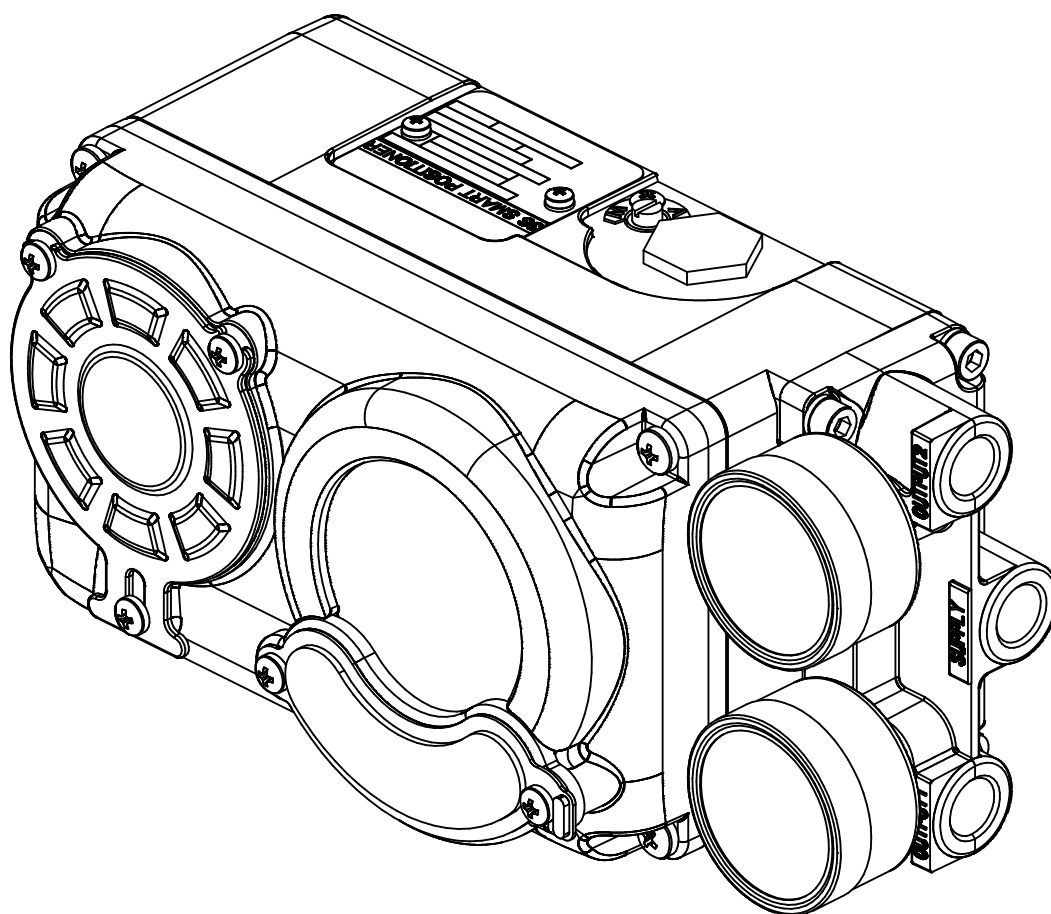


Operating Manual

Smart Positioner (Electro Pneumatic)


MP 300 Series




3S Co., Ltd.

Safety precautions

Cautions and Warnings – read carefully before operating

 Warning!	Failure to follow the guidelines marked with this symbol could result in severe personal injury or death.
---	--

- In hazardous areas, select explosion-protected option (Intrinsically-safe type), and be sure to refer to the [ANNEX1](#) and follow the instructions.
- Install, plumb, wire, adjust, maintain or remove this equipment in accordance with the laws and regulations within the country/region of use.
- When the wires are powered on, be sure that each wire is properly and firmly connected or is insulated against any conductive objects. (Be a “Caution!” item in non-hazardous area.)
- When the equipment is powered on, be sure not to open the body cover to prevent anything from touching the internal PCB. (Be a “Caution!” item in non-hazardous area.)
- When removing parts such as pressure gauges, mesh filters or pneumatic related screws for inspection, not only shut off the supply pressure but also wait and make sure that all the pressure in the pneumatic parts has dropped completely.
- Do not touch any moving parts such as feedback levers (refer to [4-2](#) and [4-3](#)), stem and clamps during operation, even for inspection or adjustment reasons.
- When in use, mount the body in the direction of either the LCD facing upward or the nameplate facing upward. (Be a “Caution!” item in non-hazardous area.)

 Caution!	Failure to follow the guidelines marked with this symbol could result in minor personal injury or the equipment's damage.
---	--

- The maximum supply pressure is 0.7MPa. Do not apply pressure more than 0.7MPa.
- Apply the body cover and the service hole cover correctly during the operation. When opening, check their rubber seal and tighten them again firmly in order not to cause water/dirt intrusion. Also for the same reason, apply proper cable gland and plug the unused cable entry hole up.
- Liquid and particulate contaminants in the supply air may accumulate and clog the fixed-orifice, causing failures. Be sure to attach an air filter with a filtration ability of 5µm or less immediately before the positioner's air supply port, and the supplying air should be cleaned with dryers or the like.
- Do not add any lubricant mist to compressed air, it may cause problems of the orifice or the nozzle.
- Air pipes should be flushed sufficiently with air before installation.
- When using a pressure regulator other than our recommendation, the expected performance may not be obtained.
- When screwing the taper-screws (i.e. air fittings) in, use sealing tape or sealant, leaving two screw threads from the tip.
- Strong impacts or excessive force may cause malfunctions.
- If it is intended to be used in a place which is not wired specifically for intrinsic safety, do not select the explosion-proof option. For noisy environments, non-explosionproof is suitable.

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1. Introduction

MP300 is 2 wire type E/P Positioner with the microprocessor which is powered from 4-20mA input signal. The auto-tuning function is one of its standard function. Valve status can be known via the optional functions such as position transmitter and/or HART communication.

2. Specifications

Items	Standard use	Explosive atmosphere use
Explosion protection type	No explosion protection	“Intrinsic Safe” type of protection ATEX : II 1G Ex ia IIC T6...T5 Ga IECEX : Ex ia IIC T6...T5 Ga ITRI : Ex ia IIC T6...T5 Ga * See ANNEX 1 for details
Input signal current	4 to 20mA DC (Minimum split range width: 4mA) Minimum required current : 3.8mA ^{*1}	
Voltage across input terminals at 20mA	10.5V (525Ω)	9.1V (455Ω)
Supply air pressure	0.14 to 0.7MPa	
Valve stroke	Linear motion : 10 to 100mm (feedback lever swing 30 to 100°) Rotary motion : feedback lever swing 30 to 100°	
Air connection	Standard screw: Rc1/4 (Pressure Gauge : Rc1/8) Optional screw: 1/4NPT (Pressure Gauge : 1/8NPT)	
Cable entry holes	Standard screw: G1/2, Optional screw: 1/2NPT or M20×1.5	
Pressure gauge's unit	Standard unit: 0.2, 0.4, 1.0MPa, Optional unit: kPa, psi ^{*5} or bar	
Protection class IP (Enclosure rating)	IP66 (IEC 60529:1989/AMD2:2013)	
Ambient temperature	-20 to 80°C	T6 : -20 to 60°C, T5 : -20 to 80°C Explosion protection works up to -40°C
Input - Position Characteristics	Linear, Equal percentage, Quick Opening, User table (17 points)	
Manual operation	Mechanical Auto/Manual selector (only for Single acting)	
Weight	Approx. 2.5 kg	
Main material	Aluminum die-cast (Trivalent chromate conversion, painted in silver color)	
Performance ^{*2}	Linearity	±1.0% F.S. ^{*3}
	Hysteresis	1.0% F.S. ^{*3}
	Air consumption (at Output pressure)	Single acting : 3 NI/min. at Sup = 0.14MPa, Output = 50% 6.5 NI/min. at Sup = 0.4MPa, Output = 50% Double acting : 10.0NI/min at Sup = 0.4MPa, Output = 75%
	Max air capacity	Single acting : 90 NI/min.at Sup = 0.14MPa 200 NI/min.at Sup = 0.4MPa Double acting : 200NI/min at Sup = 0.4MPa
	EMC ^{*4}	Comply to CE mark requirement. (i.e. Surge level ±1.0kV)

Optional feedback functions

Position transmitter	Supply	12 to 36 V DC	At 20mA, 11V or more across output terminals
	Output	4 to 20mA (Ascending or descending characteristics are available)	
	Accuracy	±1.0% to the position cognized internally	
HART communication		HART7 • Almost all button operations are available with HART command. • All HART functions can be operated with the registrated DD file.	

*1: Under this, it will "shutdown" and the LCD turns off. Below 3.9 mA, setting changes are inhibited.

*2: Some actuators may not get this performance.

*3: Measured on 90° swing width of angle sensor.

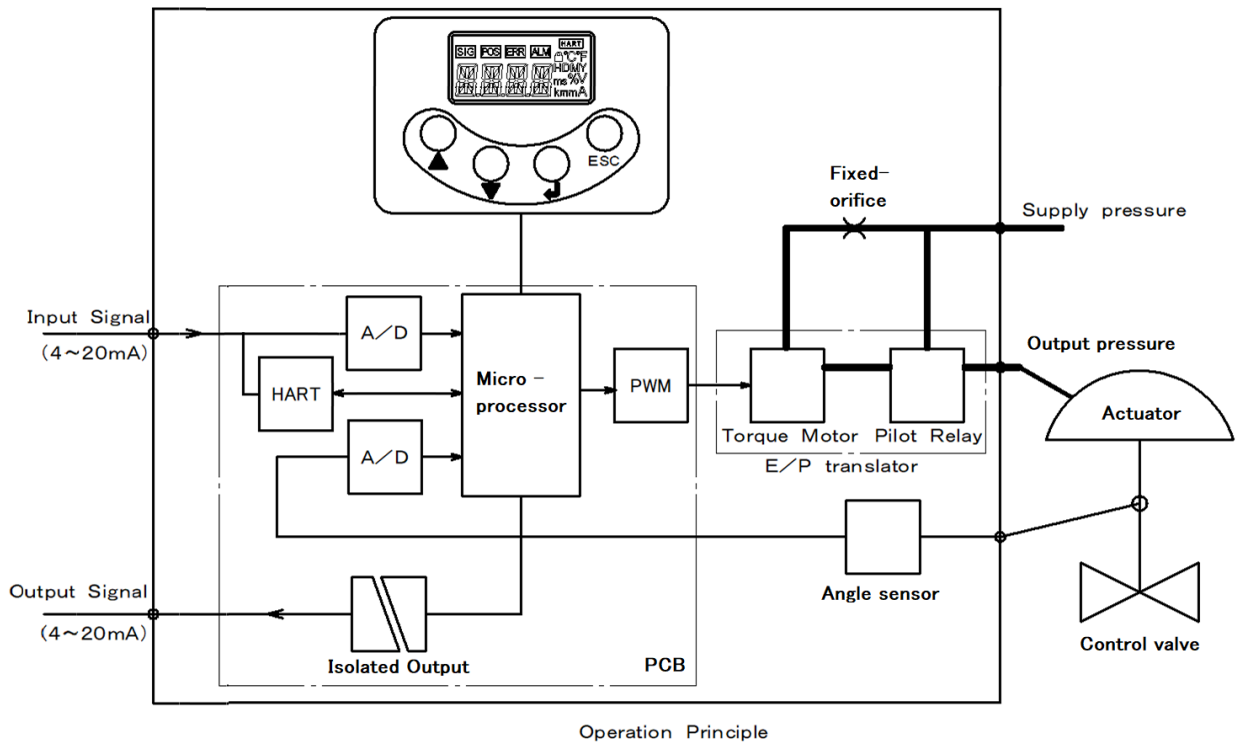
*4: Strong surge may cause a temporary malfunction, but it will soon recover automatically.

*5: According to "The Measurement ACT", it is prohibited to use the pressure unit "psi" in Japan.

3. Operating principle

MP300 controls the position of the control valve in response to the input signal value of 4-20 mA, applied by a current source such as an electronic controller. MP300 has a built-in angle sensor that detects the position of control valve.

The microprocessor captures the input signal and the angle sensor information and calculates them. Then the microprocessor drives the Torque Motor, which will be converted to an internal pneumatic signal, which then moves the Pilot Relay, which then finally generates the required air pressure output, which moves the actuator of the control valve.



