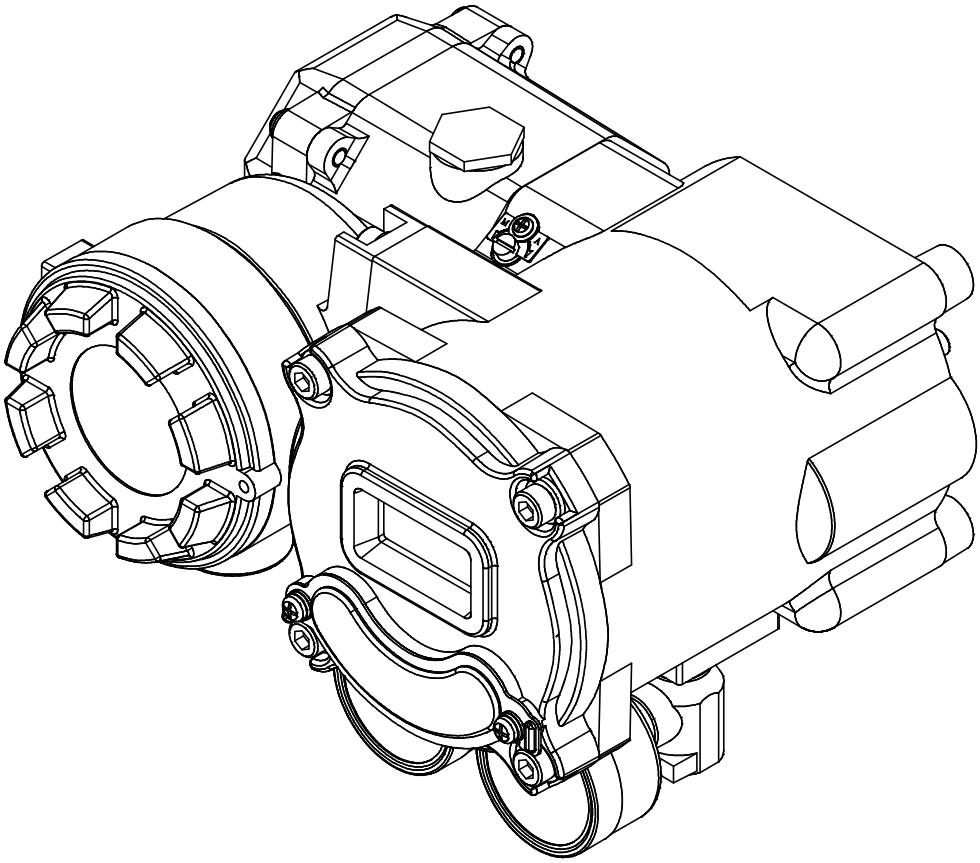
Smart Positioner Operating Manual

MP 100



3S Co., Ltd.

(E)IM-MP100-00-R10

Safety precautions

Cautions and Warnings – read before operating

Warning! Indicates a situation where incorrect operation while failing to heed the warning could result in death or serious injury if not avoided.

- To use Flame-proof equipment, be sure to refer to the ANNEX1 and follow the instructions.
- For mounting, air tubing, electric wiring, inspection, maintenance or dismantling of the product, follow the national legislation of the country to be used.
- Of the two conduit connection holes on the terminal box unit, be sure to insert a blind plug provided with the positioner tightly into the unused one. (Check the conduit connection hole size, please use the appropriate plug.)
- Turn off the power before removing the terminal box cover or blind plug.
- Before removing or disassembling component screws or pressure gauges etc. for inspection reduce, the output pressure to Zero and then disconnect the supply pressure.
- When operating the equipment during adjustment or inspection (see pages 4 and 5), do not touch moving parts such as clamps or levers with your hands.

Caution! Indicates a situation where incorrect operation while failing to heed the caution could result in malfunction or physical damage.

- During the operation, ensure the supply pressure remains below limit of usage of MP100 Positioner, 0.7 MPa.
- Use the equipment with the MP100 Positioner cover Ass'y installed.
- If drainage or debris etc. accumulates in the pressure line on the supply side, the fixed orifice will become stuck and cause a malfunction. Install an air filter of 5 μm or less and supply air cleansed by a dryer etc.
- Please ask us about compatibility when you use with other than our recommended regulator.
- When checking to see if debris or blockage is observed in the fixed orifice or mesh filter, first shut off the supply pressure.
- When carrying out pipe work, always flush the pipes sufficiently.
- When screwing pipes and fittings, wrap with seal tape or apply liquid sealant left about 2 threads from the screw top for waterproofing.
- Using lubricator on the supply side will block the orifice or nozzle. Do not use any lubricator.
- Avoid impact on or application of excessive force to the positioner to avoid malfunction.
- Loose cover of the body or terminal box may cause malfunction because of due invasion. Screw up the covers tightly after the maintenance.

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1. Introduction

MP100 smart positioner is 2 wire type E/P Positioner equipped with a microprocessor which control a valve by receiving 4-20mA of input signal. Auto-tuning function is equipped by default. Feedback signal or HART communication is available for comprehending valve status.

2. Specifications

Items		Singe acting	Double acting
Input signal		4 to 20mA DC (Minimum range : 4mA) Voltage across terminals : 10.5V DC Minimum require current : 3.8mA DC*1	
Supply air pressure		0.14 to 0.7MPa	
Stroke		Linear motion : 10 to 100mm (30 to 100°) Rotary motion : 30 to 100°	
Air connection		Standard : RC1/4 (Gauge Rc1/8) Option : 1/4NPT (Gauge 1/8NPT)	
Electrical connection		Standard : G1/2 (Not available for NEPSI flame-proof) Option1 : 1/2NPT Option2 : M20×1.5 (Not available for TIIS flame-proof)	
Pressure gauge		Standard : 0.2, 0.4, 1.0MPa Option1 : kPa, Option2 : psi *6 , Option3 : bar	
Protection of enclosure		IP66 (IEC 60529:1989/AMD2:2013) *2	
Type of protection (Flame-proof construction)		Standard : Non-explosion proof TIIS : Ex d IIC T6 Standards : Technical guidelines 2008 that conform to international standards IECEx : Ex d IIC T6 Gb Standards : IEC60079-0:2011, IEC60079-1:2007 ATEX : II 2 G Ex d IIC T6 Gb Standards : EN60079-0:2012+A11, EN60079-1:2007 NEPSI : Ex db IIC T6 Gb Standards : GB/T 3836.1-2021, GB/T 3836.2-2021 KOSHA : Ex d IIC T6 ITRI : Ex d IIC T6 Gb	
Operating temperature range		Standard : -20 to 80℃ Flame-proof : -20 to 60℃	
Characteristics		Linear, near Eq%, Quick Opening, User set (17 points)	
Manual operation		A/M switch function (only for Single action)	
Weight		Approx. 3.8 kg	
Material		Aluminum die casting	
Performance *3	Linearity	±1.0% F.S. *4	
	Hysteresis	1.0% F.S. *4	
	Air consumption	3 Nl/min. at 0.14MPa 6.5 Nl/min. at 0.4MPa (Output pressure 50%)	10 Nl/min at 0.40MPa (Output pressure 75%)
	Max air capacity	90 Nl/min.at 0.14MPa 200 Nl/min.at 0.40MPa	200 Nl/min.at 0.40MPa
	Vibration effect	No resonance in the range 10 to 300 Hz (3G)	
	Surge protection	According to IEC61000-4-5 Level 2 (±1.0kV) *5	

*1 : In case input signal goes below this limit, the unit goes "wait mode" (shutdown status). To change settings, at least 4 mA power is required.

*2 : It is applied from October 2017. The previous specification was IP65.

*3 : Performance are effected by actuator.

*4 : On condition that the angle for the sensor is 90°

*5 : When surged, temporal malfunction may be caused but the unit recovers automatically.

*6 : No domestic sales in Japan due to Non-SI unit.

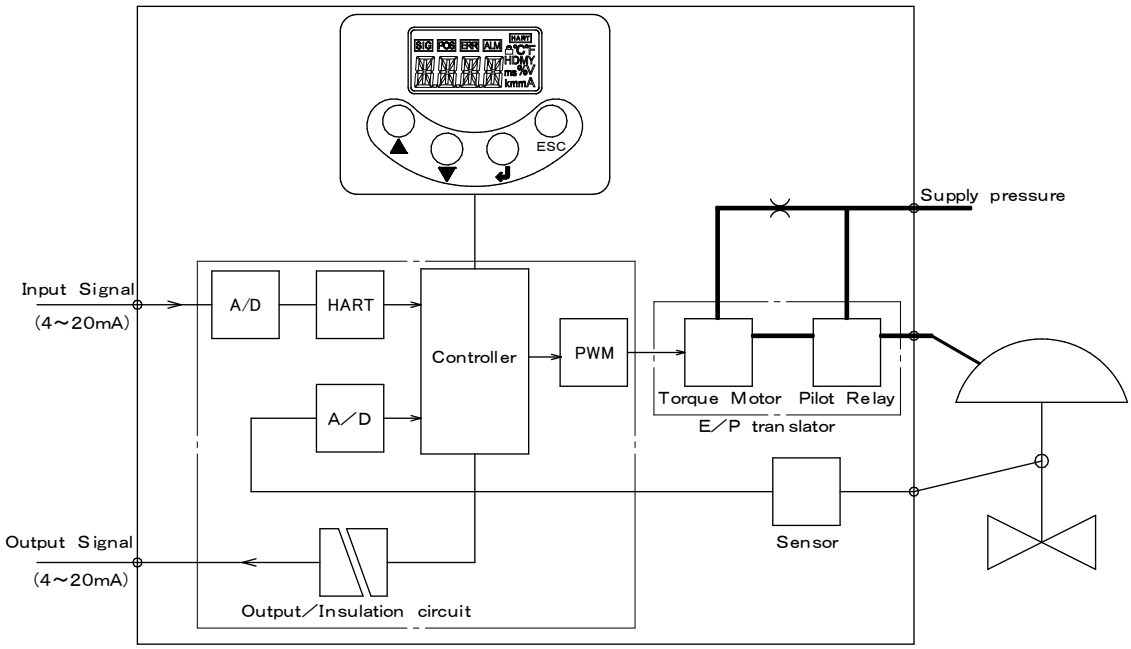
＜Option＞

Feedback signal	Power supply	12 to 36 V DC (Flame-proof up to 24V DC)
	Output signal	4 to 20mA DC (Inverted output is available)
	Accuracy	±1.0% to the position cognized internally
Communication	HART	HART7

3. Operation principle

MP100 controls the degree of opening of the control valve in response to the input signal of 4 to 20mA, which is originating from the signal source, such as an electronic controller. Internal sensor detects the degree of opening of the control valve.

MP100 captures the input signal and sensor information to the microprocessor. After the calculation, the MP100 supplies the current necessary for the Torque Motor, and converts it to a pneumatic signal. This pneumatic signal moves Pilot Relay, to adjust the air pressure that is output from the positioner. It moves the driving portion of the control valve by the air pressure.



Operation Principle

4. Installation

4-1 Prior confirmation

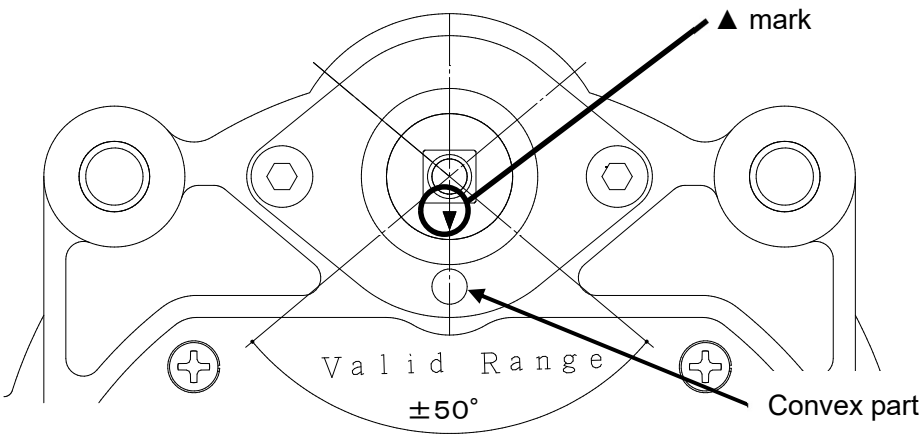
1) Position of Sensor Shaft

Feedback lever is used within the range of the sensor shaft ▲ mark is within ± 50°. It is recommended that the angle difference between the opening 0% and the 100% will be more than 40°.

