



# Operation Manual

SMART POSITIONER (ROTARY TYPE)

PRODUCT NAME

IP8101 Series

MODEL/ Series

**SMC Corporation**

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# Safety Instructions

These safety instructions are intended to prevent hazardous situations and/or equipment damage. These instructions indicate the level of potential hazard with the labels of “**Caution**,” “**Warning**” or “**Danger**.” They are all important notes for safety and must be followed in addition to International Standards (ISO/IEC)<sup>\*1)</sup>, and other safety regulations.

\*1) ISO 4414: Pneumatic fluid power - General rules and safety requirements for systems and their components  
 ISO 4413: Hydraulic fluid power - General rules and safety requirements for systems and their components  
 IEC 60204-1: Safety of machinery - Electrical equipment of machines - Part 1: General requirements  
 ISO 10218-1: Robots and robotic devices - Safety requirements for industrial robots - Part 1: Robots  
 etc.

	<b>Danger</b>	<b>Danger</b> indicates a hazard with a high level of risk which, if not avoided, will result in death or serious injury.
	<b>Warning</b>	<b>Warning</b> indicates a hazard with a medium level of risk which, if not avoided, could result in death or serious injury.
	<b>Caution</b>	<b>Caution</b> indicates a hazard with a low level of risk which, if not avoided, could result in minor or moderate injury.

## Warning

### 1. The compatibility of the product is the responsibility of the person who designs the equipment or decides its specifications.

Since the product specified here is used under various operating conditions, its compatibility with specific equipment must be decided by the person who designs the equipment or decides its specifications based on necessary analysis and test results. The expected performance and safety assurance of the equipment will be the responsibility of the person who has determined its compatibility with the product. This person should also continuously review all specifications of the product referring to its latest catalog information, with a view to giving due consideration to any possibility of equipment failure when configuring the equipment.

### 2. Only personnel with appropriate training should operate machinery and equipment.

The product specified here may become unsafe if handled incorrectly. The assembly, operation and maintenance of machines or equipment including our products must be performed by an operator who is appropriately trained and experienced.

### 3. Do not service or attempt to remove product and machinery/equipment until safety is confirmed.

1. The inspection and maintenance of machinery/equipment should only be performed after measures to prevent falling or runaway of the driven objects have been confirmed.
2. When the product is to be removed, confirm that the safety measures as mentioned above are implemented and the power from any appropriate source is cut, and read and understand the specific product precautions of all relevant products carefully.
3. Before machinery/equipment is restarted, take measures to prevent unexpected operation and malfunction.

### 4. Our products cannot be used beyond their specifications. Our products are not developed, designed, and manufactured to be used under the following conditions or environments. Use under such conditions or environments is not covered.

1. Conditions and environments outside of the given specifications, or use outdoors or in a place exposed to direct sunlight.
2. Use for nuclear power, railways, aviation, space equipment, ships, vehicles, military application, equipment affecting human life, body, and property, fuel equipment, entertainment equipment, emergency shut-off circuits, press clutches, brake circuits, safety equipment, etc., and use for applications that do not conform to standard specifications such as catalogs and operation manuals.
3. Use for interlock circuits, except for use with double interlock such as installing a mechanical protection function in case of failure. Please periodically inspect the product to confirm that the product is operating properly.



# Safety Instructions

## Caution

**We develop, design, and manufacture our products to be used for automatic control equipment, and provide them for peaceful use in manufacturing industries.**

**Use in non-manufacturing industries is not covered.**

Products we manufacture and sell cannot be used for the purpose of transactions or certification specified in the Measurement Act.

The new Measurement Act prohibits use of any unit other than SI units in Japan.

## Limited warranty and Disclaimer/Compliance Requirements

The product used is subject to the following “Limited warranty and Disclaimer” and “Compliance Requirements”.

Read and accept them before using the product.

### Limited warranty and Disclaimer

1. The warranty period of the product is 1 year in service or 1.5 years after the product is delivered, whichever is first.\*2)  
Also, the product may have specified durability, running distance or replacement parts. Please consult your nearest sales branch.
2. For any failure or damage reported within the warranty period which is clearly our responsibility, a replacement product or necessary parts will be provided.  
This limited warranty applies only to our product independently, and not to any other damage incurred due to the failure of the product.
3. Prior to using SMC products, please read and understand the warranty terms and disclaimers noted in the specified catalog for the particular products.

**\*2) Vacuum pads are excluded from this 1 year warranty.**

A vacuum pad is a consumable part, so it is warranted for a year after it is delivered.

Also, even within the warranty period, the wear of a product due to the use of the vacuum pad or failure due to the deterioration of rubber material are not covered by the limited warranty

### Compliance Requirements

1. The use of SMC products with production equipment for the manufacture of weapons of mass destruction (WMD) or any other weapon is strictly prohibited.
2. The exports of SMC products or technology from one country to another are governed by the relevant security laws and regulations of the countries involved in the transaction. Prior to the shipment of a SMC product to another country, assure that all local rules governing that export are known and followed.

## Introduction

IP8101 smart positioner is mounted on a pneumatic rotary type actuator to receive a 2-wire 4 to 20mA DC input current from an adjusting meter, to operate a pneumatic pilot valve and to control motion of the pneumatic actuator by electronic control feedback. Also, it has setting parameters which can optionally change the relation between the input current and actuator opening. This manual is intended to explain how to handle the IP8101 smart positioner.

