PARAM 5	12 max.	PSA6	8100
PARAM 6	99 max.	VA5	25300

- **Friction Level**
Select Heavy, Medium, or Light depending on the gland packing. (It is not necessary to specify this item when Custom is selected for Actuator Size.)

Table 4-3. Friction Level

Friction Level *	Gland packing material example
HEAVY	Graphite packing
MEDIUM	Yarn packing
LIGHT	Type V PTFE packing

* This is not determined by the material, but rather changes depending on the frictional force on the gland packing.

- Control Deadband

Specify the deadband. Although deadband may be effective in preventing hunting, when the friction of the gland packing is especially large, for example, we recommend keeping this value within 1 %.

- Replace Control Parameters

Replace the PID parameters selected in Actuator Size and Friction Level with the values in Control Parameters. The replacement is available only when the Actuator Size is “Custom”.

- Control Parameters

When Actuator Size is Custom, each PID must be specified individually.

The control algorithm employs dual gap PID control, which switches PID parameters between three levels depending on the control deviation size. There are 11 parameters as shown below. Set a value larger than the dual width to the gap width. The integration operation is disabled when 9999 is set as the value of the integral.

P outside of Gap1:	Proportional gain outside the gap width [1/%]
I outside of Gap1:	Integral time outside the gap width [s]
D outside of Gap1:	Differential time outside the gap width [s]
Gap Band:	Gap width [\pm %]
P inside Gap1:	Proportional gain within the gap width [1/%]
I inside Gap1:	Integral time within the gap width [s]
D inside Gap1:	Differential time within the gap width [s]
Dual Gap Band:	Dual gap width [\pm %]
P inside of Gap2:	Proportional gain within the dual gap width [1/%]
I inside of Gap2:	Integral time within the dual gap width [s]
D inside of Gap2:	Differential time within the dual gap width [s]

4-2-6 Input Characterization

This is configuration of the flow characteristics. It can be done only when the SIS positioner is in positioning mode; you will not be able to set it if it is in ON/OFF mode.

Select [Device] → [Configuration] → [Input Characterization] → [Input Characterization].

- Characterization

Select Linear, Equal Percent, Quick Open, or Custom Curve.

The concept of each characteristic is shown below.

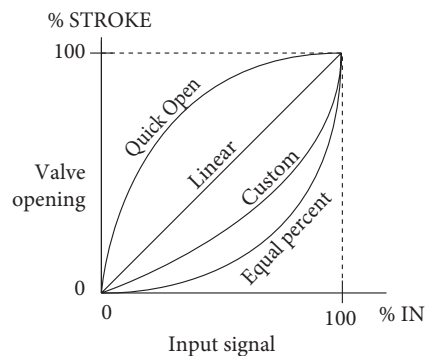


Figure 4-44. Concept of Flow Characteristics

- Custom Curve Data

When selecting Custom Curve, individually specify the input signal (Custom Data IN1 to 21) and the opening (Custom Data OUT1 to 21) to specify a polygonal line consisting of 21 points.

! Handling Precautions:

- Specify both Custom Data IN and Custom Data OUT so that they monotonically increase.
- The setting range is between 0 % and 100 %. The linear characteristic is set from both edges outside this range.

4-2-7 Travel Cutoff

Specify the input signal (%) that will force the valve fully open or fully closed. The valve fully closes when the input signal is less than or equal to the forced fully closed value. It fully opens when the input signal is greater than or equal to the forced fully open value. These values can be independently specified.

Select [Device] → [Configuration] → [Travel Cutoff], then set forced fully closed value (TravelCutoff Low) and forced fully open value (Travel Cutoff High).

The concept of input/output characteristics when the forced fully open and closed values are specified is shown below.

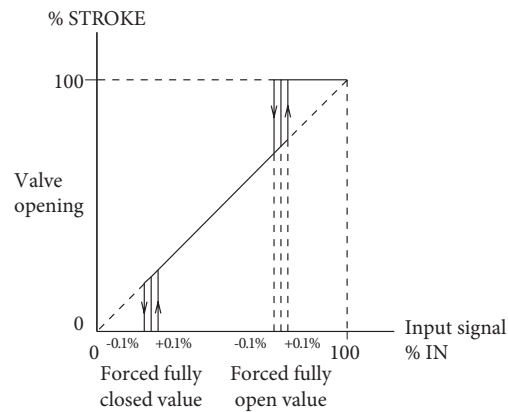


Figure 4-45. Forced Fully Open and Closed Values

! Handling Precautions:

- If the SIS positioner is in ON/OFF mode, then the forced fully open value is a fixed value of 99 %.
- Set so that the forced fully closed value is less than the forced fully opened value.
- The settable range is between -200 % and 50 % for the forced fully closed value and between 50 % and 200 % for the forced fully open value.
- If you adjust the span after auto setup, the forced fully open value is automatically changed to the value calculated by subtracting 1 % from the overstroke percentage.
- The forced fully closed and open values each have a hysteresis difference of 0.1 %.
- The set point during forced closure is fixed at 0 %. The set point during forced opening is equal to the travel cutoff high +1 %.

4-2-8 Units

Specify the units for pressure.

Select [Device] → [Configuration] → [Unit].

At the factory, the positioner is set to one of the following SI system or non-SI system units. If you require a non-SI system unit, please specify kg/cm² or psi when purchasing.



SI system: kPa, MPa and bar

Non-SI system: kPa, MPa, bar, kg/cm², psi

This unit setting is not effective for LUI displays. Only kPa is applicable for LUI display.

4-2-9 SIS Positioner Mode

The SIS positioner mode has a positioning mode (positioning mode) that controls the valve travel, and an ON/OFF mode that fully closes or opens the valve.

 Warning
 Changing the SIS positioner mode will move the valve, which could be dangerous. Ensure ahead of time that there will be no injuries or effects on process if the valve is moved.

Select [Device] → [Configuration] → [SIS Positioner Mode] → [Change SIS Positioner Mode] and modify the SIS positioner mode.

To set it to the ON/OFF mode or positioning mode, select “On/OFF” or “Positioning,” respectively.

Handling Precautions:

If you had changed the SIS positioner mode, please conduct the auto setup. If you switch from positioning mode to ON/OFF mode, the forced fully open value will be changed to 99 %, and the fully open position will be set to 100 % travel.

The fail safe action^{*1} accompanying the self-diagnosis message or PST result, as well as the method of recovery from the fail safe state, will differ depending on the SIS positioner mode.

Table 4-4. fail safe action and method of recovery from the fail safe state

	SIS positioner mode	
	Positioning mode	ON/OFF mode ^{*2}
fail safe action	Output air pressure: Zero	Output air pressure: No change
	Output signal (travel transmission output or contact output): Failure output	
method of recovery from the fail safe state	Auto resetting ^{*3}	Enable the setting of auto resetting or manual resetting ^{*4} .

*1. For self-diagnosis messages and PST results that accompany fail safe action, see section 4-2-21 and 4-2-23, respectively.

*2. The PST function is valid only when the SIS positioner mode is ON/OFF mode. Accordingly, the failsafe action associated with the PST result, and the method of recovering from the failsafe state associated with the PST result, depend on the “ON/OFF mode” column only.

*3. If all of the self-diagnosis messages related to fail safe action are resolved, the output air pressure and output signal will return to normal. (The PST function is disabled in positioning mode.)

*4. If all the self-diagnosis messages and targets of failsafe action related to PST results are resolved, executing “Reset the Failure Output” will restore normal output. (See 4-2-20 “Option.”)

4-2-10 Travel Calibration

Adjust zero and span of valve opening.

Select [Maintenance] → [Travel Calibration].

The following four types of zero / span adjustment methods are available.

- (1) Auto Travel Calibration
- (2) Angle Correction
- (3) Manual Setting
- (4) Change Travel Angle

Handling Precautions:

If you adjust the span after auto setup, the forced fully opening value is automatically changed to the value calculated by subtracting 1% from the overstroke percentage. However, if the SIS positioner mode is in ON/OFF mode, then the value will be fixed at 99 %.

- (1) Auto Travel Calibration

When you select [Maintenance] → [Travel Calibration] → [Auto Travel Calibration], the valve, which is initially fully closed, is fully opened and then fully closed, and the zero point and span point are automatically set.

Handling Precautions:

- Set the input signal to 5.6 mA or more when the SIS positioner is in positioning mode, and when it is in ON/OFF mode, set it to 12 mA or more or to 19.2 V or more.
- You will not be able to execute auto travel adjustment if it falls below 5.6 mA when the SIS positioner mode is in positioning mode, or if it falls below 12 mA or 19.2 V during ON/OFF mode.
- In the self-diagnosis results, if there is a message with a check mark in the positioning mode field in table 4-6 of section 4-2-21, “Diagnostic Messages,” auto travel calibration will not function correctly.
- Once adjustments are completed, always remember to change the input signal and to check the opening, valve travel, and other valve operations

Caution



There is a danger during automatic opening adjustment because the fully opened valve moves to fully closed. Be prepared in advance to prevent injury and effects on the process when the valve moves.

- (2) Angle Correction

Adjust the angles of the zero and span points.

Select [Maintenance] → [Travel Calibration] → [Angle Correction].

- 0 % Travel

Adjust the input current to 0 %.

After setting a value less than 0 % for Travel Cutoff Low, select the angle increment and decrement values, and adjust the zero point. (To increase the value by 0.01°, select Increment/0.01.)

After adjustment, return Travel Cutoff Low to the original value.

- 100 % Travel

Adjust the input current to 100 %.

If Travel Cutoff High is less than 100 %, set a value larger than 100 %, select the angle increment and decrement values, and adjust the span point. After adjustment, return Travel Cutoff High to its original value.

! Handling Precautions:

If the angle after adjustment changes by more than $\pm 30^\circ$, operation is disabled.

(3) Manual Setting

Manually fix the 0 % or 100 % opening and set the zero and span points.

Select [Maintenance] → [Travel Calibration] → [Manual Setting].

- 0 % Travel

Move the valve to the 0 % opening position by operating the input signal, actuator pressure, manual handle, or other means and set the zero point.

- 100 % Travel

Move the valve to the 100 % opening position by operating the input signal, actuator pressure, manual handle, or other means and set the span point.

! Handling Precautions:

If the angle after adjustment changes by more than $\pm 30^\circ$, operation is disabled.

(4) Change Travel Angle

This sets the angles for 0 % opening and 100 % opening.

The angle is 0° when the feedback lever is horizontal. The angle is negative if the lever is lower than the horizontal position. The angle is positive if the lever is higher than the horizontal position.

Select [Maintenance] → [Travel Calibration] → [Change Travel Angle].

- 0 % Travel Angle

This sets the angle for the 0 % opening position.

- 100 % Travel Angle

This sets the angle for the 100 % opening position.

! Handling Precautions:

Specify an angle within $\pm 30^\circ$. Accuracy is guaranteed between $\pm 4^\circ$ and $\pm 20^\circ$.

4-2-11 Input Signal Calibration (Model AVP77_/78_ Current Signal Input)

This calibrates the input signal (4 mA, 20 mA).

Select [Maintenance] → [Input Calibration].

- Calibrate the 4 mA signal

Set after making the current input (controller output) 4 mA.

- Calibrate the 20 mA signal

Set after making the current input (controller output) 20 mA.

4-2-12 Pressure Sensor Adjustment

Adjust the zero point of the pressure sensor.

Select [Maintenance] → [Pressure Sensor Adjustment] → [Zero Adjustment].

Shut off the supply air pressure before zero adjustment.

4-2-13 Simulation

The following two output signals can be changed for simulation.

Handling Precautions:

Set the input signal to 5.6 mA or more when the SIS positioner mode is in positioning mode, and when it is in ON/OFF mode, set it to 12 mA or more or to 19.2 V or more. It will not function properly if it falls below 5.6 mA when the SIS positioner mode is in positioning mode, or if it falls below 12 mA or 19.2 V during ON/OFF mode.

(1) Dummy input signal

Set the dummy input signal (0 % to 100 %).

Select [Maintenance] → [Simulation] → [Dummy Input Signal].

(2) Dummy EPM Drive Signal

Set the dummy EPM drive signal (0 % to 100 %).

Select [Maintenance] → [Simulation] → [Dummy Drive Signal].

Caution



When a simulation is running, it is dangerous to leave it unused for more than 10 minutes, as this will cancel out the setting, and the valve may start moving. Ensure ahead of time that there will be no injuries or effects on process if the valve is moved.

4-2-14 Adjustment of EPM Drive Signal (Pneumatic Modules)

If the EPM drive signal has shifted, it can be adjusted as described below.

Handling Precautions:

Since erroneous use of this function can damage the device, please ask one of our service representatives to do it.

Select [Maintenance] → [Pneumatic Modules] → [EPM Adjustment].

4-2-15 Restore factory settings

This procedure restores the factory settings.

Select [Maintenance] → [Restore factory settings].

(It may be necessary to restart the communication tool after restoring the factory data.)

Handling Precautions:

This operation does not change the HART communication settings such as Device Tag and Long Tag, etc., and history information.

4-2-16 Operator Action Records

This function keeps a log of settings changes.

The changed item, method of the change, and time of the last 10 changes are saved.

Simulation operations are not recorded.

Select [Maintenance] → [Operator Action Records].

4-2-17 Real Time Clock

Checks and sets the current time.

Select [Maintenance] → [Real Time Clock].

Handling Precautions:

The “Current Time” set by this function is reset to 2012/04/01 00:00:00 if the power is lost.

4-2-18 Password

Sets whether to use the password function and sets the password.

The default factory password function is set to “Enabled.”

The default factory password is “0000.”

Select [Maintenance] → [Password].

Handling Precautions:

- When changing the password function to “Enabled,” you must input a new password.
- While the device is operating, set the password function to “Enabled.”

4-2-19 Device Information

Select [Device] → [Device Information].

The following information can be checked and the settings can be changed.

- Manufacturer
Displays “Azbil Corporation” as the device manufacturer.
- Model
Displays “AVP700-SIS” as the name and model number of the device.
- Dev id
Displays the device’s unique ID information.
- Tag
Displays and changes the Tag No. assigned to the device.
- Long Tag
Displays and changes the Long Tag No. assigned to the device.
- Date
Allows display and modification of specific dates such as the last settings change date and special dates for the device.

- Descriptor
Allows display and modification of various information required for managing the device.
- Message
Displays and changes the messages registered in the device.
- Serial Number
Displays the unique serial number of the device.
- Final Asmbly num (Final Assembly Number)
Allows display and modification of specific management numbers such as the last settings change date for the device and system.
- Distributor
Displays the name of the company that sold the device.
- Cfg chng count (Config Change Counter)
Displays the number of times the device's settings have been changed.
- Operating Time
Displays the time the device has been operating.
- Poll addr (Polling Address)
Allows display and modification of the device address. Specifies the device address when multiple devices are connected to the same loop (split range, multi-drop connection, etc.).
- Num reg preams (Number of Request Preambles)
Displays the number of preambles requested from the host by the device.
- Num resp preams (Number of Response Preambles)
Displays the number of preambles returned to the host from the device.
- Revision Number
 - Universal rev (HART Version):
Displays the revision number for HART universal commands supported by this device.
 - Fld dev rev (Device Revision):
Displays the revision number of the device-specific commands supported by this device.
 - Software rev (Software Revision):
Displays the revision number of the software in a given Device Revision.
 - Hardware rev (Hardware Revision):
Displays the revision number of the hardware for this device.
- Factory Setting Information
 - Production Number:
Displays the production number.
 - Model Number:
Displays the model number.
 - Valve Model Number:
Displays the valve model number.
 - Factory Setting Date:
Displays the factory shipping date.

4-2-20 Option

Additional functions include the following.

- Travel transmission signal output

Select [Device] → [Option] → [Travel Transmission (AO)] → [Travel Transmission] allows the travel signal output to be monitored.

Select [Device] → [Option] → [Travel Transmission (AO)] → [Dummy Travel Transmission] allows the travel signal output to be changed freely.

Select [Device] → [Option] → [Travel Transmission (AO)] → [Fail Safe Direction] allows the fail safe direction (High or Low) for the travel signal to be checked.

This setting is set at the time of factory shipment, and changing the setting after delivery is not possible.

If there is a self-diagnosis message or PST result related to fail safe action (see table 4-6 of section 4-2-21 and table 4-8 of section 4-2-23), the travel signal will indicate burnout in the preset fail safe direction.

Select [Device] → [Option] → [Travel Transmission (AO)] → [D/A Trim] calibrates the travel signal output (4 mA, 20 mA). Connect to an ammeter to calibrate the current value.

Select [Device] → [Option] → [Travel Transmission (AO)] → [Failure Output Reset Method], to select the method of resetting the travel transmission burnout output and restoring normal output.

Select “Auto” if you want to have it automatically restored, and “Manual” to manually restore it. This setting will only be effective if the SIS positioner mode is in ON/OFF mode.

If you set it to “Manual,” you can restore output by selecting [Device] → [Option] → [Travel Transmission (AO)] → [Reset the Failure Output].

The precondition for restoring the output is that all self-diagnosis messages and PST results related to fail safe action are resolved.

- Contact Output

Select [Device] → [Option] → [Contact Output] → [Contact Output] to verify the status of the contact output.

Select [Device] → [Option] → [Contact Output] → [Dummy Contact Output] to verify the status of the contact output.

Select [Device] → [Option] → [Contact Output] → [Failure Output Reset Method], which will set the method of restoring the failure output signal.

Select “Auto” if you want to have it automatically restored, and “Manual” to manually restore it. This setting will only be effective if the SIS positioner mode is in ON/OFF mode

If you set it to “Manual,” you can restore output by selecting [Device] → [Option] → [Contact Output] → [Reset the Failure Output].

The precondition for restoring the output is that all self-diagnosis messages and PST results related to fail safe action are resolved.

4-2-21 Diagnostic Messages

The device has a self-diagnostic function.

Select [Diagnostics] → [Diagnostic Status] → [Positioner Diagnostic].

Table 4-5. List of Self-Diagnostic Messages

	Message
Failure	Valve Travel Detector Failure
	Valve Travel Detector Out of Range
	CPU Failure
	RAM Failure
	ROM Failure
	A/D Conversion Module 1 Failure
	A/D Conversion Module 2 Failure
	Non-Volatile Memory Failure
	Po 1 Pressure Sensor Failure
	Po 2 Pressure Sensor Failure
	Ps Pressure Sensor Failure
	Pn Pressure Sensor Failure
	Input Circuit Failure
	Temperature Sensor Failure
	Internal Program Execution Error
	Scheduled PST Start Failure
PST Scheduler Fault	
SIS RAM Data Failure	
Function Check	Local User I/F Active
	Dummy Input Signal simulation is running
	Dummy Drive Signal simulation is running
	Dummy Travel Transmission simulation is running
	Auto Setup is running
	Auto Travel Calibration is running
	Step Response Test is running
	Valve Signature is running
	Partial Stroke Test is running
	Full Stroke Test is running
Dummy Contact Output simulation is running	
Out of Specification	VTD Angle Span Out of Range
	Input Signal Low
	Insufficient Input Signal Range
	Temperature Out of Range
	Supply Pressure Out of Range
	VTD Temperature Out of Range
Incorrect Setting of Input Range High/Low	
Maintenance Required	Restriction is clogged*
	Deposits on the Nozzle-Flapper*
Information	Travel Cutoff High
	Travel Cutoff Low
	Factory Settings Restored
	In Use by an Operator
	Local User I/F Abnormal
	Failure Output (AO)
	Local User I/F was used in past 10 min.
	Rejection of Request for PST
	PST Overridden (aborted)
	PST Timeout
	Rejection of Request for FST
	FST Overridden (aborted)
	FST Timeout
	Emergency Demand Input (H/W)
	Emergency Demand Input (S/W)
Self-Shutdown	

* This message can be enabled or disabled by changing the setting of [Diagnostics] → [Diagnostic Setup] → [Positioner Air Circuit] → [Positioner Air Circuit Alarm Enabled]. The factory default setting is “Enabled.” (“Enabled” is recommended.)

In addition, you can set the threshold value of this message with [Diagnostics] → [Diagnostic Setup] → [Positioner Air Circuit] → [Drive Sig Shift Threshold +] or [Drive Sig Shift Threshold –]. The factory default setting is “±25 %.” (“±25 %” is recommended.)

Self-diagnosis messages that accompany fail safe action

The availability varies depending on the SIS positioner mode.

Table 4-6. Self diagnosis messages that accompany fail safe action

Message	SIS positioner mode	
	Positioning mode	ON/OFF mode
Valve Travel Detector Failure	●	●
Valve Travel Detector Out of Range	●	●
CPU Failure	●	●
RAM Failure	●	●
ROM Failure	●	●
Po 1 Pressure Sensor Failure	●	●
Po 2 Pressure Sensor Failure	●	●
Ps Pressure Sensor Failure	●	●
Pn Pressure Sensor Failure	●	●
A/D Conversion Module 1 Failure	●	●
A/D Conversion Module 2 Failure		●
Non-Volatile Memory Failure	●	●
Input Circuit Failure	●	●
Temperature Sensor Failure		●
Internal Program Execution Error		●
Scheduled PST Start Failure		●
PST Scheduler Fault		●
SIS RAM Data Failure		●

4-2-22 Valve Diagnosis**Valve Diagnosis Message**

The positioner is equipped with a valve diagnosis function. Select [Diagnostics] → [Diagnostic Status] → [Valve Diagnostic].

Table 4-7. List of Valve Diagnostic Message

	Message
Out of Specification	Supply Pressure High Alarm
	Supply Pressure Low Alarm
	Temp High Alarm
	Temp Low Alarm
	Deviation + Alarm
	Deviation – Alarm
	Zero Travel + Alarm
	Zero Travel – Alarm
Maintenance Required	Total Stroke Alarm
	Cycle Count Alarm
	Shut Count Alarm
	Max Tvl Speed + Alarm
	Max Tvl Speed – Alarm
	Po Validity + Alarm
	Po Validity – Alarm
	Max Friction Alarm
	Stick-Slip High Alarm
	Stick-Slip Medium Alarm
	Stick-Slip Low Alarm
	PST Start Position Failure
	No change in valve travel in PST
	Did not Reach to Target in PST
	PST Pressure Failure
	PST Incomplete
	Stick-Slip in PST
	FST Start Position Failure
	No change in valve travel in FST
	Did not Reach to Target in FST
	FST Pressure Failure
	FST Incomplete

4-2-23 PST (Partial Stroke Test)

You can set, execute and verify the result of a PST (if the SIS positioner mode is in ON/OFF mode).

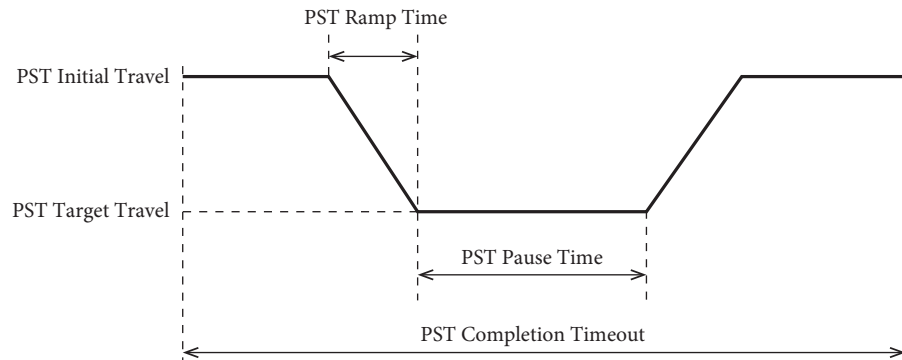


Figure: PST Pattern

Verify whether you can execute the PST as follows: [Diagnostics] → [Partial Stroke Test] → [PST Enabled]. It will display the methods of executing the PST.

Set up the PST by selecting [Diagnostics] → [Partial Stroke Test] → [Change PST Enabled]. If you select “Schedule,” you will also need to set the “PST Initial Start Date,” “PST Initial Start Time,” and “PST Interval” for the scheduled auto PST.

You can check the travel which is expected to be at the beginning of the PST: [Diagnostics] → [Partial Stroke Test] → [PST Initial Travel]. The factory default setting is “100 %.” This value cannot be modified, as it is automatically set during auto setup.

Set the target travel during the PST as follows: select [Diagnostics] → [Partial Stroke Test] → [PST Target Travel]. The factory default setting is “90 %.”

Set the wait time after reaching the target travel by selecting [Diagnostics] → [Partial Stroke Test] → [PST Pause Time]. The factory default setting is “15 sec.”

Set the operation speed until the target travel is reached by selecting [Diagnostics] → [Partial Stroke Test] → [PST Ramp Rate]. The factory default setting is “0.666 %/sec.”

Set the maximum permissible time until change in travel is detected by selecting [Diagnostics] → [Partial Stroke Test] → [PST Breakout Timeout]. The factory default setting is “15 sec.”

If the travel does not change during this time period, failure travel transmission output or failure contact output will be generated and [No change in valve travel in PST] will be reported in [PST Detailed Result].

Select [Diagnostics] → [Partial Stroke Test] → [PST Stroke Travel Timeout] to set the maximum time the target travel is reached. The factory default setting is “30 sec.” If the target travel is not reached during this time period, failure travel transmission output or failure contact output will be generated and [Did not Reach Target in PST] will be reported in [PST Detailed Result].

Set the time until completion of execution of the PST by selecting [Diagnostics] → [Partial Stroke Test] → [PST Completion Timeout]. The factory default setting is “66 sec.” If the device does not return to the original amount of travel within this time period, failure travel transmission output or failure contact output will be generated and [PST Incomplete] will be reported in [PST Detailed Result].

Set the threshold that would determine an abnormality in the output air pressure by selecting [Diagnostics] → [Partial Stroke Test] → [PST Pressure Threshold]. The factory default setting is 208 kPa, but if auto setup is executed, the device will automatically calculate it and change the setting. If an abnormality in the output air pressure is determined, failure travel transmission output or failure contact output will be generated and [PST Pressure Failure] will be reported in [PST Detailed Result].

Set the threshold for stick-slip diagnosis during PST by selecting [Diagnostics] → [Partial Stroke Test] → [PST Stick-Slip Threshold]. The factory default setting is “10.”

Set the alarm for PST stick-slip diagnosis by selecting [Diagnostics] → [Partial Stroke Test] → [PST Stick-Slip Alarm Enabled].

Verify whether the PST setting is appropriate by selecting [Diagnostics] → [Partial Stroke Test] → [Check the Validity of PST Settings].

! Handling Precautions:

If the PST settings are changed, perform this operation and make sure that there is no error message. If the device has the error messages, the PST does not operate normally.

Execute PST by selecting [Diagnostics] → [Partial Stroke Test] → [Execute PST].

Abort an executed PST by selecting [Diagnostics] → [Partial Stroke Test] → [Abort PST].

You can check the PST result by selecting [Diagnostics] → [Partial Stroke Test] → [Result].

PST detailed results that accompany fail safe action

Some PST detailed results accompany fail safe action.*

Table 4-8. PST detailed results that accompany fail safe action

Message	fail safe action
PST Start Position Failure	●
No change in valve travel in PST	●
Did not Reach to Target in PST	●
PST Pressure Failure	●
PST Incomplete	●
Stick Slip Occurred in PST	
Rejection of Request for PST	
PST Overridden (aborted)	
PST Timeout	
Scheduled PST Start Failure	
Restriction is clogged	
Deposits on the Nozzle-Flapper	

* You can check the PST Result by selecting [Diagnostics]→[Partial Stroke Test]→[Result]. The PST Result is not related to the fail safe action. If either one of the PST Detailed Result is set, the PST Result becomes “Failure”.

- Excessive valve travel and “PST Overridden” status
In software version 2.3 and later, if the valve travel exceeds the target value by 20 % when the PST is in progress, the test will be canceled. (In software version 2.2 and earlier, there was no function for detecting excessive valve travel. Check the software version on the LUI in details monitor mode with guide No. 2-1.)
The PST Result will be “Fail,” and [PST Detailed Result] will be set to “PST Overridden.”

! Handling Precautions:

- If excessive valve travel occurs, there may be a problem with this device, the actuator, or the valve. First, check the actuator and the valve for problems. If there are no problems, contact our service staff.
- PST Overridden status has one of the three possible causes described below. The cause can be identified by checking [Operator Action Records] and the self-diagnostic messages.
 - The PST was canceled by the user using HART communication or the LUI (Check [Operator Action Records] for user operations.)
 - The PST was canceled due to one of the problems marked with the symbol “•” in the Positioning mode column of table 4-6 in section 4-2-21 (“Diagnostic Messages”), or due to A/D Conversion Module 2 Failure, Temperature Sensor Failure, Internal Program Execution Error, or SIS RAM Data Failure listed in the same table.
 - The PST was canceled due to excessive valve travel (for software version 2.3 or later)

• Resetting the PST Result

If the result of a second PST is normal, previous PST result will be reset.

If you wish to reset the PST results without relaunching another PST, do the following.

Select [Diagnostic] → [Partial Stroke Test] → [Result] → [Reset PST Result].

You can also reset the PST results by turning the power off and back on again.

• Setting the automatic PST

You can enable an automatic PST for periodic execution as follows: [Diagnostics] → [Partial Stroke Test] → [Set PST Schedule], and then set the “PST Initial Start Date,” “PST Initial Start Time” and “PST Interval.”