※As shown in the figure below, it will be in a position of 0° to ▲ mark and the convex portion match.

※Open and closed positions (0%, 100% opening position) can not be set in the range of more than ± 50°. Confirmation of the sensor angle, please check the 7-3-4-9 Display angle.

Typically, the linear actuator is used in 45°, the rotary actuator is used in 90°.

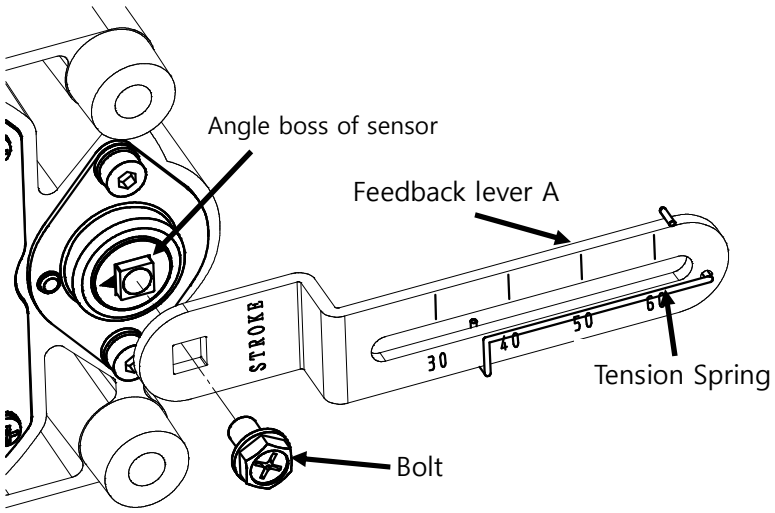


4-2 Installing to Linear-actuator

1) Assemble feedback lever

Insert Feedback lever A into the Angle boss of sensor and tighten with bolt. Make sure you keep the valid range that ▲ mark pointing out

Please install Feedback lever A as the tension spring loaded on Feedback lever A will be the underside.



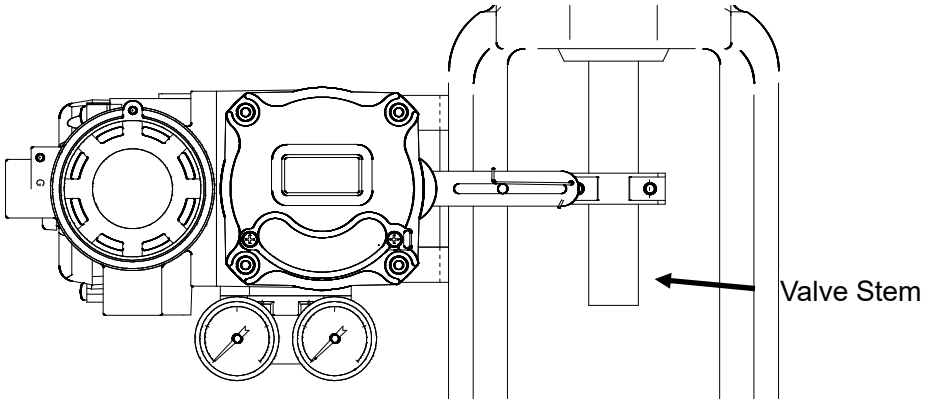
2) Install positioner and lever

① Install positioner

When the sensor angle is 0° (Valve Stem and Feedback lever is vertical), the positioner Feedback lever is mounted the positioner so that the horizontal. When this location is shifted, it is cause of linearity errors.

※Sensor angle has become the center allocation. Confirmation of the sensor angle, please refer to the 7-3-4-9 Display angle.

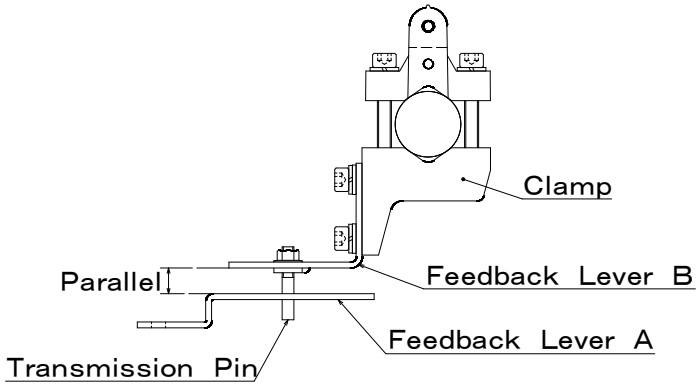
※Misalignment of mounting position can be corrected by setting. Please refer to P50P in 7-3-4-2 FB.



② Keep levers parallel

Insert Transmission pin into long hole of Feedback lever A to install positioner

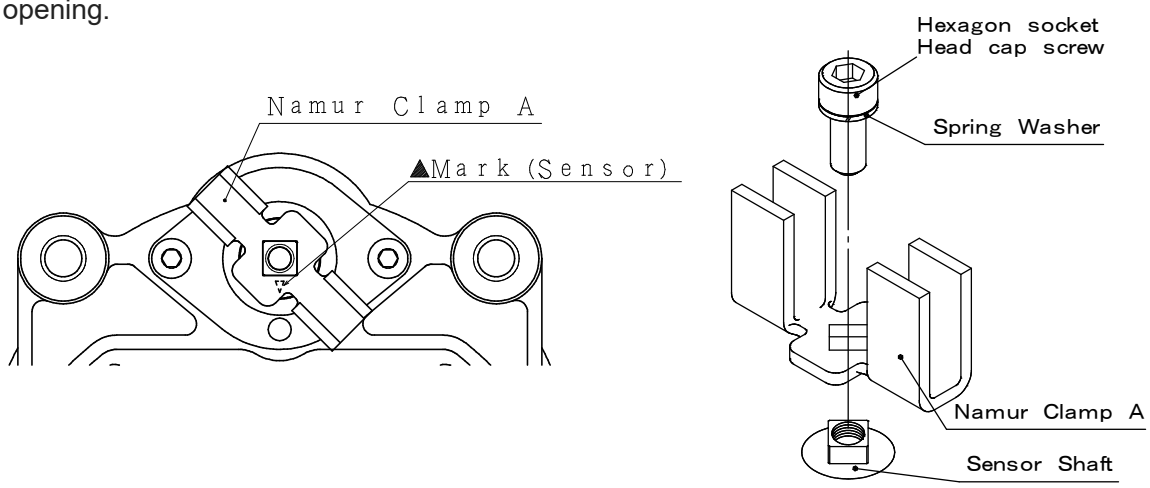
The Feedback lever A and B should be parallel to each other. If not mounted in parallel, it is cause of linearity errors.



4-3 Installing to Rotary-actuator (Namur clumping type)

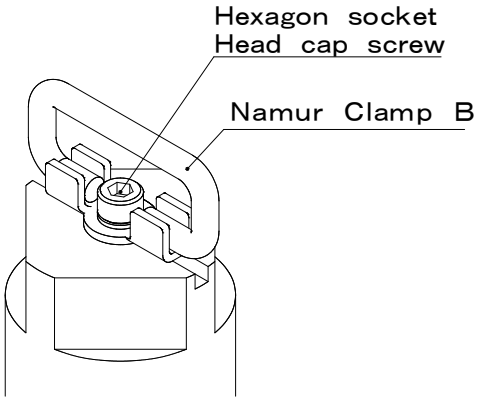
1) Assemble Namur clamp A (Positioner side)

Insert Namur clamp A into boss and fasten screw (Keep the marked range). As shown in the figure below, the position where the ▲ mark and the convex part is match is mounted so that the 50% opening.



2) Assemble Namur clamp B (Actuator side)

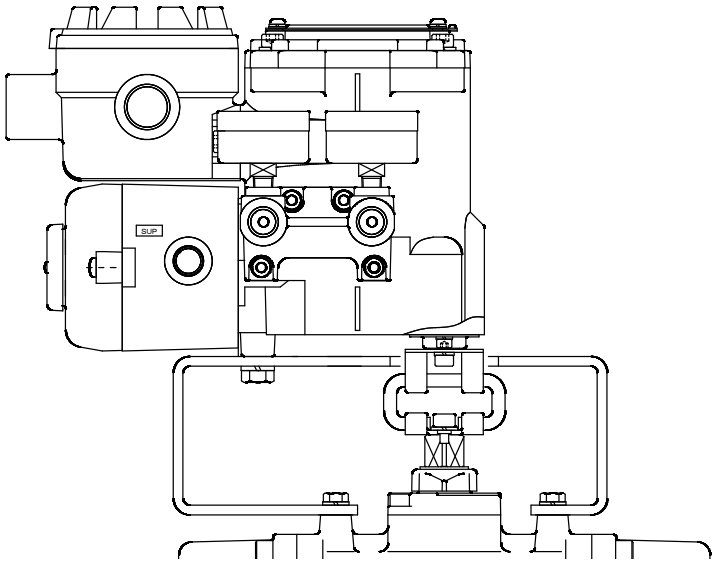
Insert Namur clamp B into Namur slot and fasten with hexagon head screws



3) Install positioner

Install positioner and fix. Keep axis of Namur clamp A, B.

※Non-alignment of the axis of A and B can lead to linearity errors.



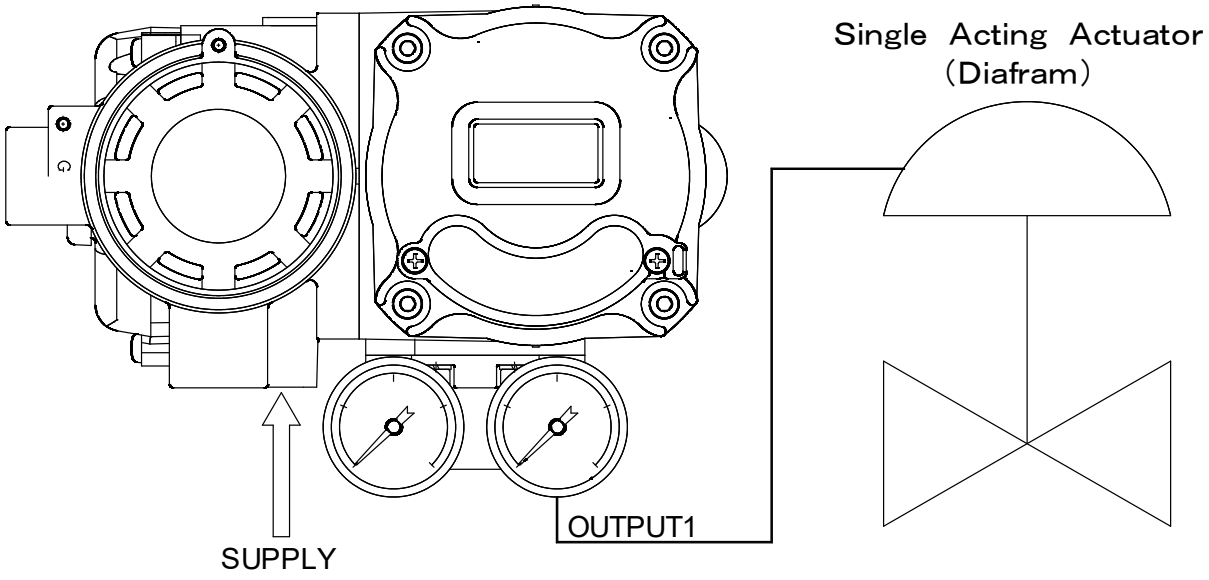
5. Pneumatic Piping

Use supply air that has been dried and filtered by 5 μm or less filter to protect against moisture or oil or dust.