4. Installation

4-1 Prior confirmation (sensor shaft position)

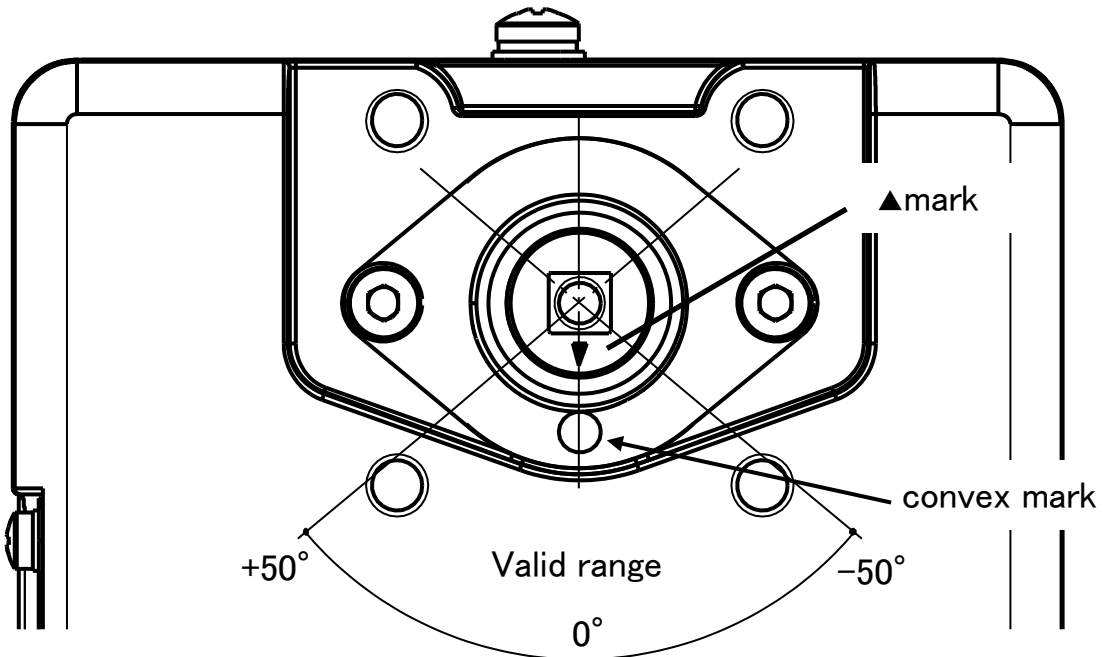
This angle sensor works within $\pm 50^\circ$ at the angle indicated by the ▲ mark on the sensor axis.

The recommended sensor swing width (angular difference between valve position 0% and 100%) to install this positioner is 30° or more.

* 0° is, as shown in the figure below, when the ▲ mark is at the position of the convex mark.

* You can check the sensor angle on the LCD. (See [7-3-4-9 Display angle](#))

* The typical maximum swing width is 45° for linear actuators and 90° for rotary actuators.

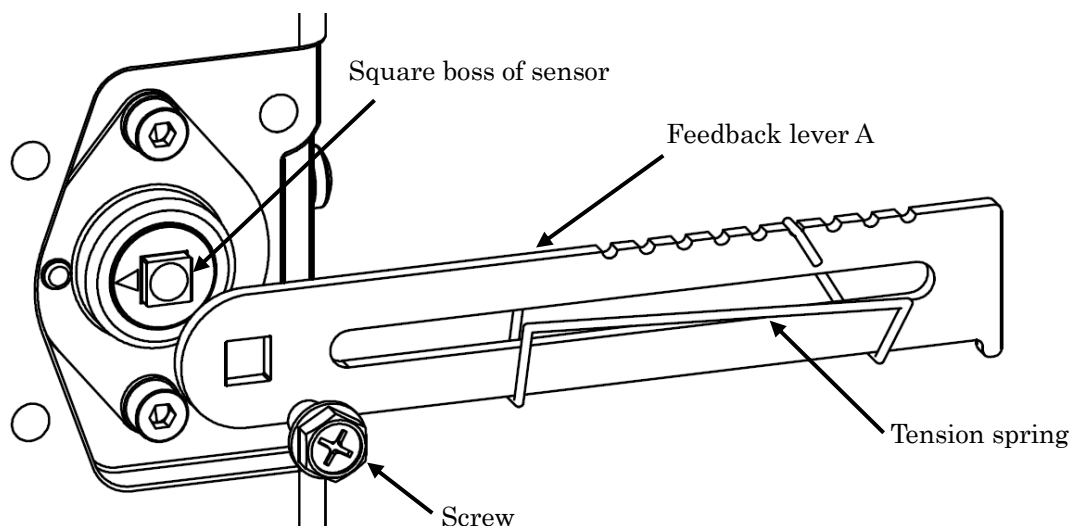


4-2 Installation for linear actuators

1) Installation of a feedback lever A

Consider that the ▲ mark must finally be in the valid range (see 4-1). Usually, the direction of Feedback Lever A is as shown below. Insert the feedback lever A into the square boss of the sensor shaft and tighten the screw with a spanner firmly.

The tension spring on the feedback lever A should appear on the lower side after installation.



2) Installation of the positioner and levers

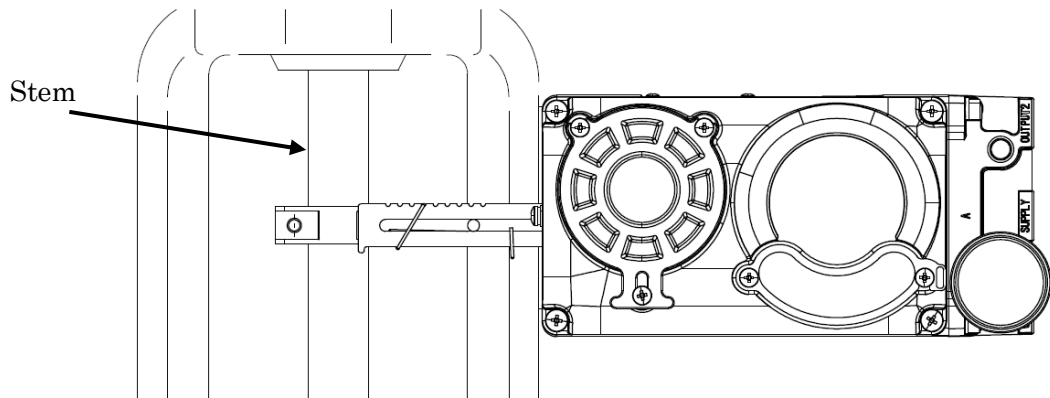
① Installation of the positioner

Mount the MP300 so that the sensor angle is 0° when the feedback lever A and the valve stem are at a right angle. Misalignment may cause the deterioration of linearity.

* The 0° of the angle sensor is the center of $\pm 50^\circ$ swing (see 4-1). Refer to [7-3-4-9 Display angle](#) to show the angle on LCD.

* When the sensor angle is 0° , the valve position does not have to be 50%.

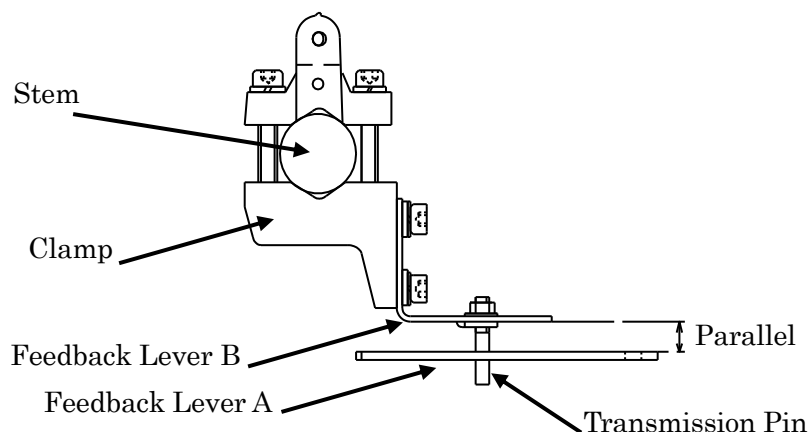
* Minor mounting misalignment can be adjusted with setting operations. Refer to "P50P" in [7-3-4-2 FB](#) for the setting information.



② Check the parallelism between feedback lever A and B

Insert the transmission pin on Feedback Lever B (the valve stem side) into the slot on feedback lever A.

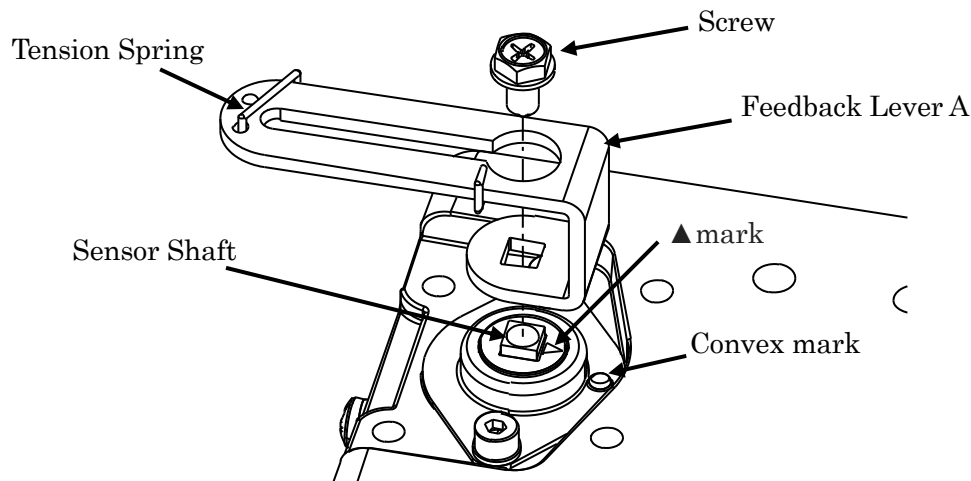
Install the Feedback lever A and B parallelly by adjusting clamps and so on. If they are not installed parallelly, it may cause deterioration of the linearity.



4-3 Installation for Rotary actuators

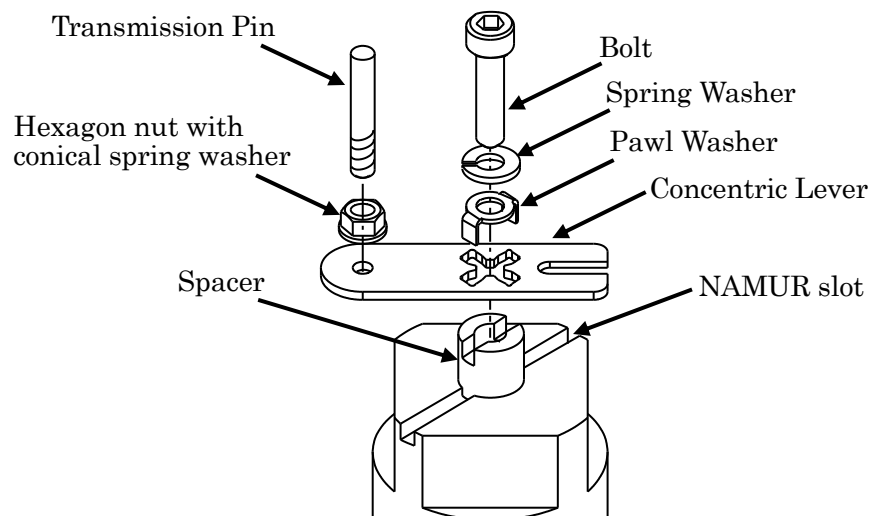
1) Installation of Feedback Lever A

As shown below, the ▲ mark and the convex mark are matched (see 4-1) at valve position 50%. Insert the feedback lever A into the square boss of the sensor shaft and tighten the screw with a spanner firmly.



2) Installation of concentric lever on the actuator side.

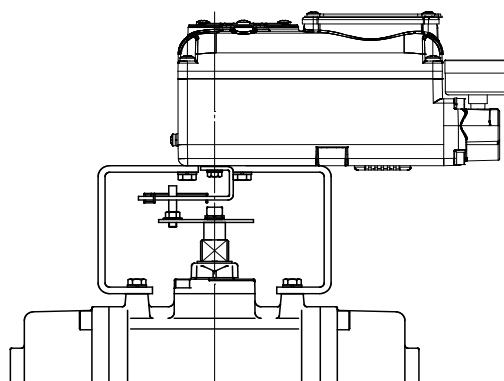
3) Insert a spacer into the actuator's NAMUR slot, put a concentric lever, a pawl washer and a spring washer then tighten the bolt. Also, screw in a transmission pin and tighten a hexagon nut with conical spring washer.