You can check the remaining time until the next execution of PST by selecting [Diagnostics] → [Partial Stroke Test] → [PST Next Execute Time]. The factory default setting is “0 days.” This value is determined by the current time and the following setting: “PST Initial Start Date,” “PST Initial Start Time,” and “PST Interval.”

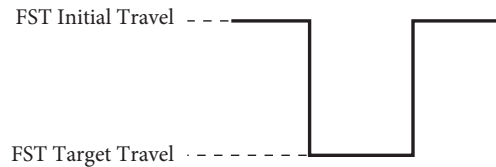
You can check the time period of when the PST will be executed by selecting [Diagnostics] → [Partial Stroke Test] → [PST Interval]. The factory default setting is “0 days.” You can set this value via the “Set PST Schedule” or “Change PST Enabled” option.

! Handling Precautions:

- Please confirm that the following conditions that allow PST execution are met before actually executing it.
 - SIS positioner mode is in ON/OFF mode
 - The supply air pressure is input appropriately
 - The input signal must be the input for regular operation as outlined in Table 2-2
 - The travel at the start of the PST must be within ±5% of the PST Initial Travel
 - There are no messages with a check mark in the positioning mode field in table 4-6 of section 4-2-21, “Diagnostic Messages.”
 - If you are executing a scheduled auto PST, other setters must not be operating it (User Operator of the Operator Action Setting must be set to “None”)
- Please test to see whether the PST can be appropriately launched with the preset parameters.

4-2-24 FST (Full Stroke Test)

You can set, execute, and verify the results of an FST.



Verify whether you can execute the FST by selecting [Diagnostics] → [Full Stroke Test] → [FST Enabled].

You can confirm the travel at the time of starting the FST as follows: [Diagnostics] → [Full Stroke Test] → [FST Initial Travel]. The factory default setting is “100%.”

This value cannot be modified, as it is automatically set during auto setup.

Set the wait time after reaching the target travel by selecting [Diagnostics] → [Full Stroke Test] → [FST Pause Time]. The factory default setting is “30 sec.”

Set the maximum time until change in travel is detected by selecting [Diagnostics] → [Full Stroke Test] → [FST Breakout Timeout]. The factory default setting is “5 sec.”

If the travel does not change during this time period, [No change in valve travel in FST] will be reported in [FST Detailed Result].

Set the maximum time until the target travel is reached by selecting [Diagnostics] → [Full Stroke Test] → [FST Stroke Travel Timeout]. The factory default setting is “30 sec.”

If the target travel is not reached during this time period, [Did not Reach to Target in FST] will be reported in [FST Detailed Result].

Set the time until completion of execution of the FST by selecting [Diagnostics] → [Full Stroke Test] → [FST Completion Timeout]. The factory default setting is “66 sec.”
If the device does not return to the original amount of travel within this time period, [FST Incomplete] will be reported in [FST Detailed Result].

Verify whether the FST settings are appropriate by selecting [Diagnostics] → [Full Stroke Test] → [Check the Validity of FST Settings].

! Handling Precautions:

- If the FST settings are changed, perform this operation and make sure that there is no error message. If the device has the error messages, the FST does not operate normally.

Execute the FST by selecting [Diagnostics] → [Full Stroke Test] → [Execute FST].

Abort an executed FST by selecting [Diagnostics] → [Full Stroke Test] → [Abort FST].

You can check the results of the FST by selecting [Diagnostics] → [Full Stroke Test] → [Result].

- Resetting the FST Results

If the result of a second FST is normal, the previous FST result will be reset.

If you wish to reset the FST results without relaunching another FST, do the following.

Select [Diagnostic] → [Full Stroke Test] → [Result] → [Reset FST Result].

You can also reset the FST results by turning the power off and back on again.

! Handling Precautions:

- Please confirm that the following conditions that enable FST execution are met before actually executing it.
 - The supply air pressure is input appropriately
 - The input signal is set appropriately
 - The travel at the start of the FST must be within $\pm 5\%$ of the FST Initial Travel
 - There are no messages with a check mark in the positioning mode field in table 4-6 in section 4-2-21, “Diagnostic Messages.”
- Please test to see whether the FST can be appropriately launched with the preset parameters.
- The FST cannot be used as a proof test to satisfy the functional safety standards. If you wish to conduct a proof test, please follow the procedure outlined in the safety manual included in the package of this device.

Chapter 5 Troubleshooting

This chapter describes how to address problems that may arise.

The following three types of problems may occur when you start up and start operating the device.

- Problems that occur because the specifications of the device are not suitable for the actual use conditions
- Problems due to setup or operation errors
- Problems due to failure of the device

If problems arise, please refer to this troubleshooting guide and take appropriate measures. For contact information, please refer to the following site.

<http://www.azbil.com/products/bi/iap/index.html>

5-1 Troubleshooting

If problems occur during startup or while operating, please use the following procedure to remedy the situation. If you cannot resolve the problem with the following procedure, the device may be faulty. Please contact our service representative.

5-1-1 If the Valve does not Close Fully (the output air pressure does not go down to 0)

- 1 Check whether the input signal is signaling full closure.
- 2 Check whether the output air pressure is 0 kPa.
If it is not at 0 kPa, please clean the flapper (section 6-3).
If it's at 0 kPa, and if the valve doesn't fully close when the supply air pressure is set to 0, there is an abnormality in the valve, which requires maintenance.

5-1-2 If the Device does not Operate (No Output Air Pressure)

1. Check that setup has been properly completed (e.g., allowable rotation angle of feedback lever).
2. Check that an appropriate supply air pressure is supplied (check for air leaks).
3. Check that an appropriate input signal (power supply) is input (e.g., whether electrical wiring is correct).
4. If HART communication is possible, conduct "self-diagnosis" on the equipment and follow the messages to resolve the problem (please refer to the message explanation in sections 5-1-6 and 5-1-7).
5. Check whether the internal data in the device is properly specified.

5-1-3 If the Valve Behaves Abnormally (Output Air Is Present)

1. Activate manual operation status with the A/M switch, adjust the air with the regulator, and check that the valve shaft moves smoothly. (Check whether galling or packing solidification has occurred.)
2. Check whether the internal data in the device is properly specified (actuator size and hysteresis, among other data).
3. If the symptoms of the problem can be found in the table below, take action according to the table.

Problem	Point to be checked and action
Hunting, Overshoot	<ul style="list-style-type: none"> • Check that the rotation angle of the feedback lever is within limits. • Change the friction level from Light to Medium to Heavy. If this does not solve the problem, change the actuator size setting to a smaller parameter with the friction level set to Heavy. (For the procedure, refer to “Adjustment Procedure when Hunting Occurs” on the next page.)
The device does not complete a full stroke. The response speed is too slow.	<ul style="list-style-type: none"> • Check that the fully closed and open positions (zero and span) of the valve are properly adjusted. • Check that the EPM drive signal is within the range of $50 \pm 25\%$.

5-1-4 Failure to Communicate with the Communicator

1. Check whether the electrical wiring is correct.
2. Check whether the communicator is correctly connected to the device.
3. Check whether both input and output devices have power sources.
4. Check whether the relationship between the power supply voltage and external load meets the specifications.

5-1-5 Adjustment Procedure When Hunting Occurs

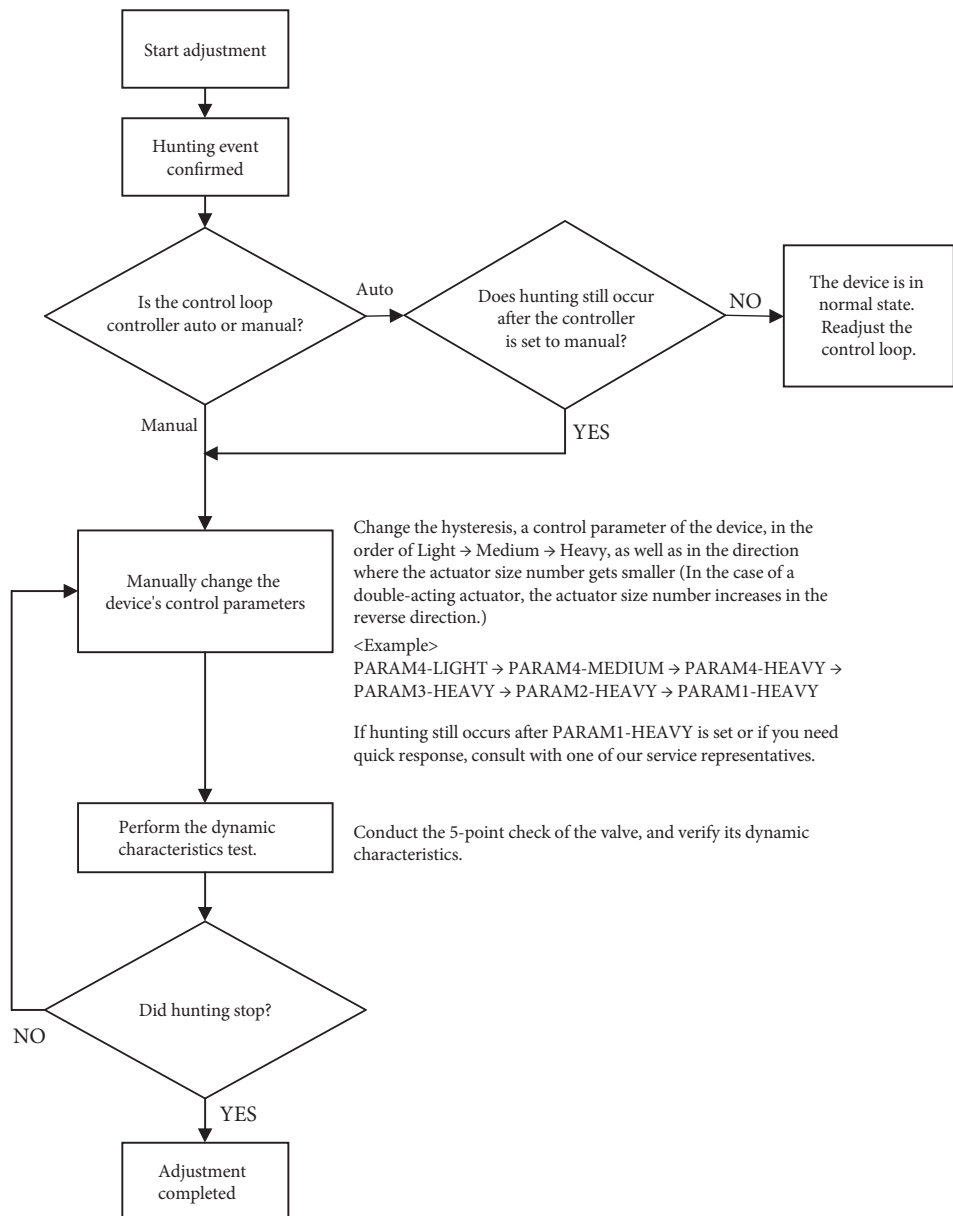








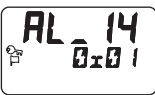







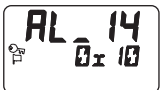














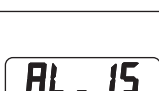









Figure 5-46.






5-1-6 Description of Messages

Message	LUI display example ¹⁾	LUI display		Description and cause	Action
		Upper part	Lower part [*: Optional]		
ROM Failure		AL_00	0x01,0x03,0x05,0x07 0x09,0x0b,0x0d,0x0F	ROM error.	Contact Azbil Corporation.
RAM Failure		AL_00	0x02,0x03,0x06,0x07 0x0A,0x0b,0x0E,0x0F	RAM error.	Contact Azbil Corporation.
Non-Volatile Memory Failure		AL_00	0x04,0x05,0x06,0x07 0x0c,0x0d,0x0E,0x0F	Non-volatile memory error.	Contact Azbil Corporation.
CPU Failure		AL_00	0x08,0x09,0x0A,0x0b 0x0c,0x0d,0x0E,0x0F	CPU error.	Contact Azbil Corporation.
Valve Travel Detector Failure		AL_01	0x*1,0x*5,0x*9,0x*d	VTD (angle sensor) error. • The VTD connector is disconnected. • VTD signal line is disconnected or short-circuited.	Contact Azbil Corporation.
Valve Travel Detector Out of Range		AL_01	0x*2,0x*6,0x*A,0x*E	VTD (angle sensor) output error. • The allowable rotation angle of feedback lever (±30°) is exceeded. • The feedback lever is disengaged.	Check that the feedback lever is not disengaged and that the angle of rotation is allowable (±30°). If the error message does not disappear after you check these points, contact Azbil Corporation.
A/D Conversion Module 1 Failure		AL_01	0x*4,0x*5,0x*6,0x*c 0x*d,0x*E	Error in the AD conversion section (operation part).	Contact Azbil Corporation.
A/D Conversion Module 2 Failure		AL_01	0x*8,0x*9,0x*A,0x*c 0x*d,0x*E	Error in the AD conversion section (pressure sensor).	Contact Azbil Corporation.
Input Circuit Failure		AL_14	0x*1,0x*3,0x*5,0x*7 0x*9,0x*b,0x*E,0x*F	Input circuit error	Contact Azbil Corporation.
Po 1 Pressure Sensor Failure		AL_01	0x1*,0x3*,0x5*,0x7* 0x9*,0xb*,0xd*,0xF*	Error in the Po1 pressure sensor.	Contact Azbil Corporation.
Po 2 Pressure Sensor Failure		AL_01	0x2*,0x3*,0x6*,0x7* 0xA*,0xb*,0xE*,0xF*	Error in the Po2 pressure sensor.	Contact Azbil Corporation.

Message	LUI display example ¹	LUI display		Description and cause	Action
		Upper part	Lower part [*: Optional]		
Ps Pressure Sensor Failure		AL_01	0x4*,0x5*,0x6*,0x7* 0xc*,0xd*,0xE*,0xF*	Error in the Ps pressure sensor.	Contact Azbil Corporation.
Pn Pressure Sensor Failure		AL_01	0x8*,0x9*,0xA*,0xb* 0xc*,0xd*,0xE*,0xF*	Error in the Pn pressure sensor.	Contact Azbil Corporation.
Temperature Sensor Failure		AL_14	0x02,0x03,0x06,0x07 0x0A,0x0b,0x0E,0x0F	Temperature sensor abnormality	Contact Azbil Corporation.
Internal Program Execution Error		AL_14	0x04,0x05,0x06,0x07 0x0c,0x0d,0x0E,0x0F	Program execution abnormality	Contact Azbil Corporation.
Scheduled PST Start Failure		AL_14	0x*8,0x*9,0x*A,0x*b 0x*C,0xD,0x*E,0x*F	Unable to execute auto PST because PST execution requirements are not satisfied	Please check the PST execution requirements.
PST Scheduler Fault		AL_14	0x1*,0x3*	Unable to execute auto PST due to internal abnormality	Contact Azbil Corporation.
SIS RAM Data Failure		AL_14	0x2*,0x3*	SIS RAM data abnormality	Contact Azbil Corporation.
Local User I/F Active	—	—	—	The LUI is operating (in setup mode).	Exit the LUI setup mode by holding down  .
Dummy Drive Signal simulation is running		AL_02	0x*8,0x*9,0x*A,0x*b	The device is in the dummy EPM drive signal output state.	Clear the dummy EPM drive signal output state.
Auto Setup is running		AL_02	0x1*	Auto setup is in progress	Wait until execution ends or stop it with the stop command as needed.
Auto Travel Calibration is running		AL_02	0x2*	Automatic opening adjustment is in progress	Wait until execution ends or stop it with the stop command as needed.
Step Response Test is running		AL_02	0x4*	The step response test is in progress	Wait until execution ends or stop it with the stop command as needed.
Valve Signature is running		AL_02	0x8*	Valve signature is in progress	Wait until execution ends or stop it with the stop command as needed.

Message	LUI display example ¹⁾	LUI display		Description and cause	Action
		Upper part	Lower part [*: Optional]		
VTD Angle Span Out of Range		AL_03	0x*1,0x*3,0x*5,0x*7 0x*9,0x*b,0x*d,0x*F	The zero and span range is too narrow.	Adjust the zero and span so that the angle of the feedback lever has a span of 4° or larger.
Input Signal Low		AL_03	0x*2,0x*3,0x*6,0x*7 0x*A,0x*b,0x*E,0x*F	The input current is too low.	Input at least 3.5 mA
Insufficient Input Signal Range		AL_03	0x*4,0x*5,0x*6,0x*7 0x*c,0x*d,0x*E,0x*F	The input signal range is too narrow.	Set the input signal span more than 2 mA.
Temperature Out of Range		AL_03	0x*8,0x*9,0x*A,0x*b 0x*c,0x*d,0x*E,0x*F	The temperature in the device is lower than -40° or higher than 80°.	Set the ambient temperature to between -40° and 80° as specified by the usage conditions. If this message is displayed even though this condition is satisfied, a sensor error is likely. Contact Azbil Corporation.
Supply Pressure Out of Range		AL_03	0x1*,0x5*	The supply air pressure detected in the device is lower than 50 kPa or higher than 715 kPa.	<ul style="list-style-type: none"> • Check that the supply air pressure is applied. • Set the supply air pressure to 715 kPa or lower. If this message is displayed even though this condition is satisfied, a sensor error is likely. Contact Azbil Corporation.
Incorrect Setting of Input Range High/Low		AL_03	0x4*,0x5*	The high and low setting of the input signal range are incorrect.	Check the settings for Input Range High (Open) and Input Range Low (Closed).
Partial Stroke Test is running		AL_15	0x01,0x03,0x05,0x07	PST is in progress	Since PST is in progress, please either wait until it finishes, or if you wish to abort it, use the abort command.
Full Stroke Test is running		AL_15	0x02,0x03,0x06,0x07	FST is in progress	Since a FST is in progress, please either wait until it finishes, or if you wish to abort it, use the abort command.
Dummy Contact Output simulation is running		AL_15	0x04,0x05,0x06,0x07	It's in dummy contact output state	Please call off the dummy contact output state.
Supply Pressure High Alarm		AL_16	0x01,0x05,0x09	The supply air pressure is higher than the specified threshold value	<ul style="list-style-type: none"> • Check the supply air pressure. • Check that the threshold value is appropriate.

Message	LUI display example ¹	LUI display		Description and cause	Action
		Upper part	Lower part [*: Optional]		
Supply Pressure Low Alarm		AL_16	0x02,0x06,0x0A	The supply air pressure is lower than the specified threshold value	
Temp High Alarm		AL_16	0x04,0x05,0x06	The internal temperature is higher than the specified threshold value	<ul style="list-style-type: none"> • Check the ambient temperature. • Check that the threshold value is appropriate for the usage environment.
Temp Low Alarm		AL_16	0x08,0x09,0x0A	The internal temperature is lower than the specified threshold value	<ul style="list-style-type: none"> • Check the ambient temperature. • Check that the threshold value is appropriate for the usage environment.
Restriction is clogged		AL_04	0x01	<p>The EPM drive signal has exceeded the normal operation range.</p> <ul style="list-style-type: none"> • The fixed diaphragm is clogged. • Air is not supplied. • Galling of the valve shaft. 	<ul style="list-style-type: none"> • Clean the fixed flow restriction. • Check the supply air pressure. • Check the EPM drive signal. • Change the input signal to confirm smooth operation. (• Perform auto setup.)
Deposits on the Nozzle-Flapper		AL_04	0x02	<p>The EPM drive signal has exceeded the normal operation range.</p> <ul style="list-style-type: none"> • The nozzle is clogged. • The A/M switch is in manual mode. 	<ul style="list-style-type: none"> • Clean the nozzle. • Check that the A/M switch is in auto mode. • Check the EPM drive signal. • Change the input signal to confirm smooth operation.
Total Stroke Alarm	—	—	—	The cumulative sliding distance is larger than the threshold value.	Check the valve's operation.
Cycle Count Alarm	—	—	—	The number of inversion operations is larger than the threshold value.	Check the valve's operation.
Shut Count Alarm	—	—	—	The number of full close operations is larger than the threshold value.	Check the valve's operation.
Max Tvl Speed+Alarm	—	—	—	The maximum operation speed + is larger than the threshold value.	Check the valve's operation.
Max Tvl Speed–Alarm	—	—	—	The maximum operation speed – is smaller than the threshold value.	Check the valve's operation.
Po Validity + Alarm	—	—	—	The output air pressure validity + is larger than the threshold value.	Check the valve's operation.
Po Validity – Alarm	—	—	—	The output air pressure validity – is smaller than the threshold value.	Check the valve's operation.

Message	LUI display example ¹	LUI display		Description and cause	Action
		Upper part	Lower part [*: Optional]		
Max Friction Alarm	—	—	—	The maximum friction is larger than the threshold value.	Check the valve's operation.
Stick-Slip High Alarm	—	—	—	Stick-slip is larger than the "High" threshold value.	Check the valve's operation.
Stick-Slip Medium Alarm	—	—	—	Stick-slip is larger than the "Medium" threshold value.	Check the valve's operation.
Stick-Slip Low Alarm	—	—	—	Stick-slip is larger than the "Low" threshold value.	Check the valve's operation.
Deviation + Alarm	—	—	—	The deviation + is larger than the threshold value.	Check the valve's operation.
Deviation – Alarm	—	—	—	The deviation – is smaller than the threshold value.	Check the valve's operation.
Zero Travel + Alarm	—	—	—	The zero point opening + is larger than the threshold value.	Check the valve's operation.
Zero Travel – Alarm	—	—	—	The zero point opening – is smaller than the threshold value.	Check the valve's operation.
Travel Cutoff High	—	—	—	The valve was forcibly fully opened.	Confirm the forced full closure value and fully open value, then specify an input signal within the setting range.
Travel Cutoff Low	—	—	—	The valve was forcibly fully closed.	
PST Start Position Failure		AL_19	0x*1,0x*3,0x*5,0x*7 0x*9,0x*b,0x*E,0x*F	PST starting travel abnormality	Set the valve travel to the initial travel for the PST.
No change in valve travel in PST		AL_19	0x*2,0x*3,0x*6,0x*7 0x*A,0x*b,0x*E,0x*F	Valve doesn't move during PST	Test the valve's operation.
Did not Reach Target in PST		AL_19	0x*4,0x*5,0x*6,0x*7 0x*C,0x*D,0x*E,0x*F	Valve doesn't reach the target travel during PST	Test the valve's operation.
PST Pressure Failure		AL_19	0x*8,0x*9,0x*A,0x*b 0x*C,0xD,0x*E,0x*F	Abnormality in pressure during PST	Test the valve's operation.
PST Incomplete		AL_19	0x1*	PST didn't finish.	Relaunch PST, or test the valve's operation.
Stick-Slip in PST	—	—	—	Stick-slip occurs during PST	Test the valve's operation.




Message	LUI display example ^{*1}	LUI display		Description and cause	Action
		Upper part	Lower part [*: Optional]		
FST Start Position Failure	—		—	FST starting travel abnormality	Set the valve travel to the initial travel for the FST.
No change in valve travel in FST	—		—	Valve doesn't move during FST	Test the valve's operation.
Did not Reach to Target in FST	—		—	Valve doesn't reach the target travel during FST	Test the valve's operation.
FST Pressure Failure	—		—	Abnormality in pressure during FST	Test the valve's operation.
FST Incomplete	—		—	FST didn't finish.	Relaunch FST, or test the valve's operation.
Factory Settings Restored	—		—	The data set when the device was shipped from the factory was restored. The factory data reset (restoring factory settings) operation was performed.	Perform appropriate adjustment and setup.
In Use by an Operator	—		—	Settings are being changed through HART communication or with the LUI.	Check which operator is changing the settings.
Local User I/F Abnormal	—		—	LUI module error. Key input is still recognized as ON. The key is being physically pressed down.	Check the key status. Move the device away from any nearby strong magnetic field.
Local User I/F was used in past 10 min.	—		—	The LUI key was used within the past 10 minutes.	There may be someone near the device. Check the safety in the field.

*1. These alarms are displayed with the normal monitor. The alarms are not displayed with other monitors.

Chapter 6 Maintenance

This chapter describes periodic maintenance for the device. You can keep the device in good working order by performing appropriate maintenance. Also, the limited life parts that may be purchased are listed in 6-9. Because the replacement frequencies of resale parts differ depending on the usage environment and usage situation of the device, specify appropriate replacement frequencies.

Precautions for safe work

 Caution	
	If appropriate maintenance is not performed, an unexpected operation may cause the feedback lever to move, causing an injury. Perform maintenance at appropriate times.
	Maintenance work is dangerous because the valve moves. Be prepared in advance to prevent injury and effects on the process when the valve moves.

6-1 A/M Switch

Maintenance work can be done by switching from Auto to Manual. The device has a built-in Auto/Manual (A/M) switch.

The A/M switch switches the control method of output air from the positioner between auto operation and manual operation.

1) Auto operation

- The device outputs the output air pressure to control the opening according to the input signal.

2) Manual operation

- The main unit directly outputs the supply air pressure.
- Manual operations with the regulator are possible. (The double-acting actuator does not support manual operation.)

 Warning	
	Operation of the A/M switch is dangerous because the valve moves. Be prepared in advance to prevent injury and effects on the process when the valve moves.

3) Structure of A/M switch

The structure of the A/M switch is shown in the figure below.

Remove the pilot relay cover.

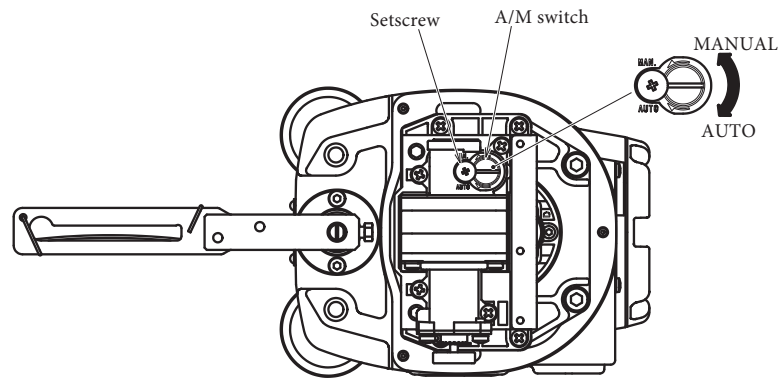


Figure 6-47. Structure of A/M Switch

! Handling Precautions:

Please note that if it's used during MAN operation state, it would not be operable during an emergency.

4) Procedure for switching from auto operation to manual operation

The procedure for switching from auto operation to manual operation is shown below.

Step	Procedure
1	Loosen the three screws to remove the pilot relay cover in order to operate the A/M switch.
2	Rotate the A/M switch counterclockwise (in the MAN direction) one revolution using a flat-head screwdriver. (Confirm that operation has switched by using the output air pressure gauge.)

5) Procedure for switching from manual operation to auto operation

The procedure for switching from auto operation to manual operation is shown below.

Step	Procedure
1	Securely rotate the A/M switch clockwise (in the AUTO direction) using a flat-head screwdriver until it stops. (Confirm that operation has switched by using the output air pressure gauge.)
2	Attach the pilot relay cover to the main unit with the three screws.

Caution



Do not loosen the setscrew. If the setscrew is loosened, the A/M switch will pop out due to the air pressure, potentially causing an injury.

6-2 Replacement of Filter and Maintenance of Flow Constriction

Foreign matter from the instrumentation air that is stuck in the constricted flow section of the device can be removed during maintenance. The replacement and maintenance procedures are described below.

! Handling Precautions:

Use clean dry air with solid particles no larger than 3 μm as the instrumentation air.

1) Replacement and Maintenance Procedure

Step	Procedure
1	Shut off the supply air to the device.
2	Loosen the three screws to remove the pilot relay cover and remove the set-screw in the A/M switch section.
3	Rotate the A/M switch in the MAN direction to remove.
4	Cut the holder with nippers or other tool to remove the old filter. ! Handling Precautions: Properly dispose of the old holder and filter.
5	Clean the constricted flow section using a wire (with a diameter of 0.25 mm) or other tool. ! Handling Precautions: When cleaning, be careful not to damage the hole of the flow constriction. Do not use an air gun. Be careful not to let oil get on the cleaned area.
6	Wrap a new filter around the A/M switch and secure it with the holder.
7	Screw in the A/M switch until it stops.
8	Screw the setscrew into the A/M switch section.
9	Attach the pilot relay cover with the three screws.

6-3 Cleaning the Flapper

If the flapper is contaminated by instrumentation air, clean it as described below.

Step	Procedure
1	Remove the three screws from the pilot relay cover.
2	Prepare a piece of 0.2 mm thick paper. A typical business card is appropriate.
3	Chip away dirt that has accumulated in the space between the nozzle and flapper in the EPM using the paper.
4	After cleaning, attach the pilot relay cover to the main unit with the three screws.

Caution



If air pressure is supplied to the device, the back pressure of the nozzle will change after the flapper is cleaned, and therefore the valve opening will suddenly change. Perform cleaning under conditions where a sudden move of the valve will not injure people or disturb plant operation.