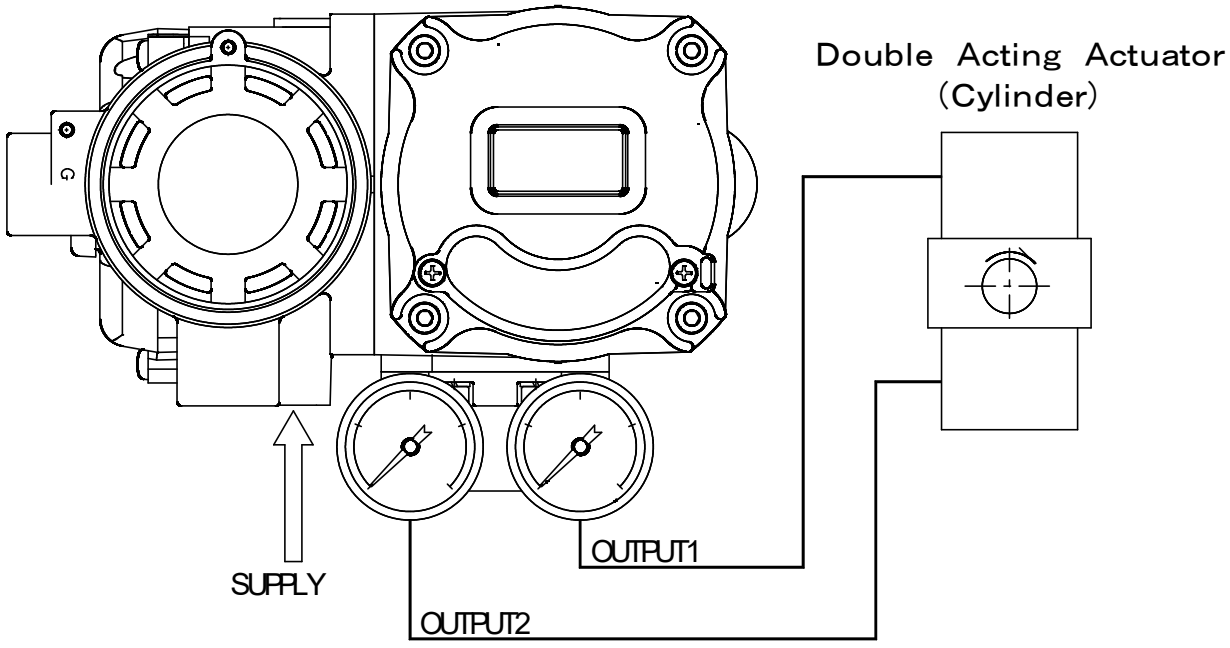
※(Single Acting) If input signal is increased, output pressure increase too.

(Configuration is required to conform to the application signal increase to decrease output pressure)

【Single acting】

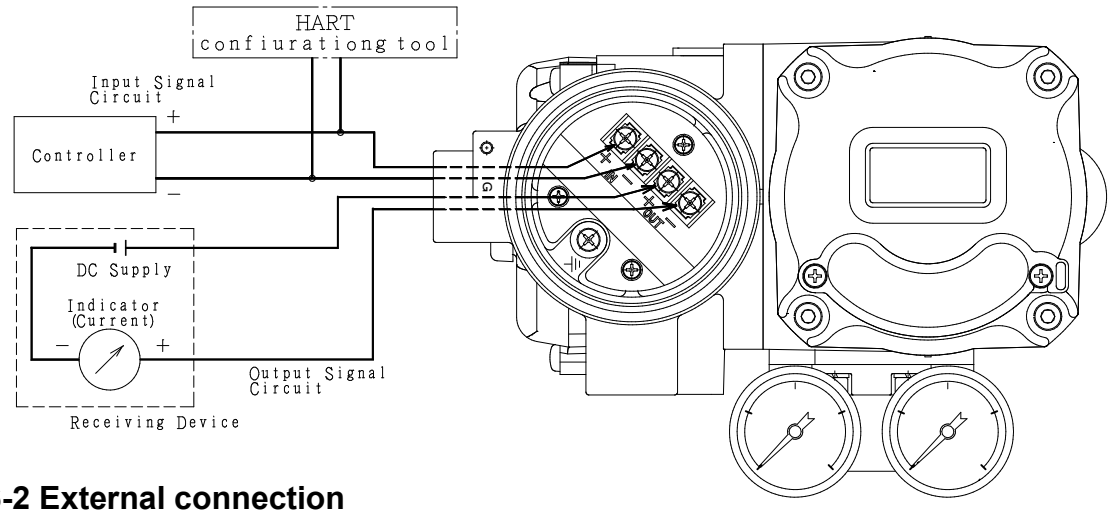


【Double acting】



6. Electric wiring

6-1 Wiring circuit



6-2 External connection

⚠ Warning

- When wiring, Please turn off the power.
- Please installing in accordance with local recommended.When using Flame-proof equipment at hazardous areas, always wiring in accordance with『ANNEX1 Instructions about Flame-proof type Equipment』.
- Be sure to close the unused connection port with a blind plug.

1) Remove Terminal Box Cover and connect wires to the terminal block with insulated terminals Connect.

   Input signal (+) and (-) wires to “In” (+) and (-) respectively.

   Connect Output signal (+) and (-) wires to “OUT” (+) and (-) respectively.

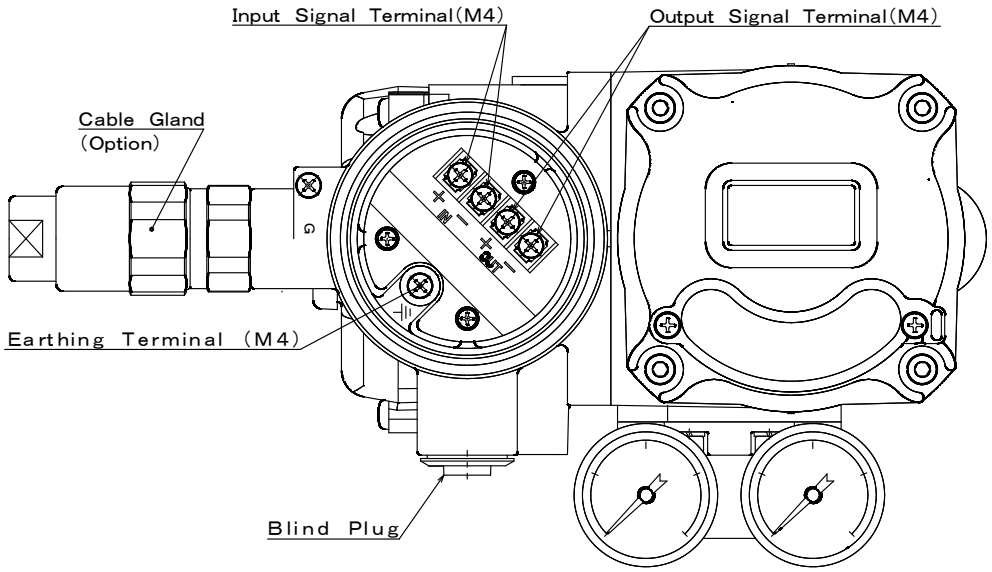
2) Choose one of the two connection ports to ensure the most suitable arrangement for the wires.

3) Impact on Positioner and use of excessive force during wiring works may result in deterioration in performance.

4) Apply a sealant to the threads of the connection port for waterproofing.

5) Please be sure to connect Earthing terminal with a cable lug surely.

6) The earth connection shall be mounted so that it is secured against loosening and twisting.

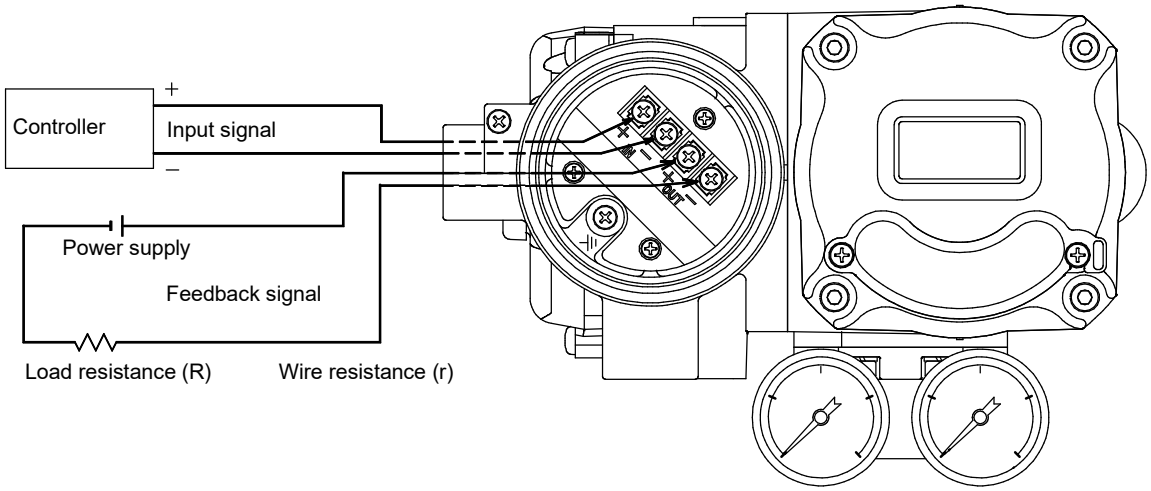


6-3 Feedback signal power and Load resistance

The load resistor connected determined based on the following equation. The load resistance is also considering conducting wire resistance.

Load resistance (R + r)[ohm] ≤ (Feedback signal power[V] – 12[V]) / (20[mA] / 1000)

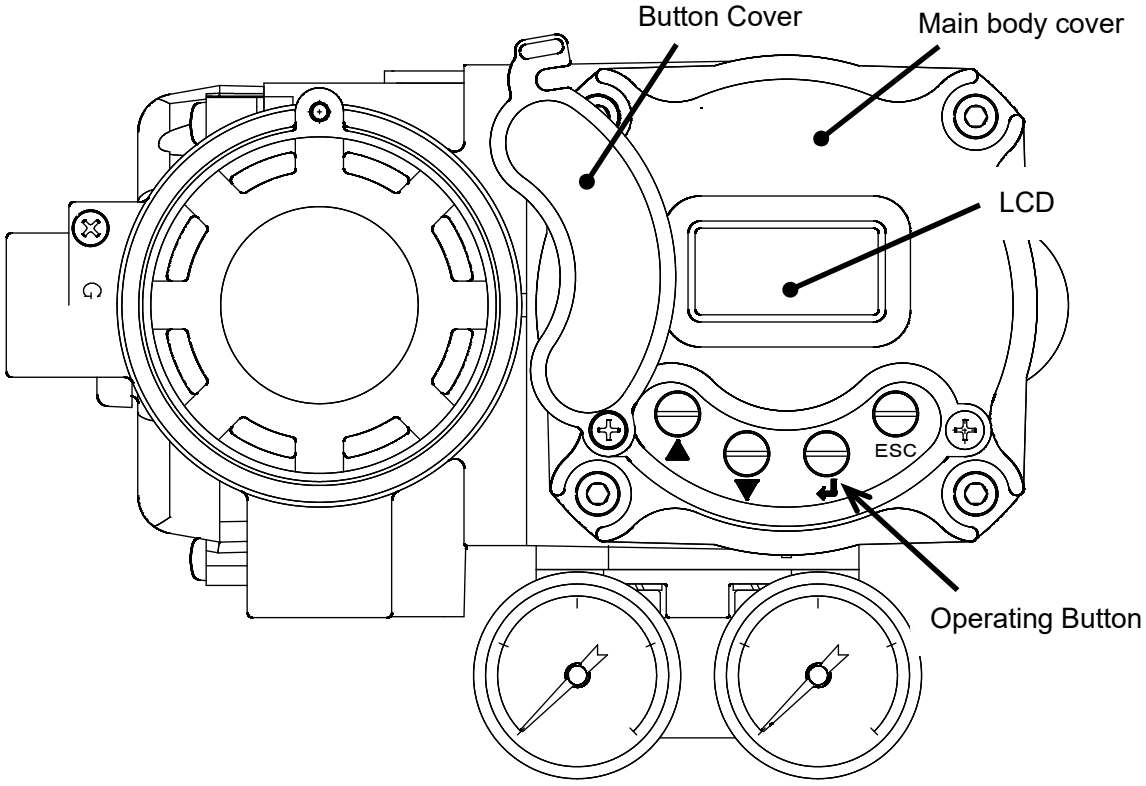
The maximum power supply voltage is the 36V DC at Flame-proof and 24V DC at Non-explosion proof.