4) Installation of a positioner

Align the axis of the feedback lever A and of the concentric lever, then install a positioner.

*Misregistration of these may cause deterioration of the linearity.



4-4 The orientation of the body in use.

When in use, mount the body in the direction of either the LCD facing upward or the nameplate facing upward. Otherwise, if the liquid in the supplying air condenses and stays inside, it will not be drained properly.

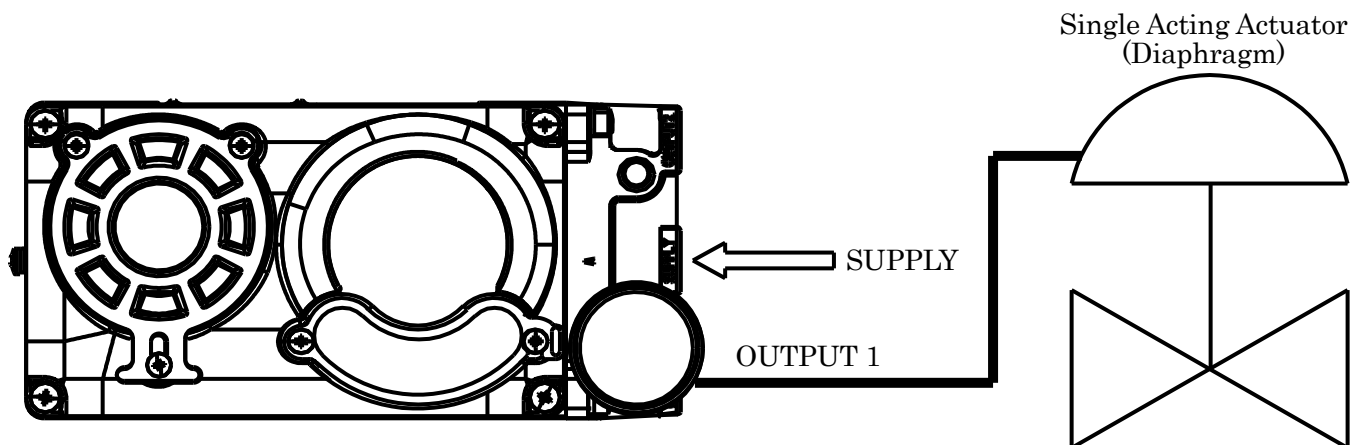
5. Pneumatic Plumbing

The supplying air should not contain any liquid or particulate contaminants. Use dry air and attach an air filter with a filtration ability of 5 μ m or less immediately before the positioner's air supply port. Even lubricant mist should not be added in compressed air.

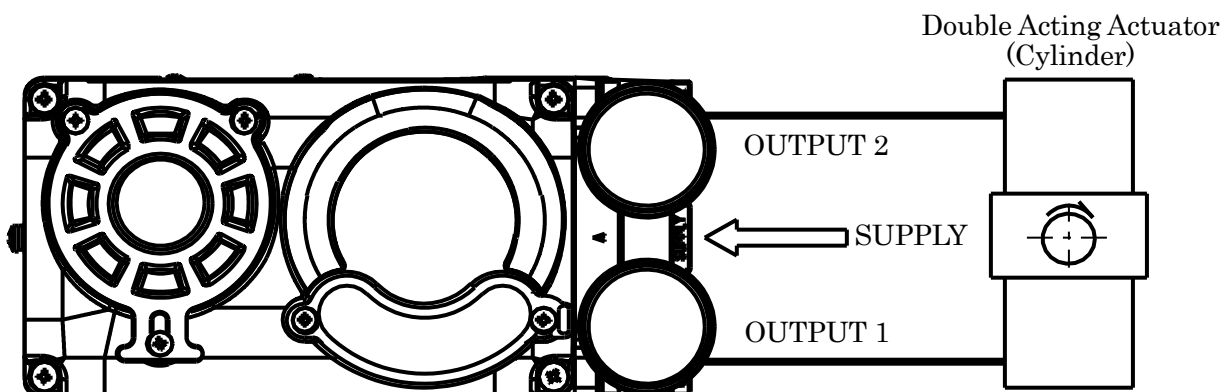
Air pipes should be flushed sufficiently with air before installation.

* Be sure to know that when the input signal increases, the OUTPUT 1 pressure always increases, regardless of any electronic setting. (Contact us if you need a single-acting reverse operation, which means that the input signal and output pressure are reversed.)

【Single acting】

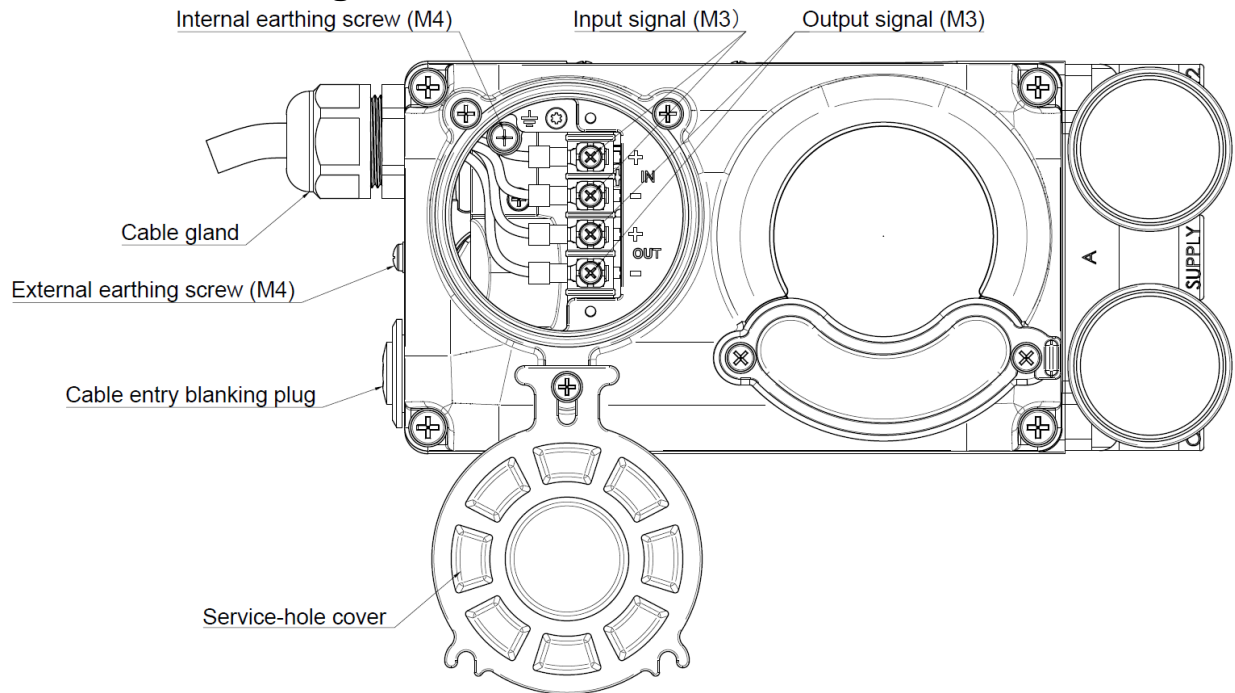


【Double acting】



6. Electric wiring

6-1 Electric wiring overall

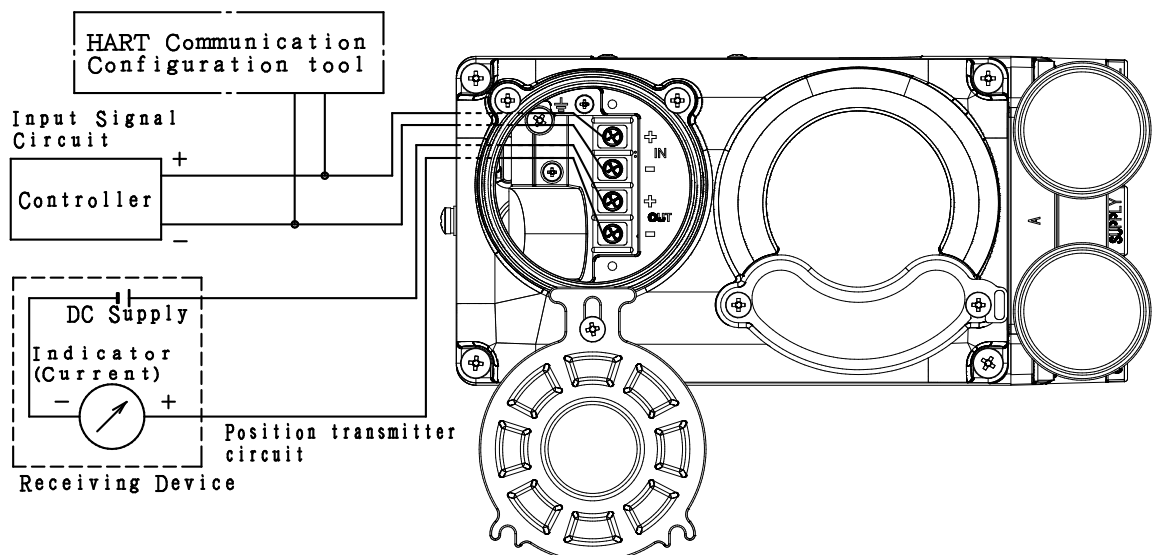


Warning!

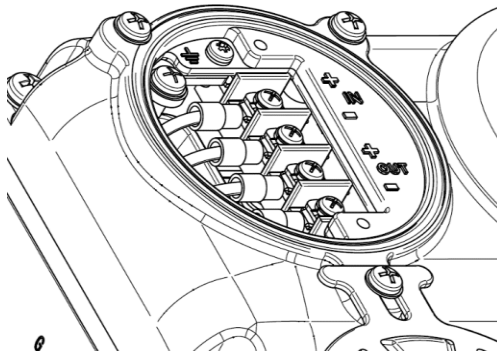
(Can be “Caution!” items in non-hazardous area.)

- Follow appropriate electrical work standards within the country/ region of use.
- When wiring, turn off the power.
- Be sure to keep the cable entry holes waterproof.
- Strong impacts or excessive force when wiring may degrade the performance of the positioner.

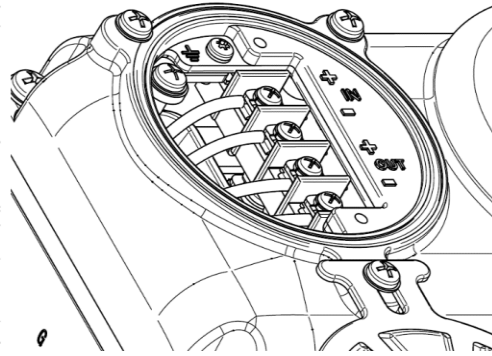
- 1) Open the service hole cover and connect each wire with insulated ring terminal.
 - Connect the input signal wires to “IN” (+) and (-) respectively.
 - Connect the position transmitter wires to “OUT” (+) and (-) respectively.
- 2) There are two cable entry holes available. These can be used to the user’s convenience.
- 3) For waterproofing of the cable entry, apply sealants to these threads or use proper O-rings.
- 4) If using earthing connection, connect to the earthing screw with a ring terminal.
- 5) Be sure that the wires do not loosen or twist.
- 6) In an environment with strong radio noise, attaching a ferrite core to the cable can prevent the deterioration of control accuracy.



Wires with insulated ring terminals



Wires just stripped off



The figure on the left is using insulated ring terminals at the tip of the wire. The figure on the right shows direct connections with just the tip of the wire stripped off. In this case, pay attention to the length of the wire to be stripped, and keeping the bare wire section away from the wall.

6-2 Position transmitter

In order for position transmitter to work, both the input signal and the output signal must be connected.

- Supply power and Load resistance –

Find the allowable load resistance value from the following formula. The wire resistance should be known prior to this.