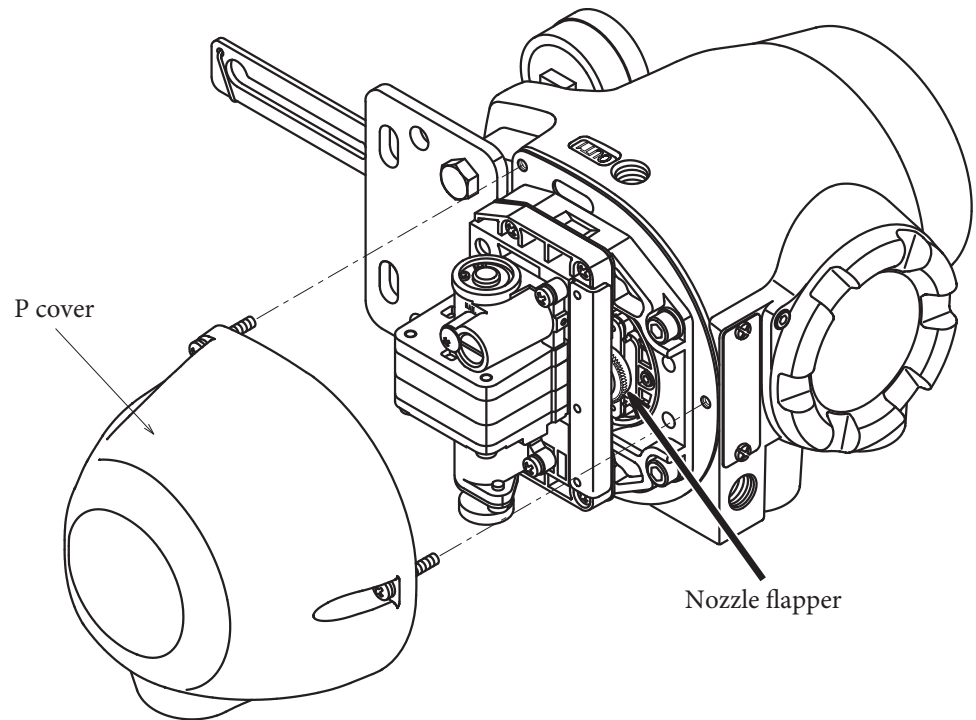


Figure 6-48. Structure

6-4 Adjusting the Pilot Relay

The adjustment method for the pilot relay differs depending on whether the single-acting or double-acting actuator is used.

Adjust as appropriate for the actuator being used, referring to the procedures below.

1) Procedure for adjusting the pilot relay for a double-acting actuator (adjustment from single-acting to double-acting type)

Step	Procedure
1	Rotate the pilot relay adjustment screw clockwise (tightening direction) until it stops. The balance pressure of output air pressures P_{out1} and P_{out2} is used as the supply air pressure.
2	Perform auto setup. (Use the LUI or communication.) Auto setup configures the double-acting settings and roughly adjusts the zero point and span.
3	After confirming that auto setup is completed, apply the input signal to make the opening 50 %.
4	While checking output air pressure P_{out1} or P_{out2} with the LUI or pressure gauge, rotate the pilot relay adjustment screw to adjust the output air pressure to 70 % \pm 10 % of the supply air pressure. Rotating the adjustment screw clockwise increases the balance pressure while rotating it counterclockwise decreases the balance pressure. ! Handling Precautions: If the actuator has a large capacity, it takes time for the balance pressure to stabilize. Rotating the adjustment back a bit facilitates stabilization.
5	Perform auto setup again. The final adjustment value is measured.
6	Perform operation checks including a five-point check (0, 25, 50, 75, 100 % opening).

2) Procedure for adjusting the pilot relay for a single-acting actuator (adjustment from double-acting to single-acting type)

Step	Procedure
1	Rotate the pilot relay adjustment screw counterclockwise (loosening direction) until it stops. Output air pressure P_{out2} becomes 0.
2	Perform auto setup.
3	Perform operation checks including a five-point check (0, 25, 50, 75, 100 % opening).

Caution



When rotating the pilot relay adjustment screw, be careful not to get your finger caught in the space between it and the adapter.



The adjustment screw may be damaged if you rotate it with excessive force using a tool.

6-5 Insulation Resistance Test

Caution



In principle, do not test the insulation resistance. This test may damage the built-in varistor for absorbing surge voltage. If it is absolutely necessary to perform this test, carefully follow the specified procedure.

1) Test procedure

- Remove external wiring from the device.
- Connect the input signal + and – terminals together, and connect the output signal + and – terminals together.
- Perform the test between each of these connected parts and the ground terminal.
- The applied voltage and evaluation criteria are shown in the table below.

Handling Precautions:

Do not apply a voltage higher than the value below to prevent the instrument from being damaged.

2) Evaluation criteria

The evaluation criteria for this test are shown below.

Test	Evaluation criteria
Insulation resistance	$2 \times 10^7 \Omega$ or higher at a test voltage of 25 V DC (at 25 °C, 60 % RH or less)

6-6 Adjustment Procedure When Using the Device with a Booster Relay Attached

When using the device with a booster relay attached, adjust using the following procedure.

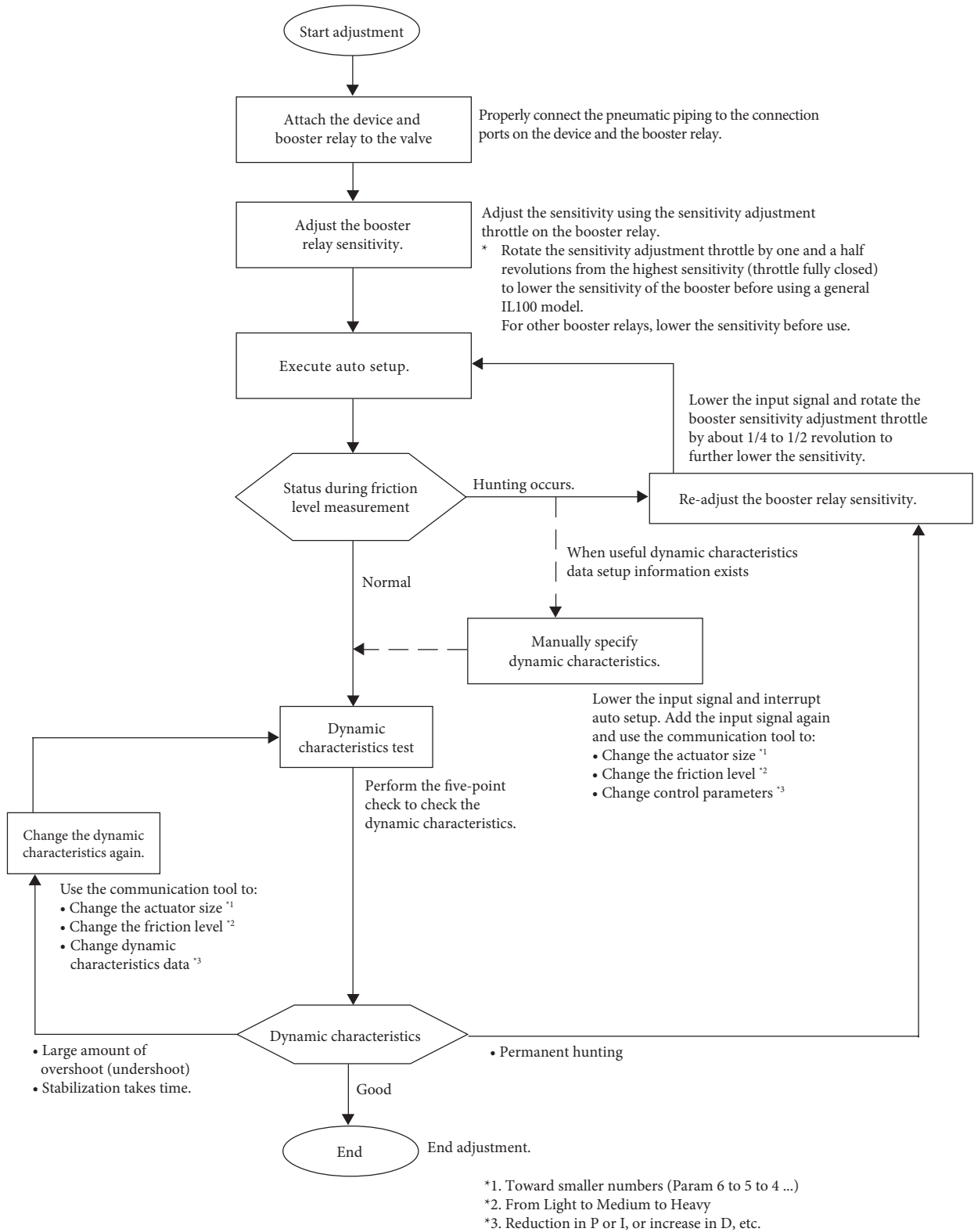


Figure 6-49.

6-7 List of Default Values for Internal Data

Item	Parameter	Default	
Device tag	Device Tag	XXXXXXXX	
Long tag	Long Tag	Number of characters: 32	
Input value to fully open the valve	Input Range High (Open)	20 mA	
Input value to fully close the valve	Input Range Low (Close)	4 mA	
Actuator type	Actuator Type	Linear	
Position of valve when fully closed	Valve Closed Position	FeedBack Lever Down	
With/without booster relay	With booster relay	Without Booster Relay	
Feedback lever operation	Feedback Lever Motion	UP when P_{oi} increases	
Pilot relay type	Pilot Relay Type	Single Acting	
Positioner action	Positioner Action	Direct	
Electrical fail direction	Electrical Fail to	Close	
Actuator size	Actuator Size	Param 1	
Friction level	Friction Level	Heavy	
Control deadband	Control Deadband	0.05	
Controlled parameter	Proportional gain (beyond GAP1)	P out of GAP1	1
	Integral time (beyond GAP1)	I out of GAP1	10
	Differential time (beyond GAP1)	D out of GAP1	0.2
	GAP width 1	GAP1	5
	Proportional gain (within GAP1)	P inside of GAP1	0.5
	Integral time (within GAP1)	I inside of GAP1	5
	Differential time (within GAP1)	D inside of GAP1	0.2
	GAP width 2	GAP2	1
	Proportional gain (within GAP2)	P inside of GAP2	0.2
	Integral time (within GAP2)	I inside of GAP2	2
Differential time (within GAP2)	D inside of GAP2	0.2	
Flow amount characteristic	Input Characterization	Linear	
Forced fully open value	Travel Cutoff High	109	
Forced fully closed value	Travel Cutoff Low	0.5	
Pressure display unit	Unit of Pressure	kPa	

6-8 Internal Block Diagram of the 700 Series

1) Internal block diagram of the 700 Series

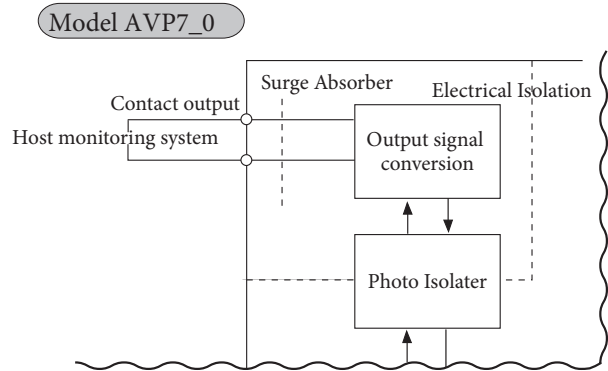
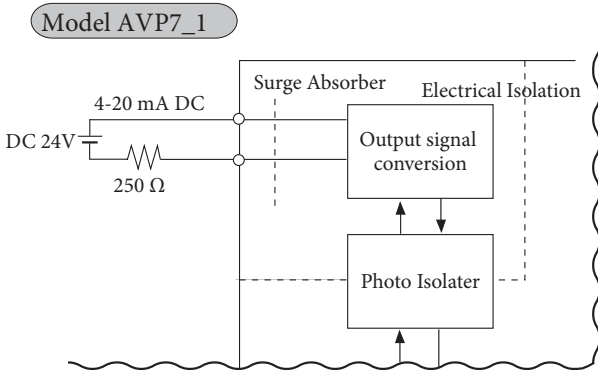
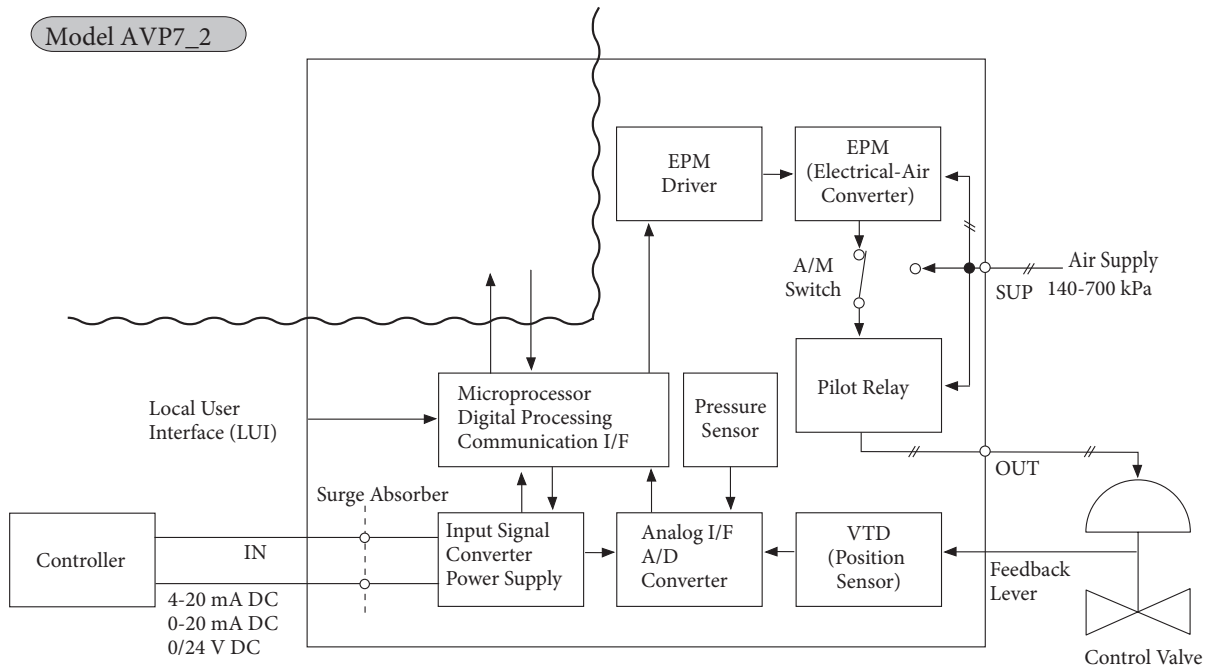


Figure 6-50.

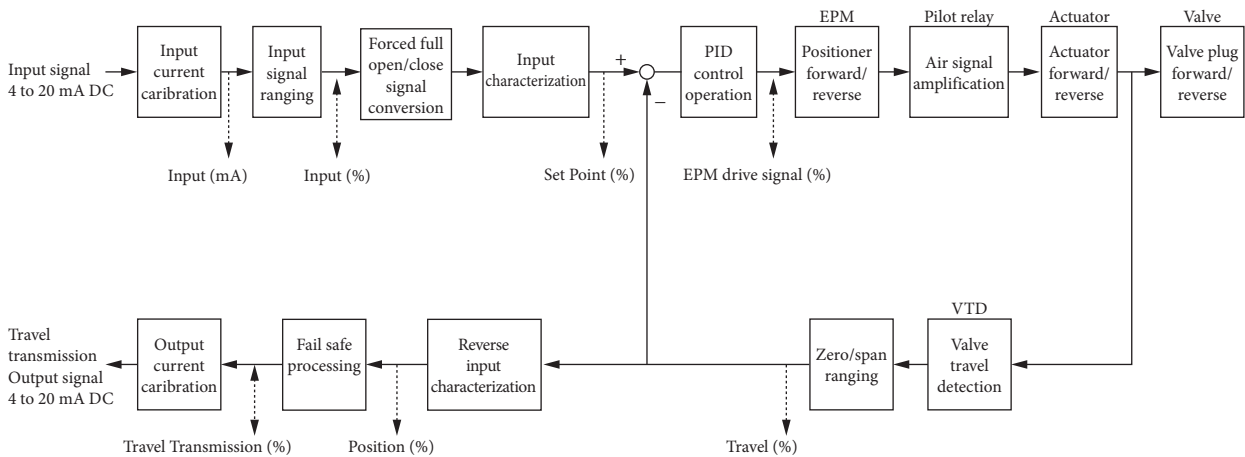


Figure 6-51.

6-9 Replacement Parts

Replacement parts for maintenance are listed in the table below. For the position of each part, refer to Figure 6-6.

No.	Name	Part No.	Qty	Recommended replacement period (yrs) ¹⁾	Recommended tightening torque (N·m)
1	Face cover assembly	80388840-102	1	—	0.9±0.1
2	Face cover	80388841-002	1	—	-
3	Hexagon socket flat head bolt (for face cover, M4×16)	80388843-101	2	—	0.9±0.1
4	Screw retainer ring (for face cover)	80235519-010	2	—	-
5	Switch block assembly	80388910-901	1	5	1.02±0.33
6	S-TITE (for switch block, equivalent to M3×6)	80388918-001	2	—	1.02±0.33
7	Terminal cover assembly	80388820-001 (finish S) 80388820-002 (finish B) 80388820-003 (finish D)	1	5	—
8	O-ring (AS568-151) (for terminal cover)	80388828-151	1	5	—
9	Hexagon socket bolt (lock screw for terminal cover, M4×8)	314-204-080	1	—	0.9±0.1
10	Set of five cross recessed head screws with captive spring washers (terminal screw, M4×8)	80277581-001	5	—	1.5±0.2
11	Cross recessed head screws with captive spring washers (external grounding terminal screw, M4×8)	80277581-001	1	—	1.5±0.2
12	Exhaust cap	80388823-001 (finish S) 80388823-002 (finish B) 80388823-003 (finish D)	1	—	—
13	S-TITE (equivalent to M3×6) (for exhaust cap)	80388918-001	2	—	1.33±0.46
14	P cover assembly (with screw)	80388825-001 (finish S) 80388825-002 (finish B) 80388825-003 (finish D)	1	—	1.5±0.2
15	Special cross recessed head screws with captive spring washers (for P cover, M4×16, shank: 9)	80388844-001	3	—	1.5±0.2
16	Seal washer (for P cover)	80357789-001	3	—	—
17	Pilot relay assembly (including the A/M screw assembly)	80388850-001 (single acting) 80388850-002 (double acting)	1	5	—
18	Cross recessed head screws with captive spring washers (for pilot relay, M4×25)	398-204-250	4	—	1.8±0.2
19	O-ring (AS568-014) (for pilot relay)	80020935-409	4	5	—
20	O-ring (S7) (for pilot relay)	80020935-323	1	5	—
21	A/M screw assembly	80388885-001	1	4	—
22	Filter	80377077-001	1	4	—
23	Holder	80377078-001	1	—	—
24	Cross recessed truss head screw (for A/M screw, M4×6)	310-240-060	1	—	1.5±0.2
25	O-ring (AS568-007) (for A/M screw)	80020935-216	1	5	—
26	O-ring (AS568-010) (for A/M screw)	80020935-324	1	5	—
27	O-ring (AS568-012) (for A/M screw)	80020935-325	1	5	—
28	Feedback lever assembly	80377049-001 (without option M6) 80377049-002 (with option M6)	1	—	—
29	Feedback lever	80377148-001 (without option M6) 80377148-002 (with option M6)	1	—	—
30	Arm spring	80377149-001 (without option M6) 80377149-002 (with option M6)	1	—	—

No.	Name	Part No.	Qty	Recommended replacement period (yrs) ¹	Recommended tightening torque (N·m)
31	Hexagon socket bolt with captive spring washer (for feedback lever, M5×8)	80377127-001	2 (4) ²	—	2.9±0.3
32	Extension lever	80377142-001 (40 mm extension, without option M6) 80377142-101 (40 mm extension, with option M6) 80377142-002 (80 mm extension, without option M6) 80377142-102 (80 mm extension, with option M6)	1	—	2.9±0.3
33	Blind plug/pressure-resistant explosion-proof plug (G1/2)	80377115-001	1	5	—
34	Blind plug/plug (for general use, NPT 1/2)	80277971-001	1	—	—
35	Blind plug/plug (for IECEx/ATEX, NPT 1/2)	80372545-001	1	—	—
36	Blind plug/plug (for general use/ATEX, M20)	80377205-001	1	5	—
37	Blind plug/plug (for IECEx, M20)	80372699-001	1	5	—
38	Flameproof cable gland	80388728-002	1 (2) ³	10	—
39	Flameproof elbow (G1/2)	80357206-108	1 (2) ³	10	—

*1. The recommended replacement period assumes standard conditions (JIS C 1804, C 1805). The replacement period may be shorter depending on environmental conditions (such as temperature, humidity, vibration, and air quality) and usage conditions (such as operation frequency and ON/OFF operations).

*2. If the extension lever is required.

*3. When using two conduit connection ports

Ask our service representative to replace the parts in the table below. Expertise is required to replace these parts.

 Caution
 Do not attempt to replace the parts listed in the table below. Doing so can damage the device. Please ask one of our service representatives to replace these parts.

No.	Name	Part No.	Qty	Recommended replacement period (yrs) ^{*1}	Recommended tightening torque (N·m)
41	Main cover assembly	80388816-001 (finish S, except for structure V) 80388816-002 (finish B, except for structure V) 80388816-011 (finish S, structure V) 80388816-012 (finish B, structure V)	1	5	—
42	O-ring (AS568-154) (for main cover)	80388828-154 (except for structure V) 80020935-164 (structure V)	1	5	—
44	Hexagon socket bolt (lock screw for main cover, M4×8)	314-204-080	1	—	0.9±0.1
45	Guide plate	80388905-001	1	—	—
47	LCD assembly	80388931-001	1	5	—
50	Adapter assembly	80388836-001	1	—	0.9±0.1
51	O-ring (AS568-021) (for adapter)	80020935-612	1	5	—
52	Hexagon socket bolt with captive spring washer (for adapter, M3×6)	80377046-001	3	—	0.9±0.1
53	Adapter gasket	80388846-001	1	5	—
54	Filter screen	80377087-001	4	—	—
55	Cross recessed head screws with captive spring washer (for adapter, M4×12)	398-204-120	4	—	1.8±0.2
56	Case packing	80388847-001	1	10	—
57	Magnet unit assembly (EPM)	80377010-001 (forward)	1	—	—
58	O-ring (AS568-007) (for EPM)	80020935-216	1	5	—
59	Hexagon socket bolt with captive spring washer (for EPM, M3×6)	80377046-001	2	—	0.9±0.1
60	Sensor board	<Except for structure L,T> 80388935-001 <Structure L,T> 80384101-001	1	—	—
61	Sensor cable	80388944-001	1	—	—
62	O-ring (AS568A-013) (for pressure sensor)	80388829-013	4	10	—
63	Hexagon socket bolt with captive spring washer (for sensor cover, M3×8)	80377047-001	4	—	0.9±0.1
64	Hexagon socket bolt with captive spring washer (for coil, M3×8)	80377047-001	2	—	0.9±0.1
65	Hexagon socket bolt with captive spring washer (M6×16)	80388845-001	4	—	4.4±0.5
66	VTD assembly (with hexagon socket bolt M4×14)	80388909-001	1	—	1.5±0.2

*1. The recommended replacement period assumes standard conditions (JIS C 1804, C 1805). The replacement period may be shorter depending on environmental conditions (such as temperature, humidity, vibration, and air quality) and usage conditions (such as operation frequency and ON/OFF operations).

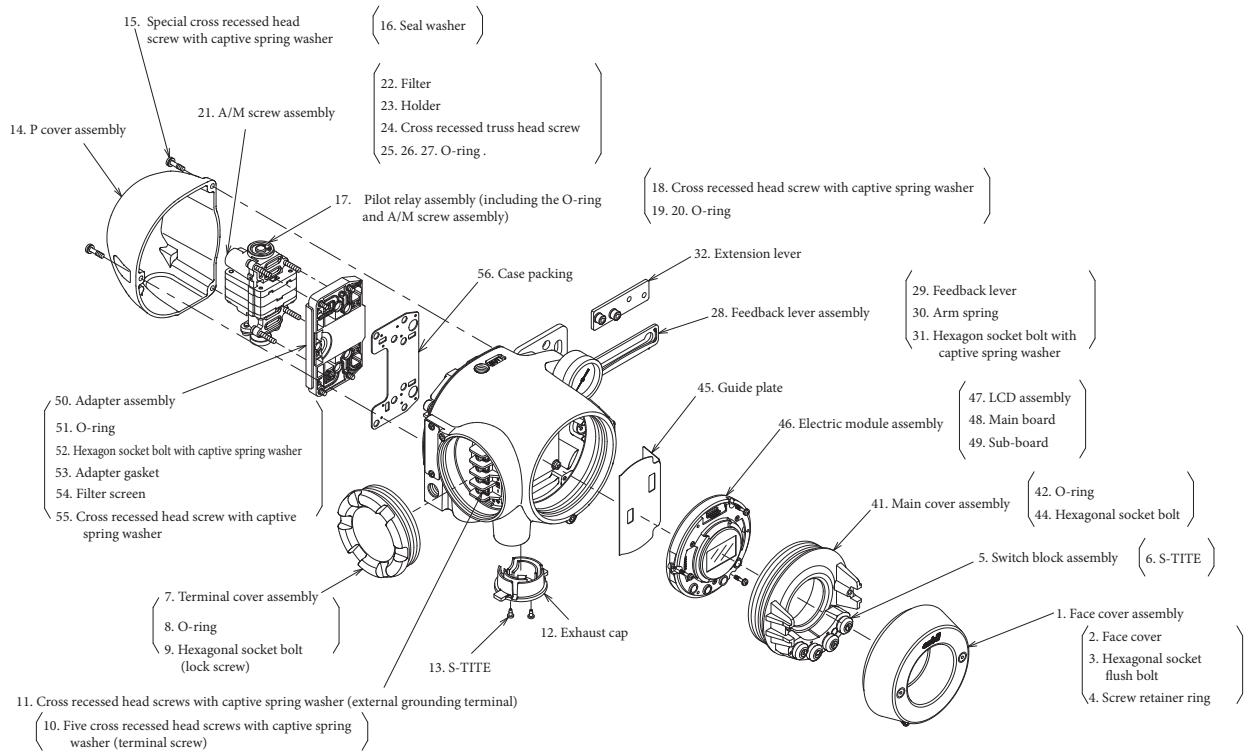


Figure 6-52. Replacement Parts (please ask our service engineer to replace parts 41-56)

6-9-1 Procedure for Changing Switch Block

Step	Procedure
1	Loosen two screws with a hexagon socket screw keys and remove the face cover (Figure 6-7)
2	Loosen two screws and remove the face cover (Figure 6-8)
3	Tighten the new switch block with two screws. (Torque: 1.02 ± 0.33 N·m)
4	Press the four buttons and check whether the display changes or not.
5	Tighten the face cover with the two screws. (Torque: 0.9 ± 0.1 N·m)

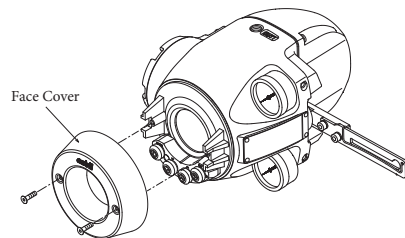


Figure 6-53. Removal of face cover

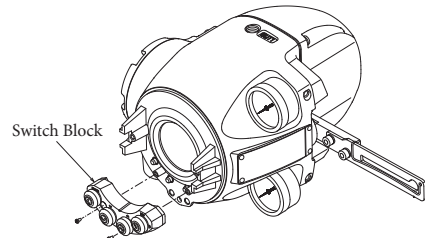


Figure 6-54. Removal of switch block

6-9-2 Procedure for Changing the Pilot Relay

Step	Procedure
1	Loosen three screws and remove the P cover. (Figure 6-9)
2	Loosen four screws and remove the pilot relay. (Figure 6-10)
3	Tighten the new pilot relay with four screws. (Torque: 1.8 ± 0.2 N·m)
4	Tighten the P cover with three screws. (Torque: 1.5 ± 0.2 N·m)

! Handling Precautions:

Please make sure that the O-ring does not fall off when assembling the pilot relay.

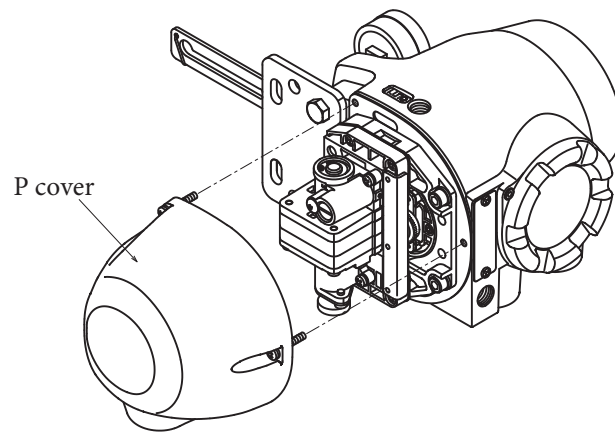


Figure 6-55. Removal of P cover

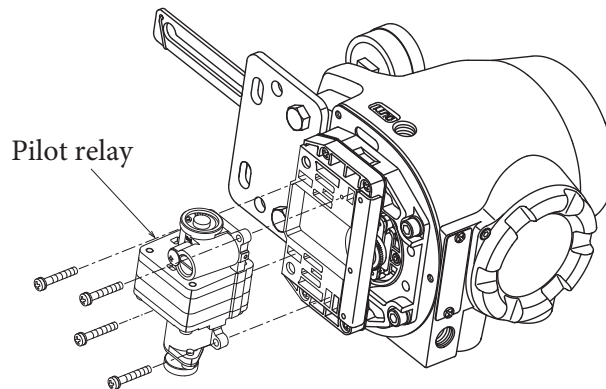


Figure 6-56. Removal of Pilot Relay

Chapter 7 Notes on Explosion-Proof Structure

This chapter contains notes on explosion-proof structure.