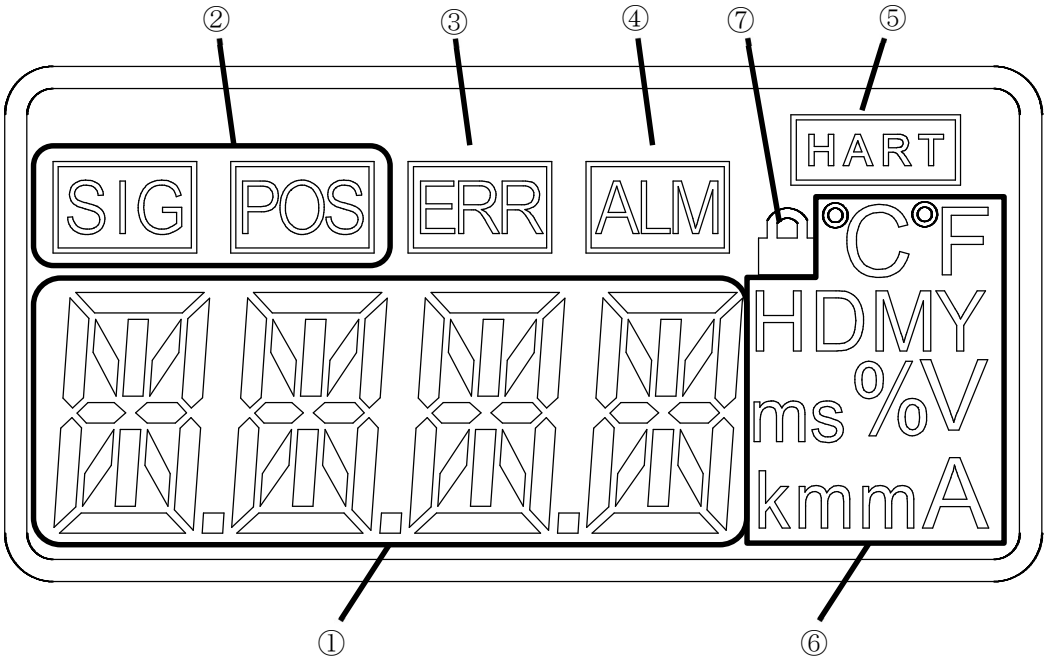
7. Adjustment and Setting

⚠ Warning

- Do not open Main body cover and Terminal box cover with its power turned on. Always check that there is no explosive gas or vapor in that location to remove the cover (Main body cover or Terminal Box cover) of Fame-proof enclosure with the power on.
  * Button Cover is not Flame-proof enclosure.
- Opening button cover and operating buttons with its power turned on is allowed. But do not open the Main body cover.
- Be sure never to cause mechanical sparks with tools.
- When using Flame-proof equipment at hazardous areas, always wiring in accordance with『ANNEX1 Instructions about Flame-proof type Equipment』.



7-1 LCD-Display description



① Numerical display

Display the numeric portion of setting parameters, input signal, or position value.

② Mode

Display the mode of the value shown, SIG means 'Displaying input signal value' and POS means 'Displaying position signal value'

③ Error

Blinking when the device is occurred to controlled error

④ Alarm

Blinking when the value exceed alarm set limit

⑤ HART

Displayed when HART communication function works

※HART communication function is option.

⑥ Unit

Display the unit corresponding to the value

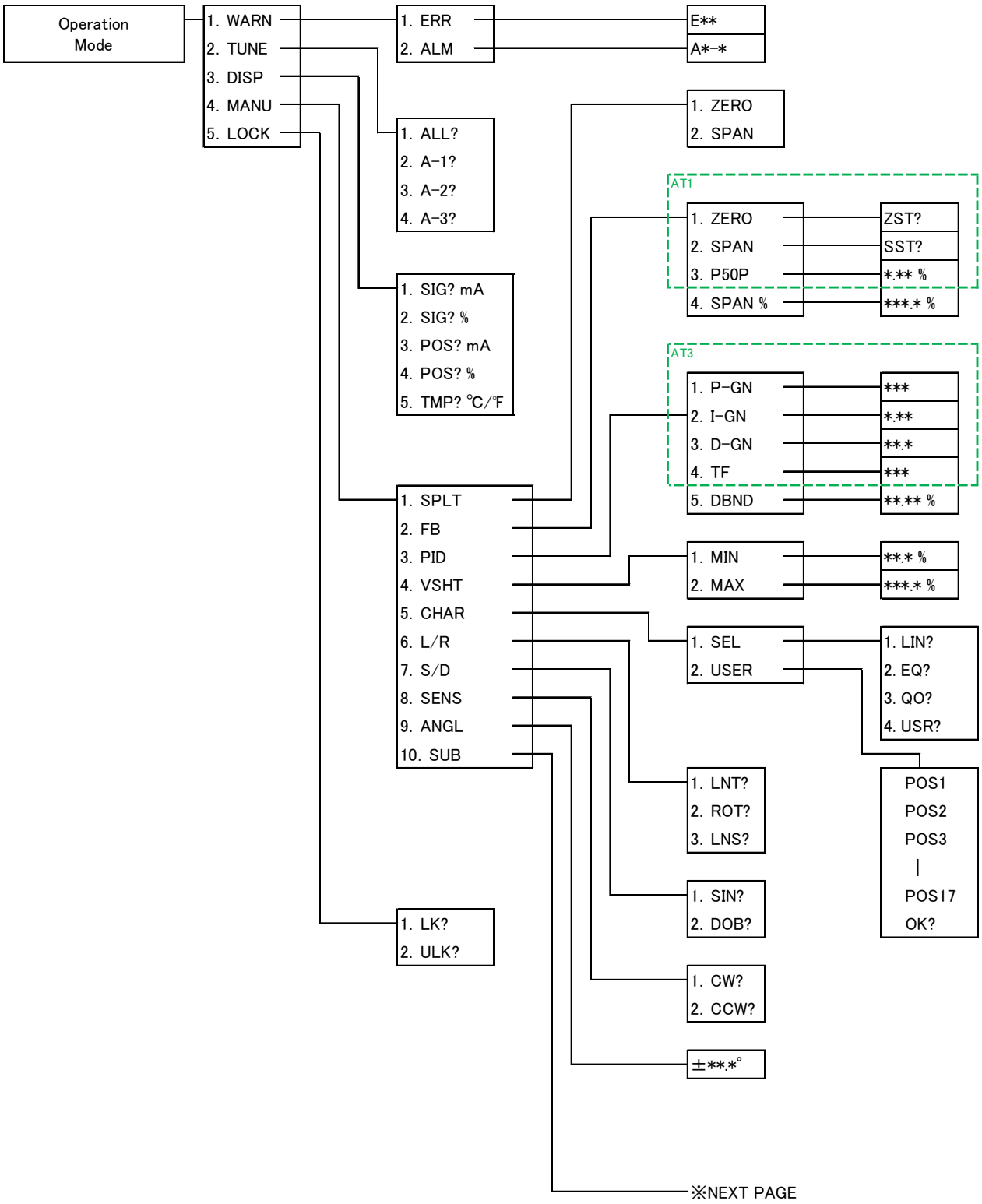
⑦ Lock

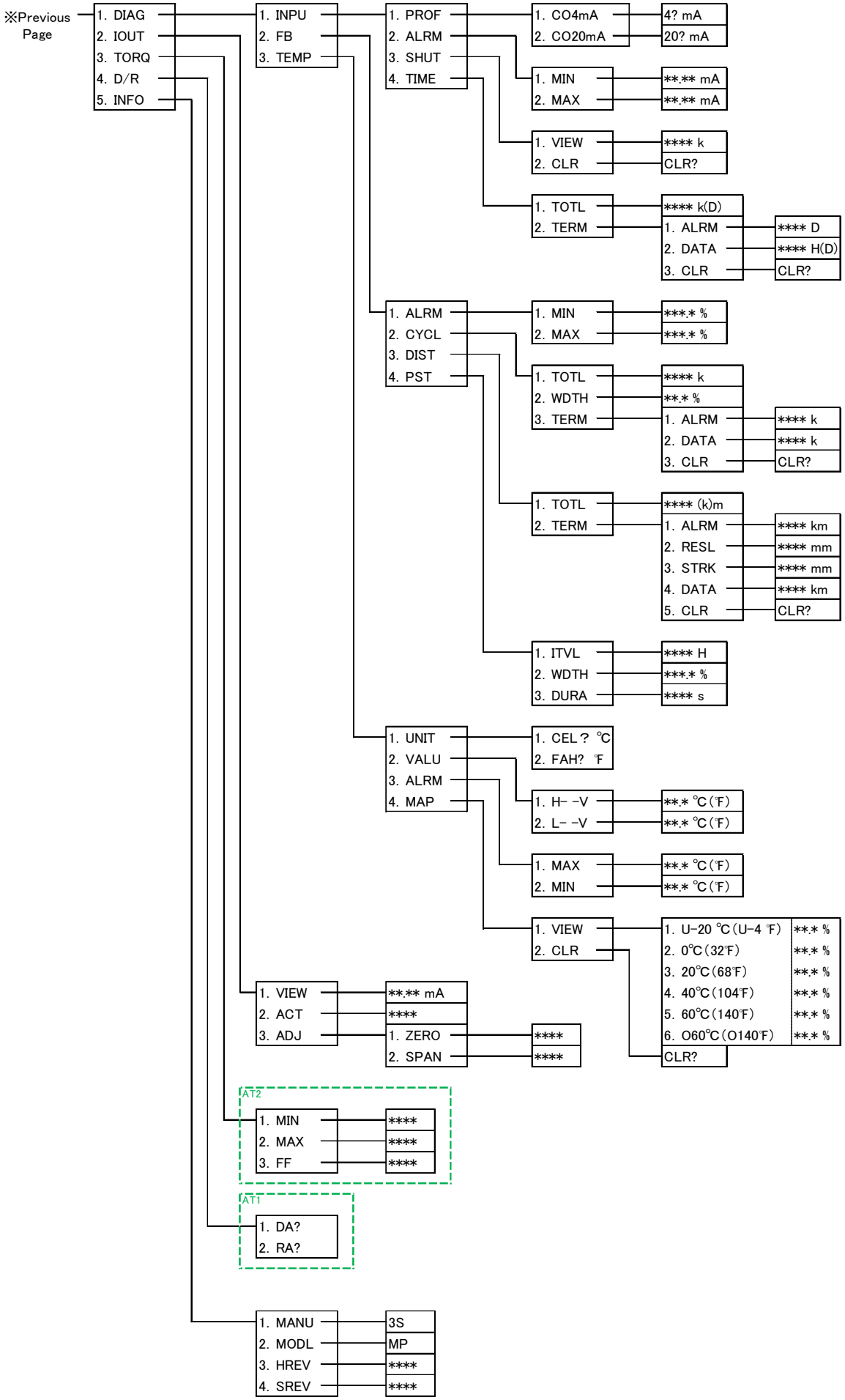
Displayed during the setting function is locked

7-2 Menu tree

※When the software revision is older than 0121, please contact because there is a different part.