1) Not explosion protected

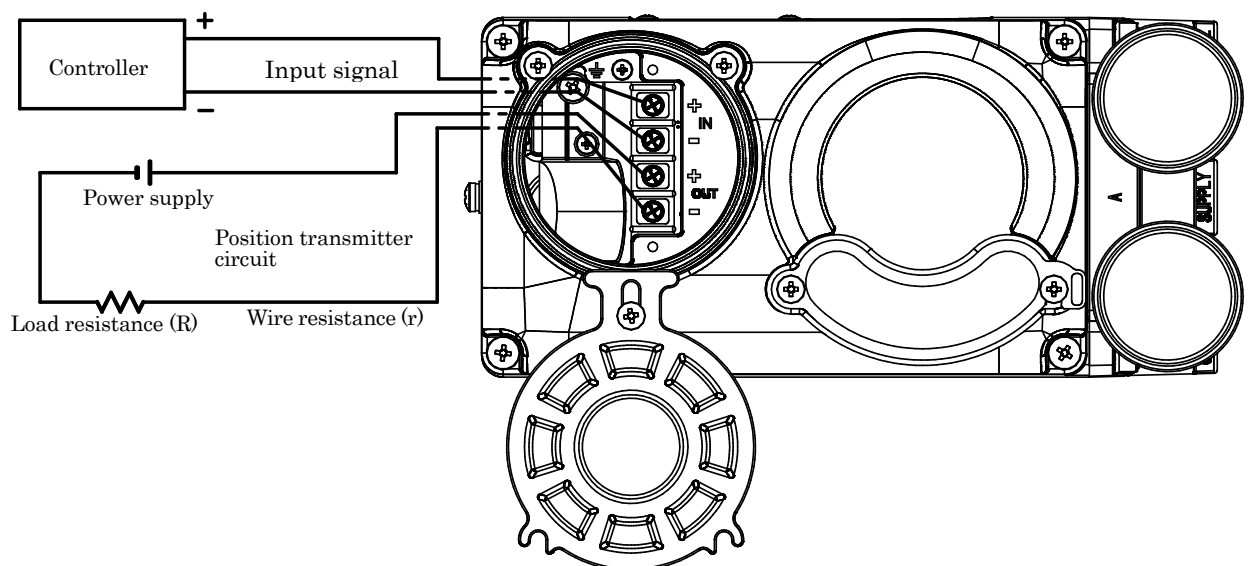
The maximum supply voltage is 36V DC.

$$\text{Allowable load resistance value } (R + r) [\text{ohm}] \leq (\text{Supply voltage [V]} - 12[\text{V}]) / (20[\text{mA}] / 1000)$$

2) “Intrinsic Safe” type protection

The maximum supply voltage is limited by the barrier. (< 30V DC)

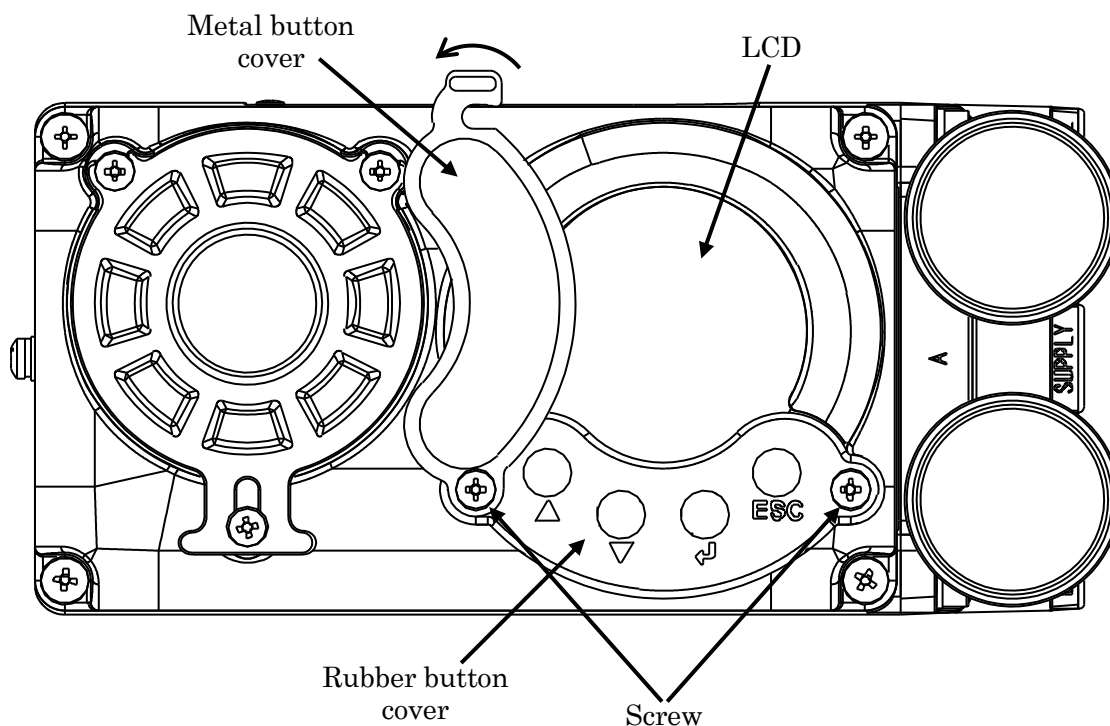
$$\text{Allowable load resistance value } (R + r) [\text{ohm}] \leq (\text{Supply voltage [V]} - 11[\text{V}]) / (20[\text{mA}] / 1000)$$



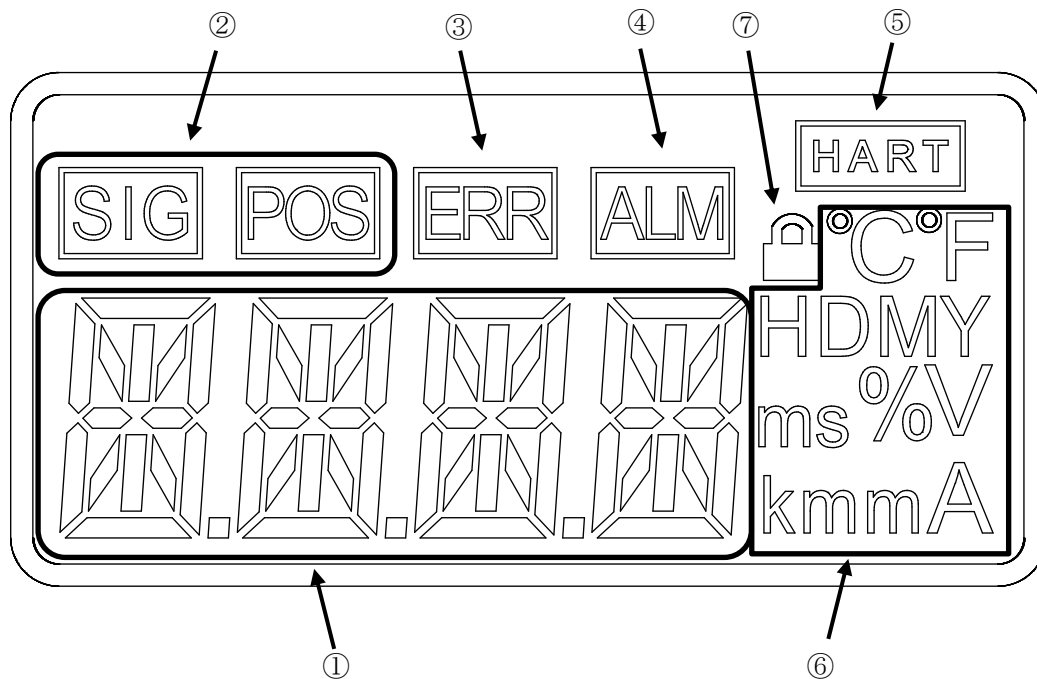
7. Adjustment and Setup

As shown below, loosen the screws and slide the metal button cover, and press the 4 buttons over the rubber button cover.

Do not press the buttons with sharp objects such as screwdrivers. If the rubber button cover is damaged, dust and water resistance will be lost.



7-1 LCD (display)



① Main display

When the input signal is turned on, it always starts up with Initial & usual displaying value.

During the setting, setting parameters are displayed.

② Mode

The mode of the initial & usual displaying value. (i.e. **SIG** means 'Displaying input signal value' and **POS** means 'Displaying valve position')

③ Error

Blinks when the device has error codes

④ Alarm

Blinks when the value exceed alarm threshold

⑤ HART

Blinks during HART communication is working

※HART communication is optional function.