For correct use of the explosion-proof 700 series, please be sure you have a good understanding of the notes in this section.

7-1 TIIS Flameproof Model

1) Symbol information

Ex d IIC T6

Ambient gas with an ignition point of 85 °C or higher

Ambient gas with IIC explosion rating








Ambient temperature range: -20 °C to +55 °C

This pressure-resistant explosion-proof product can be installed in Place types 1 or 2 depending on the target gas. Installation in Place type 0 is not possible.

2) Applicable standards

Factory Electrical Facilities Explosion Protection Guidelines (Technical Guidelines 2008, which conform to international standards)

3) Precautions for safe work

 Warning	
	Do not loosen the retaining screws on the cover or angle sensor while the power is applied and within one minute after the power supply is shut off. Doing so may cause an explosion, leading to a severe accident.
 Caution	
	Be sure to mount the attached (specified) pressure-resistant packing cable adapter onto the signal wiring outlet of the device. Use the attached pressure-resistant elbow if it is necessary to change the orientation of the wiring. To guarantee the explosion-proof specifications, products other than the specified pressure-resistant packing cable adapter and pressure-resistant elbow cannot be used.
	Please take extra precaution to not corrode, deform, damage, etc., the device's cases and covers. Thoroughly tighten the cover's hex socket screw-locking bolts, and never open the cover while the device is in use.
	When wiring in an environment similar to the low pressure power distribution work in a Class 1 danger zone, perform work following the "(New) Electrical Facilities Explosion-Proofing Guidelines (Gas Explosion-Proofing 1985)" issued by the Technology Institution of Industrial Safety.
	Apply the correct supply air pressure in accordance with chapter 2, "Installation." Incorrect pressure may cause abnormal action of the control valve or damage to the pressure gauge.

7-2 IECEx Flameproof and Dust Ignition Protection

IECEx Flameproof and Dust Ignition Protection

1. Marking information

IECEx DEK 12.0025X

Ex d IIC T6 Gb $-30\text{ }^{\circ}\text{C} \leq T_{\text{amb}} \leq +75\text{ }^{\circ}\text{C}$ IP66

Ex tb IIIC T85 $^{\circ}\text{C}$ Db $-30\text{ }^{\circ}\text{C} \leq T_{\text{amb}} \leq +75\text{ }^{\circ}\text{C}$ IP66

2. Applicable standards

- IEC 60079-0:2011
- IEC 60079-1:2007
- IEC 60079-31:2008

3. Special conditions for safe use Caution

- The gap between the shaft for magnetic pass and the pneumatic module body has 0.065mm max.
- The terminal cover has at least 7.5 engaged threads.
- The gap between the pneumatic module body and the housing has 0.13 mm max.
- The electronic cover has at least 6.8 engaged threads.
- The gap between the housing and the feedback sensor has 0.11 mm max.
- The gap between the flame arrestor and the pneumatic module body has 0.145 mm max.
- The gap between the sensor housing and the outside sleeve has 0.07 mm max.
- The gap between the rotary shaft and the inside sleeve has 0.07 mm max.
- The screws used to assemble the pneumatic body to the Ex d housing shall be of class A2-70 or A4-70.
- For the use in the area where EPL Db apparatus is required, electrostatic discharge shall be avoided.

4. Instruction for safe use Caution

- 4.1** Do not open when an explosive atmosphere is present.
- 4.2** Use supply wires suitable for 5 $^{\circ}\text{C}$ above surrounding ambient.
- 4.3** When Model No. is given with AVP7xx-xyx-x ... ,
if y=N, P, U, C, the thread type of the end of all entries is 1/2NPT, or
if y=M, the thread type of the end of all entries is M20.
- 4.4** To maintain the degree of protection of at least IP66 in accordance with IEC60529, suitable cable glands, conduit sealing devices or blanking elements must be used and correctly installed.
- 4.5** Cables glands or conduit sealing devices used must be certified for the IECEx protection mentioned above in item 1.

- 4.6** Unused openings must be closed with a blanking element certified for the IECEx protection mentioned above in item 1.
- 4.7** If thread adapters are used these must be certified for the IECEx protection mentioned Above in item 1.
Per entry not more than one thread adapter may be used.
- 4.8** This equipment shall be mounted in such a manner that it is not been heated by the process medium.
- 4.9** The cable connection of external grounding terminal shall be used with a cable lug.
*See the section 2-3-3 for the connection.
- 4.10** This product is shipped with the IECEx certified blanking element only to avoid ingress of solid foreign objects and water during transportation, the certification of this product does not include the blanking element.
When installed, check the conformity of the blanking element to the relevant standards.

7-3 FM Explosion-proof / Dust Ignition Protection

FM Explosion-proof and Dust Ignition Protection

Explosion-proof

Class I, Division 1, Group B, C and D T6;

Flameproof

Class I, Zone 1, AEx d IIC T6 Gb

Dust ignition

Class II and III, Division 1, Group E, F, and G T6, Zone 21, AEx tb II C T85 °C Db

Ambient temperature: -30 °C to +75 °C

Indoor/Outdoor Enclosure IP66

Warning

- Install the apparatus only in hazardous (classified) locations for which the apparatus has been approved.
- For division applications:
Factory sealed, conduit seal not required
Not including gasoline atmospheres
- Do not open the apparatus enclosure when an explosive atmosphere is present.

Caution

- Use supply wires suitable for 5 °C above ambient temperature.

7-4 FM Intrinsically Safe Explosion-Proof Type (ic) and Non-incendive Type

FM Intrinsically safe (ic) and Nonincendive

Intrinsically safe(ic)

Class I, Zone 2, AEx ic IIC T4

Entity Parameters:

Positioner Circuit: $U_i=30$ V, $I_i=100$ mA, $P_i=1$ W, $C_i=24$ nF, $L_i=0.22$ mH

Transmitter Circuit (AVP7_1): $U_i=30$ V, $I_i=100$ mA, $P_i=1$ W, $C_i=20$ nF, $L_i=0.22$ mH

DO Circuit (AVP7_0): $U_i=30$ V, $I_i=100$ mA, $P_i=1$ W, $C_i=20$ nF, $L_i=0.22$ mH

Nonincendive

Class I, Division 2, Group A, B, C and D, T4

Nonincendive Field Wiring Parameters:

Positioner Circuit: $V_{max}=30$ V, $I_{max}=100$ mA, $C_i=24$ nF, $L_i=0.22$ mH

Transmitter Circuit (AVP7_1): $V_{max}=30$ V, $I_{max}=100$ mA, $C_i=20$ nF, $L_i=0.22$ mH

DO Circuit (AVP7_0): $V_{max}=30$ V, $I_{max}=100$ mA, $C_i=20$ nF, $L_i=0.22$ mH

Suitable

Class II and Class III, Division 2, Group E, F and G, T4

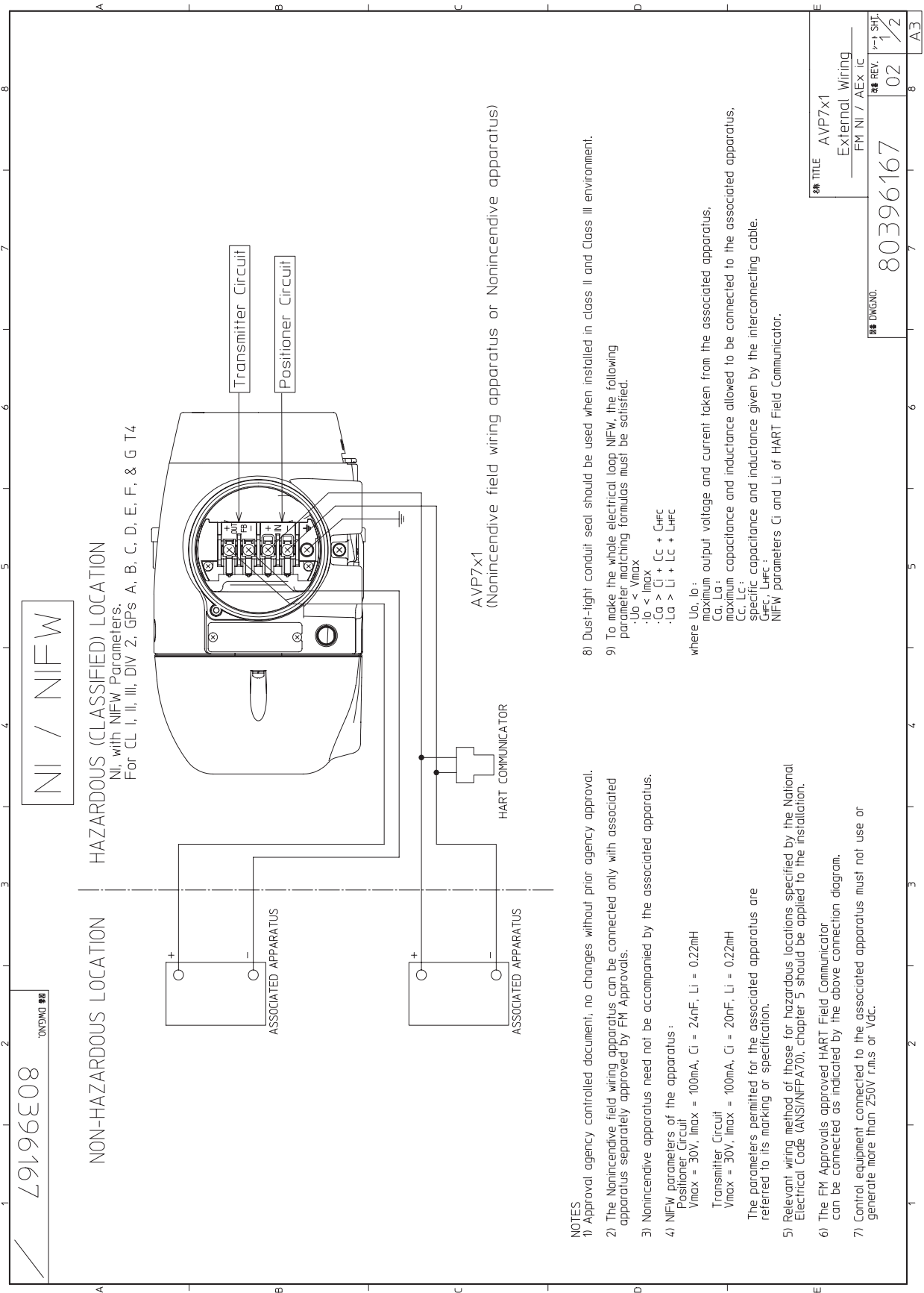
Indoor/Outdoor Enclosure

NEMA Type 4X, IP66

Ambient Temperature:-24 to 75 °C

Instruction for safe use

- Models AVP7_0/ AVP7_1/7_2 shall be installed in accordance with control drawings 80396167 and 80396168.
- Installations in the US shall comply with the relevant requirements of the National Electrical CodeR (ANSI/NFPA-70 (NECR)).
- Tampering and replacement with non-factory components may adversely affect the safe use of the system.
- For guidance on installation in the US, see ANSI/ISA-RP12.06.01, Installation of Intrinsically Safe Systems for Hazardous (Classified) Locations.
- Electrical equipment connected to the Associated Apparatus shall not use or generate more than 250 Volts rms.
- The products discussed in this report were certified by FM Approvals under a Type3 Certification System as identified in ISO Guide 67.



79196E08

CONFORMING

NOTES

- 1) Approval agency controlled document, no changes without prior agency approval.
- 2) The Nonincendive field wiring apparatus can be connected only with associated apparatus separately approved by FM Approvals.
- 3) Nonincendive apparatus need not be accompanied by the associated apparatus.
- 4) NIFW parameters of the apparatus:
 Positioner Circuit:
 $V_{max} = 30V, I_{max} = 100mA, C_i = 24nF, L_i = 0.22mH$
 Transmitter Circuit:
 $V_{max} = 30V, I_{max} = 100mA, C_i = 20nF, L_i = 0.22mH$
 The parameters permitted for the associated apparatus are referred to its marking or specification.
- 5) Relevant wiring method of those for hazardous locations, specified by the National Electrical Code (ANSI/NFPA70), chapter 5 should be applied to the installation.
- 6) The FM Approvals approved HART Field Communicator can be connected as indicated by the above connection diagram.
- 7) Control equipment connected to the associated apparatus must not use or generate more than 250V r.m.s or Vdc.

8) Dust-tight conduit seal should be used when installed in class II and Class III environment.

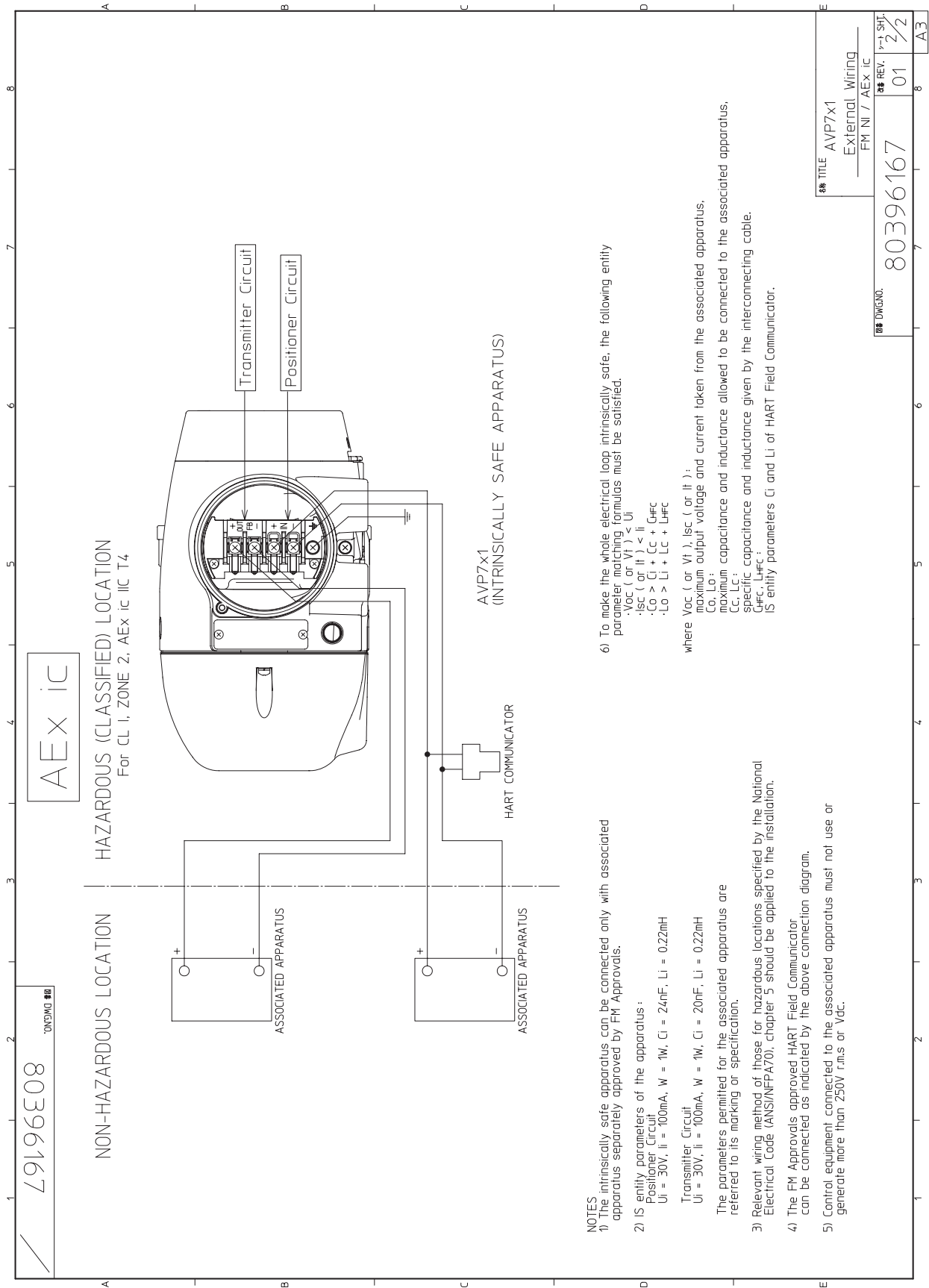
9) To make the whole electrical loop NIFW, the following parameter matching formulas must be satisfied:

- $I_o < I_{max}$
- $C_a > C_i + C_c + C_{HFC}$
- $L_a > L_i + L_c + L_{HFC}$

where I_o, I_a :

- maximum output voltage and current taken from the associated apparatus.
- C_a, L_a : maximum capacitance and inductance allowed to be connected to the associated apparatus.
- C_c, L_c : specific capacitance and inductance given by the interconnecting cable.
- C_{HFC}, L_{HFC} : NIFW parameters C_i and L_i of HART Field Communicator.

# TITLE	AVP7x1
External Wiring	
FM NI / AEX IC	
# REV. $\frac{1}{2}$ SHT.	02
# DWG. NO.	80396167
	8 7 6 5 4 3 2 1
	A B C D E

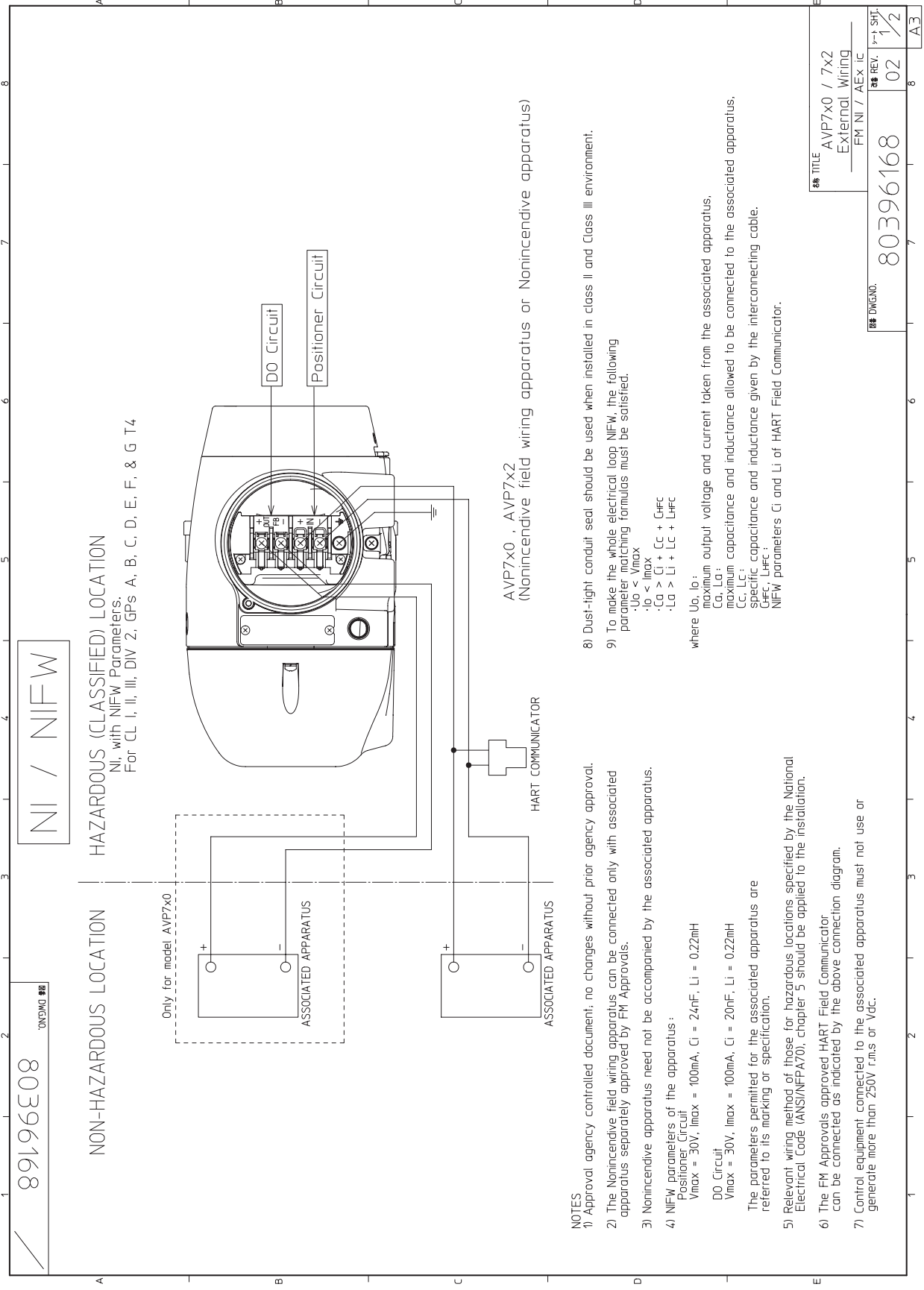


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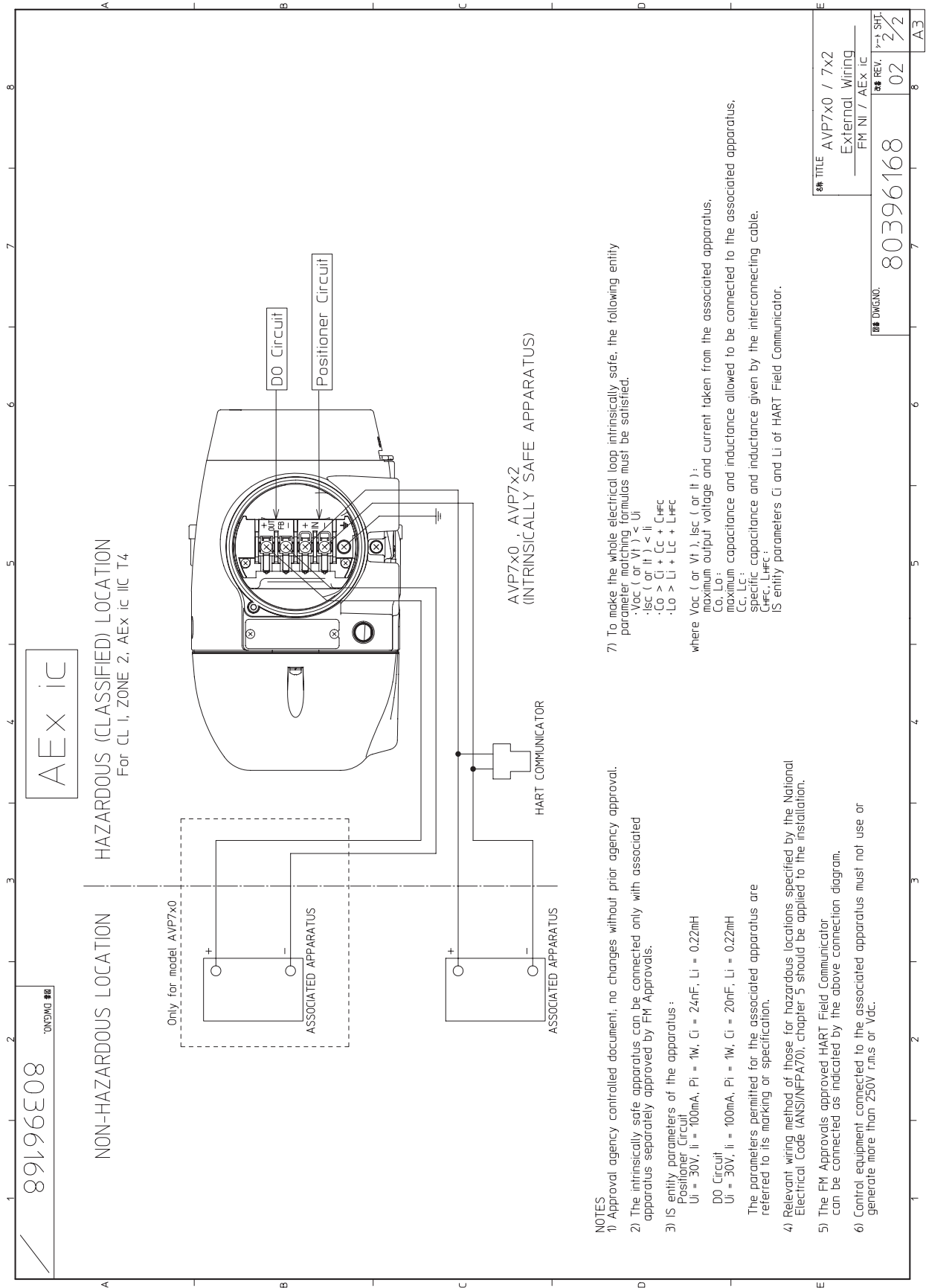
DANGER

FIG. DWGNO.	80396167	REV.	01
TITLE	AVP7X1 External Wiring	REV.	2/2
		REV.	01
		REV.	2/2

- NOTES**
- 1) The intrinsically safe apparatus can be connected only with associated apparatus separately approved by FM Approvals.
 - 2) IS entity parameters of the apparatus :
 Positioner Circuit:
 $U_i = 30V, I_i = 100mA, W = 1W, C_i = 24nF, L_i = 0.22mH$
 Transmitter Circuit:
 $U_i = 30V, I_i = 100mA, W = 1W, C_i = 20nF, L_i = 0.22mH$
 The parameters permitted for the associated apparatus are referred to its marking or specification.
 - 3) Relevant wiring method of those for hazardous locations specified by the National Electrical Code (ANSI/NFPA70), chapter 5 should be applied to the installation.
 - 4) The FM Approvals approved HART Field Communicator can be connected as indicated by the above connection diagram.
 - 5) Control equipment connected to the associated apparatus must not use or generate more than 250V r.m.s or V_{DC}.
- 6) To make the whole electrical loop intrinsically safe, the following entity parameter matching formulas must be satisfied.
- V_{oc} (or V_t) < U_i
 - I_{sc} (or I_t) < I_i
 - C_o > C_i + C_c + C_{HFC}
 - L_o > L_i + L_c + L_{HFC}
- where V_{oc} (or V_t), I_{sc} (or I_t) :
 maximum output voltage and current taken from the associated apparatus.
 C_o, L_o :
 maximum capacitance and inductance allowed to be connected to the associated apparatus.
 C_c, L_c :
 Specific capacitance and inductance given by the interconnecting cable.
 C_{HFC}, L_{HFC} :
 IS entity parameters C_i and L_i of HART Field Communicator.



- NOTES**
- 1) Approval agency controlled document, no changes without prior agency approval.
 - 2) The Nonincendive field wiring apparatus can be connected only with associated apparatus separately approved by FM Approvals.
 - 3) Nonincendive apparatus need not be accompanied by the associated apparatus.
 - 4) NIFW parameters of the apparatus:
 - Positioner Circuit: $V_{max} = 30V, I_{max} = 100mA, C_i = 24nF, L_i = 0.22mH$
 - D0 Circuit: $V_{max} = 30V, I_{max} = 100mA, C_i = 20nF, L_i = 0.22mH$
 The parameters permitted for the associated apparatus are referred to its marking or specification.
 - 5) Relevant wiring method of those for hazardous locations specified by the National Electrical Code (ANSI/NFPA70), Chapter 5 should be applied to the installation.
 - 6) The FM Approvals approved HART Field Communicator can be connected as indicated by the above connection diagram.
 - 7) Control equipment connected to the associated apparatus must not use or generate more than 250V r.m.s or Vdc.
- 8) Dust-tight conduit seal should be used when installed in class II and Class III environment.
- 9) To make the whole electrical loop NIFW, the following parameter matching formulas must be satisfied:
- $U_o < U_{max}$
 - $I_o < I_{max}$
 - $C_o > C_i + C_c + C_{HFC}$
 - $L_o > L_i + L_c + L_{HFC}$
- where U_o, I_o : maximum output voltage and current taken from the associated apparatus.
 C_o, L_o : maximum capacitance and inductance allowed to be connected to the associated apparatus.
 C_c, L_c : specific capacitance and inductance given by the interconnecting cable.
 N_{HFC}, L_{HFC} : NIFW parameters C_i and L_i of HART Field Communicator.



NOTES

- 1) Approval agency controlled document; no changes without prior agency approval.
- 2) The intrinsically safe apparatus can be connected only with associated apparatus separately approved by FM Approvals.
- 3) IS entity parameters of the apparatus :
 Positioner Circuit
 $U_i = 30V, I_i = 100mA, P_i = 1W, C_i = 24nF, L_i = 0.22mH$
 DO Circuit
 $U_i = 30V, I_i = 100mA, P_i = 1W, C_i = 20nF, L_i = 0.22mH$
 The parameters permitted for the associated apparatus are referred to its marking or specification.
- 4) Relevant wiring method of those for hazardous locations, specified by the National Electrical Code (ANSI/NFPA70), chapter 5 should be applied to the installation.
- 5) The FM Approvals approved HART Field Communicator can be connected as indicated by the above connection diagram.
- 6) Control equipment connected to the associated apparatus must not use or generate more than 250V r.m.s or Vdc.