※The soft revision can check it by MANU ⏎ SUB ⏎ INFO ⏎ SREV .




※Previous Page
1. DIAG
2. IOUT
3. TORQ
4. D/R
5. INFO
1. INPU
2. FB
3. TEMP
1. PROF
2. ALRM
3. SHUT
4. TIME
1. CO4mA
2. CO20mA
4? mA
20? mA
1. MIN
2. MAX
. mA
. mA
1. VIEW
2. CLR
**** k
CLR?
1. TOTL
2. TERM
**** k(D)
1. ALRM
2. DATA
3. CLR
**** D
**** H(D)
CLR?
1. ALRM
2. CYCL
3. DIST
4. PST
1. MIN
2. MAX
***.* %
***.* %
1. TOTL
2. WDTH
3. TERM
**** k
**.* %
1. ALRM
2. DATA
3. CLR
**** k
**** k
CLR?
1. TOTL
2. TERM
**** (k)m
1. ALRM
2. RESL
3. STRK
4. DATA
5. CLR
**** km
**** mm
**** mm
**** km
CLR?
1. ITVL
2. WDTH
3. DURA
**** H
***.* %
**** s
1. UNIT
2. VALU
3. ALRM
4. MAP
1. CEL? ℃
2. FAH? ℉
1. H- -V
2. L- -V
**.* ℃(℉)
**.* ℃(℉)
1. MAX
2. MIN
**.* ℃(℉)
**.* ℃(℉)
1. VIEW
2. CLR
1. U-20 ℃(U-4 ℉)
2. 0℃(32℉)
3. 20℃(68℉)
4. 40℃(104℉)
5. 60℃(140℉)
6. O60℃(O140℉)
CLR?
**.* %
**.* %
**.* %
**.* %
**.* %
**.* %
1. VIEW
2. ACT
3. ADJ
. mA
****
1. ZERO
2. SPAN
****
****
AT2
1. MIN
2. MAX
3. FF
****
****
****
AT1
1. DA?
2. RA?
1. MANU
2. MODL
3. HREV
4. SREV
3S
MP
****
****

7-3 Menu description

Operation

- Use four buttons ▲, ▼, ⏎, ESC
- Press the ⏎ button to complete the operation
- Press the ESC button to cancel the operation
- Input signal should be kept to a minimum 4mA
- After finishing operation, press ESC button to get back to the operating mode

(It would not be switched automatically)

7-3-1 Lock/Unlock

Enable/Disable to change settings.

When locked, the key mark will light up.

○Sequence

Unlock

LOCK ⏎ LK? ▼ ULK? ⏎

Lock

LOCK ⏎ ULK? ▼ LK? ⏎

○Notice

- After completing setup, lock the setting function to prevent misoperation.
- Before you start operations, set to unlock
- When the input signal is shut with this status unlocked, it will be locked when the signal recovered.

7-3-2 Switching display

Switch display mode

○ Sequence

DISP ⏎ SIG? mA ⏎ : Show Input signal (mA)

▼ SIG? % ⏎ : Show input signal (%)

▼ POS? mA ⏎ : Show position signal (mA)

▼ POS? % ⏎ : Show position signal (%)

▼ TMP? ℃ ⏎ : Show internal temperature℃ (℉)

○Notice

- SIG or POS is displayed to indicate input signal or position signal.
- The default setting is SIG mA
- Switching display is available while the device is locked
- Ambient temperature would be displayed using ℃ or ℉ which you have chosen

7-3-3 Auto-tuning

ALL : Start Auto-tuning for all setting

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

A-2 : Adjust torque motor setting

A-3 : Adjust PID constant and input signal filter

○ Sequence

①Unlock

LOCK ⏎ LK? ▼ ULK? ⏎

②Tuning

TUNE ⏎ ALL? ⏎ ---> DONE : Full tuning

▼ A-1? ⏎ ---> DONE : A-1 Tuning

▼ A-2? ⏎ ---> DONE : A-2 Tuning

▼ A-3? ⏎ ---> DONE : A-3 Tuning

○ Notice

・Do not touch the moving parts during tuning is in progress.

・Input signal should be kept to a minimum 4mA while operating.

・After the Auto-tuning is complete, DONE is shown on the display

・By the actuator, there is a case the proper dynamic characteristics can not be obtained.You can also go into manual mode and set the dynamic characteristics. Please refer to the 7-3-4-3 PID.

・Recommend to perform full Auto tuning first, after you have installed device

・【Important】Operate below three configuration before operate auto tuning

7-3-4-6 Actuator

7-3-4-7 Single / Double action

7-3-4-8 Direction of rotation

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 input signal 0% with ▼▲ buttons

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

○ Notice

・The signal difference between 0 % and 100 % needs to be 4.00 mA or more.

・The signal corresponds to 0% shall be 4.00 mA or more.

・The signal corresponds 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 value as 0 % position

▼ SPAN ⏎ SST? ⏎ : Set current value as 100 % position

▼ P50P ⏎ *.** % ⏎ : Correct the linearity of the valve position with reference to the 50 % position

▼ SPAN % ⏎ ***.* % ⏎ : Set the SPAN value multiplied by the value (%) as 100 % position

○ Notice

・Valid range of sensor is ±50°. Make sure to keep valid range.

※Refer to 4-1 Prior confirmation

・Be sure to set 0% and 100% position within valid operation range.

・For setting of P50P, refer to the following.

Set to -2.00 %, when the position value of LCD is 50.0% and the exact position value is 48.0%.

Set to +1.00 %, when the position value of LCD is 50.0% and the exact position value is 51.0%.

・The value of P50P is initialized (value is 0.00%) by Full tuning or A-1 tuning.

7-3-4-3 PID

Adjust PID Parameter, input signal filter and dead band

○ Sequence

①Unlock

LOCK ⏎ LK? ▼ ULK? ⏎

②Operation

MANU ⏎ SPLT ▼ PID ⏎ P-GN ⏎ *** ⏎ : Set the total gain

▼ I-GN ⏎ **.** ⏎ : Set the integral gain

▼ D-GN ⏎ **.* ⏎ : Set the differential gain

▼ TF ⏎ **.* ms ⏎ : Set the constant for input signal filter

▼ DBND ⏎ **.* % ⏎ : Set the dead band

○ Notice

・The total gain, integral gain and differential gain are automatically set in the Full tuning or A-3 tuning. Case of changing, refer to the following matters.

・Effects of every parameters will increase along with the figure increase.

・Integral gain and differential gain can be set to OFF.

・Input signal filter is set to smooth the follow-up to the target value. It is automatically set in the Full tuning or A-3 tuning. Case of changing, refer to the following matters.

OFF : Non-filter (for big size actuator)

1 : Equal to the target value after about 3 seconds

10 : Equal to the target value after about 5 seconds

・The set value of the dead band is ±.

・Where deflection is in valid range, integral calculation within the dead band is suspended.

7-3-4-4 Valve closing function

Set shut off or full open of the valve

○ Sequence

①Unlock

LOCK ⏎ LK? ▼ ULK? ⏎

②Operation

MANU ⏎ SPLT ▼ VSHT ⏎ MIN ⏎ **.* % ⏎ : Set the input signal value (%) where output pressure of OUT1 is shut

▼ MAX ⏎ ***.* % ⏎ : Set the input signal value where output pressure of OUT1 is maximized

○ Notice

・0.05 mA of hysteresis exists while opens and shuts valve (Each 1 cycle)

・The default setting is, MIN=0.5%, MAX＝OFF

7-3-4-5 Characteristics

Set characteristics

○ Sequence

①Unlock

LOCK ⏎ LK? ▼ ULK? ⏎

②Operation

MANU ⏎ SPLT ▼ CHAR ⏎ SEL ⏎ LIN? ⏎ : Choose linear characteristics

▼ EQ? ⏎ : Choose near Eq% characteristics

▼ QO? ⏎ : Choose 'quick open' characteristics

▼ USR? ⏎ : Choose user characteristics

▼ USR? ⏎ ***.** % ⏎ : Customize user characteristics

	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）

・You can customize 17 kinds of user Characteristics

(Push ⏎ button to confirm each setting)

The interval of input signal is fixed. (6.25%)

7-3-4-6 Actuator

Choose Linear / Rotary mode.

Choose mounting of the transmission pin in the case of Linear actuator.

○ Sequence

①Unlock

LOCK ⏎ LK? ▼ ULK? ⏎

②Operation

MANU ⏎ SPLT ▼ L/R ⏎ LIN? ⏎ : Linear actuator mode, fixed transmission pin to the actuator side

▼ ROT? ⏎ : Rotary actuator mode

▼ LINS? ⏎ : Linear actuator mode, fixed transmission pin to the positioner side

○ Notice

・When the selection is wrong, linearity is worse.

7-3-4-7 Single / Double action

Choose Single / Double acting mode

○ Sequence

①Unlock

LOCK ⏎ LK? ▼ ULK? ⏎

②Operation

MANU ⏎ SPLT ▼ S/D ⏎ SIN? ⏎ : Single acting mode

▼ DOB? ⏎ : Double acting mode

○ Notice

・The default setting is SIN

7-3-4-8 Direction of rotation

Choose the direction of rotation.

This is usually CW mode, it is possible to match the position display by the CCW mode when the direction of rotation has changed.

○ Sequence

①Unlock

LOCK ⏎ LK? ▼ ULK? ⏎

②Operation

MANU ⏎ SPLT ▼ SENS ⏎ CW? ⏎ : Position is reduced in the clockwise

▼ CCW? ⏎ : Position is reduced in the counter-clockwise

○ Notice

・The default setting is CW

・When changing this setting, 7-3-5-4 Direction D / R changes. Please execute the A-1 tuning once again.

7-3-4-9 Display angle

Show the angle of sensor.

When installing a positioner, used to check the value of the angle sensor.

○ Sequence

①Operation

MANU ⏎ SPLT ▼ ANGL ⏎ ±**.*° ⏎

○ Notice

・The maximum value that can be displayed is ±50° .

7-3-5 SUB

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

7-3-5-1 Diagnostic function

Describe 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 ⏎ : calibrate figure for 4mA

▼ CO20 mA ⏎ 20? mA ⏎ : calibrate figure for 20mA

[Alarm set]

▼ ALRM ⏎ MIN ⏎ *.** mA ⏎ : Set the alarm (Min)

▼ MAX ⏎ **.** mA ⏎ : Set the alarm (Max)

[Shut down Count]

▼ SHUT ⏎ VIEW ⏎ **** : Show Shut down times

▼ CLR ⏎ CLR? ⏎ : Delete records

[Total uptime record]

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

▼ TERM ⏎ ALRM ⏎ **** D ⏎ : Set limit total uptime

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

▼ CLR ⏎ CLR? ⏎ : Delete records

○ Notice

・The default setting is OFF

・Initializing of total uptime record is not allowed

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 lower limit

▼ MAX ⏎ ***.* % ⏎ : Set upper limit

[Change direction times]

▼ CYCL ⏎ TOTL ⏎ **** (k) : Show changing direction times after shipping

▼ WDTH ⏎ **.* % ⏎ : Set the minimum travel counted as changing direction

▼ TERM ⏎ ALRM ⏎ **** k ⏎ : Set alarm for changing direction times

▼ DATA ⏎ **** k : Show changing direction times after setting

▼ CLR ⏎ CLR? ⏎ : Clear changing direction times after setting

[Travel distance]

▼ DIST ⏎ TOTL ⏎ **** (k)m : Show travel distance after shipping

▼ TERM ⏎ ALRM ⏎ **** km ⏎ : Set alarm for the travel distance

▼ RESL ⏎ **** mm ⏎ : Set the resolution for sensing the travel

▼ STRK ⏎ **** mm ⏎ : Set actuator 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 carried out stroke span

▼ DURA ⏎ **** s ⏎ : Set duration

○ Notice

・The default setting for alarm is OFF

・Change direction times after shipping and travel distance after shipping cannot be cleared.