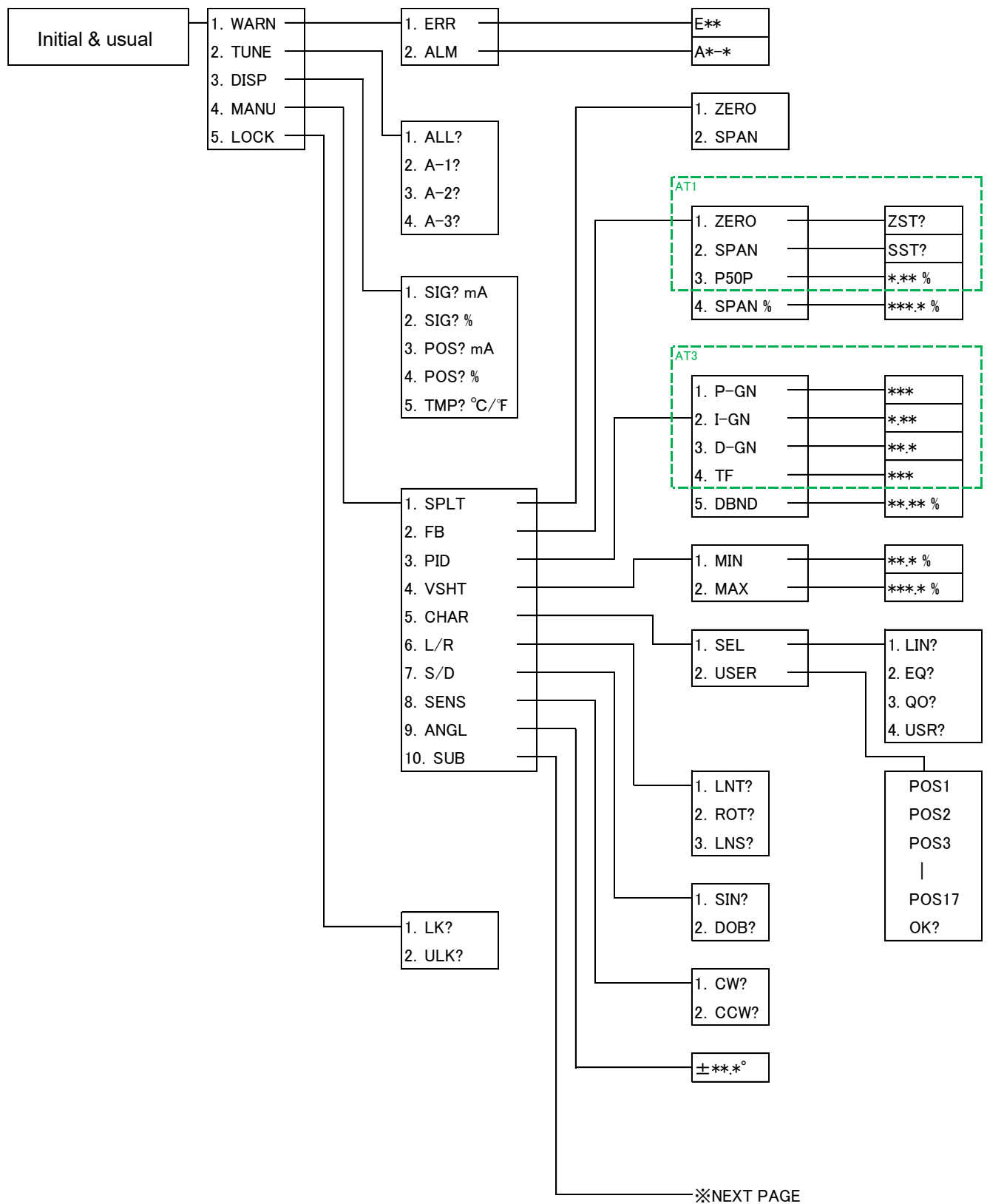
⑥ Unit

The unit corresponding to the value in Main display

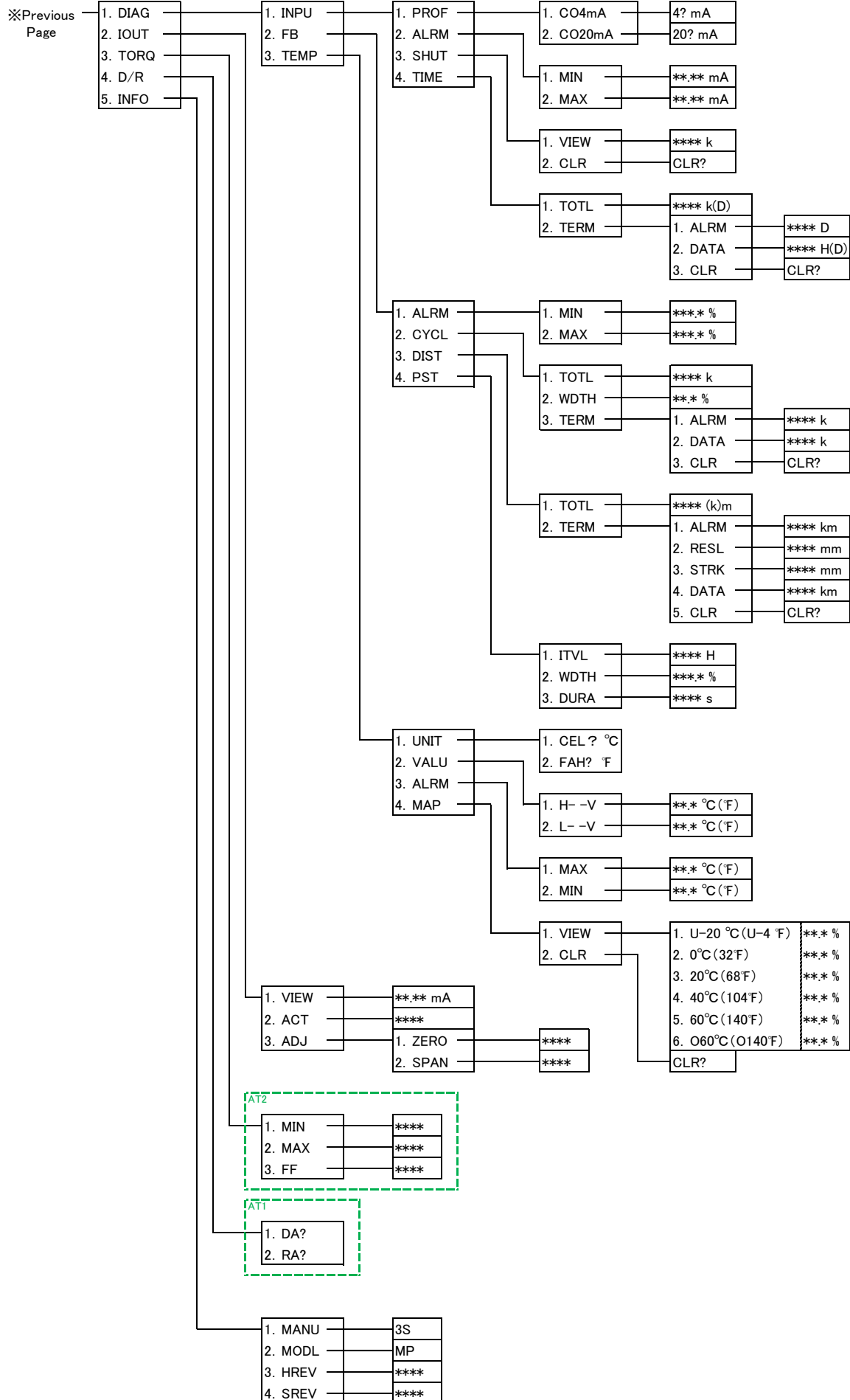
⑦ Lock

Shows that the setting function is locked

7-2 Menu overview (menu tree)



AT1, AT3 are parameters that are automatically set by Auto-tune.



AT1, AT2 are parameters that are automatically set by Auto-tune.

7-3 Menu details

< Button operation >

- Use four buttons : ▲, ▼, ⇐, ESC
- Press the ⇐ button to memorize the number, or go to a lower level of the menu.
- Press the ESC button to go to an upper level of the menu without doing anything.
- Input signal should be 4mA or more in order to change settings.
- After these operations, press ESC button to go back to initial & usual display. (It is not done automatically)

7-3-1 Lock/Unlock

Enable/Disable to change settings.

When locked, the padlock mark (7-1 ⑦) appears.

○Sequence

Unlock

LOCK ⇐ LK? ▼ ULK? ⇐

Lock

LOCK ⇐ ULK? ▼ LK? ⇐

○Notice

- After completing setup, lock to prevent misoperation.
- Unlock before starting the setting change operations.
- When the input signal is turned off and then on, it always starts up with “locked” mode.
- If 30 minutes pass without any setting operations, it automatically changes to “locked” mode.

7-3-2 Initial & usual displaying

Change initial & usual display values.

○ Sequence

DISP ⇐ SIG? mA ⇐ : Show Input signal (mA)
 ▼ SIG? % ⇐ : Show input signal (%)
 ▼ POS? mA ⇐ : Show position signal (mA)
 ▼ POS? % ⇐ : Show position signal (%)
 ▼ TMP? °C ⇐ : Show internal temperature °C (°F)

○Notice

- SIG or POS shows when displaying input signal or position value.
- The default setting is SIG mA
- These operations can be done even in locked mode.
- Internal temperature can be displayed using °C or °F ,whichever preferred.

7-3-3 Auto-tuning

ALL : Start continuous execution of the following A-1, A-2 and A-3.

A-1 : Start Zero-span and operation direction setting

A-2 : Start torque motor adjustment setting

A-3 : Start PID constant adjustment and input signal filter setting

○ Sequence

①Unlock

LOCK ↵ LK? ▼ ULK? ↵

②Tuning

TUNE ↵ ALL? ↵ ---> DONE : ALL Tunings start ---> successfully finished

▼ A-1? ↵ ---> DONE : A-1 Tuning start ---> successfully finished

▼ A-2? ↵ ---> DONE : A-2 Tuning start ---> successfully finished

▼ A-3? ↵ ---> DONE : A-3 Tuning start ---> successfully finished

○ Notice

- Do not touch any moving parts during Auto-tuning is in progress.
- It is strongly recommended to finish the following three setups before starting this operation.

[7-3-4-6 Linear / Rotary actuator](#)

[7-3-4-7 Single / Double action](#)

[7-3-4-8 Direction of rotation](#)

- When this operation is successfully completed, DONE will be shown on the display
If not, error code is shown. See [7-3-6-2 Error Code](#).
- For some actuators, this may not provide the best parameters. Additional manual adjustments can be made with [7-3-4-3 PID](#), or see items surrounded by the dotted rectangle in [7-2 Menu tree](#).
- After installing MP300, it is recommended to select "ALL" as the first Auto-tuning.
- Input signal would be kept at 4mA during this operation.

7-3-4 Manual-tuning

Configure manually

7-3-4-1 Split range

Set split range

○ Sequence

①Unlock

LOCK ↵ LK? ▼ ULK? ↵

②Operation

MANU ↵ SPLT ↵ ZERO ↵ **. ** mA ↵ : Set mA of input signal 0% with ▼ ▲ buttons

▼ SPAN ↵ **. ** mA ↵ : Set mA of input signal 100% with ▼ ▲ buttons

○ Notice

- The signal difference between 0 % and 100 % shall be +4.00 mA or more.
- The signal corresponding to 0% shall be 4.00 mA or more.
- The signal corresponding to 100% shall be 20.00 mA or below.
- The default value is 0%=4.00mA, 100%=20.00mA

7-3-4-2 FB

Set open/close position manually

Set linearity correction of valve position

○ Sequence

①Unlock

LOCK ↵ **LK?** ▼ **ULK?** ↵

②Operation

MANU ↵ **SPLT** ▼ **FB** ↵ **ZERO** ↵ **ZST?** ↵ : Set current position as 0 %

▼ **SPAN** ↵ **SST?** ↵ : Set current position as 100 %

▼ **P50P** ↵ ***. ** %** ↵ : Correct the linearity by setting the difference between the actual 50% position and the sensor value.

▼ **SPAN %** ↵ *****. * %** ↵ :Set the desired SPAN according to the calculation below.

“Current SPAN × desired percentage”

○ Notice

- Valid range of sensor is $\pm 50^\circ$. Make sure to use within it.

※Refer to [4-1 Prior confirmation](#)

- The 0% and 100% position can be set within the range of actual movement.
- P50P can help a minor misalignment issue of positioner mounting (e.g. the sensor is not 0° when the Feedback Lever A and the valve stem are at a right angle).

See 2) of [4-2 Installation for linear actuators](#).

- Setting example of P50P is as follows.

Set -2.00 %, if the LCD shows 52.0% when the actual position is 50.0%.

Set -2.00 %, if the actual position is 48.0% when the LCD shows 50.0%.

Set +1.00 %, if the LCD shows 49.0% when the actual position is 50.0%.

Set +1.00 %, if the actual position is 51.0% when the LCD shows 50.0%.

- The value of P50P will be cleared to zero by Auto-tuning “ALL” or “A-1”.

7-3-4-3 PID

Adjust PID Parameter, TF and Dead-band.

○ Sequence

①Unlock

LOCK ↵ LK? ▼ ULK? ↵

②Operation

MANU ↵ SPLT ▼ PID ↵ P-GN ↵ *** ↵ : Set the Proportional gain (P-gain)
 ▼ I-GN ↵ **.** ↵ : Set the Integral gain (I-gain)
 ▼ D-GN ↵ **.*** ↵ : Set the Derivative gain (D-gain)
 ▼ TF ↵ **.*** ↵ : Set the Target change speed dropping filter
 ▼ DBND ↵ **.*** % ↵ : Set the Dead-band for Integral calculation

○ Notice

- The P-gain, I-gain, D-gain and TF are automatically set in the Auto-tuning “ALL” or “A-3”.
- I-gain, D-gain and TF can be set to OFF.
- TF is set for soft-landing to the target position. In case of changing, refer to the following.
 OFF : Non-filter (good for big size (slow) actuator)
 1 : Reach the target value after about 3 seconds
 10 : Reach the target value after about 5 seconds
- The dead-band value means both \pm boundaries. When the difference between the target and actual position comes within this range, integral calculation suspends.

7-3-4-4 Valve full opening/closing function

Set the input signal threshold for forcing the valve to fully open or fully close.

○ Sequence

①Unlock

LOCK ↵ LK? ▼ ULK? ↵

②Operation

MANU ↵ SPLT ▼ VSHT ↵ MIN ↵ **.*** % ↵ : Set the input signal lower threshold % where
 to make OUT1 (output pressure) to zero.
 ▼ MAX ↵ **.*** % ↵ : Set the input signal upper threshold % where
 to make OUT1 (output pressure) to maximize.

○ Notice

- Each threshold has a hysteresis of 0.05 mA between the rising judgment and falling judgment.
- The default setting is MIN=0.5%, MAX=OFF
- The relationship between the zero/maximum pressure and the opening/closing of the valve is determined by the mechanism of the actuator. It cannot be changed by the positioner.

7-3-4-5 Input-Position Characteristics

Set characteristics

○ Sequence

①Unlock

LOCK ↵ **LK?** ▼ **ULK?** ↵

②Operation

MANU ↵ **SPLT** ▼ **CHAR** ↵ **SEL** ↵ **LIN?** ↵ : Choose Linear characteristic

▼ **EQ?** ↵ : Choose Equal percentage characteristic

▼ **QO?** ↵ : Choose Quick open characteristic

▼ **USR?** ↵ : Choose User-defined characteristic

▼ **USR?** ↵ *****.** %** ↵ : Create user-defined characteristic curve

	Input signal [%]		Target position[%]		
	Actuator direction DA	Actuator direction RA	LIN	EQ (1/50)	QO (1/75)
POS1	100	0	0	0	0
POS2	93.75	6.25	6.25	0.55	25.26
POS3	87.5	12.5	12.5	1.26	44.21
POS4	81.25	18.75	18.75	2.16	58.41
POS5	75	25	25	3.32	69.01
POS6	68.75	31.25	31.25	4.79	77.06
POS7	62.5	37.5	37.5	6.67	83.05
POS8	56.25	43.75	43.75	9.07	87.54
POS9	50	50	50	12.14	90.91
POS10	43.75	56.25	56.25	16.06	93.44
POS11	37.5	62.5	62.5	21.06	95.33
POS12	31.25	68.75	68.75	27.45	96.75
POS13	25	75	75	35.61	97.82
POS14	18.75	81.25	81.25	46.02	98.61
POS15	12.5	87.5	87.5	59.32	99.21
POS16	6.25	93.75	93.75	76.3	99.66
POS17	0	100	100	100	100

○ Notice

- Refer to [7-3-5-4 Direction D / R](#).
- The default setting is LIN (Linear)
- The user-defined characteristic curve is formed by a 17-point polygonal line.
(Push ↵ button to set each value.)
- The 6.25% interval of the input signal table is fixed.