7) To make the whole electrical loop intrinsically safe, the following entity parameter matching formulas must be satisfied.

- $V_{oc} (\text{ or } V_t) < V_i$
- $I_{sc} (\text{ or } I_t) < I_i$
- $C_o > C_i + C_c + C_{ifc}$
- $L_o > L_i + L_c + L_{ifc}$

where V_{oc} (or V_t), I_{sc} (or I_t) :

- maximum output voltage and current taken from the associated apparatus,
- C_o : maximum capacitance and inductance allowed to be connected to the associated apparatus,
- C_c : L_c : specific capacitance and inductance given by the interconnecting cable,
- C_{ifc} : L_{ifc} : IS entity parameters C_i and L_i of HART Field Communicator.

7-5 FMC Explosion-proof / Dust Ignition Protection

FMC Explosion-proof and Dust Ignition Protection

Explosion-proof

Class I, Division 1, Group C and D T6;

Flameproof

Class I, Zone 1, Ex d IIB T6 Gb

Dust ignition

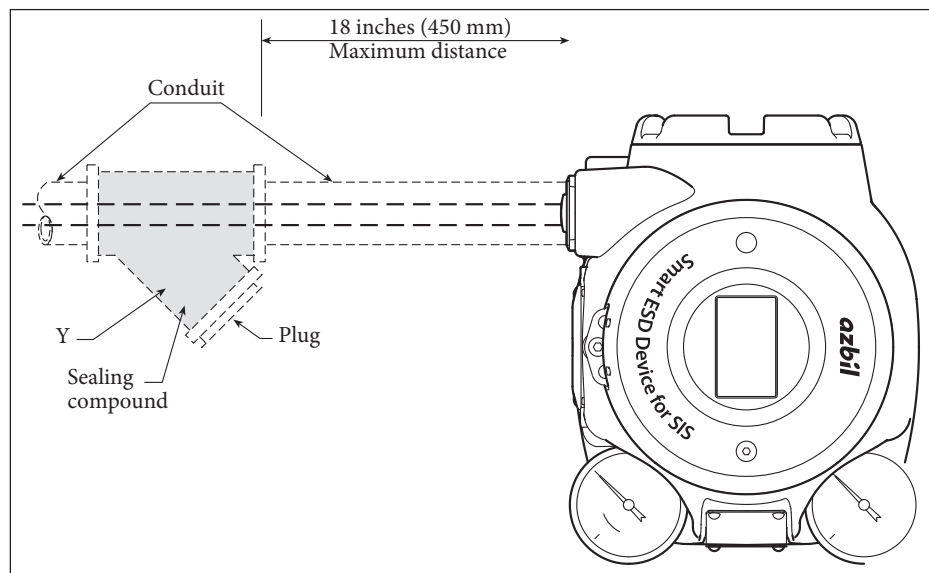
Class II and III, Division 1, Group E, F, and G T6;

Ambient temperature: $-30\text{ }^{\circ}\text{C}$ to $+75\text{ }^{\circ}\text{C}$

Indoor/Outdoor Enclosure IP66

Warning

- Install the apparatus only in hazardous (classified) locations for which the apparatus has been approved.
- For division applications:
Factory sealed, conduit seal not required
Not including gasoline atmospheres
- For zone applications
Seal all conduits within 450 mm (18 inches)
- Do not open the apparatus enclosure when an explosive atmosphere is present.



Caution

- Use supply wires suitable for $5\text{ }^{\circ}\text{C}$ above ambient temperature.

7-6 CCC Flameproof / Dust Ignition Protection

CCC 隔爆

1. 防爆标志

Ex db IIC T6 Gb

Ex tb IIIC T85°C Db

2. 国家防爆标准

GB/T 3836.1-2021 爆炸性环境 第1 部分：设备 通用要求

GB/T 3836.2-2021 爆炸性环境 第2 部分：由隔爆外壳“d”保护的设备

GB/T 3836.31-2021 爆炸性环境 第31 部分：由防粉尘点燃外壳“t”保护的设备

3. 产品安全使用特殊条件

3-1. 涉及隔爆接合面的维修须联系产品制造商。

3-2. 隔爆结合面用特殊紧固件性能等级为A2-70/A4-70。

3-3. 产品在爆炸性粉尘环境使用时，应采取措施避免传播型刷型放电产生引燃危险。
仅允许使用湿布擦拭。

3-4. 使用环境温度：-30°C~+75°C。

4. 产品使用注意事项

4-1. 产品设有外接地端子，用户在安装使用时应可靠接地。

4-2. 产品电缆引入口须配用经国家指定的检验机构认可的、符合国家标准GB/T 3836.1-2021和GB/T 3836.2-2021 规定的、螺纹规格为M20×1.5 或1/2-14NPT、具有防爆等级为Ex db IIC 的电缆引入装置或封堵件，方可用于爆炸性危险场所。该电缆引入装置或封堵件的使用必须符合使用说明书的要求。冗余电缆引入口应有效封堵。电缆引入装置或封堵件安装后，须确保设备整体外壳防护等级不低于IP66。

4-3. 现场使用和维护时，必须遵循“存在爆炸性环境时严禁打开”的原则。

4-4. 用户不得自行更换该产品的零部件，应会同产品制造商共同解决运行中出现的故障，以杜绝损坏现象的发生。

4-5. 用户应当保持产品外壳表面清洁，以防粉尘堆积，但严禁用压缩空气吹扫。

4-6. 产品的安装、使用和维护应同时遵守产品说明书及下列相关标准、规范的要求：

GB/T 3836.13-2021 爆炸性环境 第13 部分：设备的修理、检修、修复和改造

GB/T 3836.15-2017 爆炸性环境 第15 部分：电气装置的设计、选型和安装

GB/T 3836.16-2017 爆炸性环境 第16 部分：电气装置的检查与维护

GB 15577-2018 粉尘防爆安全规程

GB 50257-2014 电气装置安装工程爆炸和火灾危险环境 电气装置施工及验收规范

CCC型号**AVP7xy - ①②③ - ④⑤⑥⑦**

where:

x=0(Valve positioner)

x=1(Emergency valve shutdown function with Foundation Fieldbus communication)

x=3(valve travel transmitter only)

x=7(Positioner with emergency valve shutdown function @4.48mA)

x=8(Positioner with emergency valve shutdown function @0.5mA)

x=9(Emergency valve shutdown function only)

y=0(Positioner & contact output for alarm)

y=1(Positioner& Valve travel transmitter)

y=2(no output)

x=3(Foundation Fieldbus communication)

y=4(Positioner & Foundation Fieldbus communication)

AVP7xy 所有组合搭配: AVP700/701/702/703/704/770/771/772/780/781/782/790/791/792/
713/731

					Code
① Structure	CCC Flameproof / Dust ignition protection (Electrical connection G1/2 is not available)				N
	CCC Intrinsically Safe				R
② Connection	Electrical connection	Air piping connection	Mounting thread	Pressure gauge thread	
	M20x1.5	1/4NPT	M8	Rc1/8	M
	1/2NPT	1/4NPT	M8	Rc1/8	N
	1/2NPT	1/4NPT	M8	1/8NPT	P
	1/2NPT	1/4NPT	5/16-18UNC	Rc1/8	U
	1/2NPT	1/4NPT	5/16-18UNC	1/8NPT	C
	G1/2	Rc1/4	M8	Rc1/8	G
③ Finish	Standard				S
	Corrosion Proof				B
	Silver Finish				D
④⑤ Display	Display with push button				DX
⑥ Diagnostic	Advanced diagnosis				A
⑦ Overvoltage Protection	None				X
	With overvoltage protection				V

7-7 KCs Flameproof Type

KCs Flameproof

1. Marking information

Ex d IIC T6 -30 °C < T_{amb} < +75 °C

2. Special conditions for safe use Caution

- The gap between the shaft for magnetic pass and the pneumatic module body has 0.065 mm max.
- The terminal cover has at least 7.5 engaged threads.
- The gap between the pneumatic module body and the housing has 0.13 mm max.
- The electronic cover has at least 6.8 engaged threads.
- The gap between the housing and the feedback sensor has 0.11 mm max.
- The gap between the flame arrestor and the pneumatic module body has 0.145 mm max.
- The gap between the sensor housing and the outside sleeve has 0.07 mm max.
- The gap between the rotary shaft and the inside sleeve has 0.07 mm max.
- The screws used to assemble the pneumatic body to the Ex d housing shall be of class A2-70 or A4-70.

3. Instruction for safe use Caution

- 3.1** Do not open when an explosive atmosphere is present.
- 3.2** Use supply wires suitable for 5 °C above surrounding ambient.
- 3.3** When Model No. is given with AVP7xx-xyx-x ... ,
if y=N, P, U, C, the thread type of the end of all entries is 1/2 NPT, or
if y=M, the thread type of the end of all entries is M20.
- 3.4** Cables glands or conduit sealing devices used must be certified for the protection mentioned above in item 1.
- 3.5** Unused openings must be closed with a blanking element certified for the protection mentioned above in item 1.
- 3.6** If thread adapters are used these must be certified for the protection mentioned Above in item 1.
Per entry not more than one thread adapter may be used.
- 3.7** This equipment shall be mounted in such a manner that it is not been heated by the process medium.
- 3.8** The cable connection of external grounding terminal shall be used with a cable lug.
*See section 2-3-3 for the connection.

7-8 INMETRO Flameproof / Dust Ignition Protection

INMETRO Flameproof and Dust Ignition Protection

Equipamento à prova de explosão do INMETRO

Segurança

Sobre este manual

Este manual contém informações e advertências que devem ser observadas para manter posicionador de válvula smart o AVP7XX que opera seguramente.

Instalação correta, operação correta e manutenção regular são essenciais para assegurar segurança enquanto usando este dispositivo.

Para o uso correto e seguro deste dispositivo é essencial que ambos que operam e pessoal de serviço segue procedimentos de segurança geralmente aceitos além das precauções de segurança especificadas neste manual.

Os símbolos seguintes são usados neste manual para alertar a possíveis perigos:

Advertência

Denota um potencialmente situação perigosa que, se não evitou, poderia resultar em morte ou dano sério.

Precaução

Denota uma situação potencialmente situação perigosa que, se não evitar, poderá resultar em um dano secundário ao operador ou poderá danificar o dispositivo.

~ Informação de nota que pode ser útil ao usuário.

Precauções de segurança

ADVERTINDO

- PERIGO DE CHOQUE ELÉTRICO! Desligue antes de executar qualquer instalação elétrica.
- NUNCA abra a tampa do invólucro do terminal enquanto o AVP7XX está energizado em um ambiente de atmosfera explosiva.
- Não toque o AVP7XX desnecessariamente enquanto estiver em operação. A superfície pode estar muito quente ou muito fria, enquanto dependendo do ambiente operacional.

PRECAUÇÃO

Não pisar, apoiar-se ou subir no AVP7XX. Você pode danificar o aparelho.

1. Marcação conforme a Portaria 179 do INMETRO:

Azbil Corporation

Tipo:AVP 7XX

Ex db IIC T6 Gb

Ex tb IIIC T85 °C Db

$-30\text{ °C} \leq T_a \leq +75\text{ °C}$

Número de série: ...

NCC 14.03175 X

ATENÇÃO – NÃO ABRA QUANDO UMA ATMOSFERA EXPLOSIVA PUDER ESTAR

PRESENTE

2. Normas conforme a Portaria 179 do INMETRO:

ABNT NBR IEC 60079-0:2013

ABNT NBR IEC 60079-1:2009

ABNT NBR IEC 60079-31:2011

3. Condições especiais para uso seguro:

- As dimensões das juntas à prova de explosão estão detalhadas nos documentos do fabricante.
- Os parafusos usados para montar o corpo pneumático do invólucro 'Ex d' devem ser de classes A2-70 ou A4-70.
- Quando usado em área onde são exigidos equipamentos com nível de proteção EPL Db, deve ser evitada descarga eletrostática.

4. Instruções para o uso seguro

Este produto é expedido com o elemento de vedação certificado por IECEx apenas para evitar a entrada de objetos estranhos sólidos e água durante o transporte.

A certificação deste produto não inclui o elemento de vedação.

Ao instalar, verifique a conformidade do elemento de vedação com os padrões pertinentes.

7-9 EAC Flameproof

EAC Flameproof

Взрывозащищенное исполнение в соответствии с техническим регламентом ТР ТС 012/2011 «О безопасности оборудования для работы во взрывоопасных средах»

1. Маркировка

EAЭС RU C-JP,EX01.B.00075/19

1Ex d IIC T6 Gb X -30 °C ≤ Ta ≤ +75 °C IP66

Ex tb IIC T85°C Db X -30 °C ≤ Ta ≤ +75 °C IP66

2. Применяемые стандарты

- ГОСТ 31610.0-2014 (IEC 60079-0:2011)

- ГОСТ IEC 60079-1-2011

- ГОСТ IEC 60079-31-2013

3. Специальные условия применения

- Зазор между валом магнитного блока и корпусом пневматического модуля должен быть не больше 0,065 мм.
- Крышка клеммной коробки должна быть закручена по резьбе как минимум на 7,5 оборотов.
- Зазор между корпусом пневматического модуля и оболочкой изделия должен быть не больше 0,13 мм.
- Крышка электроники должна быть закручена по резьбе как минимум на 6,8 оборотов.
- Зазор между корпусом изделия и датчиком обратной связи должен быть не больше 0,11 мм.
- Зазор между пламегасителем и корпусом пневматического модуля должен быть не больше 0,145 мм.
- Зазор между корпусом датчика и наружным рукавом должен быть не больше 0,07 мм.
- Зазор между вращающимся валом и внутренним рукавом должен быть не больше 0,07 мм.
- Для крепления пневматического модуля к оболочке Ex d следует использовать винты класса A2-70 или A4-70.
- Корпуса позиционеров способны накапливать электростатический заряд, поэтому они должны устанавливаться в местах, где риск электростатического разряда сведен к минимуму.
- Ремонт взрывонепроницаемых соединений позиционеров допускается, если он произведен изготовителем или его уполномоченным представителем.

4. Инструкции для безопасной эксплуатации

- 4.1 Не открывайте корпус при наличии взрывоопасной атмосферы.
- 4.2 Используйте подходящие кабели и кабельные вводы с температурным диапазоном на 5°C выше температуры окружающей среды.
- 4.3 Чтобы обеспечить степень защиты не ниже IP66 в соответствии со стандартом IEC 60529, необходимо использовать и правильно устанавливать подходящие кабельные вводы, уплотнения кабелепроводов и заглушки.
- 4.4 Используемые кабельные вводы и уплотнения кабелепроводов должны иметь соответствующий сертификат взрывозащиты.
- 4.5 Неиспользуемые отверстия должны быть закрыты заглушками, имеющими соответствующий сертификат взрывозащиты.
- 4.6 Если используются резьбовые переходники, они должны иметь сертификат соответствующий сертификат взрывозащиты.
Можно использовать не более одного переходника на каждый ввод. 4.7 Данное оборудование следует устанавливать так, чтобы оно не нагревалось за счет технологической среды.
- 4.8 Соединительный кабель внешнего заземления должен быть оснащен кабельным наконечником.
*Описание подключения см. в разделе 2-3.
- 4.9 Данное изделие комплектуется заглушкой с сертификатом IECEx лишь для предотвращения попадания внутрь посторонних предметов и воды во время транспортировки, и эта заглушка не включается в сертификацию изделия. Во время установки убедитесь, что заглушка соответствует надлежащим стандартам.

7-10 ATEX Intrinsic Safety and Dust Ignition Protection

1. Marking information

 0344 Baseefa16ATEX0088X



II 1G Ex ia IIC T4 Ga $-40^{\circ}\text{C} \leq \text{Ta} \leq +60^{\circ}\text{C}$
 II 1D Ex ia IIIC T135°C Da $-40^{\circ}\text{C} \leq \text{Ta} \leq +60^{\circ}\text{C}$ IP66

+/-IN $U_i = 30\text{V}$, $I_i = 93\text{mA}$, $P_i = 0.9\text{W}$, $C_i = 4\text{nF}$, $L_i = 220\mu\text{H}$

+/-OUT(AVP7x0/AVP7x1) $U_i = 30\text{V}$, $I_i = 93\text{mA}$, $P_i = 0.9\text{W}$, $C_i = 22\text{nF}$, $L_i = 220\mu\text{H}$

2. Applicable standards

- EN IEC 60079-0: 2018
- EN 60079-11: 2012

3. Special conditions for safe use Caution

- 3.1** For Group III, the enclosure must be mounted in a location where the risk of electrostatic discharge is minimised.
- 3.2** The enclosure of the product is made of aluminium, if it is mounted in an area where the use of EPL Ga apparatus is required, it must be installed such that, even in the event of rare incidents, ignition sources due to impact or friction sparks are excluded.
- 3.3** The equipment is not capable of passing a 500V dielectric strength test between the power and signal connections and the housing. This shall be taken into account during installation.

4. Instruction for safe use Caution

- 4.1** To maintain the degree of protection of IP66 in accordance with IEC 60529, suitable cable glands, conduit sealing devices or blanking elements must be used and correctly installed.
- 4.2** The equipment is to be connected with power supplies through a safety barrier suitable for the terminal parameters of the equipment.

7-11 IECEx Intrinsic Safety and Dust Ignition Protection

1. Marking information

IECEx BAS 16.0069X

Ex ia IIC T4 Ga $-40^{\circ}\text{C} \leq \text{Ta} \leq +60^{\circ}\text{C}$

Ex ia IIIC T135°C Da $-40^{\circ}\text{C} \leq \text{Ta} \leq +60^{\circ}\text{C}$ IP66

+/-IN $U_i = 30\text{V}$, $I_i = 93\text{mA}$, $P_i = 0.9\text{W}$, $C_i = 4\text{nF}$, $L_i = 220\mu\text{H}$

+/-OUT(AVP7x0/AVP7x1) $U_i = 30\text{V}$, $I_i = 93\text{mA}$, $P_i = 0.9\text{W}$, $C_i = 22\text{nF}$, $L_i = 220\mu\text{H}$

2. Applicable standards

- IEC 60079-0 : 2017

- IEC 60079-11 : 2011

3. Special conditions for safe use Caution

- 3.1** For Group III, the enclosure must be mounted in a location where the risk of electrostatic discharge is minimised.
- 3.2** The enclosure of the product is made of aluminium, if it is mounted in an area where the use of EPL Ga apparatus is required, it must be installed such that, even in the event of rare incidents, ignition sources due to impact or friction sparks are excluded.
- 3.3** The equipment is not capable of passing a 500V dielectric strength test between the power and signal connections and the housing. This shall be taken into account during installation.

4. Instruction for safe use Caution

- 4.1** To maintain the degree of protection of IP66 in accordance with IEC 60529, suitable cable glands, conduit sealing devices or blanking elements must be used and correctly installed.

7-12 CCC Intrinsic Safety and Dust Ignition Protection

CCC本安防爆

1. 防爆标志

Ex ia IIC T4 Ga

Ex ia IIIC T₂₀₀ 135°C Da

2. 国家防爆标准

GB/T 3836.1-2021 爆炸性环境 第1部分：设备 通用要求

GB/T 3836.4-2021 爆炸性环境 第4部分：由本质安全型“i”保护的的设备

3. 产品安全使用特殊条件

- 3-1. 当产品安装于要求EPL Ga级的场所时，用户须采取有效措施防止产品外壳由于冲击或摩擦引起的点燃危险。
- 3-2. 产品在爆炸性粉尘环境使用时，应采取措施避免传播型刷型放电产生引燃危险。仅允许使用湿布擦拭。
- 3-3. 关联设备应优先选用隔离式安全栅；如选用齐纳式安全栅，应符合GB/T 3836.15-2017标准关于本安电路接地的要求。
- 3-4. 使用环境温度：-40°C~+60°C。

4. 产品使用注意事项

- 4-1. 产品使用环境温度范围：-40°C ~ +60°C。
- 4-2. 产品必须与经防爆检验认可的关联设备配套共同组成本安防爆系统方可使用于现场存在爆炸性气体混合物的危险场所。其系统接线必须同时遵守该产品和所配关联设备的使用说明书要求，接线端子不得接错。产品本安电气参数见下表：

4.2.1 AVP7a 0、AVP7a 1、AVP7a 2

输入信号端子：

最高输入电压 U_i (V)	最大输入电流 I_i (mA)	最大输入功率 P_i (W)	最大内部等效参数	
			C_i (nF)	L_i (μ H)
30	93	0.9	4	220

输出信号端子：

最高输出电压 U_o (V)	最大输出电流 I_o (mA)	最大输出功率 P_o (W)	最大内部等效参数	
			C_o (nF)	L_o (μ H)
30	93	0.9	22	220

4-2.2 AVP703型用户端子

最高输入电压 U_i (V)	最大输入电流 I_i (mA)	最大输入功率 P_i (W)	最大内部等效参数	
			C_i (nF)	L_i (μ H)
17.5	380	5.32	2	近似为0

4-3. 用户不得自行更换该产品的零部件，应会同产品制造商共同解决运行中出现的故障，以杜绝损坏现象的发生。

4-4. 用户应当保持产品外壳表面清洁，以防粉尘堆积，但严禁用压缩空气吹扫。

4-5. 产品的安装、使用和维护应同时遵守产品说明书及下列相关标准、规范的要求：

GB/T 3836.13-2021 爆炸性环境 第13部分：设备的修理、检修、修复和改造

GB/T 3836.15-2017 爆炸性气体环境用电气设备 第15部分：危险场所电气安装（煤矿除外）

GB/T 3836.16-2017 爆炸性气体环境用电气设备 第16部分：电气装置的检查和维护（煤矿除外）

GB/T 3836.18-2017 爆炸性环境 第18部分：本质安全系统

GB 15577-2018 粉尘防爆安全规程

GB 50257-2014 电气装置安装工程爆炸和火灾危险环境 电气装置施工及验收规范

CCC型号**AVP7xy - ①②③ - ④⑤⑥⑦**

where:

x=0(Valve positioner)

x=1(Emergency valve shutdown function with Foundation Fieldbus communication)

x=3(valve travel transmitter only)

x=7(Positioner with emergency valve shutdown function @4.48mA)

x=8(Positioner with emergency valve shutdown function @0.5mA)

x=9(Emergency valve shutdown function only)

y=0(Positioner & contact output for alarm)

y=1(Positioner& Valve travel transmitter)

y=2(no output)

x=3(Foundation Fieldbus communication)

y=4(Positioner & Foundation Fieldbus communication)

AVP7xy 所有组合搭配: AVP700/701/702/703/704/770/771/772/780/781/782/790/791/792/
713/731

					Code
① Structure	CCC Flameproof / Dust ignition protection (Electrical connection G1/2 is not available)				N
	CCC Intrinsically Safe				R
② Connection	Electrical connection	Air piping connection	Mounting thread	Pressure gauge thread	
	M20x1.5	1/4NPT	M8	Rc1/8	M
	1/2NPT	1/4NPT	M8	Rc1/8	N
	1/2NPT	1/4NPT	M8	1/8NPT	P
	1/2NPT	1/4NPT	5/16-18UNC	Rc1/8	U
	1/2NPT	1/4NPT	5/16-18UNC	1/8NPT	C
	G1/2	Rc1/4	M8	Rc1/8	G
③ Finish	Standard				S
	Corrosion Proof				B
	Silver Finish				D
④⑤ Display	Display with push button				DX
⑥ Diagnostic	Advanced diagnosis				A
⑦ Overvoltage Protection	None				X
	With overvoltage protection				V

7-13 CNS Flameproof

CNS 耐壓防爆外殼認證

1. 防爆等級內容

型式檢定合格字號 工電(2016)第 00229X 號

防爆規格標示

Ex d IIC T6 Gb $-30^{\circ}\text{C} \leq T_{\text{amb}} \leq +75^{\circ}\text{C}$

2. 依據標準

IEC 60079-0 : 2011

IEC 60079-1 : 2007

3. 電氣規格

型式	輸入	輸出	最大消耗功率
AVP701	20mA dc	20mA、45V dc	1.16W
AVP702	20mA dc	N/A	0.26W
AVP703	Fieldbus	20mA、32V dc	0.64W
AVP770	20mA dc	100mA、30V dc	0.76W
AVP771	20mA dc	20mA、45V dc	1.16W
AVP772	20mA dc	N/A	0.26W
AVP780	20mA dc	100mA、30V dc	0.76W
AVP781	20mA dc	20mA、45V dc	1.16W
AVP782	20mA dc	N/A	0.26W
AVP790	35mA dc	100mA、30V dc	0.955W
AVP791	35mA dc	20mA、45V dc	1.355W
AVP792	35mA dc	N/A	0.455W

4. 特殊條件

檢定範圍未包含電纜入口保護裝置，應正確使用合格電纜接頭或盲塞以維持設備保護型式之完整性；

有關耐壓防爆接合面尺寸詳見製造商文件；

用於將氣壓本體組裝至耐壓防爆外殼的螺栓，性能等級應為 A2-70 或 A4-70。

7-14 CNS Intrinsic Safety and Dust Ignition Protection

CNS 本質安全認證

1. 防爆等級內容

型式檢定合格字號	(ITRI)2019第07-00133X號
防爆規格標示	
Ex ia IIC T4 Ga	$-40^{\circ}\text{C} \leq T_{\text{amb}} \leq +60^{\circ}\text{C}$
Ex ia IIIC T135°C Da	$-40^{\circ}\text{C} \leq T_{\text{amb}} \leq +60^{\circ}\text{C}$

2. 依據標準

IEC 60079-0 : 2017
IEC 60079-11 : 2011

3. 電氣規格

AVP7x0、AVP7x1、AVP7x2型

輸入信號端 : $U_i = 30\text{V}$ 、 $I_i = 93\text{mA}$ 、 $P_i = 0.9\text{W}$ 、 $C_i = 4\text{nF}$ 、 $L_i = 220\mu\text{H}$ 。

輸出信號端 : $U_i = 30\text{V}$ 、 $I_i = 93\text{mA}$ 、 $P_i = 0.9\text{W}$ 、 $C_i = 22\text{nF}$ 、 $L_i = 220\mu\text{H}$ 。

AVP703型

使用者端 : $U_i = 17.5\text{V}$ 、 $I_i = 380\text{mA}$ 、 $P_i = 5.32\text{W}$ 、 $C_i = 2\text{nF}$ 、 $L_i =$ 可忽略。

4. 特殊條件

檢定範圍未包含電纜入口保護裝置，應正確使用合格電纜接頭或盲塞以維持設備保護型式之完整性；

本設備安裝於需粉塵防爆的區域時，應讓靜電風險降至最低。

本設備鋁製外殼安裝於需 EPL Ga 區域使用時，應避免外殼碰撞或摩擦；

本設備無法通過電源端，信號端與外殼間的介電強度試驗，此情況於安裝時需納入考量。

7-15 NEPSI Intrinsic Safety and Dust Ignition Protection

NEPSI 本质安全认证

1. 标志资讯

GYJ23.1038X

Ex ia IIC T4 Ga $-40^{\circ}\text{C} \leq T_{\text{amb}} \leq +60^{\circ}\text{C}$ 、Ex ia IIIC T₂₀₀ 135°C Da

2. 适用的标准

-GB/T 3836.1-2021

-GB/T 3836.4-2021

3. 产品安全使用特殊条件

防爆合格证号后缀“X”表明产品具有安全使用特殊条件，具体内容如下：

1. 当产品安装于要求EPL Ga 级的场所时，用户须采取有效措施防止产品外壳由于冲击或摩擦引起的点燃危险。
2. 关联设备应优先选用隔离式安全栅；如选用齐纳式安全栅，应符合GB/T 3836.15-2017 标准关于本安电路接地的要求。
3. 在可燃性粉尘环境中应用时，应避免将产品安装于存在静电释放危险的场所。
4. 产品使用环境温度范围： $-40^{\circ}\text{C} \sim +60^{\circ}\text{C}$ 。

4. 产品使用注意事项

1. 产品必须与经防爆检验认可的关联设备配套共同组成本安防爆系统方可使用于现场存在爆炸性混合物的危险场所。其系统接线必须同时遵守该产品和所配关联设备的使用说明书要求，接线端子不得接错。

产品本安电气参数见下表：

1.1 AVP7a 0、AVP7a 1、AVP7a 2

输入信号端子：

最高输入电压 U_i (V)	最大输入电流 I_i (mA)	最大输入功率 P_i (W)	最大内部等效参数	
			C_i (nF)	L_i (μH)
30	93	0.9	4	220

输出信号端子：

最高输出电压 U_o (V)	最大输入电流 I_o (mA)	最大输入功率 P_o (W)	最大内部等效参数	
			C_o (nF)	L_o (μH)
30	93	0.9	22	220

1.2 AVP703 型用户端子

最高输入电压 U_i (V)	最大输入电流 I_i (mA)	最大输入功率 P_i (W)	最大内部等效参数	
			C_i (nF)	L_i (μH)
17.5	380	5.32	2	近似为 0