・The default setting for partial stroke is OFF

・If the shut off or the full open of the valve is working, partial stroke test is not performed

・When it changes the interval time of the partial stroke test, immediately once, partial stroke test is performed. Please make sure there is no problem in 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? ℃ ⏎ : Show in ℃

▼ FAH? ℉ ⏎ : Show in ℉

[Temperature History]

▼ VALU ⏎ H--V ⏎ **.* ℃(℉) : Display highest temperature record

▼ L--V ⏎ **.* ℃(℉) : Display lowest temperature record

[Alarm set]

▼ ALRM ⏎ MAX ⏎ **.* ℃(℉) ⏎ : Set Max. temperature

▼ MIN ⏎ **.* ℃(℉) ⏎ : Set Min. temperature

[Temperature Distribution]

▼ MAP ⏎ VIEW ⏎ U-20℃（U-4℉） **.* % : Display temperature distribution

⏎ 0℃（32℉） **.* %

⏎ 20℃（68℉） **.* %

⏎ 40℃（104℉） **.* %

⏎ 60℃（140℉） **.* %

⏎ O60℃（O140℉） **.* % ⏎

▼ CLR ⏎ CLR? ⏎ : Delete records

○ Notice

・The default temperature unit setting is show in ℃

・The default alarm setting is OFF

・Initializing of Temperature History is not allowed

7-3-5-2 Calibration of Feedback signal

Below is operating sequence IOUT (Feedback signal)

○ Sequence

①Unlock

LOCK ⏎ LK? ▼ ULK? ⏎

②Operation

MANU ⏎ SPLT ▼ SUB ⏎ DIAG ▼ IOUT

⏎ VIEW ⏎ **.** mA : Display feedback signal value

▼ ACT ⏎ **** ⏎ : Set the direction of feedback signal. (4 to 20 or 20 to 4)

▼ ADJ ⏎ ZERO ⏎ **** ⏎ : Set the current output of feedback signal at 0%

▼ SPAN ⏎ **** ⏎ : Set the current output of feedback signal at 100%

○ Notice

・It can have this set in the specification does not have feedback signal. But feedback signal can not be used.

・Default direction of feedback signal is 4 to 20 mA.

・The current output count of feedback signal is 0 by default, for both 4 mA and 20 mA. The current output changes 0.00989 mA by 1 count.

7-3-5-3 Torque motor

Adjust torque motor. It is set the value adapted to the conditions of use in the A-2 tuning. It is not recommended to change.

7-3-5-4 Direction D / R

Choose Direct /Revers acting mode. It is set the value adapted to the conditions of use in the A-1 tuning. It is not recommended to change.

○ 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.

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 of circuit board

○ Notice

・Changing device information is unavailable

・Model code depends on option

MP : None

MP-K : Feedback signal

MP-H : HART communication

MP-D : Feedback signal and HART communication

7-3-6 Alarm display

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

Refer to the following table for further details

7-3-6-1 Alarm code

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

Code	Meaning	Details
A1-1	SIG lower limit alarm	Input signal was below the lower limit setting
A1-2	SIG upper limit alarm	Input signal was above the upper limit setting
A2-1	Uptime alarm	Uptime was above the limit setting
A3-1	POS lower limit alarm	Position signal was below the lower limit setting
A3-2	POS upper limit alarm	Position signal was above the upper limit setting
A4-1	Change direction times alarm	Change direction times of the actuator was above the limit setting
A5-1	Travel distance alarm	Travel distance was above the limit setting.
A6-1	Ambient Temperature upper limit alarm	Ambient temperature was above the upper limit setting
A6-2	Ambient temperature lower limit alarm	Ambient temperature was below the lower limit setting.
A7-1	PST processing	PST is processing ※Automatically disappears.

○ Displaying Sequence

To display alarm code, follow below procedures

MANU ▼ WARN ⏎ ERR ▼ ALRM ⏎

○ Notice

・To display more alert, click ▲▼ buttons

・ALM mark will be disappeared when problem have solved

・「－－－－」 means ‘nothing alarm’

7-3-6-2 Error Code

Code	Meaning	Details
E1	CPU Error 1	CPU was hung-up and restarted
E2	CPU Error 2	CPU clock error
E3	EEPROM Error1	ROM data which normally replaced is broken. * This error indicates the data of accumulation, open/close position, PID parameter is broken.
E4	EEPROM Error2	Data loss (Not E3. Mainly settings)
E5	Temperature Sensor Error	Temperature sensor were damaged * Not E15
E6	SW Error	SW has been on over 5 minutes
E7	Input signal Error	Input signal is out of range * Input signal is less than 3.91mA
E8	Actuator Setting Error	Position keeps MAX for more than 30 seconds while output of torque motor is 0 (unconforming). * RA/DA setting is not correct
E9	Output Error	Position keeps 0 for more than 30 seconds while output of torque motor is MAX (unconforming). * Clogging fixed orifice
E10	TORQ value Error	TORQ_MIN or MAX is out of range. * Occur in A-2 tuning
E11	Shut off Error	Input signal is shut off but position does not reach shut off (±1.0%) in 40 seconds.
E12	Full open Error	Input signal is full open but position does not reach full open (more than 99%) in 40 seconds.
E13	Install Error1	Sensor angle is less than - 50°.
E14	Install Error2	Sensor angle is more than 50°.
E15	Temperature Error	Beyond the operating temperature range
E16	PST Error	During PST processing, position does not change.
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

○ Displaying Sequence

To display error code, follow below procedures

LOCK ⏎ LK? ▼ ULK? ⏎ ▼ MANU ▼ WARN ⏎ ERR ⏎

○ Notice

- To display more results of Error, click ▲▼ buttons
- Except E1,3,4 and 16, ERR mark will be disappeared when problem solved
- E1,3,4,16 would not be recovered automatically. Press⏎ button to clear the error code
- 「－－－－」 means 'nothing error'

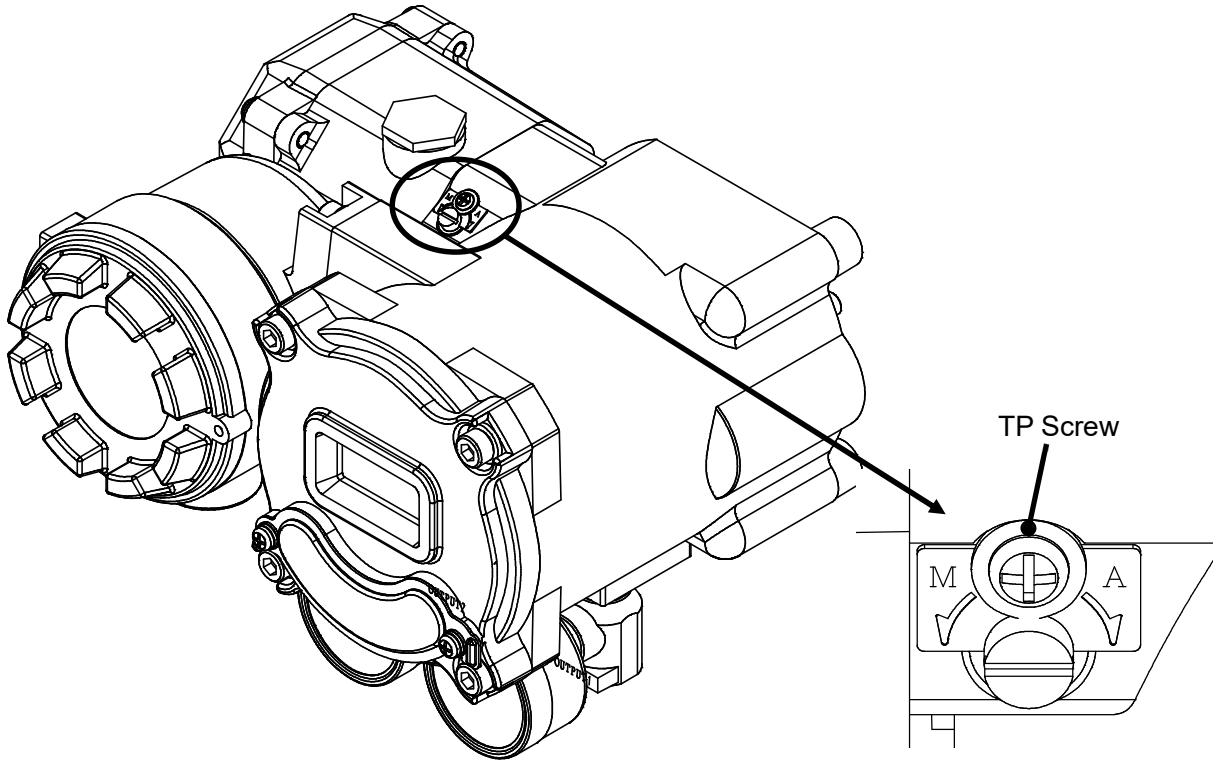
8. A/M Selector (Only for Single action)

To use in manual mode turn the Selector to M (counter-clockwise).The actuator can be operated in manual mode adjusting the supply pressure reduction valve.

※ A/M Selector is left-hand thread.

※ Do not remove or loosen TP screw.

When it is manual operation in state of supplying the input signal, ERR may light up on the LCD. In this case, after returning to the auto, ERR will be off when it comes to the normal control state.



9. Maintenance

Carry out regular inspections for maintenance based on Regular Inspection Manual table.

They can be different for different circumstances. Making your own Regular Inspection Manual is recommended.

・For maintenance of Flame-proof type Equipment, see “ANNEX1”.

－Regular Inspection Manual－

Check point	Interval of Inspection (year)	Details
Pressure gauge	2	Damage, Discrepancy
Fixed orifice ASS’Y	1	Clogging of fixed orifice
Transmission pin, Lever	2	Signs of wear
Pilot relay unit	1	Operating
Terminals		Loose connection

Note1. **Dismantling / reassembling main body cover, sensor, torque motor, terminal box is prohibited, because its Flame-proof function or performance may be damaged.**
When direction changing of the main body cover, it is taken care the clearance of Flame-proof sufficiently.

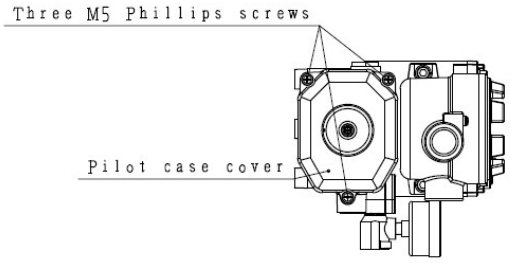
Note2. ① **Dismantling the Pilot Relay Unit can harm the performance. It is prohibited.**
② Be sure to replace pilot relay unit regularly. Keep extra pilot relay unit.
※Considering operation frequency, closing and opening speed (reciprocating motion), ambient temperature and replace the parts flexibly

9-1. Replacing Pilot Relay Unit

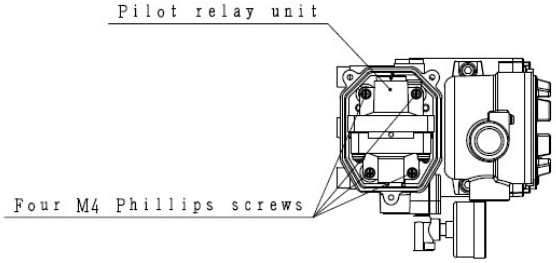
Before replacement work, be sure to shut off the supply air and make sure there is no residual pressure.

Removal

① Remove the pilot case cover after loosen the three M5 Phillips screws.