7-3-4-6 Linear / Rotary actuator

Select Linear / Rotary mode.

Select according to the geometry of the lever mount and the pin.

○ Sequence

①Unlock

LOCK ↵ **LK?** ▼ **ULK?** ↵

②Operation

MANU ↵ **SPLT** ▼ **L/R** ↵ **LNT?** ↵ : Linear actuator, transmission pin is fixed to the actuator side. Positioner side lever (Lever A) has a slot.

▼ **ROT?** ↵ : Rotary actuator. (1:1 rotation)

▼ **LNS?** ↵ : Linear actuator, transmission pin is fixed to the positioner side lever (Lever A). (mechanical positioner's usual)

○ Notice

- The positioner works even with the wrong selection, but the linearity around 25% and 75% will be worse.

7-3-4-7 Single / Double action

Select single-action / double-action mode according to the actual mechanical configuration.

○ Sequence

①Unlock

LOCK ↵ **LK?** ▼ **ULK?** ↵

②Operation

MANU ↵ **SPLT** ▼ **S/D** ↵ **SIN?** ↵ : Single-action mode

▼ **DOB?** ↵ : Double-action mode

○ Notice

- The default setting is SIN.
- There is no way for this mechanical configuration to be detected automatically.

7-3-4-8 Direction of rotation

Select the direction of rotation (from the front view) of the angle sensor when closing the valve.

○ Sequence

①Unlock

LOCK ↵ **LK?** ▼ **ULK?** ↵

②Operation

MANU ↵ **SPLT** ▼ **SENS** ↵ **CW?** ↵ : Rotate clockwise when closing the valve

▼ **CCW?** ↵ : Rotate counter-clockwise when closing the valve

○ Notice

- The default setting is CW
- There is no way for this to be detected automatically.
- The valve works even with the wrong selection, but LCD shows upside-down valve position.
- If this is manually changed, [7-3-5-4 Direction D / R](#) also needs to be changed. It is strongly recommended to set this automatically by executing Auto-tuning "ALL" or "A-1".

7-3-4-9 Display angle

Show the actual angle of sensor.

(This is not the same as "Position" which is converted to a range of 0% to 100%.)

This is useful to check if the angle sensor is within the range of $\pm 50^\circ$ when the positioner is installed.

- Sequence

- ① Operation

MANU ↵ SPLT ▼ ANGL ↵ ±**.*° ↵

- Notice

- The maximum value that can be displayed is $\pm 50^\circ$.

7-3-5 SUB

Description of SUB menu below. (diagnostic function, position transmitter function, device information)

7-3-5-1 Diagnostic function

Description of diagnostic function

7-3-5-1-1 Calibration & Diagnostic of input signal

Adjust calibration and diagnose of input signal

○ Sequence

①Unlock

LOCK ↵ LK? ▼ ULK? ↵

②Operation

MANU ↵ SPLT ▼ SUB ↵ DIAG ↵ INPU ↵ PROF

[Calibrate input signal]

↵ CO4 mA ↵ 4? mA ↵ : Set the actual measured current as 4mA.

▼ CO20 mA ↵ 20? mA ↵ : Set the actual measured current as 20mA.

[Alarm set]

▼ ALRM ↵ MIN ↵ *.* mA ↵ : Set the alarm threshold for input signal (Min)

▼ MAX ↵ *.* mA ↵ : Set the alarm threshold for input signal(Max)

[Shut down Count]

▼ SHUT ↵ VIEW ↵ **** : Show Shut down counts

▼ CLR ↵ CLR? ↵ : Reset the count to zero

[Total uptime record]

▼ TIME ↵ TOTL ↵ **** H(D) : Show total uptime

▼ TERM ↵ ALRM ↵ **** D ↵ : Set the alarm threshold of total uptime

▼ DATA ↵ **** H(D) : Show running hours from the first setting

▼ CLR ↵ CLR? ↵ : Reset the time to zero

○ Notice

- The default setting for the alarm is OFF.
- The total uptime record cannot be initialized.

7-3-5-1-2 Diagnostic of Sensor

Diagnose Sensor and set partial stroke

○ Sequence

①Unlock

[LOCK] ↵ [LK?] ▼ [ULK?] ↵

②Operation

[MANU] ↵ [SPLT] ▼ [SUB] ↵ [DIAG] ↵ [INPU] ▼ [FB]

[Alarm Set]

↵ [ALRM] ↵ [MIN] ↵ [***.* %] ↵ : Set the alarm threshold for valve position(Min)
 ▼ [MAX] ↵ [***.* %] ↵ : Set the alarm threshold for valve position(Max)

[Change direction times]

▼ [CYCL] ↵ [TOTL] ↵ [**** (k)] : Show changing direction counts after shipping
 ▼ [WDTH] ↵ [***.* %] ↵ : Set the minimum travel distance (percentage) to
 detect a change of direction
 ▼ [TERM] ↵ [ALRM] ↵ [**** k] ↵ : Set alarm threshold for changing direction counts
 ▼ [DATA] ↵ [**** k] : Show changing direction counts after setting
 ▼ [CLR] ↵ [CLR?] ↵ : Clear changing direction counts after setting

[Travel distance]

▼ [DIST] ↵ [TOTL] ↵ [**** (k)m] : Show travel distance after shipping
 ▼ [TERM] ↵ [ALRM] ↵ [**** km] ↵ : Set alarm threshold for the travel distance
 ▼ [RESL] ↵ [**** mm] ↵ : Set the resolution for sensing the travel
 ▼ [STRK] ↵ [**** mm] ↵ : Set actuator travel per one stroke
 ▼ [DATA] ↵ [**** km] : Display the travel distance after setting
 ▼ [CLR] ↵ [CLR?] ↵ : Clear the travel distance after setting

[Partial stroke test]

▼ [PST] ↵ [ITVL] ↵ [**** H] ↵ : Set the interval time
 ▼ [WDTH] ↵ [***.* %] ↵ : Set partial stroke width
 ▼ [DURA] ↵ [**** s] ↵ : Set duration of execution

○ Notice

- The default setting for alarm is OFF
- Changing direction counts: number of times the actuator switched its direction of movement.
- Travel distance: total length the actuator traveled.
- The total changing direction counts after shipping and travel distance after shipping cannot be cleared.
- The default setting for partial stroke is OFF
- When the [7-3-4-4 Valve full opening/closing function](#) is working, partial stroke test is not performed.
- After changing the interval time of the partial stroke test, immediately, a partial stroke test is performed. This is to make sure that it works as expected with this setting.

7-3-5-1-3 Calibration & Diagnostic of thermometer

Show the internal temperature

○ Sequence

①Unlock

[LOCK] ↵ [LK?] ▼ [ULK?] ↵

②Operation

[MANU] ↵ [SPLT] ▼ [SUB] ↵ [DIAG] ↵ [INPU] ▼ [TEMP]

[Set temperature unit]

↵ [UNIT] ↵ [CEL?] °C ↵ : Show in °C

▼ [FAH?] °F ↵ : Show in °F

[Temperature History]

▼ [VALU] ↵ [H--V] ↵ [*** °C(°F)] : Display highest recorded temperature

▼ [L--V] ↵ [*** °C(°F)] : Display lowest recorded temperature

[Alarm set]

▼ [ALRM] ↵ [MAX] ↵ [*** °C(°F)] ↵ : Set the alarm threshold (Max. temperature)

▼ [MIN] ↵ [*** °C(°F)] ↵ : Set the alarm threshold (Min. temperature)

[Temperature Distribution]

▼ [MAP] ↵ [VIEW] ↵ [U-20°C (U-4°F)] [*** %] : Display recorded temperature distribution

↵ [0°C (32°F)] [*** %]

↵ [20°C (68°F)] [*** %]

↵ [40°C (104°F)] [*** %]

↵ [60°C (140°F)] [*** %]

↵ [060°C (O140°F)] [*** %] ↵

▼ [CLR] ↵ [CLR?] ↵ : Clear records

○ Notice

- The default temperature unit is °C.
- The default alarm setting is OFF.
- Initializing of Temperature History is not possible.

7-3-5-2 Calibration of Position transmitter

Below is operating sequence IOUT (Position transmitter)

○ Sequence

①Unlock

LOCK ↵ **LK?** ▼ **ULK?** ↵

②Operation

MANU ↵ **SPLT** ▼ **SUB** ↵ **DIAG** ▼ **IOUT**

↵ **VIEW** ↵ *****.*** mA** : Display position transmitter value

▼ **ACT** ↵ ******** ↵ : Set ascending/descending characteristic ("4 to 20" or "20 to 4")

▼ **ADJ** ↵ **ZERO** ↵ ******** ↵ : Set the adjustment value at 0% current output

▼ **SPAN** ↵ ******** ↵ : Set the adjustment value at 100% current output

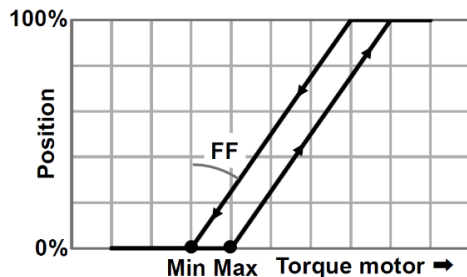
○ Notice

- Even without the Position Transmitter option, these setting menus exist.
- Default characteristic is ascending (4 to 20 mA).
- The default adjustment values are zero for both 4mA and 20mA.

The setting value "1" will adjust 0.01mA.

7-3-5-3 Torque motor

Adjust torque motor.



○ Sequence

①Unlock

LOCK ↵ **LK?** ▼ **ULK?** ↵

②Operation

MANU ↵ **SPLT** ▼ **SUB** ↵ **DIAG** ▼ **TORQ** ↵ **MIN** ↵ ******* ↵ : Set Min value

▼ **MAX** ↵ ******* ↵ : Set Max value

▼ **FF** ↵ ******* ↵ : Set FF value

○ Notice

- These values are automatically set in the Auto-tuning "ALL" or "A-2".

It is highly recommended not to manually set these values at first. After auto-tuning, in some case, these values may be adjusted.

7-3-5-4 Direction D / R

Choose Direct/Revers acting mode.

○ Sequence

①Unlock

LOCK ↵ **LK?** ▼ **ULK?** ↵

②Operation

MANU ↵ **SPLT** ▼ **SUB** ▼ **DIAG** ▼ **D/R** ↵ **DA?** ↵ : Direct acting mode
 ▼ **RA?** ↵ : Reverse acting mode

○ Notice

- DA means that the valve position is reduced when the input signal is increased.
- RA means that the valve position is increased when the input signal is increased.
- As the input signal increases, OUT1 (output pressure) will increase. This rule is immutable regardless of whether it is DA, RA, or any other electrical setting.
- The relationship between the increasing/decreasing pressure and the opening/closing of the valve is determined by the mechanism of the actuator. It cannot be changed by the positioner.
- In case if you need to reverse the relationship between the input signal and the valve position of double acting actuator, you can connect the OUT1 and OUT2 piping in reverse. Be sure to auto-tune again after changing the plumbing.
- In case this is manually changed, [7-3-4-8 Direction of rotation](#) also needs to be changed. Otherwise, the positioner will not work properly, and executing auto-tune will revert this setting.

It is strongly recommended to set “Direction of rotation” first, and executing Auto-tuning “ALL” or “A-1” to set this parameter.

7-3-5-5 Information

Display device information

○ Sequence

①Unlock

LOCK ↵ **LK?** ▼ **ULK?** ↵

②Operation

MANU ↵ **SPLT** ▼ **SUB** ↵ **DIAG** ▼ **INFO**
 ↵ **MANU** ↵ **3S** : Display manufacturer
 ▼ **MODL** ↵ **MP** : Display model code
 ▼ **HREV** ↵ ******** : Display hardware revision of circuit board
 ▼ **SREV** ↵ ******** : Display software revision

○ Notice

- Changing device information is not possible
- Model code depends on option

MP : None

~~MP-K : Position transmitter only~~

~~MP-H : HART communication only~~

MP-D : Position transmitter and HART communication

7-3-6 Alarm display

ALM, **ERR** and each code will be displayed at the top of the LCD when malfunction occurs.