2. 用户不得自行更换该产品的零部件，应会同产品制造商共同解决运行中出现的故障，以杜绝损坏现象的发生。
3. 用户应当保持产品外壳表面清洁，以防粉尘堆积，但严禁用压缩空气吹扫。
4. 产品的安装、使用和维护应同时遵守产品说明书及下列相关标准、规范的要求：
 - GB/T 3836.13-2021 爆炸性环境 第13 部分：设备的修理、检修、修复和改造
 - GB/T 3836.15-2017 爆炸性环境 第15 部分：电气装置的设计、选型和安装
 - GB/T 3836.16-2017 爆炸性环境 第16 部分：电气装置的检查与维护
 - GB/T 3836.18-2017 爆炸性环境 第18 部分：本质安全电气系统
 - GB 50257-2014 电气装置安装工程爆炸和火灾危险环境 电气装置施工及验收规范
 - GB 15577-2018 粉尘防爆安全规程

7-16 NEPSI Flameproof

NEPSI 隔爆认证

1. 标志资讯

GYJ24.1020X

Ex db IIC T6 Gb; Ex tb IIIC T85°C Db

2. 适用的标准

-GB/T 3836.1-2021

-GB/T 3836.2-2021

-GB/T 3836.31-2021

3. 产品安全使用特殊条件

防爆合格证号后缀“X”表明产品具有安全使用特殊条件，具体内容如下：



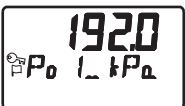
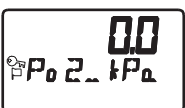

1. 涉及安装、维护、维修时需咨询制造厂，索取并参考带有隔爆面参数的文件。
2. 紧固螺钉的性能等级为 A2-70 或 A4-70。
3. 使用环境温度范围：-30°C ~ +75°C。

4. 产品使用注意事项


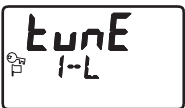


1. 产品设有外接地端子，用户在安装使用时应可靠接地。
2. 产品电缆引入口须配用经国家指定的检验机构认可的、符合国家标准 GB/T 3836.1-2021、GB/T 3836.2-2021 和 GB/T 3836.31-2021 规定的、螺纹规格为 M20×1.5 或 1/2-14NPT、具有防爆等级为 Ex db IIC Gb; Ex tb IIIC 的电缆引入装置或封堵件，方可用于爆炸性危险场所。该电缆引入装置或封堵件的使用必须符合使用说明书的要求。冗余电缆引入口应有效封堵。电缆引入装置或封堵件安装后，须确保设备整体外壳防护等级不低于 IP66。
3. 现场使用和维护时，必须遵循“严禁带电开盖”的原则。
4. 用户不得自行更换该产品的零部件，应会同产品制造商共同解决运行中出现的故障，以杜绝损坏现象的发生。
5. 用户应当保持产品外壳表面清洁，以防粉尘堆积，但严禁用压缩空气吹扫。
6. 产品的安装、使用和维护应同时遵守产品说明书及下列相关标准、规范的要求：
 - GB/T 3836.13-2021 爆炸性环境 第13 部分：设备的修理、检修、修复和改造
 - GB/T 3836.15-2017 爆炸性环境 第15 部分：电气装置的设计、选型和安装
 - GB/T 3836.16-2022 爆炸性环境 第16 部分：电气装置的检查与维护
 - GB 50257-2014 电气装置安装工程爆炸和火灾危险环境 电气装置施工及验收规范
 - GB 15577-2018 粉尘防爆安全规程

Appendix A LUI Display Examples

Normal monitor

Guide number	Display	Reading	Item	Remarks
1-1		70.0	Opening	Displays the item value in percentage.
		TRAVEL		Valve opening
1-2		70.0	Input signal	Displays the item value in percentage.
		SP		Set point
1-3	—	—	—	—
1-4		192.0	Output air pressure OUT1	Displays the item value in kPa.
		Po1_kPa		Pressure OUT1 (kPa)
1-5		0.0	Output air pressure OUT2	Displays the item value in kPa.
		Po2_kPa		Pressure OUT2 (kPa)
1-6		270.0	Supply air pressure Ps	Displays the item value in kPa.
		Ps_kPa		Pressure Supply (kPa)

Details monitor

Guide number	Display	Reading	Item	Remarks
2-1		1.00	Software version	Displays the item value. (The initial setting is the same as that on the seal affixed on the case.)
		S/W_VER		Software Version
2-2		TUNE	Control parameters	Tuning Parameter
		1-L		Left: Actuator Size Right: Friction Level (Initial setting value: 2-L)
2-3		23.5	Electronic substrate temperature	Displays the item value in degrees.
		PWATEMP		Substrate temperature
2-4		56.5	Electropneumatic transduction mod- ule drive current	Displays the item value in percentage.
		EPM_DRV		EPM Drive Signal (EPM: Electropneumatic transduction module)

Guide number	Display	Reading	Item	Remarks
2-5		150.5	Electropneumatic transduction module output air pressure	Displays the item value in kPa.
		Pn_kPa		Pressure Nozzle back in EPM (kPa)
2-6		70.0	Input %	Displays the item value in percentage.
		INPUT		Input Signal
2-7		70.1	Opening (Reverse transduction of flow amount characteristic)	Displays the item value in percentage.
		POS		Position
2-8		O_TYP	Single-acting/double-acting	Output Type
		SINGLE (single-acting) DOUBLE (double-acting)		SINGLE: Single-acting DOUBLE: Double-acting Set during auto setup. (Initial setting: SINGLE)
2-9		P_ACT	Forward/reverse	Positioner Action
		DIRECT (forward) REVERSE (reverse)		DIRECT: Forward REVERSE: Reverse Set during auto setup. (Initial setting: DIRECT)
2-10		15.3	Angle when the valve opening is 0 %	Displays the item value in degrees.
		0%.DEG		0 % angle (degree)
2-11		13.2	Angle when the valve opening is 100 %	Displays the item value in degrees.
		100%.DEG		100 % angle (degree)
2-12		ON/OFF POS	SIS positioner mode	ON/OFF mode Positioning mode
		SISMODE		Software version 2.3 or later only*
2-13		771	Basic model No.	Three-digit basic model No.
		MODEL		Software version 2.3 or later only*










*Check the software version on the LUI in details monitor mode with guide No. 2-1.

Status monitor




Guide number	Display	Upper part	Item	Remarks
3-1		SS_00	Status	SS: Status Summary Numerical value: Status category
		0x01		0x: Hexadecimal format Numerical value: Details of status

Setup mode

Auto Setup

Guide number	Display	Reading	Item	Remarks
7-1		ASU	ASU initial screen	Auto Setup
		60s		Time until the setup mode automatically ends (Not displayed if the time is longer than 60 seconds.)
7-2		ASU	Waiting for ASU execution	Auto Setup
		START→→		To perform auto setup, hold down the  button.
7-3		ASU	ASU is in progress.	Auto Setup
		RUNNING		Flashes.
7-4		ASU	Waiting until ASU stops.	Auto Setup
		STOP →→		To abort auto setup, hold down the  button.
7-5		80.5	ASU monitor	Valve opening (%)
		208.5 kPa		Output air pressure OUT1
7-6		ASU	ASU successfully completed	Auto Setup
		SUCCESS		
7-7		ASU	ASU failed	Auto Setup
		FAIL_01		The numerical value is an error code.






Zero/span adjustment

Guide number	Display	Reading	Item	Remarks
8-1		Adj	ADJ initial screen	Angle Adjustment
		60s		Time until the setup mode automatically ends (Not displayed if the time is longer than 60 seconds.)
8-2		AJ100 (AJ 0)	ADJ adjustment opening selection	AJ100: Adjust 100 % Angle (AJ 0: Adjust 0 % Angle)
		→		

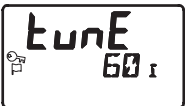



Guide number	Display	Reading	Item	Remarks
8-3		AJ100 (AJ 0)	ADJ adjustment angle selection	AJ100: Adjust 100 % Angle (AJ 0: Adjust 0 % Angle)
		COARSE→ MID → FINE →		Angle adjusted by operating the button once COARSE: 1° MID: 0.1° FINE: 0.01°
8-4		97.5	ADJ is being adjusted	Valve opening (%)
		AJ100 % (2.5) (AJ 0 %)		AJ100 %: Adjust 100 % Angle (AJ 0 %: Adjust 0 % Angle)
8-5		99.8	ADJ monitor	Valve opening (%)
		235.0 kPa		Output air pressure OUT1
8-6		ST 0 ST100	ADJ Manual Setting adjustment opening selection	ST 0: Set 0 % angle ST100: Set 100 % angle
		→		
8-7		ST 0 ST100	Waiting until ADJ Manual Setting is performed	ST 0: Set 0 % angle ST100: Set 100 % angle
		OK?→→		To perform manual setting, hold down the
8-8		ST 0 ST100	ADJ Manual Setting completed	ST 0: Set 0 % angle ST100: Set 100 % angle
		SUCCESS		

Supply bypass






Guide number	Display	Reading	Item	Remarks
9-1		BPS	BPS initial screen	Supply Bypass
		60s		Time until the setup mode automatically ends (Not displayed if the time is longer than 60 seconds.)
9-2		BPS	BPS pressure selection	Supply Bypass
		: P_MIN→→ : P_MAX→→		To perform the selected supply bypass, hold down the

Guide number	Display	Reading	Item	Remarks
9-3		BPS	BPS execution	Supply Bypass
		: RUN_MIN : RUN_MAX		Flashes.
9-4		BPS	BPS stop selection	Supply Bypass
		CLEAR→→		To abort the supply bypass, hold down the  button.
9-5		BPS	BPS stop completed	Supply Bypass
		CLEARED		
9-6		BPS	BPS execution impossible	Supply Bypass
		FAIL_01		The numerical value is an error code.

Control parameters

Guide number	Display	Reading	Item	Remarks
11-1		TUNE	Control parameter initial screen	Tuning Parameter
		60s		Changes depending on the time until the setup mode automatically ends [Longer than 60 seconds] Current control parameter [60 seconds or less] Time until the setup mode automatically ends (in seconds)
11-2		TUNE	Control parameter selection	Tuning Parameter
		1-L		To change control parameters, hold down the  button.
11-3		TUNE	Control parameter check	Tuning Parameter
		1-L		

Configuration

Guide number	Display	Reading	Item	Remarks
12-1		CONF	Actuator Type and Valve Closed Position specification initial screen	Valve Configuration
		60 s		Lower section: Time until the setup mode automatically ends (Not displayed if the time is longer than 60 seconds.)
12-2		A_TYP	Actuator Type specification screen	Actuator Type
		LINEAR R 90 R OTH R_S 90 R_S OTH		Flashes. LINEAR: Linear valve R 90: Rotary valve with an operating angle of 90° R OTH: Rotary valve with an operating angle other than 90° R_S 90: Rotary sub valve with an operating angle of 90° R_S OTH: Rotary sub valve with an operating angle other than 90°
12-3		CLS_P	Valve Closed Position specification screen	Valve Closed Position
		UP DOWN		Flashes.
12-4		A_TYP	Actuator Type confirmation screen	Actuator Type
		LINEAR R 90 R OTH R_S 90 R_S OTH		Same as 12-2. (Does not flash.)
12-5		CLS_P	Valve Closed Position confirmation screen	Valve Closed Position
		UP DOWN		

Appendix B Menu List

Menu			
Process Variables			
	Input (mA)		
	Input (%) ¹		
	Set Point (SP)		
	Travel		
	Position ²		
	Drive Signal		
	Po 1		
	Po 2 ³		
	Ps		
	Pn		
	Temperature		
Device			
Basic Setup			
	Auto Setup		
	Travel Angle 100 %		
	Travel Angle 0 %		
	Stroke Time Open		
	Stroke Time Closed		
	Stroke Time Average		
	Friction Index		
	Initial Supply Pressure		
	Spring Range High		
	Spring Range Low		
	Drive Sig Range High		
	Drive Sig Range Low		
	Drive Sig-Pn Gain		
	Drive Sig-Pn Intercept		
Configuration			
Operator Action Setting			
	Using Operator		
	Allow operator action		
	Forbid operator action		
Input Range ⁴			
	PV URV ⁴		
	PV LRV ⁴		
	Change Unit of PV Range ⁴		
Valve System			
	Actuator Type		
	Valve Closed Position		
	Feedback Lever Motion		
	Pilot Relay Type		
	Positioner Action		
	Electrical Fail To		
	Air Fail To		
Control Configuration			
	Actuator Size		
	Friction Level ⁵		
	Control Deadband		
	Replace Control Parameters ⁶		
Control Parameters ⁶			
			P Outside of GAP1 ⁶
			I Outside of GAP1 ⁶
			D Outside of GAP1 ⁶
			GAP1 ⁶
			P Inside of GAP1 ⁷
			I Inside of GAP1 ⁷
			D Inside of GAP1 ⁷
			GAP2 ⁷
			P Inside of GAP2 ⁸
			I Inside of GAP2 ⁸
			D Inside of GAP2 ⁸
Input Characterization ⁴			
	Input Characterization ⁴		
Custom Curve Data ⁹			
			Custom Data IN 1 ⁹
			Custom Data IN 21 ⁹
			Custom Data OUT 1 ⁹
			Custom Data OUT 21 ⁹
Travel Cutoff ⁴			
	Travel Cutoff High ⁴		
	Travel Cutoff Low ⁴		
Unit			
	Unit of Pressure		
	Change Unit of Pressure		
SIS Positioner Mode			
	SIS Positioner Mode		
	Change SIS Positioner Mode ¹⁰		
Device Information			
	Manufacturer		
	Model		
	Dev id		
	Tag		
	Long tag		
	Date		
	Descriptor		
	Message		
	Serial Number		
	Final assembly num		

Appendix B Menu List

		Distributor		
		Cfg chng count		
		Operating Time		
		Poll addr		
		Num req preams		
		Num resp preams		
		Revision Numbers		
			Universal rev	
			Fld dev rev	
			Software rev	
			Hardware rev	
		Factory Setting Information		
			Production Number	
			Model Number	
			Valve Model Number	
			Factory Setting Date	
	Option			
		Travel Transmission (AO) ¹¹		
			Travel Transmission ¹¹	
			Dummy Travel Transmission ¹¹	
			Fail Safe Direction ¹¹	
			D/A Trim ¹¹	
			Failure Output Reset Method ¹²	
			Reset the Failure Output ¹³	
		Contact Output ¹⁴		
			Contact Output ¹⁴	
			Dummy Contact Output ¹⁴	
			Failure Output Reset Method ¹⁵	
			Reset the Failure Output ¹⁶	
	Review			
		* Reference MENU (Review)		
Maintenance				
	Travel Calibration			
		Auto Travel Calibration		
		Angle Correction		
		Manual Setting		
		Change Travel Angle		
	Input Calibration ¹⁹			
		Calibrate 4 mA signal ¹⁹		
		Calibrate 20 mA signal ¹⁹		
	Pressure Sensor Adjustment			
		Zero Adjustment		
	Simulation			
		Dummy Input Signal		
		Dummy Drive Signal		
	Pneumatic Modules			
		Pilot Adjustment ¹⁷		
		EPM Adjustment ¹⁷		
	Restore factory settings			
		Restore factory settings		
	Operator Action Records			
		Operator Action Records		
	Real Time Clock			
		Current Date		
		Current Time		
		Set Real Time Clock		
	Password			
		Password Use		
		Change password use setting		
		Change Password ¹⁸		
Diagnostics				
	Diagnostic Status			
		Positioner Diagnostic		
			Failure	
				Valve Travel Detector Failure
				Valve Travel Detector Out of Range
				Po 1 Pressure Sensor Failure
				Po 2 Pressure Sensor Failure
				Ps Pressure Sensor Failure
				Pn Pressure Sensor Failure
				Temperature Sensor Failure
				CPU Failure
				RAM Failure
				ROM Failure
				A/D Conversion Module 1 Failure
				A/D Conversion Module 2 Failure
				Non-Volatile Memory Failure
				Input Circuit Failure
				Internal Program Execution Error
				Scheduled PST Start Failure ¹⁹
				PST Scheduler Fault ¹⁹
				SIS RAM Data Failure
			Function Check	
				Local User I/F Active
				Dummy Input Signal is running
				Dummy Drive Signal is running
				Dummy Travel Transmission is running ¹¹
				Dummy Contact Output is running _14
				Auto Setup is running
				Auto Travel Calibration is running
				Step Response Test is running
				Valve Signature is running
				Partial Stroke Test is running ¹⁹
				Full Stroke Test is running
			Out of Specification	
				VTD Angle Span Out of Range

			Supply Pressure Out of Range
			Temperature Out of Range
			Input Signal Low
			Insufficient Input Signal Range ¹⁹
			Incorrect Setting of Input Range
		Maintenance Required	
			Restriction is clogged
			Deposits on the Nozzle-Flapper
		Information	
			Travel Cutoff High
			Travel Cutoff Low
			Factory Settings Restored
			In Use by an Operator
			Local User I/F Abnormal
			Local User I/F was used in past 10 min.
			Failure Output (AO) ¹¹
			Failure Output (Contact) ¹⁴
			Emergency Demand Input (H/W)
			Emergency Demand Input (S/W)
			Self-Shutdown ¹⁰
		Valve Diagnostic	
			Out of Specification
			Supply Pressure High Alarm
			Supply Pressure Low Alarm
			Temp High Alarm
			Temp Low Alarm
		Maintenance Required	
			Stick-Slip High Alarm ²⁰
			Stick-Slip Medium Alarm ²⁰
			Stick-Slip Low Alarm ²⁰
			Zero Travel + Alarm
			Zero Travel - Alarm
			Deviation + Alarm
			Deviation - Alarm
			Po Validity + Alarm
			Po Validity - Alarm
			Max Friction Alarm
			Total Stroke Alarm
			Cycle Count Alarm
			Shut Count Alarm
			Max Tvl Speed + Alarm
			Max Tvl Speed - Alarm
		Partial Stroke Test *19	
			Maintenance Required ¹⁹
			PST Start Position Failure ¹⁹
			No change in valve travel in PST ¹⁹
			Did not Reach to Target in PST ¹⁹
			PST Pressure Failure ¹⁹
			PST Incomplete ¹⁹
			Stick-Slip Occurred in PST ¹⁹
			Information ¹⁹
			Rejection of Request for PST ¹⁹
			PST Overridden (aborted) ¹⁹
			PST Timeout ¹⁹
		Full Stroke Test	
			Maintenance Required
			FST Start Position Failure
			No change in valve travel in FST
			Did not Reach to Target in FST
			FST Pressure Failure
			FST Incomplete
			Information
			Rejection of Request for FST
			FST Overridden (aborted)
			FST Timeout
	Diagnostic Status Records		
		Positioner Diagnostic	
		Valve Diagnostic	
	Partial Stroke Test ¹⁹		
		PST Enabled ¹⁹	
		Change PST Enabled ¹⁹	
		Set PST Schedule ¹⁹	
		PST Initial Travel ¹⁹	
		PST Target Travel ¹⁹	
		PST Pause Time ¹⁹	
		PST Ramp Rate ¹⁹	
		PST Next Execute Time ¹⁹	
		PST Interval ¹⁹	
		PST Breakout Timeout ¹⁹	
		PST Stroke Travel Timeout ¹⁹	
		PST Completion Timeout ¹⁹	
		PST Pressure Threshold ¹⁹	
		PST Stick-Slip Threshold ¹⁹	
		PST Stick-Slip Alarm Enabled ¹⁹	
		Check the Validity of PST Settings ¹⁹	
		Execute PST ¹⁹	
		Abort PST ¹⁹	
		Partial Stroke Test is running ²¹	
		Result ¹⁹	
			PST Result ¹⁹
			Detailed Result ¹⁹
			PST Start Position Failure ¹⁹
			No change in valve travel in PST ¹⁹
			Did not Reach to Target in PST ¹⁹
			PST Pressure Failure ¹⁹
			PST Incomplete ¹⁹

Appendix B Menu List

			Stick-Slip Occurred in PST ¹⁹
			Rejection of Request for PST ¹⁹
			PST Overridden (aborted) ¹⁹
			PST Timeout ¹⁹
			Scheduled PST Start Failure ¹⁹
			Restriction is clogged ¹⁹
			Deposits on the Nozzle-Flapper ¹⁹
			PST Breakout Time ¹⁹
			PST Start Travel ¹⁹
			PST Start Pressure ¹⁹
			PST Pause Travel ¹⁹
			PST Pause Pressure ¹⁹
			PST End Travel ¹⁹
			PST End Pressure ¹⁹
			PST Stick-Slip X ¹⁹
			PST Stick-Slip Y ¹⁹
			Reset PST Result ¹⁹
	Full Stroke Test		
		FST Enabled	
		FST Initial Travel	
		FST Pause Time	
		FST Breakout Timeout	
		FST Stroke Travel Timeout	
		FST Completion Timeout	
		Check the Validity of FST Settings	
		Execute FST	
		Abort FST ²²	
		Result	
			FST Result
			FST Detailed Result
			FST Start Position Failure
			No change in valve travel in FST
			Did not Reach to Target in FST
			FST Pressure Failure
			FST Incomplete
			Rejection of Request for FST
			FST Overridden (aborted)
			FST Timeout
			FST Breakout Time
			FST Stroke Travel Time
			FST Start Travel
			FST Start Pressure
			FST Pause Travel
			FST Pause Pressure
			FST End Travel
			FST End Pressure
			Reset FST Result
	Diagnostic Setup		
		Positioner Air Circuit	
			Drive Sig Max Shift +
			Drive Sig Max Shift -
			Update Drive Sig Max Shift
			Reset Drive Sig Max Shift
			Drive Sig Shift Threshold + (Initial Value: 25 %)
			Drive Sig Shift Threshold - (Initial Value: -25 %)
			Drive Sig Stable Threshold
			Pn Stable Threshold
			Drive Sig + Alarm Count
			Drive Sig - Alarm Count
			Update Drive Sig Alarm Count
			Positioner Air Circuit Alarm Enabled (You will now set the notification for the alarms of "Restriction is clogged" and "Deposits on the Nozzle- Flapper.")
		Stick-Slip ²⁰	
			Stick-Slip X ²⁰
			Stick-Slip Y ²⁰
			Stick-Slip Validity ²⁰
			Stick-Slip Updated Date ²⁰
			Stick-Slip Updated Time ²⁰
			Update Stick-Slip ²⁰
			Stick-Slip High Alarm Count ²⁰
			Stick-Slip Medium Alarm Count ²⁰
			Stick-Slip Low Alarm Count ²⁰
			Update Stick-Slip Alarm Count ²⁰
			Stick-Slip Threshold High ²⁰ (Initial Value: 10)
			Stick-Slip Threshold Medium ²⁰ (Initial Value: 5.5)
			Stick-Slip Threshold Low ²⁰ (Initial Value: 3)
			Stick-Slip Alarm Enabled ²⁰
		Zero Travel	
			Zero Travel Max
			Zero Travel Min
			Update Zero Travel Max/Min
			Reset Zero Travel Max/Min
			Zero Travel Stable Threshold
			Zero Travel Static Time
			Zero Travel Error Waiting Time (Initial Value: 10 s)
			Zero Travel Threshold + (Initial Value: 1 %)
			Zero Travel Threshold - (Initial Value: -3 %)

		Zero Travel Waiting Time (Initial Value: 40 s)	
		Zero Travel + Alarm Count	
		Zero Travel - Alarm Count	
		Update Zero Travel Alarm Count	
		Zero Travel Alarm Enabled	
	Deviation		
		Deviation Time Max +	
		Deviation Time Max -	
		Update Deviation Time Max	
		Reset Deviation Time Max	
		Deviation Threshold + (Initial Value: 5 %)	
		Deviation Threshold - (Initial Value: -5 %)	
		Deviation Waiting Time (Initial Value: 10 s)	
		Deviation + Alarm Count	
		Deviation - Alarm Count	
		Update Deviation Alarm Count	
		Deviation Alarm Enabled	
	Supply Pressure		
		Sup Press Max note 2	
		Sup Press Min note 2	
		Update Sup Press Max/Min	
		Reset Sup Press Max/Min	
		Sup Press Threshold High note 1	
		Sup Press Threshold Low note 1	
		Sup Press High Alarm Count	
		Sup Press Low Alarm Count	
		Update Sup Press Alarm Count	
		Sup Press Alarm Enabled	
	Temperature		
		Temp Max note 2	
		Temp Min note 2	
		UpdateTemp Max/Min	
		Reset Temp Max/Min	
		Temp Threshold High (Initial Value: 80 °C)	
		Temp Threshold Low (Initial Value: -40 °C)	
		Temp High Alarm Count	
		Temp Low Alarm Count	
		UpdateTemp Alarm Count	
		Temp Alarm Enabled	
	Force Balance		
		Po Validity	
			Po Validity + note 2
			Po Validity - note 2
			Unbalance Force Seg 1 note 2
			Unbalance Force Seg 26 note 2
			Update Unbalance Force ²³
			Po Validity Threshold + note 1
			Po Validity Threshold - note 1
			Po Validity Alarm Enabled
		Max Friction	
			Max Friction note 2
			Friction Seg 1 note 2
			Friction Seg 26 note 2
			Update Friction ²³
			Max Friction Threshold note 1
			Max Friction Alarm Enabled
		Common Parameters	
			Po Max Seg 1 note 2
			Po Max Seg 26 note 2
			Po Min Seg 1 note 2
			Po Min Seg 26 note 2
			Update Po Max/Min ²³
			Travel Seg Divider 1
			Travel Seg Divider 25
			Po Stable Threshold
			Travel Stable Threshold
			Travel Upper Limit
			Travel Lower Limit
		Update Force Balance ²²	
		Reset Force Balance	
	Total Stroke		
		Total Stroke	
		Change Total Stroke ²²	
		Update Total Stroke	
		Total Stroke Dead Band	
		Total Stroke Threshold (Initial Value: 20000000 %)	
		Change Total Stroke Threshold ²²	
		Total Stroke Alarm Enabled	
	Cycle Count		
		Cycle Count	
		Change Cycle Count ²²	
		Update Cycle Count	
		Cycle Count Dead Band High	
		Cycle Count Dead Band Low	
		Cycle Count Threshold (Initial Value: 100000 revolutions)	

		Change Cycle Count Threshold ^{**}	
		Cycle Count Alarm Enabled	
	Shut Count		
		Shut Count	
		Change Shut Count ^{**}	
		Update Shut Count	
		Shut Count Threshold	
		Change Shut Count Threshold ^{**}	
		Shut Count Alarm Enabled	
	Max Travel Speed		
		Max Tvl Speed +	
		Max Tvl Speed -	
		Update Max Tvl Speed	
		Reset Max Tvl Speed	
		Max Tvl Speed Threshold + (Initial Value: +1000 %/s)	
		Change Max Tvl Speed Threshold + ^{**}	
		Max Tvl Speed Threshold - (Initial Value: -1000 %/s)	
		Change Max Tvl Speed Threshold - ^{**}	
		Max Tvl Speed Alarm Enabled	
	Travel Histogram		
		Travel Histogram	
			Travel Histogram 1
			Travel Histogram 26
			Update Travel Histogram
			Reset Travel Histogram
		Travel Segmentation	
			Travel Seg Divider 1
			Travel Seg Divider 25

Notes

- these parameters sometimes get updated during auto setup.
 - there may be times when random symbols such as "1.\$," "<<<," ">>>," "1.#INF," etc., will be displayed in the data display column, but this simply shows that the value is non-numerical (NAN) or ∞.
 - Asterisk (*) notes follow the Menu Summary below.

- *1. Displayed only for Model AVP77_ or Model AVP78_ and only if the input characterization is "Linear"
- *2. Displayed only if the SIS positioner mode is in "POSITIONING" as well as if the input characterization is set to a mode other than "Linear."
- *3. Displayed only if the pilot relay type is "double acting"
- *4. Displayed only for Model AVP77_ or Model AVP78_, as well as if the SIS Positioner Mode is in "POSITIONING" mode
- *5. Displayed only if the actuator size is "Param1 - Param6"
- *6. Displayed only if the actuator size is "Custom"
- *7. Displayed only if the actuator size is "Custom" and GAP1 ≠ 0.00
- *8. Displayed only if the actuator size is "Custom" and GAP1 ≠ 0.00 and GAP2 ≠ 0.00
- *9. Displayed only for Model AVP77_ or Model AVP78_, as well as if the SIS Positioner Mode is in "POSITIONING" mode, and the input characterization is set to "custom curve"
- *10. Displayed only for Model AVP77_ or Model AVP78_
- *11. Displayed only for Model AVP7_1
- *12. Displayed only for Model AVP7_1, as well as if the SIS Positioner Mode is in "ON/OFF" mode
- *13. Displayed only for Model AVP7_1, as well as if the SIS Positioner Mode is in "ON/OFF" mode and failure output reset method is set to "Manual"
- *14. Displayed only for Model AVP7_0
- *15. Displayed only for Model AVP7_0, as well as if the SIS Positioner Mode is in "ON/OFF" mode
- *16. Displayed only for Model AVP7_0, as well as if the SIS Positioner Mode is in "ON/OFF" mode and failure output reset method is set to "Manual"
- *17. Please ask one of our service engineers for adjustment.
- *18. Displayed only if Password Use is set to "Enabled"
- *19. Displayed only if the SIS Positioner Mode is in "ON/OFF" mode
- *20. Displayed only if the SIS Positioner Mode is in "POSITIONING" mode
- *21. Only for EDD and if SIS positioner mode is in "ON/OFF" mode
- *22. Displayed only for EDD
- *23. Displayed only for DD

MENU (Summary)

Displayed parameters and their order are shown below.