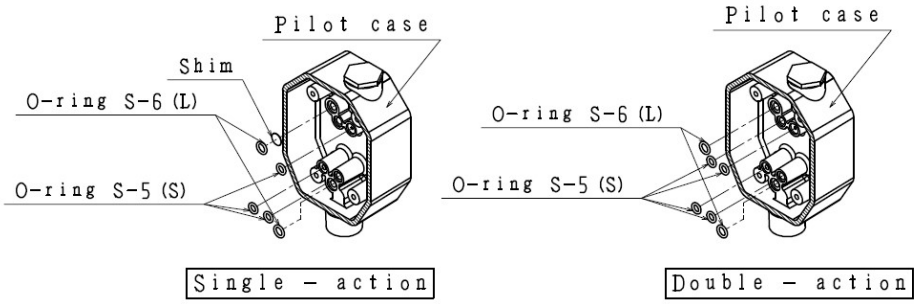


② Remove the used pilot relay unit after loosening the four M4 Phillips screws.



③ Remove the O-rings from pilot case.

[See figures below]



Replacement

① Place the new O-rings to the pilot case.

In case of Single- action, make sure the shim is placed.

If you lost the shim, use the new shim included in the repair kit.

> **Caution! Different numbers of the O-rings and shim are used for Single- action and Double- action.**
> **Please replace them referring to the above figures.**

② Place the new pilot relay unit to the pilot case with the four M4 Phillips screws.

Be careful not to drop the O-ring during work.

③ After the installation of the pilot relay unit, start Auto-tuning.

・Be sure to check the noise during Auto-tuning.

・If the noise is loud, Check the position of O-rings and reinstall the pilot unit.

④ Mount the pilot case cover with the three M5 Phillips screws.

10. Troubleshooting

Issue	Cause	Action
LCD doesn't display	Bad connection	Tighten terminal
	Wrong with + / - wiring	Re wiring
	Breakdown of LCD	Replace circuit board
	Input signal is less than 3.8 mA	Input signal is more than 3.8 mA
Not working	Clogging of fixed orifice	Replace fixed orifice
	Device is in manual mode	Change to auto mode
	Settings were changed	Re tuning
	Broken Wires	Replace broken wires
	Ruptures of diaphragm	Replace pilot relay
	Lack of supply air pressure	Supply prescribed air pressure
Shift the set point	Wear on the levers Levers have worked loose	Replace levers Re-tightening
	Sensor was damaged	Replace sensor
Continuous hunting Not stabilized Heavy overshooting	Mismatching in PID	Re-tuning Adjust manually
	Clogging of fixed orifice	Replace fixed orifice
Poor linearity	The positioner is installed in poor posture	Reinstall positioner Refer to 4. Installation

	Linear and rotary settings are wrong	Modify setting Refer to 7-3-4-6 Actuator

※Perform Sensor Unit and Torque Motor Unit shall be replaced in our factory.
Please contact us when it is necessary.

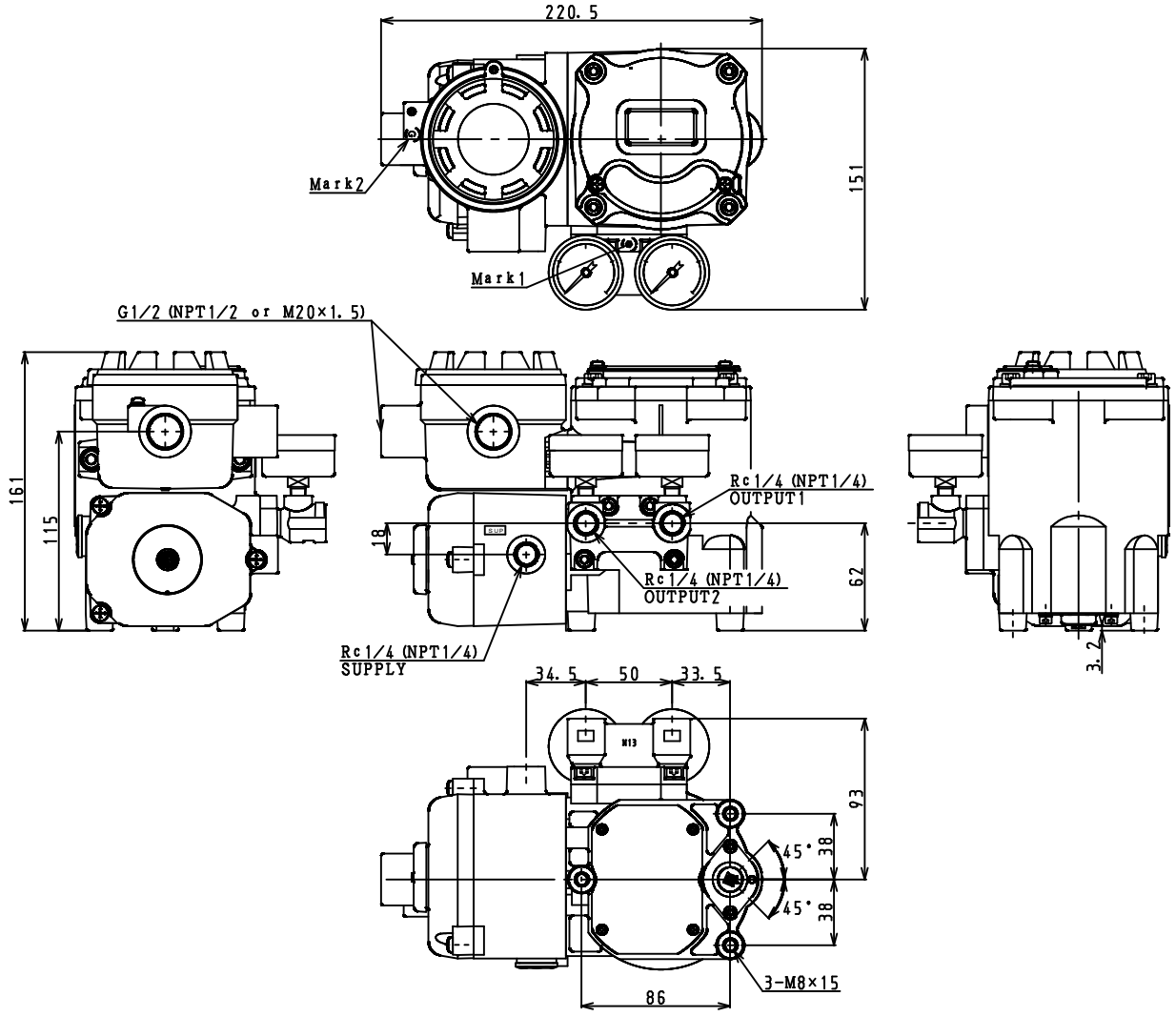
<Feedback signal>

Not working (No output signal)	No power supply Wrong with + / - wiring	Rewiring DC power supply
	The device don't include Feedback signal	Replace device which includes position transmitter
different direction of the output (4-20 mA, 20-4 mA)	Setting is mistaken	Modify setting Refer to 7-3-5-2 Calibration of Feedback signal
Feedback signal is not change (about 1mA)	Input signal is less than 3.8 mA	Input signal is more than 3.8 mA

<HART>

Problem with HART communication	The device don't have HART communication function	Replace device which includes HART communication function

11. Outline Dimension



Air Connection Port

Supply Port	Output Port	Gauge Port	Mark 1
Rc1/4	Rc1/4	Rc1/8	A
1/2NPT	1/4NPT	1/8NPT	B
Rc1/4	Rc1/4	1/8NPT	C

Cable Entry Conduit

Cable Entry Conduit	Mark 2
G1/2	G
1/2NPT	N
M20×1.5	M

12. Model notation

Basic Model

MODEL	Code	Description
UNIT	**MP**	Smart
Series	**1**	100Series
Housing	**0**	Standard Type
	6 ※1	Ex d IIC T6 (TIIS etc.) Ex d IIC T6 Gb (IECEx) Ex db IIC T6 Gb (NEPSI) II 2 G Ex d IIC T6 Gb (ATEX)
Pneumatic piping connection	**1**	Rc(PT)1/4 Single acting
	2	Rc(PT)1/4 Double acting
	3	1/4NPT Single acting
	4	1/4NPT Double acting
External wiring connection	**1**	G1/2 ※5
	2	1/2NPT
	3	M20 × 1.5 ※6
Option	**1**	None
	2	Feedback signal※7
	3	HART※7
	4	Feedback signal and HART communication

Auxiliary Model

MODEL	Code	Description
Ambient Temp. Range ※2	**S**	Standard: −20 to 80℃
		Flameproof: −20 to 60℃
Mounting actuator	**L**	Linear motion
	R	Rotary motion

Additional model

MODEL	Code	Description
Outlet Pressure gauge ※3	**M2**	0.2MPa
	M4	0.4MPa
	M0	1.0MPa
	K2	200kPa
	K4	400kPa
	K0	1000kPa
	P2	30psi ※4
	P4	60psi ※4
	P0	150psi ※4
	B2	2bar
	B4	4bar
	B0	10bar

Note) Standard specifications are indicated in bold, and optional are indicated in fine.

※1 It is different marking and accessories by the standard. Please specify the required standard.

※2 Standard type and Flameproof type are different temperature range.

※3 Contact us for kPa, psi, bar unit (only NPT).

※4 Not available for Japan.

※5 Not available for NEPSI flame-proof.

※6 Not available for TIIS flame-proof.

※7 Feedback signal was discontinued after August 2019
HART communication was discontinued after April 2023

ANNEX1
Instructions about Flame-proof type Equipment

1. Introduction

When using Flame-proof equipment, thoroughly review the notes on this clause, please use it correctly.
Do not open when an explosive atmosphere may be present.

2. Electrical Equipment of Flame-proof Construction

The Flame-proof construction is of completely enclosed type and its enclosure shall endure explosive pressures in cases where explosive gases or vapors entering the enclosure cause explosion.
In addition, the enclosure construction shall be such that flame caused by explosion does not ignite gases or vapors outside the enclosure.

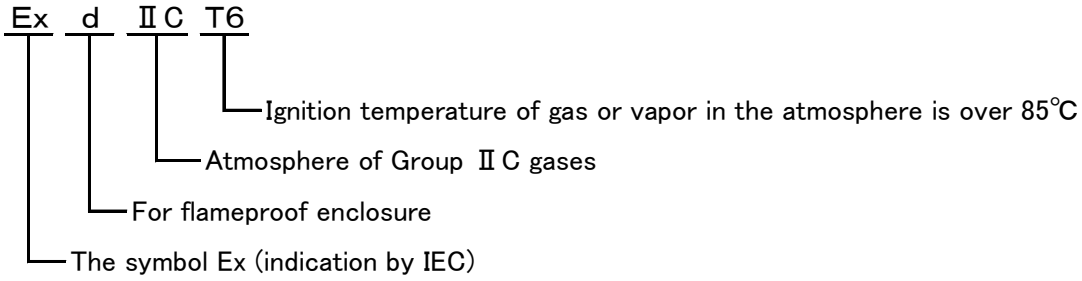
3. Installation of Flame-proof Equipment

For installation, please select according to the following conditions.

(1) Installation Area

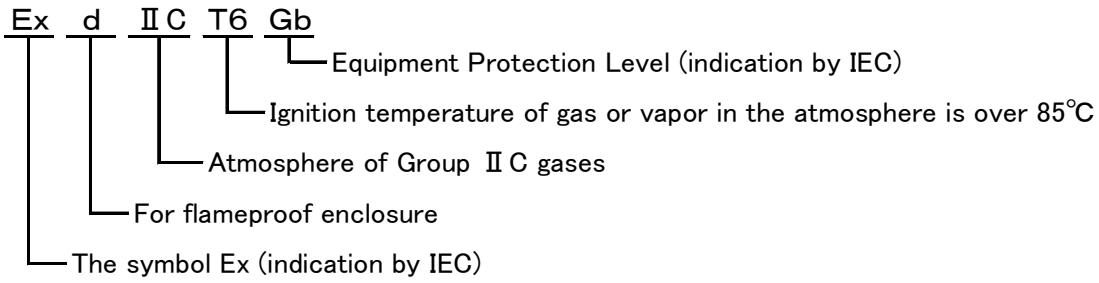
Hazardous area that can be installed in Flame-proof equipment is defined as follows.
Using Flame-proof equipment is listed in the displayed nameplate.
Thoroughly review the specifications, please use it correctly.