Refer to the following table for further details

7-3-6-1 Alarm code

These will be displayed when it exceeds the alarm set value.

Code	Meaning	Details
A1-1	SIG lower alarm	Input signal is below the lower threshold
A1-2	SIG upper alarm	Input signal is above the upper threshold
A2-1	Uptime alarm	Uptime is over the threshold
A3-1	POS lower alarm	Position is below the lower threshold
A3-2	POS upper alarm	Position is above the upper threshold
A4-1	Changing direction counts alarm	Changing direction count of the actuator is over the threshold
A5-1	Travel distance alarm	Travel distance is over the threshold.
A6-1	Temperature upper alarm	Internal temperature is above the upper threshold
A6-2	Temperature lower alarm	Internal temperature is below the lower threshold.
A7-1	PST processing	PST is processing ※Automatically disappears.

○ Sequence

To display alarm code, do the following

MANU ▼ **WARN** ⇐ **ERR** ▼ **ALRM** ⇐

○ Notice

- To display other alerts, click ▲ ▼ buttons
- When the problem is resolved, the alarm will disappear. They are not memorized.
- 「— — —」 means that there are no alarms.

7-3-6-2 Error Code

Code	Meaning	Details
E3	EEPROM Error1	One of auto updating log data, 0%/100% position or PID parameters was broken, and was restored to default value.
E4	EEPROM Error2	One of set-value other than the above was broken, and was restored to default value.
E5	Temperature Sensor Error	Temperature sensor was damaged. * Not E15
E6	SW Error	Button(s) is ON for more than 5 minutes.
E7	Input signal Error	Input signal is less than 3.9mA. EEP cannot work with this.
E8	Actuator Setting Error	OUT1 has attempted to keep zero for 30 sec, but position is at the opposite side. * Probably wrong RA/DA setup is the reason.
E9	Output Error	OUT1 has attempted to keep max for 30 sec, but position is at the opposite side. * Probably clogging of fixed orifice
E10	TORQ value Error	TORQ_MIN or MAX is out of range. * Occur in A-2 tuning
E11	Shut off Error	The actual position is 5% higher than the set-point, and it stopped for more than 40 sec.
E12	Full open Error	The actual position is 5% lower than the set-point, and it stopped for more than 40 sec.
E13	Install Error1	Angle sensor reads less than -50 deg. (Sensor just showing -50)
E14	Install Error2	Angle sensor reads more than 50 deg. (Sensor just showing 50)
E15	Temperature Error	Temperature is out of range. (-40 ~ 80°C)
E16	PST Error	The result of performing Partial-stroke test was a failure.
E21	AT Time out Error	Could not finished auto tuning in time
E22	Install Error3	Setting for open / close position is less than -50°. * Occur in A-1 tuning
E23	Install Error4	Setting for open / close position is more than 50°. * Occur in A-1 tuning
E28	Low Input signal	Unable to save settings because input signal is less than 3.91mA

○ Sequence

To display error code, do the following

LOCK **LK?** **ULK?** **MANU** **WARN** **ERR**

○ Notice

- To display more results of Error, click buttons
- Except E3,4 and 16, when the problem is resolved, the error will disappear. They are not memorized.
- E3,4,16 would not disappear automatically. Press button to clear the error code.
- 「— — —」 means that there are no errors.

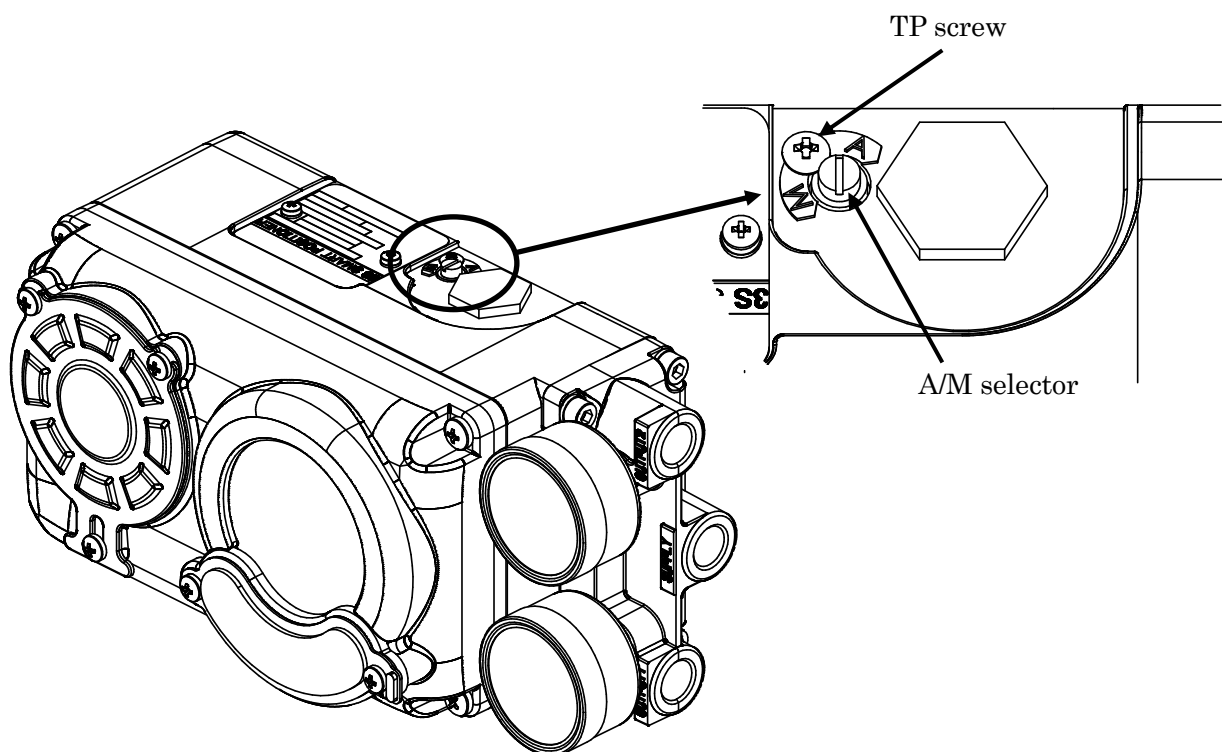
8. A/M selector

To use in manual mode, turn the A/M Selector to M (counter-clockwise). Then the single action actuator can be operated by adjusting the supply pressure from the regulator. (i.e. The output pressure will be equal to the supply pressure.)

* A/M Selector is left-hand threaded.

* Do not remove or loosen the TP screw beside the A/M Selector.

When manual mode is selected with power on, **ERR** may blink on LCD. It is not a problem. After returning the A/M Selector to A (clockwise), it will come back to the normal control and **ERR** will go off.



9. Maintenance

Carry out periodic maintenance inspections in accordance with the below table.

Depending on the usage and conditions, consider other check points or set the appropriate inspection cycles.

— Periodic inspection manual table —

Check points	Inspection cycles (year)	Checking details
Pressure gauges	2	Damage, Discrepancy
Fixed orifice assembly	1	Dirty filter, Clogging of fixed orifice
Transmission pin, Levers	2	Frictional wear.
Pilot relay unit	1	Check if functioning properly.
External earthing terminal	1	Loosen screw

Note 1. Opening the body cover is allowed, but disassembling the body cover assembly, sensor and torque motor is prohibited because its performance may not be maintained.

Note 2. ①Disassembling the pilot relay unit is also prohibited because its performance may not be maintained after reassembly.

②The pilot relay unit can be provided for replacement, and contact us if necessary.

* In order to determine the periodic replacement cycle, it is common to use statistical methods by classifying the usage status into “normal”, “slightly severe”, and “severe”. As an indicator of severity, there are operation frequency, switching speed, ambient temperature, etc.

* In addition to periodic replacement, it is recommended to prepare spare parts if there is a possibility of urgent replacement.

10. Troubleshooting

Problems	Causes	Solutions
LCD doesn't display	Loose wire	Tighten terminals
	Wrong +/- polarity	Re wire
	LCD is damaged	Replace the circuit board *
	Input signal is less than 3.8mA	Apply proper input current
Positioner doesn't work	Fixed orifice is clogging	Replace the fixed orifice assembly
	A/M selector is in manual mode	Turn it to auto mode
	Settings are wrong	Re auto-tune
	Internal wiring break	Replace broken parts
	Tears in diaphragm	Replace the pilot relay unit
	Insufficient supply pressure	Supply proper pressure
Off from the set position	Looseness or wear of levers	Replace or re-tighten levers
	Angle sensor is damaged	Replace the sensor unit *
Continuous hunting Not stabilized Large overshooting	Mismatch of setting	Refer to "notice" of 7-3-3 Auto-tuning Re auto-tune Adjust settings manually
	Fixed orifice is clogging	Replace the fixed orifice assembly
Poor linearity	Poor installation	Reinstall the positioner, refer to 4.installation
	Setting of linear / rotary is wrong	Correct the setting, refer to 7-3-4-6 Actuator

* Contact us as it has to be replaced at our factory.

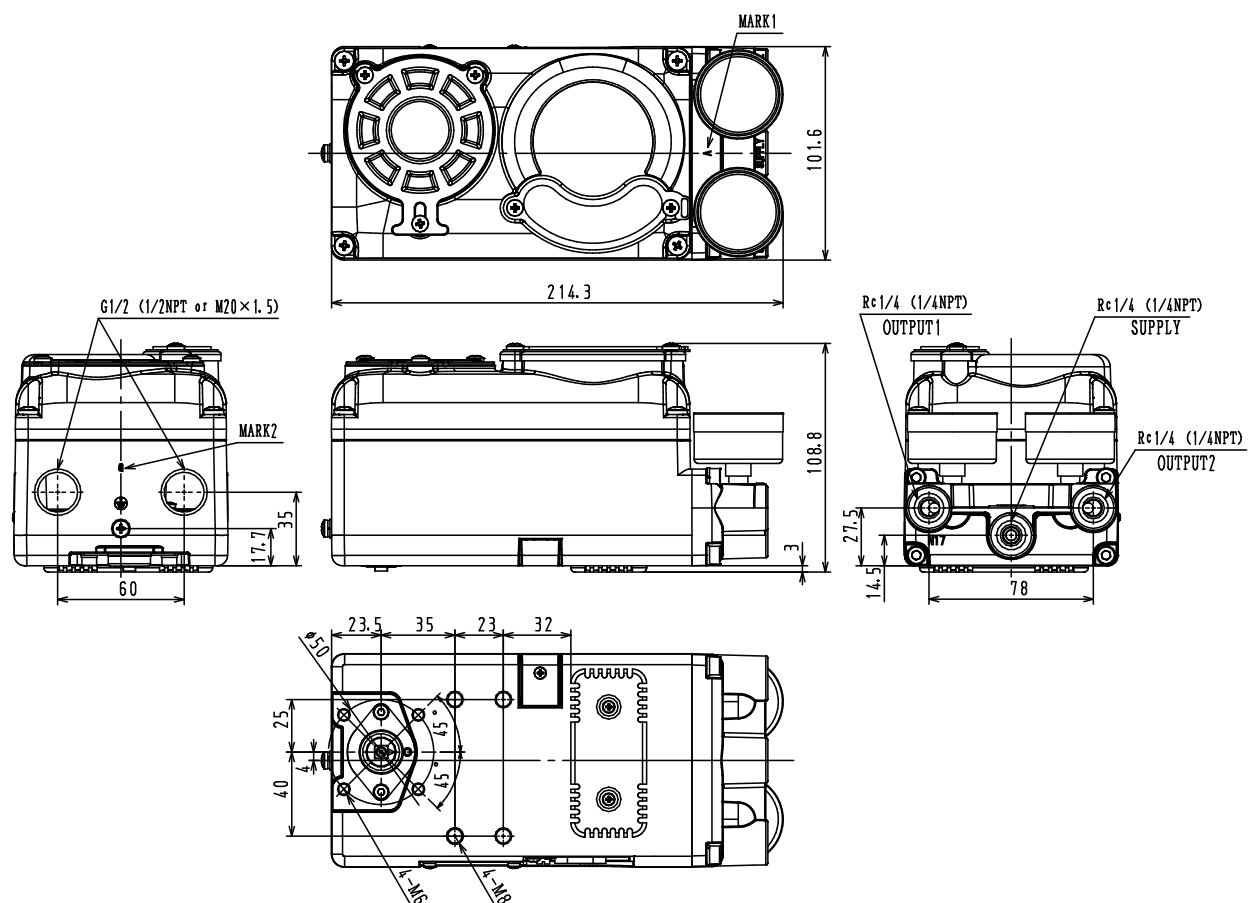
<Position transmitter>

Not working (No output signal)	Not enough power supply	Apply proper DC power refer to 6-2 Position transmitter
	Wrong +/- polarity	Re wire
	The positioner doesn't have this option	Replace with the product of correct option
Not expected ascending or descending characteristic (4-20mA、20-4mA)	Wrong setting	Correct the setting, refer to 7-3-5-2 position transmitter
The position transmitter signal is around 1mA	Positioner is not working (Input signal is less than 3.8mA)	Apply proper input current