Review1
Manufacturer
Model
Dev id
Tag
Long tag
Date
Descriptor
Message
Serial Number
Final asbly num
Distributor
Cfg chng count
Operating Time
Poll addr
Num req preams
Num resp preams
Universal rev
Fld dev rev
Software rev
Hardware rev
Production Number
Model Number
Valve Model Number
Factory Setting Date
Review2
Input (mA)
Input (%) ¹
Set Point (SP)
Travel
Position ²
Drive Signal
Po 1
Po 2 ³
Ps
Pn
Temperature
VTD Angle
Travel Angle 100 %
Travel Angle 0 %
Stroke Time Open
Stroke Time Closed
Stroke Time Average
Friction Index
Initial Supply Pressure
Spring Range High
Spring Range Low
Drive Sig Range High
Drive Sig Range Low
Drive Sig-Pn Gain
Drive Sig-Pn Intercept
PV URV ⁴
PV LRV ⁴
Actuator Type
Valve Closed Position
Feedback Lever Motion
Pilot Relay Type
Positioner Action
Electrical Fail To
Air Fail To
Actuator Size
Friction Level ⁵
Control Deadband
P Outside of GAP1 ⁶
I Outside of GAP1 ⁶
D Outside of GAP1 ⁶
GAP1 ⁶
P Inside of GAP1 ⁷
I Inside of GAP1 ⁷
D Inside of GAP1 ⁷
GAP2 ⁷

P Inside of GAP2 ^{*8}
I Inside of GAP2 ^{*8}
D Inside of GAP2 ^{*8}
Review3
Input Characterization ^{*4}
Custom Data IN 1 ^{*9}
Custom Data IN 21 ^{*9}
Custom Data OUT 1 ^{*9}
Custom Data OUT 21 ^{*9}
Travel Cutoff High ^{*4}
Travel Cutoff Low ^{*4}
Unit of Pressure
SIS Positioner Mode
Current Date
Current Time
Password Use
Travel Transmission ^{*11}
Fail Safe Direction ^{*11}
Contact Output ^{*14}
PST Enabled ^{*19}
PST Initial Travel ^{*19}
PST Target Travel ^{*19}
PST Pause Time ^{*19}
PST Ramp Rate ^{*19}
PST Next Execute Time ^{*19}
PST Interval ^{*19}
PST Breakout Timeout ^{*19}
PST Stroke Travel Timeout ^{*19}
PST Completion Timeout ^{*19}
PST Pressure Threshold ^{*19}
PST Stick-Slip Threshold ^{*19}
PST Stick-Slip Alarm Enabled ^{*19}

- *1. Displayed only for Model AVP77_ or Model AVP78_ and only if the input characterization is “Linear”
- *2. Displayed only if the SIS positioner mode is in “POSITIONING” as well as if the input characterization is set to a mode other than “Linear.”
- *3. Displayed only if the pilot relay type is “double acting.”
- *4. Displayed only for Model AVP77_ or Model AVP78_, as well as if the SIS Positioner Mode is in “POSITIONING” mode
- *5. Displayed only if the actuator size is “Param1 - Param6”
- *6. Displayed only if the actuator size is “Custom”
- *7. Displayed only if the actuator size is “Custom” and GAP1 ≠ 0.00
- *8. Displayed only if the actuator size is “Custom” and GAP1 ≠ 0.00 and GAP2 ≠ 0.00
- *9. Displayed only for Model AVP77_ or Model AVP78_, as well as if the SIS Positioner Mode is in “POSITIONING” mode, and the input characterization is set to “custom curve”
- *10. Displayed only for Model AVP77_ or Model AVP78_
- *11. Displayed only for Model AVP7_1
- *12. Displayed only for Model AVP7_1, as well as if the SIS Positioner Mode is in “ON/OFF” mode
- *13. Displayed only for Model AVP7_1, as well as if the SIS Positioner Mode is in “ON/OFF” mode and failure output reset method is set to “Manual”
- *14. Displayed only for Model AVP7_0
- *15. Displayed only for Model AVP7_0, as well as if the SIS Positioner Mode is in “ON/OFF” mode
- *16. Displayed only for Model AVP7_0, as well as if the SIS Positioner Mode is in “ON/OFF” mode and failure output reset method is set to “Manual”
- *17. Please ask one of our service engineers for adjustment.
- *18. Displayed only if Password Use is set to “Enabled”
- *19. Displayed only if the SIS Positioner Mode is in “ON/OFF” mode
- *20. Displayed only if the SIS Positioner Mode is in “POSITIONING” mode
- *21. Only for EDD and if SIS positioner mode is in “ON/OFF” mode
- *22. Displayed only for EDD
- *23. Displayed only for DD

Appendix C Specifications

List of Features

Item	Feature
Emergency operation	This function sets the output air pressure to zero when there is emergency signal input.
PST	This function partially moves the valve to diagnose it.
FST	This function fully opens and then closes the valve to diagnose it.
Forced full closure / full throttle	You can fully close or open the valve with accuracy by means of a percentage (%) input signal. (When the SIS positioner mode is in positioning mode)
Flow characteristics	You can define the relationship between the input signal and throttle level that suits a particular process by using a polygonal line with 21 dots. (When the SIS positioner mode is in positioning mode)
Travel transmission (optional) Model AVP7_1 only	By transmitting the valve's position, it can accurately monitor the valve's behavior, and can give notice of any abnormalities in the self diagnosis result or the PST result using failure output.
Contact output (optional) Model AVP7_0 only	Notifies abnormalities of self diagnosis result or PST result via the failure output.

Composition of Basic Model No.

Model AVP 77_ Analog Signal 4-20 mA DC HART Communication

Model AVP 78_ Analog Signal 0-20 mA DC HART Communication

Model AVP 79_ Discrete Signal 0/24 V DC HART Communication

_ 0: Contact Output

1: Analog Output

2: No output

Input Signal Specification

When used for an emergency shut down valve (or the emergency open valve) (when the SIS positioner mode is set to ON/OFF mode)

Basic Model No.	Input Specification	Emergency Operation		Normal Operation		PST Execution (Feasibility)
		Input Signal	Output Air Pressure	Input Signal	Output Air Pressure	
Model AVP 77_	4-20 mA DC	3.84-4.48 mA DC	0 ¹	12-20 mA DC	Maximum Pressure	PST Executable
Model AVP 78_	0-20 mA DC	Less than 0.5 mA DC		24±4.8 V DC		
Model AVP 79_	0/24 V DC	Less than 0.5 V DC				

If used for a control valve (When the SIS positioner mode is in positioning mode)

Basic Model No.	Input Specification	Emergency Operation		Normal Operation		PST Execution (Feasibility)
		Input Signal	Output Air Pressure	Input Signal	Output Air Pressure	
Model AVP 77_	4-20 mA DC	3.84-4.48 mA DC	0 ¹	5.6-20 mA DC	Control Pressure	PST Not executable
Model AVP 78_	0-20 mA DC	Less than 0.5 mA DC		4-20 mA DC		

*1 For double-acting units, OUT1's pressure will be at 0, and OUT2's will be at supplied air pressure.

Standard Specifications

Item	Specifications
Applicable actuator type	Pneumatic single and double acting, linear and rotary motion actuator
Input signal	4-20 mA DC, 0-20 mA DC, 0/24 V DC
Input resistance	600 Ω typically / 20 mA DC
Output signal	Travel Transmission Signal 4-20 mA DC ^{*1} , (failure output Hi: 21mA min. Lo: 3.6mA max.) Contact Output (contact volume: 30 V DC max, 100 mA DC max, saturation voltage: 5 V DC max except for structure L, T / 30V DC max, 93 mA DC max, saturation voltage: 5 V DC max for structure L, T) ^{*2}
Lightning protection	Peak value of voltage surge: 12 kV; peak value of current surge: 1000 A
Flow characteristics	Linear, equal percentage, quick opening, user-defined optional characteristics (can set a maximum of 21 points) (When the SIS positioner mode is in ON/OFF mode, you can only select "linear")
Manual operation	Possible with the A/M switch or LUI operation
Supply air pressure	140 kPa-700 kPa
Air consumption	3.2 l/min [N] or less: with steady supply air pressure of 140 kPa and output of 50% 4.0 l/min [N] or less: with steady supply air pressure of 280 kPa and output of 50% 4.8 l/min [N] or less: with steady supply air pressure of 500 kPa and output of 50% 8 l/min [N] or less: with double-acting reversing relay and steady supply air pressure of 400 kPa
Maximum air deliver flow rate	110 l/min [N]: if the supply air pressure is 140 kPa
Air pipe connection	Rc1/4, 1/4NPT
Electrical wiring connection	G1/2, 1/2NPT, M20×1.5

Item		Specifications
Ambient temperature limits		General model: -40 to +80 °C TIIS Flameproof: -20 to +55 °C FM/FMC/IECEX/CCC/KCs/CNS Explosion Proof: -30 to +75 °C FM intrinsically safe (ic) and Nonincendive: -24 to +75 °C ATEX/IECEX/CCC/CNS Intrinsically safe: -40 to +60 °C However, the LCD usage range is 0 to 50 °C
Ambient humidity limits		5-100% RH
Vibration Characteristics		20 m/s ² (5-400 Hz) (vibration within the positioner main unit)
Finish and color		Finish: baked acrylic; color: silver
Material		Aluminum alloy
Weight		Without Pressure regulator with filter: 4.2 kg With Pressure regulator with filter model RA1B: 4.7 kg With Pressure regulator with filter model KZ03: 4.9 kg
Performance	Accuracy	±1.0% FS But: ±3.0 % FS if the feedback lever angle is outside the ±4° to ±20° range (see Table 1) There is an additional 0.5 % FS (input error) if 4 mA ≤ input signal span < 8 mA
	Travel transmission accuracy	±1.0% FS ^{*1}
	Stroke coverage	14.3 to 100 mm (when the feedback lever rotation angle is between ±4° to ±20°)

*1. Only applies when the travel transmission is provided (Model AVP 7_1). In such a case, a power supply circuit for travel transmission is necessary.

*2. Only applies when the contact output is provided (Model AVP 7_0). In such a case, a power supply circuit for contact output is necessary.

Note: Depending on the inside diameter and length of the air pipes, optimal operation may not be possible using auto-setup alone. In such cases, please set the control parameters.

Structure	<p>Waterproof JIS C0920 TIIS Flameproof: Ex d IIC T6 FM Explosionproof / Dust Ignition Protection: Explosionproof (Division System): Class I, Division 1, Group B, C, D T6 • Cannot be used in an environment with gasoline. • Electrical conduit sealing fitting is unnecessary. Explosionproof (Zone System): Class I, Zone 1, AEx d IIC T6 Gb Dust Ignition Protection (Division System): Class II, III, Division 1, Group E, F, G T6 Dust Ignition Protection (Zone System): Zone 21 AEx tb IIIC T85 °C Db Container protection grade: IP66 FM Intrinsically Safe (ic) and Nonincendive Intrinsically safe (ic) (Zone System) Class I, Zone 2, AEx ic IIC T4 Entity Parameters: Input Circuit Side: Ui=30 V, Ii=100 mA, Pi=1 W, Ci=24 nF, Li=0.22 mH Travel Transmission Circuit (Model AVP 7_1): Ui=30 V, Ii=100 mA, Pi=1 W, Ci=20 nF, Li=0.22 mH Contact output circuit (Model AVP 7_0): Ui=30 V, Ii=100 mA, Pi=1 W, Ci=20 nF, Li=0.22 mH Nonincendive (Division System) Class I, Division 2, Group A, B, C and D, T4 Nonincendive Field Wiring Parameters: Input Circuit Side: Vmax=30 V, Imax=100 mA, Ci=24 nF, Li=0.22 mH Travel Transmission Circuit (Model AVP 7_1): Vmax=30 V, Imax=100 mA, Ci=20 nF, Li=0.22 mH Contact output circuit (Model AVP 7_): Vmax=30 V, Imax=100 mA, Ci=20 nF, Li=0.22 mH Suitable Class II and Class III, Division 2, Group E, F and G, T4 Container Protection Grade: NEMA Type 4X, IP66 FMC Explosionproof / Dust Ignition Protection Explosionproof (Division System): Class I, Division 1, Group C, D T6 • Cannot be used in an environment with gasoline. • It is unnecessary to seal-fetch the conduit pipe. Explosionproof (Zone System): Class I, Zone 1, Ex d IIB T6 • For connection with a conduit pipe, seal it within 450 mm (18 in). Explosionproof (Division System): Class II, III, Division 1, Group E, F, G T6 Container protection grade: IP66 • The wiring conduit cable gland and electrical wiring must be compliant with the National Electrical Code (NEC). ATEX Intrinsically safe/Dust Ignition Protection Intrinsically safe: II 1 G Ex ia IIC T4 Ga Dust ignition protection: II 1 D Ex ia IIIC T135°C Da Enclosure classification: IP66 The barriers should be ATEX certified types and comply with the following conditions: Input Signal Terminals (+/- IN): Ui=30 V, Ii=93 mA, Pi=0.9 W, Ci=4 nF, Li=220 μH Output Signal Terminals (+/- OUT): (AVP7_0/7_1) Ui=30 V, Ii=93 mA, Pi=0.9 W, Ci=22 nF, Li=220 μH</p>
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Structure	<p>IECEX Flameproof / Dust Ignition Protection Flameproof: Ex d IIC T6 Gb Dust Ignition Protection: Ex tb IIIC T85 °C Db Container Protection Grade: IP66 Please use IECEX Ex d IIC-approved products as the cable gland for connecting it to the electrical connection port. However, please use IP66-approved products when using it in an environment that requires IP66.</p> <p>IECEX Intrinsically safe/Dust Ignition Protection Intrinsically safe: Ex ia IIC T4 Ga Dust ignition protection: Ex ia IIIC T135°C Da Enclosure classification: IP66 The barriers should be IECEX certified types and comply with the following conditions: Input Signal Terminals (+/- IN): Ui=30 V, Ii=93 mA, Pi=0.9 W, Ci=4 nF, Li=220 μH Output Signal Terminals (+/- OUT): (AVP7_0/7_1) Ui=30 V, Ii=93 mA, Pi=0.9 W, Ci=22 nF, Li=220 μH</p> <p>CCC Flameproof / Dust Ignition Protection Flameproof: Ex db IIC T6 Gb -30°C ≤ Tamb ≤ +75°C IP66 Dust Ignition Protection: Ex tb IIIC T85°C Db Container Protection Grade: IP66 Please use Ex db IIC or Ex tD A21-approved products as the cable gland to be connected to the electrical connection port. Please use IP66-approved products in an environment that requires IP66.</p> <p>CCC Intrinsically safe/Dust Ignition Protection Intrinsically safe: Ex ia IIC T4 Ga Dust ignition protection: Ex ia IIIC T₂₀₀ 135 °C Da Enclosure classification: IP66 The barriers should be CCC certified types and comply with the following intrinsically safe conditions: Input Signal Terminals (+/- IN): Ui=30V, Ii=93mA, Pi=0.9W, Ci=4nF, Li=220uH Output Signal Terminals (+/- OUT): (AVP7_0/7_1) Ui=30V, Ii=93mA, Pi=0.9W, Ci=22nF, Li=220uH</p> <p>KCs Flameproof: Ex d IIC T6 Please use KCs Ex d II C -approved products as the cable gland to be connected to the electrical connection port.</p> <p>CNS Flameproof Flameproof: Ex d IIC T6 Gb Enclosure classification: IP66 For the cable gland connected to the electrical connection port, use products with CNS Ex d IIC explosion-proof certification. Please use IP66-approved products in an environment that requires IP66.</p> <p>CNS Intrinsically safe/Dust Ignition Protection Intrinsically safe: Ex ia IIC T4 Ga Dust ignition protection: Ex ia IIIC T135 °C Da Enclosure classification: IP66 The barriers should be CCC certified types and comply with the following conditions: Input Signal Terminals (+/- IN): Ui=30V, Ii=93mA, Pi=0.9W, Ci=4nF, Li=220uH Output Signal Terminals (+/- OUT): (AVP7_0/AVP7_1) Ui=30V, Ii=93mA, Pi=0.9W, Ci=22nF, Li=220uH</p>
Electrical standard	CE Marking (EN61326-1: 2013)
Related devices	Field Communication Software (Model CFS100)

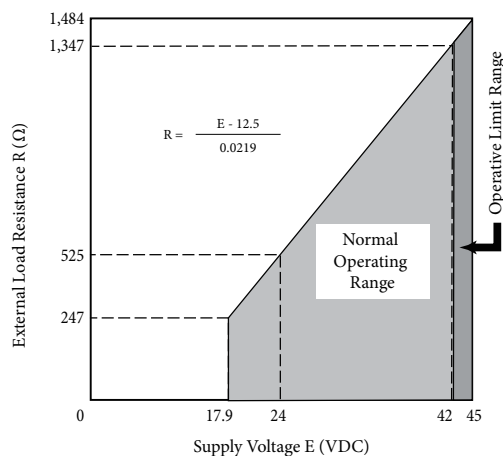


Figure 1. Supply Voltage and External Load Resistance of the Travel Transmission

Table 1 - Stroke and Accuracy of the Standard Operating Unit

Actuator	Stroke [mm]	Accuracy [%FS]
PSA1, 2	14.3, 20, 25	1.0
PSA3, 4	20, 38	1.0
HA1	6, 8, 10	3.0
	14.3, 25	1.0
HA2	10	3.0
	14.3, 25, 38	1.0
HA3	14.3	3.0
	25, 38, 50	1.0
HA4	14.3	3.0
	25, 38, 50, 75	1.0
VA5	25, 37.5, 50, 75, 100	1.0
VA6	14.3	3.0
PSA6, 7	25, 37.5, 50, 75, 100	1.0
HK1	10	3.0
PSK1	19	1.0
DAP560, 1000	14.3	3.0
	25-100	1.0
DAP1500, 1500X	14.3, 25	3.0
	38-100	1.0

Air Specifications of Applicable Instruments (according to JIS C1805-1 (2001))

Item	Specifications
Solid particles	There must be no particles with diameter that exceeds 3 μm .
Oil content	The mass must be less than 1 ppm
Supply air temperature	Dew point temperature must be at least 10 °C lower than temperature of the main unit

Please appropriately install the following air cleaner at each of the installation locations to satisfy the above instrumentation air specification.

Appendix D Model Number Configuration Table

Model Number Configuration Table

Basic Model No.

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
AVP770	Analog Signal (4-20 mA DC) HART communication with contact output									
AVP771	Analog Signal (4-20 mA DC) HART communication with travel transmission output									
AVP772	Analog Signal (4-20 mA DC) HART communication without output signal									
AVP780	Analog Signal (0-20 mA DC) HART communication with contact output									
AVP781	Analog Signal (0-20 mA DC) HART communication with travel transmission output									
AVP782	Analog Signal (0-20 mA DC) HART communication without output signal									
AVP790	Discrete Signal (0/24 V DC) HART communication with contact output									
AVP791	Discrete Signal (0/24 V DC) HART communication with travel transmission output									
AVP792	Discrete Signal (0/24 V DC) HART communication without output signal									
(1) Structure	Waterproof			X						
	TIIS Flameproof G1/2 electrical conduit only, with flameproof packing cable adapter [Note 1]			E						
	FM Explosionproof/Dust ignition protection (G1/2 electrical conduit cannot be selected.)			F						
	FM Intrinsically safe (ic) and Nonincendive			V						
	FMC Explosionproof/Dust ignition protection (G1/2 electrical conduit cannot be selected.)			A						
	ATEX Intrinsically safe/Dust Ignition Protection			L						
	IECEx Flameproof/Dust ignition protection (G1/2 electrical conduit cannot be selected.)			D						
	IECEx Intrinsically safe/Dust Ignition Protection			T						
	CCC Flameproof/Dust ignition protection (G1/2 electrical conduit cannot be selected.)			N						
	CCC Intrinsically safe/Dust Ignition Protection			R						
	KCs Flameproof (G1/2 electrical conduit cannot be selected.)			K						
	CNS Flameproof (Electrical connection G1/2 is not available.)			S						
	CNS Intrinsically safe/Dust Ignition Protection			H						
(2) Connection	Electrical conduit connection	Air Pipe Connection	Mounting Bracket Screw	Pressure Gauge Screw						
	G1/2	Rc1/4	M8	Rc1/8	G					
	1/2 NPT	1/4 NPT	M8	Rc1/8	N					
	M20×1.5	1/4 NPT	M8	Rc1/8	M					
(3) Finish	Standard finish (baked acrylic)				S					
	Corrosion-Resistant Finish (baked urethane)				B					
(4)(5) Display	Display (LCD) with push button					D	X			
(6) Diagnostic	Advanced Diagnosis (with 4 pressure sensors)							A		
(7) Overvoltage protection	With over-voltage protection								V	

Appendix D Model Number Configuration Table

(8)(9) Optional	None	X	X
	Flameproof Universal Elbow (G1/2) 1 Piece	A	A
	Flameproof Universal Elbow (G1/2) 2 Pieces	A	C
	Model RA1B pressure regulator with filter (mounted on Positioner) ^{*2}	M	7
	Model RA1B pressure regulator with filter (with bracket for separated mount)	M	8
	Model RA1B pressure regulator with filter (with bracket for separated mount onto horizontal-installed actuator)	M	9
	Model KZ03 pressure regulator with filter (mounted on positioner) ^{*2}	M	1
	Model KZ03 pressure regulator with filter (with bracket for separated mount)	M	2
	Model KZ03 pressure regulator with filter (with bracket for separated mount onto horizontal-installed actuator)	M	3
	Extension lever (only in case of mounting without mounting bracket)	M	L
	Sealing tape prohibited	M	J
	Mounting Bracket Material SUS316 (only in case of mounting with mounting bracket) ^{*3}	M	6
	With mounting bracket (PSA1,2,PSK1)	Y	S
	With mounting bracket (New model PSA3, 4 (produced after 2000),VA1 to 3(produced after May.'83))	Y	Q
	With mounting bracket (PSA6, VA4 to 6(produced after May. '83))	Y	L
	With mounting bracket (PSA7)	Y	8
	With mounting bracket (HA1)	Y	A
	With mounting bracket (HA2, HL2)	Y	T
	With mounting bracket (HA3, HL3)	Y	C
	With mounting bracket (HA4, HL4)	Y	N
	With mounting bracket (VR1)	Y	V
	With mounting bracket (VR2, 3)	Y	R
	With mounting bracket (VR3H)	Y	6
	With mounting bracket (RSA1)	Y	F
	With mounting bracket (RSA2)	Y	U
	With mounting brackets (Previous model of PSA3, 4 [Those manufactured before 1999])	Y	Y
	With mounting brackets (VA1 to 3 (produced before Apr. '83) [motion connector (previous model)], 800-1, 2, 3) ^{*4}	Y	W
	With mounting brackets (VA4,5 (produced before Apr. '83) [motion connector (previous model)], 800-4, 5) ^{*4}	Y	J
	With mounting bracket (VP5, 6)	Y	1
	With mounting bracket (VP7)	Y	7
With mounting bracket (DAP560, 1000, 1000X (until 100 mm stroke))	Y	4	
With mounting bracket (DAP1500, 1500X (until 100 mm stroke))	Y	5	

*1. One or two pressure-resistant packing cable adapter(s) are included with Model AVP 7_2 and Model AVP 7_0/7_1, respectively.

*2. Select the code "M7" or "M1" only when the direction of drain of the pressure regulator with filter on the control valve is downward(ground).

Not available code "M7" or "M1" when AVP is installed with the LCD facing upwards.

*3. SUS304 is the material used for the mounting bracket when code "M6" is not selected.

*4. Consult with sales representative in case of no mounting hole on the side of valve yoke.

Setting Data

Device tag (maximum of 8 characters)	Must be set.
Long tag (maximum of 32 characters)	Set if necessary.
Input characterization *1	L (Linear: standard), EQ% (equal percentage), QO (quick opening) and USER (custom setting)
Positioner action	D (Single acting increasing-output: standard; cannot select decreasing-output), W (double-acting)
Supply pressure classification	1 (140≤Ps≤150 kPa) 2 (150<Ps≤300 kPa: standard) 3 (300<Ps≤400 kPa) 4 (400<Ps≤450 kPa) 5 (450<Ps≤700 kPa)
Unit of pressure gauge	A (kPa: standard) B (kgf/cm ²)* C (MPa) D (bar) E (psi)* * No domestic sales in Japan due to Non-SI unit.
Valve closed position	DOWN (standard), UP
Actuator Type	L (Linear motion: standard) R90 (90° rotation) R60 (60° rotation) RS90 (90° rotation sub) RS60 (60° rotation sub)
SIS Positioner Mode	ESD: ON/OFF mode CTL: Positioning mode (Only Model AVP77_ /78_)
Travel transmission fail safe direction (Only Model AVP 7_1)	DOWN (standard), UP You cannot change the setting after the delivery of the failure output direction
LCD facing upwards	X No optional parts A LCD cover and Pressure gages jointed to elbows B LCD cover C Pressure gages jointed to elbows

*1. When the SIS positioner mode is in "ESD: ON/OFF mode", you can only select "L (linear)"
Refer to following when selecting the input/output characteristics.

The graph plots Travel (%) on the y-axis (0 to 100) against Input Signal (%) on the x-axis (0 to 100). Three curves are shown: 'Quick Opening' (a curve that rises steeply at the beginning and then levels off), 'Linear' (a straight diagonal line from (0,0) to (100,100)), and 'Equal Percentage' (a curve that rises slowly at first and then more steeply towards the end).

Selection of Input-Output Characteristics

The flow rate characteristics of the valve are set by selecting the valve plug characteristics, so "linear" is selected as the input-output characteristics of the positioner. However, the valve plug flow rate characteristics are determined based on the relationship between the shape, structure, etc., of the valve, and if these do not fit the requirements, the positioner can be used to compensate for the total flow rate characteristics of the valve by selecting "equal percentage" or "quick opening" as shown in Table 2.

Valve Plug Characteristics	Positioner I/O Characteristics	Valve Total Flow Characteristics
Linear	Quick Opening	Quick Opening
Linear	Equal Percentage	Equal Percentage
Equal Percentage	Quick Opening	Linear

Table 2. Compensation of Valve Flow Rate Characteristics using Positioner

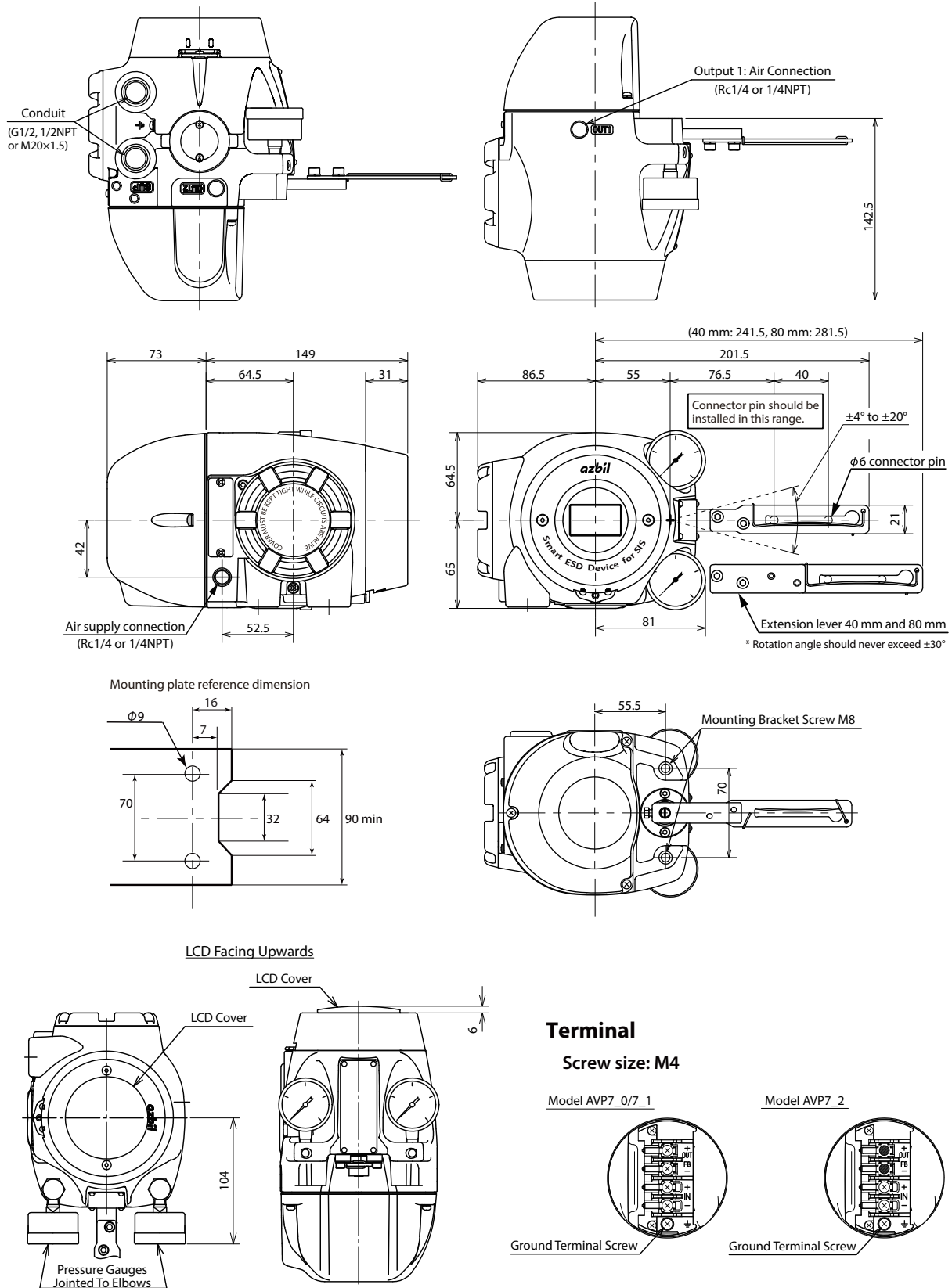
Caution: If the valve plug has a quick-opening characteristic, the total flow rate will not be linear even if "equal percentage" is set as the input-output characteristics of the positioner. (This is due to the fact that, if quick opening is set as the valve plug's characteristic, it becomes the equivalent of an on/off valve, and compensation using a positioner will be difficult.)