【TIIS, KOSHA Flame-proof】



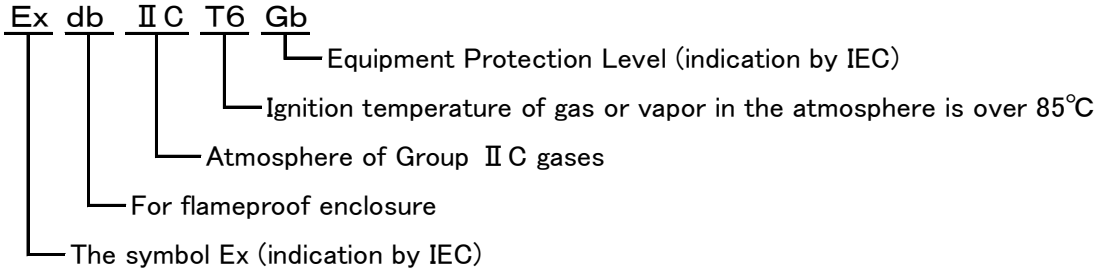
Flame-proof equipment may be installed, with targeted gases, in a hazardous area in Zone 1 or 2.
Flame-proof equipment shall not be installed in a hazardous area in Zone 0.

【IECEx Flame-proof】



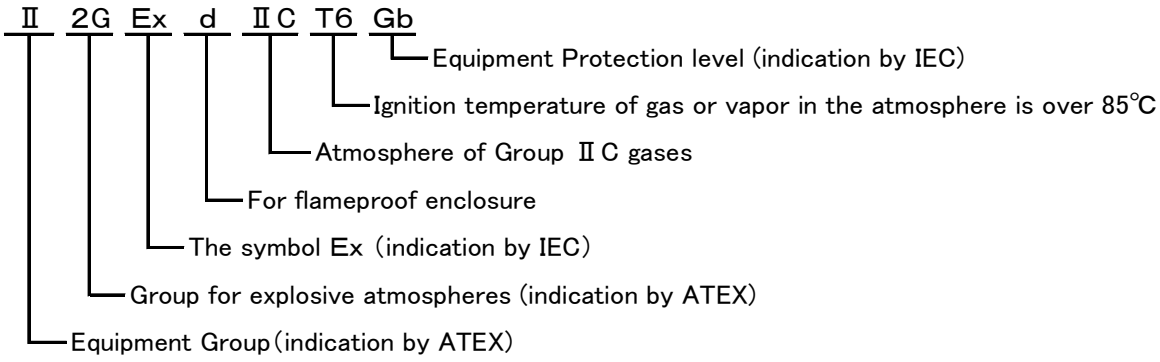
Flame-proof equipment may be installed, with targeted gases, in a hazardous area in Zone 1 or 2.
Flame-proof equipment shall not be installed in a hazardous area in Zone 0.

【NEPSI Flame-proof】



Flame-proof equipment may be installed, with targeted gases, in a hazardous area in Zone 1 or 2.
Flame-proof equipment shall not be installed in a hazardous area in Zone 0.

【ATEX Flame-proof】



Flame-proof equipment may be installed, with targeted gases, in a hazardous area in Zone 1 or 2.
Flame-proof equipment shall not be installed in a hazardous area in Zone 0.

(2) Environmental Conditions

The temperature range for MP100 positioner of Flame-proof type is certified at an ambient temperature range from -20 to +60℃.
This is also indicated on the nameplate.
When using the equipment, please operate in the ambient temperature range.

【NEPSI Flame-proof】

Do not use in environments where aluminum alloy is corroded.

4. Marking

【TIIS Flame-proof】

Following the Labor Safety and Health Laws of Japan, MP100 positioner is certified by Technology Institution of Industrial Safety (TIIS), and approved to use in a hazardous area.

Positioner is certainly installed certification label and equipment nameplate.

- Marking of Flame-proof-

MODEL	MP16
SUPPLY	～
INPUT	4 ～ 20 mADC
OUTPUT	～ mADC (VDC)
AMBIENT TEMP.	-20℃ ≤ Tamb ≤60℃
EXPLOSION PROOF	Ex d ⅡC T6
SER. NO.	20

3S Co., Ltd.
2-6-7, Ukima, Kita-ku,
Tokyo, 115-0051, Japan
See Instruction manual

－Certification Label－

労(平－－.－検
第TC-----号
(株)スリーエス

【IECEx, ATEX, KOSHA Flame-proof】

- Marking of Flame-proof -

CE 0344 KCs

Ex II2G

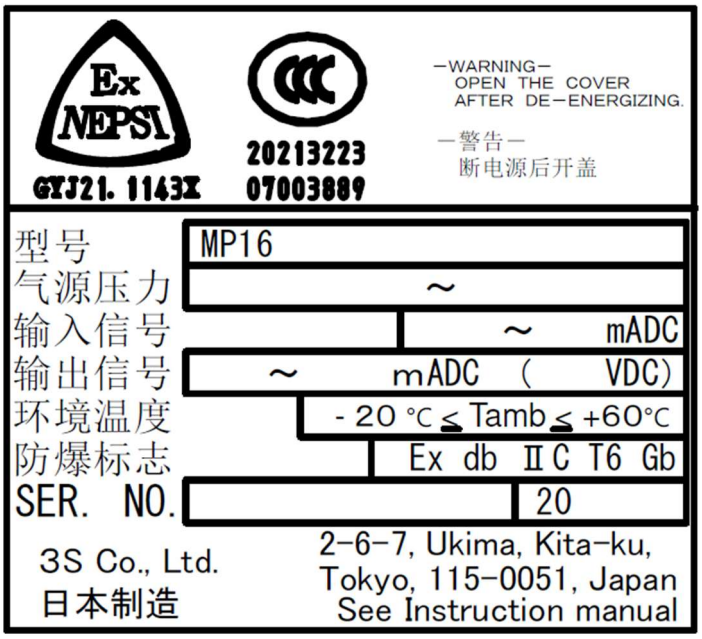
IECEx TIIS 16.0004X
DEKRA 15ATEX0075X
KOSHA 16-AV4BO-0349X

MODEL	MP16
SUPPLY	～
INPUT	4 ～ 20 mADC
OUTPUT	～ mADC (VDC)
AMBIENT TEMP.	-20℃ ≤ Tamb ≤60℃
EXPLOSION PROOF	Ex d ⅡC T6 Gb
SER. NO.	20

3S Co., Ltd.
2-6-7, Ukima, Kita-ku,
Tokyo, 115-0051, Japan
See Instruction manual

【NEPSI Flame-proof】

- Marking of Flame-proof -



5. Wiring of Flame-proof Equipment

【TIIS Flame-proof】

In the case of TIIS (Japanese certificator) flameproof enclosure's regulations, the cable gland and the blind plug has been approved in the state in combination with the equipment. Accordingly, only the cable gland / blind plug specified by us are permitted.

Following table shows cable glands specified by us. From the table, also select a rubber packing size that matches your cable. As for the specified blind plug, a proper one is attached to the product at the factory.

For flameproof enclosure, seal the wiring related gap by applying the cable gland / blind plug described above in the electrical wiring work. Apply a sealant to the threads for waterproofing.

Cable gland

Electrical connection	Cable gland code	Fit cable size	Manufacturer
G1/2	KXBE-16/Packingφ9 KXBE-16/Packingφ10 KXBE-16/Packingφ11 KXBE-16/Packingφ12	φ8.1 to 9.0 φ9.1 to 10.0 φ10.1 to 11.0 φ11.1 to 12.0	Ex-Kokusan
1/2NPT	KXBE-N16/Packingφ9 KXBE-N16/Packingφ10 KXBE-N16/Packingφ11 KXBE-N16/Packingφ12	φ8.1 to 9.0 φ9.1 to 10.0 φ10.1 to 11.0 φ11.1 to 12.0	

※ **After installing the Terminal Box Cover, lock the cover using a set screw required of Flame-proof construction.**

※ **Details of Flame-proof structures can be found in the report "Recommended Practices for Explosion-Protected Electrical Installations in General Industries", issued by the National Institute of Occupational Safety and Health, Japan.**

【IECEx, ATEX Flame-proof】

For Installation, follow the EN/IEC60079-14.

For wiring connection port of positioner, use cable gland and blind plug corresponding to Ex d IIC approved. Please use the cable gland is selected with the correct size to fit the cable used.

Apply a sealant to the threads of the connection port for waterproofing.

For the wiring, please conduct in accordance with national legislation of the country to be used.

When connecting the earth, the cable lug shall be connected between spring washer and plain washer. Please ensure to connect to the earth ground by wire cross section of 4mm^2 or more with ring terminal etc.

【NEPSI Flame-proof】

For Installation, follow the GB3836.13-2013, GB/T3836.15-2017, GB/T3836.16-2017 and GB50257-2014.

For wiring connection port of positioner, use cable gland and blind plug corresponding to Ex db IIC NEPSI approved. Please use the cable gland is selected with the correct size to fit the cable used.

Apply a sealant to the threads of the connection port for waterproofing.

For the wiring, please conduct in accordance with national legislation of the country to be used.

When connecting the earth, the cable lug shall be connected between spring washer and plain washer. Please ensure to connect to the earth ground by wire cross section of 4mm^2 or more with ring terminal etc..

【KOSHA Flame-proof】

For wiring connection port of positioner, use cable gland and blind plug corresponding to ExdIIC approved. Please use the cable gland is selected with the correct size to fit the cable used.

Apply a sealant to the threads of the connection port for waterproofing.

For the wiring, please conduct in accordance with national legislation of the country to be used.

When connecting the earth, the cable lug shall be connected between spring washer and plain washer. Please ensure to connect to the earth ground by wire cross section of 4mm^2 or more with ring terminal etc..

6. Maintenance of Flame-proof Equipment

For maintenance of Flame-proof Equipment, please according to the following.
Details of maintenance, please conducted in accordance with national legislation of the country to be used.

(1) Maintenance

Flame-proof equipment shall not be maintenance with its power turned on.

Always check that there is no explosive gas or vapor in that location to remove the cover (Main body cover or Terminal Box cover) of Flame-proof enclosure with the power on.

※Button Cover and Pilot case cover are not Flame-proof enclosure.

If it cannot be checked whether an explosive gas or vapor is present or not, note the following, no matter the power is on or not.

When adjustment, be sure never to cause mechanical sparks with tools.

Operate the button with bare hands or with conductive gloves.

Be sure to keep the metal button cover closed except when operating buttons.

(2) Repair

If the Flame-proof equipment requires repair, turn off the power and transport it to a safety (non-hazardous) location. For the Flame-proof equipment, the gaps and path lengths of joints and mating surfaces, and mechanical strength of enclosures are critical factors in explosion protection. And the Flame-proof joints are not intended to be repaired. Therefore, the parts (e.g. Glass in the main body cover and terminal box) related to the frame-proof performance is prohibited disassemble. Because there is the fear that cannot keep Flame-proof characteristics and specifications after reassembling it.If any damage occurs (e.g. in threads, joints or mating surfaces, connections between the base and terminal box, locking, external wiring connection), immediately stop using and contact us.

Before starting to service the equipment, be sure to check all parts necessary for retaining the requirements for Flame-proof equipment.

(3) Prohibition of specification changes and modifications

Do not attempt to change specifications or make modifications involving addition of or changes in external wiring connections.

(4) Cleaning

Always clean with a wet cloth, in order to minimize the risk from electrostatic discharge, on maintenance, repair and etc.

Regardless of the presence of explosive gases or vapors, always use a damp cloth to clean the translucent rubber button cover.

(5) Others

【TIIS Flame-proof】

The hexagon socket head cap screw must use what was paid from our company. Such as if it is lost, please contact us.

【IECEx, ATEX, NEPSI, KOSHA Flame-proof】

The hexagon socket head cap screw must use the stainless steel material of property class “A2-70”.

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