<HART Communication>

No communication	The positioner doesn't have this option	Replace with the product of correct option

11. Outside dimension



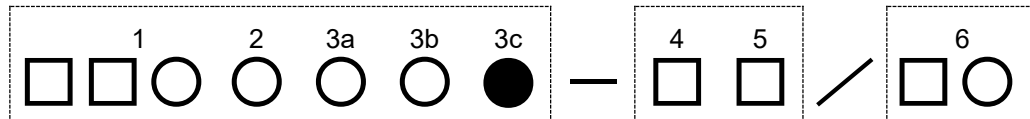
Air connection port

Supply port	Output port	Pressure gauge port	MARK 1
Rc1/4	Rc1/4	Rc1/8	A
1/4NPT	1/4NPT	1/8NPT	B

Electrical cable entry hole

Thread type	MARK 2
G1/2	G
1/2NPT	N
M20x1.5	M

12. Model number notation



□...Alphabetic character ○...Numerical character ●...Alphanumeric character

Basic model number designation						
1		2		3a		3b
Model		Explosion protection type		Air connection port		Electrical cable entry hole
MP3	MP300 Series	0	Non-ex-protection	1	Single Rc1/4 (Pressure Gauge : Rc1/8)	1 G1/2
		4	Intrinsic Safe ^{*1} type of protection	2	Double Rc1/4 (Pressure Gauge : Rc1/8)	2 1/2NPT
				3	Single 1/4NPT (Pressure Gauge : 1/8NPT)	3 M20×1.5
				4	Double1/4NPT (Pressure Gauge : 1/8NPT)	

Basic model number designation				
3c				
Electronic Circuit Variety				
		Availability of the feedback function	Input signal line	Position transmitter line
1	Non-explosion-protection	None	n/a	—
4		Both HART communication & Position transmitter	n/a	n/a
A	Intrinsic Safe ^{*1} type of protection	None	Ci = 0.005μF	—
B			Ci = 0.022μF	—
D		Both HART communication & Position transmitter	Ci = 0.005μF	Ci = 0.005μF
E			Ci = 0.022μF	Ci = 0.005μF
F				Ci = 0.05μF

Auxiliary number				
4			5	
Ambient temperature range (Depending on explosion protection)			Actuator	
S	Non-explosion-protection	-20~80℃	L	Linear motion
			R	Rotary motion
	Intrinsic Safe ^{*1} type of protection	T6 = -20~60℃ T5 = -20~80℃		

Additional number					
6					
Pressure Gauge Unit & Range					
M2	0.2MPa	“MPa” is the standard unit. For “psi” or “bar” only 1/8NPT is available. Please contact us.			
M4	0.4MPa				
M0	1.0MPa				
K2	200kPa	P2	30psi ^{*2}	B2	2bar
K4	400kPa	P4	60psi ^{*2}	B4	4bar
K0	1000kPa	P0	150psi ^{*2}	B0	10bar

^{*1} See [ANNEX 1](#) for detail.


^{*2} According to "The Measurement ACT", it is prohibited to use the pressure unit "psi" in Japan.

ANNEX 1 - Explosion Protection Guide -

Instructions for “Intrinsic Safe” type Equipment

1. Introduction

When using “Intrinsic Safe” type equipment, thoroughly review this ANNEX.

 Warning!	Failure to follow the guidelines marked with this symbol could result in severe personal injury or death.
---	--

Follow all instructions in this ANNEX correctly in hazardous areas.

2. Overview of "intrinsic safety"

Intrinsic safety is a type of protection based on the restriction of electrical energy within equipment and of interconnecting wiring exposed to the explosive atmosphere to a level below which can cause ignition by either sparking or heating effects.

3. Specifications related to "Intrinsic safety"

(Some specs here are overlapping with the chapter 2 of the main text.)

Model number		Starting with “MP34” *1
Type of explosion-protection		“Intrinsic Safe”
ATEX / IECEx / ITRI		ATEX : II 1G Ex ia IIC T6...T5 Ga Certificate DEKRA 19ATEX0116 X IECEx : Ex ia IIC T6...T5 Ga Certificate IECEx DEK 19.0077X ITRI : Ex ia IIC T6...T5 Ga Certificate ML121200705NO7
		EN IEC 60079-0:2018, EN 60079-11:2012 IEC 60079-0:2017, IEC 60079-11:2011
Specific conditions of use		Shown with <u>underline</u> in this ANNEX.
Explosion protecting temperature		T6 : -40 – 60°C T5 : -40 – 80°C (Below -20°C, it may suffer a failure of operation, but still protect against explosion.)
Input signal	Maximum input voltage U_i	30V DC
	Maximum input current I_i	100 mA
	Maximum input power P_i	750 mW
	Maximum internal capacitance C_i	0.005 μ F or 0.022 μ F selectable *1
	Maximum internal inductance L_i	negligibly small
Position transmitter	Maximum input voltage U_i	30V DC
	Maximum input current I_i	100 mA
	Maximum input power P_i	750 mW
	Maximum internal capacitance C_i	0.005 μ F or 0.050 μ F selectable *1
	Maximum internal inductance L_i	negligibly small
Dielectric strength		Conformance to EN 60079-11:2012
Main material of case		Aluminum diecast (Painted in silver color)

*1 refer to [12. Model number notation](#)

4. Installation

When in use, mount the body in the direction of either the LCD facing up or the LCD facing forward and the characters standing upright. Otherwise, if the liquid in the air condenses and stays inside, it will not be drained properly.

When in use, do not cover any part of the equipment with thermal insulation materials. The temperature rise is assessed with all six sides of the equipment exposed to air.

5. Product identification

The nameplate for explosion protected model is shown below. The material is either a screwed aluminum plate or a label (glued plastic film).

It indicates the level of explosion protection and its certificate. The model code starts with "MP34" means Intrinsic-safe type equipment. (refer to [12. Model number notation](#))



Screwed aluminum plate

Manufacturing date



Glued plastic film

Manufacturing date

【ITRI explosion-proof】

The above nameplate and TS mark are always attached to the product.



TS mark

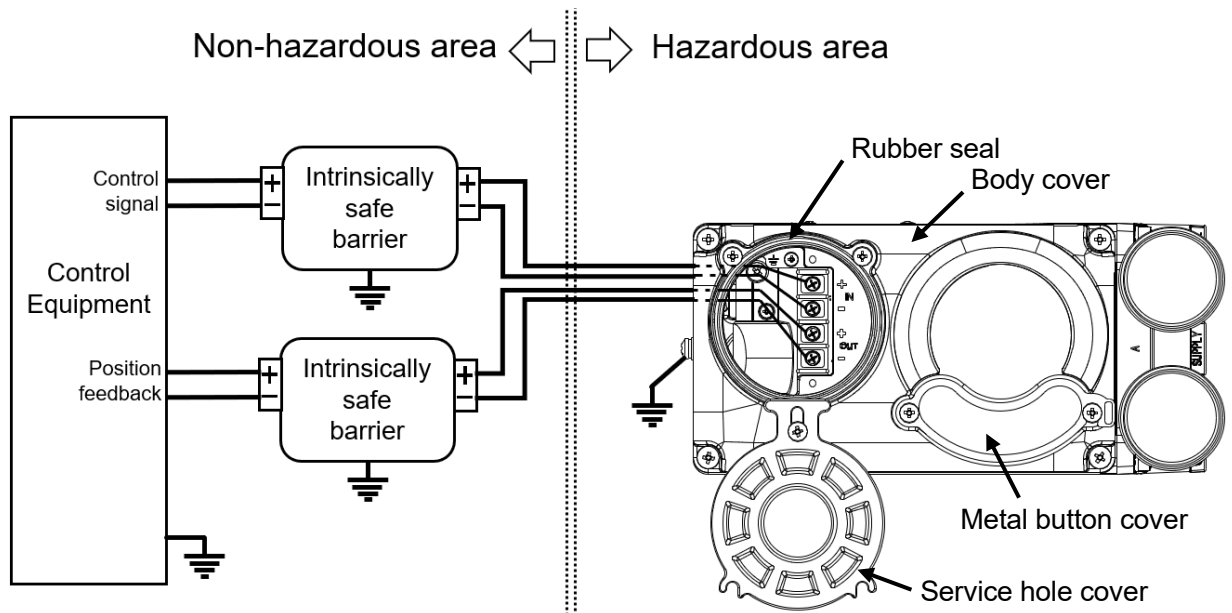
6. Electric wiring

(Some notes here are overlapping with the chapter 6 of the main text.)

Wire in accordance with appropriate electrical work standards of the country/ region of use.

The intrinsically safe equipment alone is not enough to be protected in explosive atmospheres. At least select intrinsically safe barriers that match our specifications and install them in the non-hazardous area with proper earthing. An example is shown below, but refer to the appropriate standards for correct understanding.

And these apparatuses and cables shall be erected in such a way that their intrinsic safety is not adversely affected by external electric or magnetic fields such as from nearby power lines or heavy current-carrying single core cables.



[Wiring procedure]

Turn off the power, open the service hole cover and connect each wire to proper terminal. Be sure that the wires do not loosen or twist.

In environments that may get wet or dust, intruding liquid/particulate contaminants may spoil the electrically safe circuit. Apply appropriate cable glands. Plug the unused cable entry hole up. Apply sealants to these threads or use proper O-rings. Firmly close the service hole cover, after checking its rubber seal.

[Earthing note]

Four terminals on this positioner are isolated against the earth respectively, so the earthing screw on this positioner is not necessary for control performance at all.

In case there is a large potential difference or noise between each earthing points, it may be a matter of safety even if not a matter of control. Earthing screws can be used on this positioner.

In case of using earthing screws, avoid direct contact between copper wire and aluminum case. Be sure that the earthing wire does not carry large current to the earthing screw on this positioner. When the positioner is attached to a conductive structure, the earthing wire should be connected to the conductive structure, not to the positioner.

[Cable glands note]

Cable gland types and its thread types are not a matter of protection directly against explosive atmospheres. Select them from the viewpoint of water/dirt intrusion.

7. Maintenance

(Some notes here are overlapping with the main text.)

Specific conditions of use:

Regardless of the presence of explosive gases or vapors,

- (*a) Use a damp cloth to clean any surface part including the translucent rubber button cover under metal button cover. (in order not to damage the plastic/rubber parts.)

In the presence of explosive gases or vapors,

- (*b) Do not cause mechanical sparks by tools. (against the Aluminum part of the case.)
- (*c) Keep the metal button cover closed except when operating buttons.
- (*d) Operate the button with bare hands or with conductive gloves.
- (*e) Do not open the body cover. (Even if a while passed after turning the power off, there may be electricity charge remaining somewhere on the PCB.)

(1) Cleaning

Cleaning is not necessary to maintain the control performance of this positioner. But it may be necessary to clean the LCD or indications for visibility.

Regardless of the presence of explosive gases or vapors, do (*a).

(2) Inspections and Adjustments

Even in the presence of explosive gases or vapors, and while the system is in operation, it is allowed to make inspections, adjustments and settings on LCD by button operation, which is described in chapter 7 of the main text.

In the presence of explosive gases or vapors, be sure to (*b), (*c) and (*d).

(3) Parts/Unit replacement

In the presence of explosive gases or vapors, some parts may be replaced whilst not opening the body cover. Be sure to (*b), (*e).

(4) Reassembling

Power must remain off until reassembly is complete.

If the body cover was opened, make sure that the PCB is not damaged or dirty.

If the body cover or the service hole cover was opened, check their rubber seal, then put them back and tighten them firmly. (In order not to cause water/dirt intrusion.)

If the wires were disconnected, put them properly and firmly back to the terminals.

Supply the pressure after confirming that all pneumatic parts are properly restored.

Turn on the power after confirming that everything is properly restored.