Appendix E External Dimension

External Dimensions Diagram

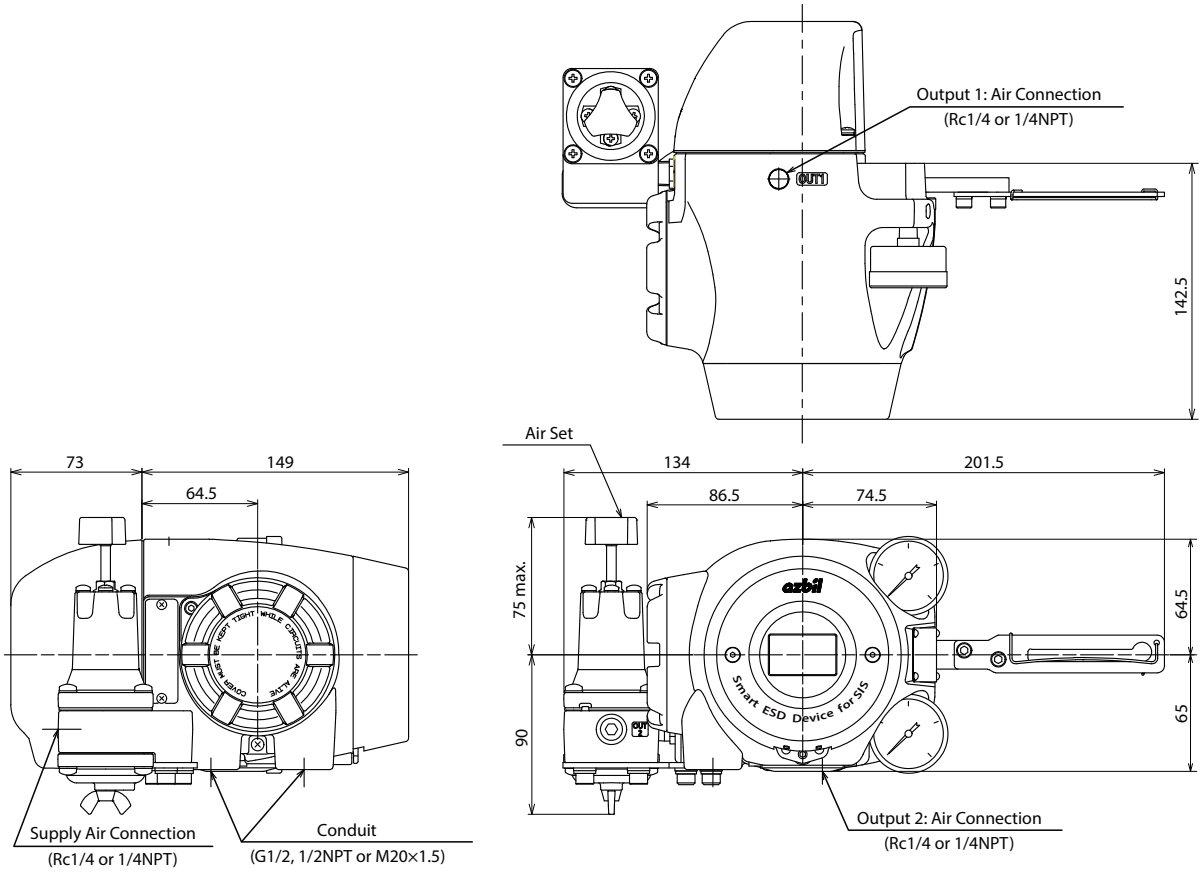
For single-acting actuator without regulator

[Units: mm]



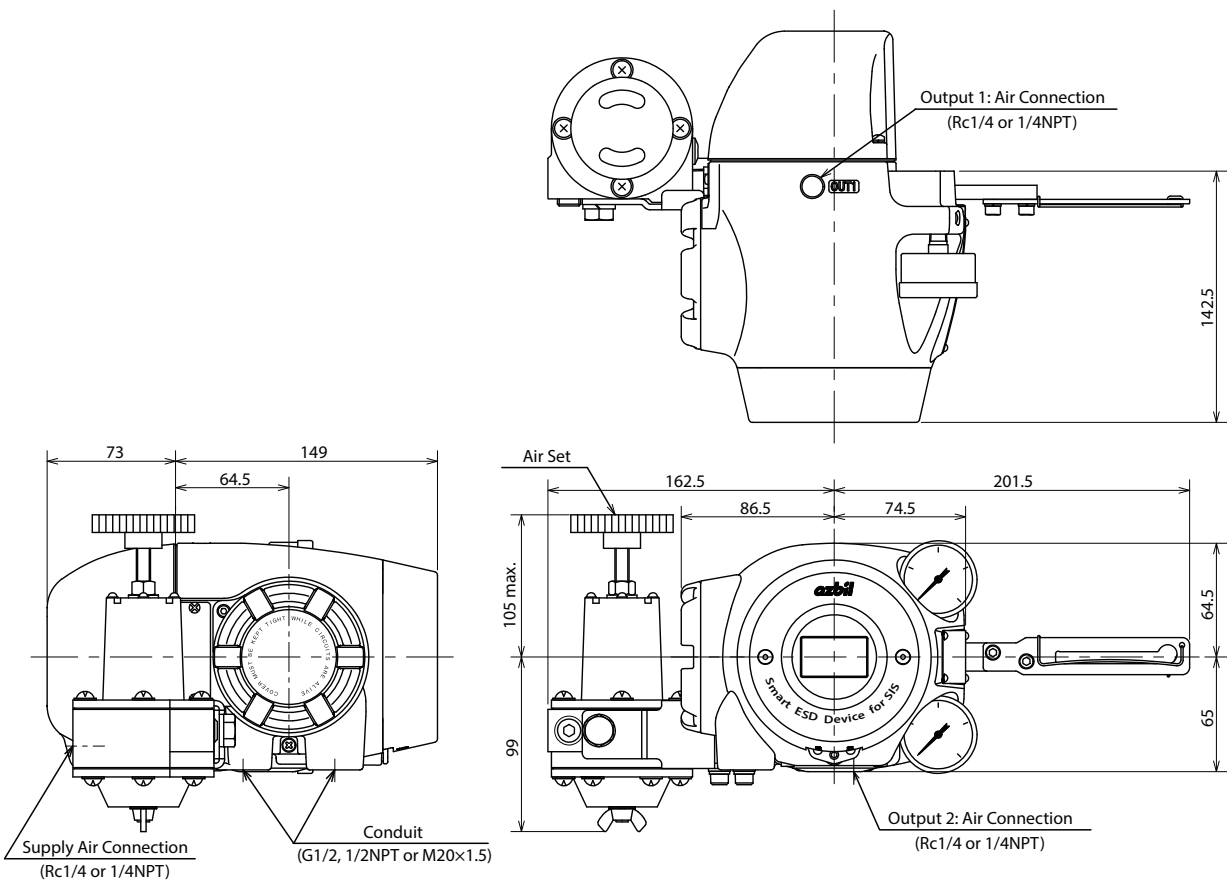
For single-acting actuator with RA1B regulator

[Units: mm]



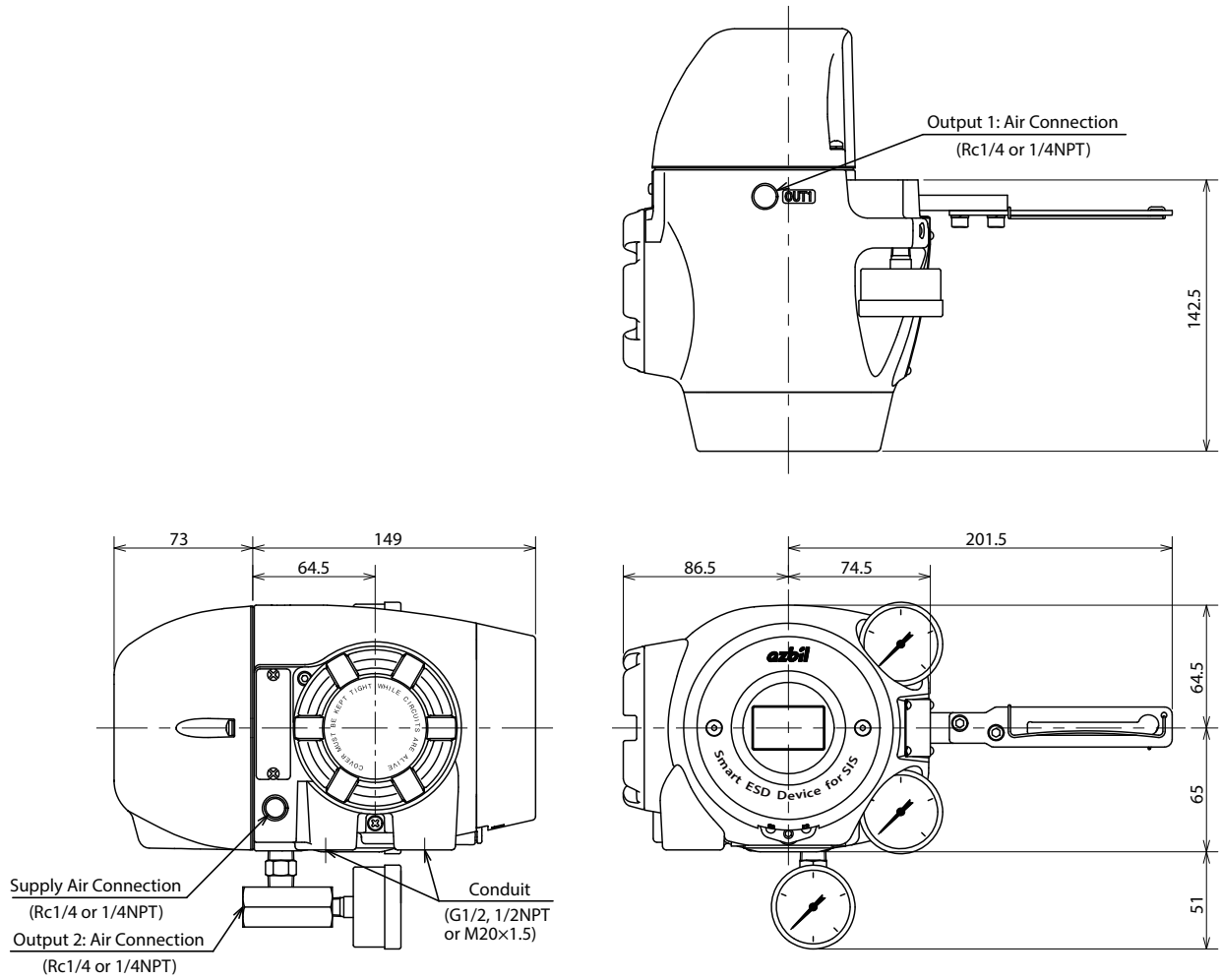
For single-acting actuator with KZ03 regulator

[Units: mm]

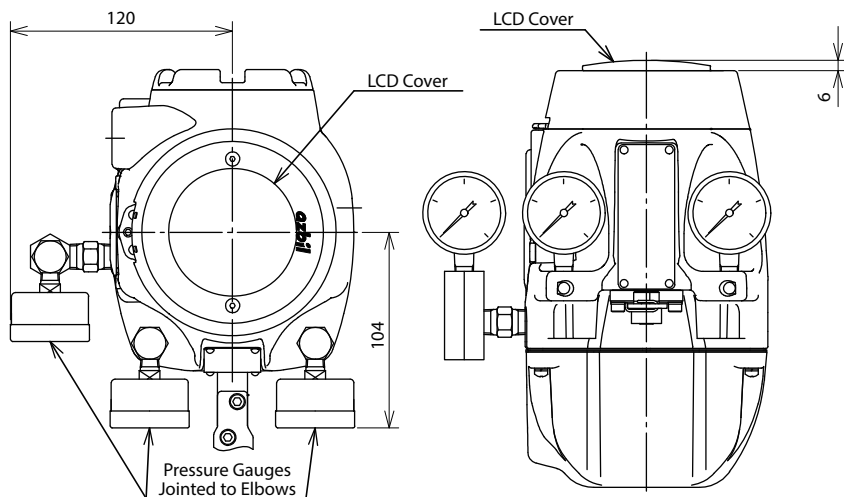


For double-acting actuator without regulator

[Units: mm]

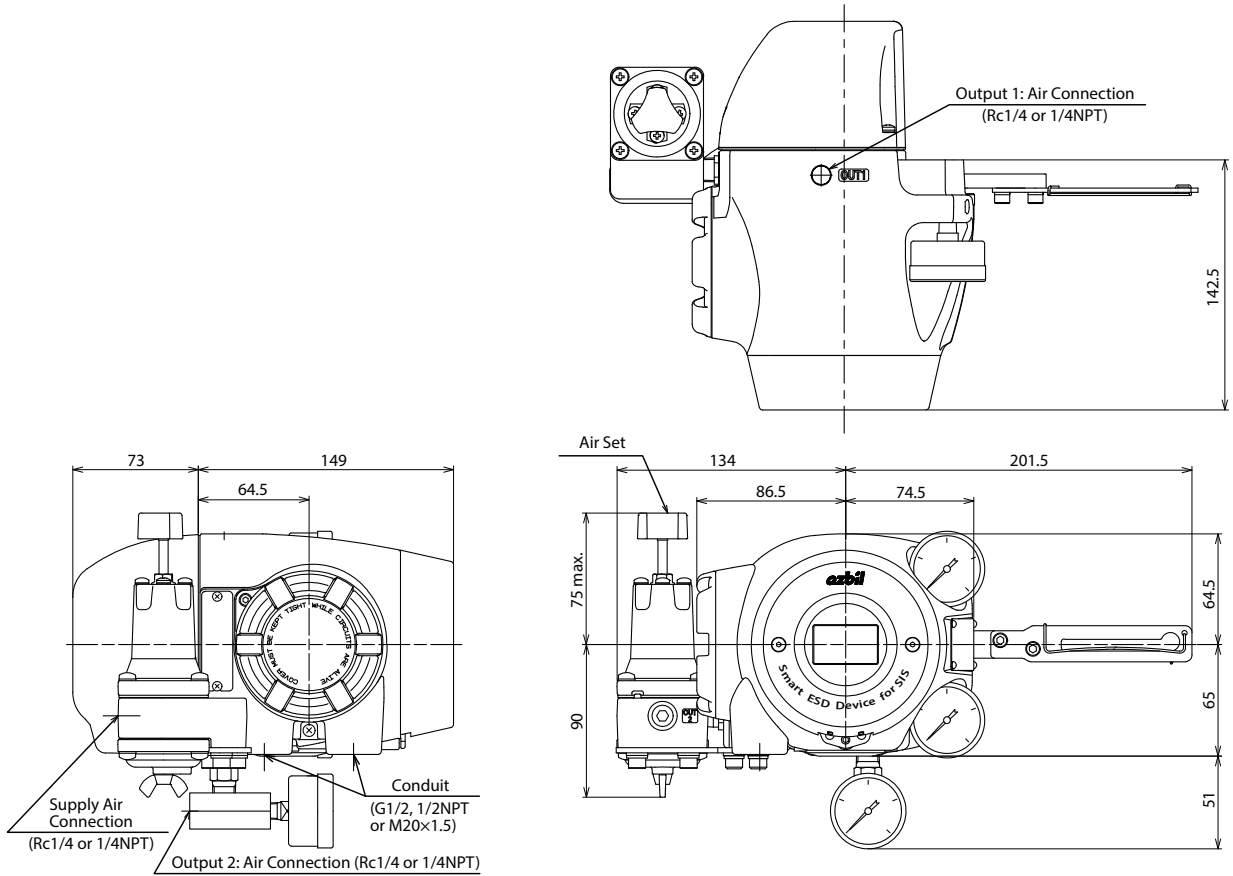


LCD Facing Upwards



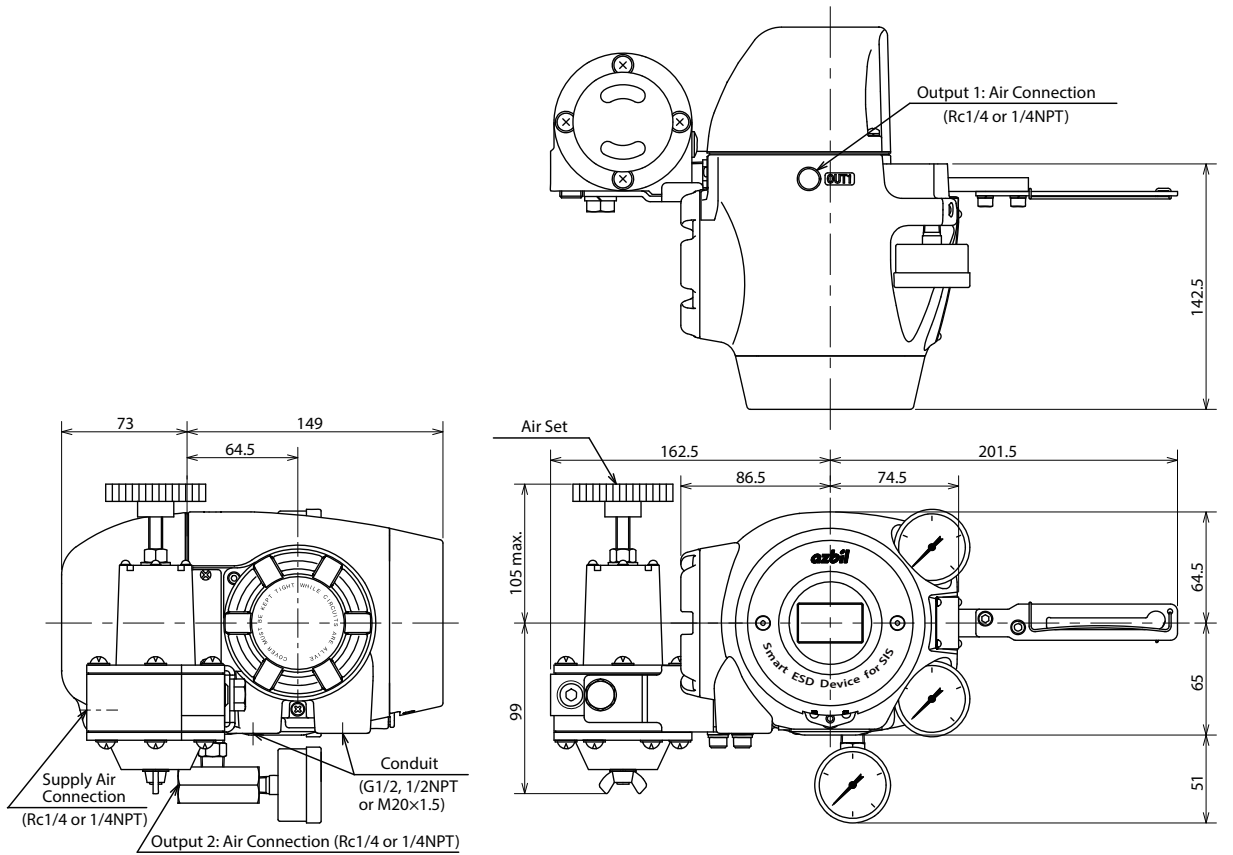
For double-acting actuator with RA1B regulator

[Units: mm]



For double-acting actuator with KZ03 regulator

[Units: mm]



Terms and Conditions

We would like to express our appreciation for your purchase and use of Azbil Corporation's products.

You are required to acknowledge and agree upon the following terms and conditions for your purchase of Azbil Corporation's products (system products, field instruments, control valves, and control products), unless otherwise stated in any separate document, including, without limitation, estimation sheets, written agreements, catalogs, specifications and instruction manuals.

1. Warranty period and warranty scope

1.1 Warranty period

Azbil Corporation's products shall be warranted for one (1) year from the date of your purchase of the said products or the delivery of the said products to a place designated by you.

1.2 Warranty scope

In the event that Azbil Corporation's product has any failure attributable to azbil during the aforementioned warranty period, Azbil Corporation shall, without charge, deliver a replacement for the said product to the place where you purchased, or repair the said product and deliver it to the aforementioned place. Notwithstanding the foregoing, any failure falling under one of the following shall not be covered under this warranty:

- (1) Failure caused by your improper use of azbil product (noncompliance with conditions, environment of use, precautions, etc. set forth in catalogs, specifications, instruction manuals, etc.);
- (2) Failure caused for other reasons than Azbil Corporation's product;
- (3) Failure caused by any modification or repair made by any person other than Azbil Corporation or Azbil Corporation's subcontractors;
- (4) Failure caused by your use of Azbil Corporation's product in a manner not conforming to the intended usage of that product;
- (5) Failure that the state-of-the-art at the time of Azbil Corporation's shipment did not allow Azbil Corporation to predict; or
- (6) Failure that arose from any reason not attributable to Azbil Corporation, including, without limitation, acts of God, disasters, and actions taken by a third party.

Please note that the term "warranty" as used herein refers to equipment-only-warranty, and Azbil Corporation shall not be liable for any damages, including direct, indirect, special, incidental or consequential damages in connection with or arising out of Azbil Corporation's products.

2. Ascertainment of suitability

You are required to ascertain the suitability of Azbil Corporation's product in case of your use of the same with your machinery, equipment, etc. (hereinafter referred to as "Equipment") on your own responsibility, taking the following matters into consideration:

- (1) Regulations and standards or laws that your Equipment is to comply with.
- (2) Examples of application described in any documents provided by Azbil Corporation are for your reference purpose only, and you are required to check the functions and safety of your Equipment prior to your use.
- (3) Measures to be taken to secure the required level of the reliability and safety of your Equipment in your use

Although azbil is constantly making efforts to improve the quality and reliability of Azbil Corporation's products, there exists a possibility that parts and machinery may break down. You are required to provide your Equipment with safety design such as fool-proof design,*1 and fail-safe design*2 (anti-flame propagation design, etc.), whereby preventing any occurrence of physical injuries, fires, significant damage, and so forth. Furthermore, fault avoidance,*3 fault tolerance,*4 or the like should be incorporated so that the said Equipment can satisfy the level of reliability and safety required for your use.

*1. A design that is safe even if the user makes an error.

*2. A design that is safe even if the device fails.

*3. Avoidance of device failure by using highly reliable components, etc.

*4. The use of redundancy.

3. Precautions and restrictions on application

3.1 Restrictions on application

Please follow the table below for use in nuclear power or radiation-related equipment.

	Nuclear power quality*5 required	Nuclear power quality*5 not required
Within a radiation controlled area*6	Cannot be used (except for limit switches for nuclear power*7)	Cannot be used (except for limit switches for nuclear power*7)
Outside a radiation controlled area*6	Cannot be used (except for limit switches for nuclear power*7)	Can be used

*5. Nuclear power quality: compliance with JEAG 4121 required

*6. Radiation controlled area: an area governed by the requirements of article 3 of "Rules on the Prevention of Harm from Ionizing Radiation," article 2 2 4 of "Regulations on Installation and Operation of Nuclear Reactors for Practical Power Generation," article 4 of "Determining the Quantity, etc., of Radiation-Emitting Isotopes," etc.

*7. Limit switch for nuclear power: a limit switch designed, manufactured and sold according to IEEE 382 and JEAG 4121.

Any Azbil Corporation's products shall not be used for/with medical equipment.

The products are for industrial use. Do not allow general consumers to install or use any Azbil Corporation's product. However, azbil products can be incorporated into products used by general consumers. If you intend to use a product for that purpose, please contact one of our sales representatives.

3.2 Precautions on application

you are required to conduct a consultation with our sales representative and understand detail specifications, cautions for operation, and so forth by reference to catalogs, specifications, instruction manual, etc. in case that you intend to use azbil product for any purposes specified in (1) through (6) below. Moreover, you are required to provide your Equipment with fool-proof design, fail-safe design, anti-flame propagation design, fault avoidance, fault tolerance, and other kinds of protection/safety circuit design on your own responsibility to ensure reliability and safety, whereby preventing problems caused by failure or nonconformity.

- (1) For use under such conditions or in such environments as not stated in technical documents, including catalogs, specification, and instruction manuals
- (2) For use of specific purposes, such as:
 - * Nuclear energy/radiation related facilities
[When used outside a radiation controlled area and where nuclear power quality is not required]
[When the limit switch for nuclear power is used]
 - * Machinery or equipment for space/sea bottom
 - * Transportation equipment
[Railway, aircraft, vessels, vehicle equipment, etc.]
 - * Antidisaster/crime-prevention equipment
 - * Burning appliances
 - * Electrothermal equipment
 - * Amusement facilities
 - * Facilities/applications associated directly with billing
- (3) Supply systems such as electricity/gas/water supply systems, large-scale communication systems, and traffic/air traffic control systems requiring high reliability
- (4) Facilities that are to comply with regulations of governmental/public agencies or specific industries
- (5) Machinery or equipment that may affect human lives, human bodies or properties
- (6) Other machinery or equipment equivalent to those set forth in items (1) to (5) above which require high reliability and safety

4. Precautions against long-term use

Use of Azbil Corporation's products, including switches, which contain electronic components, over a prolonged period may degrade insulation or increase contact-resistance and may result in heat generation or any other similar problem causing such product or switch to develop safety hazards such as smoking, ignition, and electrification. Although acceleration of the above situation varies depending on the conditions or environment of use of the products, you are required not to use any Azbil Corporation's products for a period exceeding ten (10) years unless otherwise stated in specifications or instruction manuals.

5. Recommendation for renewal

Mechanical components, such as relays and switches, used for Azbil Corporation's products will reach the end of their life due to wear by repetitious open/close operations.

In addition, electronic components such as electrolytic capacitors will reach the end of their life due to aged deterioration based on the conditions or environment in which such electronic components are used. Although acceleration of the above situation varies depending on the conditions or environment of use, the number of open/close operations of relays, etc. as prescribed in specifications or instruction manuals, or depending on the design margin of your machine or equipment, you are required to renew any Azbil Corporation's products every 5 to 10 years unless otherwise specified in specifications or instruction manuals. System products, field instruments (sensors such as pressure/flow/level sensors, regulating valves, etc.) will reach the end of their life due to aged deterioration of parts. For those parts that will reach the end of their life due to aged deterioration, recommended replacement cycles are prescribed. You are required to replace parts based on such recommended replacement cycles.

6. Other precautions

Prior to your use of Azbil Corporation's products, you are required to understand and comply with specifications (e.g., conditions and environment of use), precautions, warnings/cautions/notices as set forth in the technical documents prepared for individual Azbil Corporation's products, such as catalogs, specifications, and instruction manuals to ensure the quality, reliability, and safety of those products.

7. Changes to specifications

Please note that the descriptions contained in any documents provided by azbil are subject to change without notice for improvement or for any other reason. For inquires or information on specifications as you may need to check, please contact our branch offices or sales offices, or your local sales agents.

8. Discontinuance of the supply of products/parts

Please note that the production of any Azbil Corporation's product may be discontinued without notice. After manufacturing is discontinued, we may not be able to provide replacement products even within the warranty period.

For repairable products, we will, in principle, undertake repairs for five (5) years after the discontinuance of those products. In some cases, however, we cannot undertake such repairs for reasons, such as the absence of repair parts. For system products, field instruments, we may not be able to undertake parts replacement for similar reasons.

9. Scope of services

Prices of Azbil Corporation's products do not include any charges for services such as engineer dispatch service. Accordingly, a separate fee will be charged in any of the following cases:

- (1) Installation, adjustment, guidance, and attendance at a test run
- (2) Maintenance, inspection, adjustment, and repair
- (3) Technical guidance and technical education
- (4) Special test or special inspection of a product under the conditions specified by you

Please note that we cannot provide any services as set forth above in a nuclear energy controlled area (radiation controlled area) or at a place where the level of exposure to radiation is equivalent to that in a nuclear energy controlled area.

Document Number: CM2-AVP772-2001
Document Name: Smart ESD Device 700 Series for Safety Instrumented
Systems Model AVP77_/78_/79_
User's Manual

Date: 1st edition: Dec. 2015
12th edition: Feb. 2024
Issued/Edited by: Azbil Corporation

Azbil Corporation