## Specifications

Table 1 Specifications

Item	Model
	IP8101-03* - *
Input current	4~20mADC *1 (2 wire system, Separate power source unnecessary)
Minimum current	3.85mADC or more
Voltage between terminals	12VDC (Input resistance equivalent to 600Ω, at 20mADC)
Max supply power	1W *2 (I <sub>max</sub> :100mADC, V <sub>max</sub> :28VDC)
Supply air pressure	0.3~0.7MPa
Standard stroke	60° ~100° *3
Sensitivity	±0.2%F.S. or less *4
Linearity	±1%F.S. or less *4
Hysteresis	0.5%F.S. or less
Repeatability	±0.5%F.S. or less
Temperature coefficient	0.05%F.S./°C or less
Max output flow rate	200 L/min(ANR) or more (SUP=0.4MPa) *5
Air consumption	11 L/min(ANR) or less (SUP=0.4MPa) *5
Ambient temperature and operating fluid temperature	-20°C~80°C *6, *7
Explosion protected construction (Option) *8	ATEX Intrinsic safety type of explosion protected construction CE 0344 II 1G Ex h ia II CT4/T5/T6 Ga
Intrinsically safe parameter *8	U <sub>i</sub> ≤28V、I <sub>i</sub> ≤100mA、P <sub>i</sub> ≤0.7W、C <sub>i</sub> ≤12.5nF、L <sub>i</sub> ≤1.5mH
Classification of degree of Protection	JISF8007 IP65 (Conform to IEC Pub.60529)
Communication (Option)	HART communication (preparing)
Air connection ports *9	Rc1/4 female thread、1/4NPT female thread、G1/4 female thread
Electrical connections *9	G1/2 female thread、M20 × 1.5 female thread、 1/2NPT female thread
Material	Body/Cover : Die cast aluminum (Coating : Epoxy organization resin baked)
	Shaft / Screw : Stainless
Weight	Approx 2.6kg

D  
C H  
F J  
C  
E  
E

Table 2. Specifications of options

Item	Model	
	IP8101-0 * 2- *	52-IP8101-0 * 4- * -M
Alarm output1, 2 *10		
Wiring method	2 wire system	
Corresponding standard	-	DIN19234/NAMUR Standard
Power supply voltage	10~28VDC	5~28VDC
Load current	10~40mADC *11	(Constant Current)
Signal status High (Not Active)	R=350Ω ± 10%	≥ 2.1mADC
Signal status Low (Active) *12	0.5mADC or less	≤ 1.2mADC
Response time	50msec or less	
Analog output *13, *14		
Wiring method	2 wire system	
Supply source voltage	10~28V DC	
Output current	4~20mADC	
Load resistance	0~750Ω	
Accuracy	±0.5%F.S. or less *15	

- \*1: 1/2 split range is available as split range setting (parameter code: 300).
- \*2: <Ex.> When applying an input current of 80mA DC, an input power supply voltage of 12.5V DC or less can prevent damage to the positioner.  
 Max. supply power = 80mA DC×12.5V = 1W
- \*3: If the actuator rotating angle is 100° or less, its stroke can be adjusted optionally in a range from 0 to 60° and from 0 to 100°.
- \*4: Linearity is a characteristic checked without loads using our inspection machine. The positioner cannot work independently and is used as a part of loop including actuating equipment such as a valve, actuator and DCS. Therefore, it should be noted that the described characteristic values may vary depending on the loop conditions.
- \*5: (ANR) shows standard air in accordance with JIS B0120.
- \*6: The visibility of LCD display may be reduced at lower temperature. This does not affect the positioner operation.
- \*7: Voltage between terminals depends on temperature change.
- \*8: Intrinsic safety type of explosion protected construction can be selected from “How to Order”. If the explosion protected construction specification is not selected, the product will not have the explosion protected construction.
- \*9: Connections can be selected from “How to Order”.
- \*10: When no input current has been applied, an alarm is output.  
 Fig. 1 shows an internal alarm circuit of the IP8101-0 \* 2- \* (Non explosion protected construction).
- \*11: 10mADC or more load current is needed to operate the main circuit of the internal switch, and it should be 40mADC or less to protect the internal resistance circuit. Therefore, use a power supply voltage and load resistance with a load current of 10 to 40mADC when the output is on. (refer to ■Electrical wiring).
- \*12: The current consumption to drive a main circuit of an internal switch is included.
- \*13: Connect a load resistance with consideration given to the minimum power supply voltage (refer to ■Electrical wiring).
- \*14: If input current is cut while analog output source voltage is supplied, analog output current before the cut is maintained.
- \*15: Analog output accuracy to position value (P value) in the LCD display.

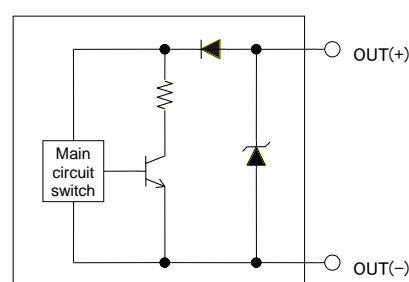


Fig.1

## Parameter Settings List

The IP8101 smart positioner operates at settings suitable for various applications by changing the setting parameters\*1. Table 3 shows the main positioner functions which can be changed. For details of the setting parameters, refer to “■Parameter Code Detail”.

Table 3

Setting parameters	Description	Remarks
(000) Actuator type	• Changes the type of actuator (available for rotary actuators)	Not available to user
(200) Operation direction	• Changes the operation direction between direct or reverse.	-
(300) Split range	• Changes between split range and non-split range.	-
(400) Zero point / span	• Changes the actuator opening at input current 0% and 100% respectively.	-
(500) Forced fully close / fully open	• Changes the input current to open or close the actuator fully with increased force. • Set to ON (fully closed = 0.5% and fully open = 99.5%) at the time of factory shipment.	-
(600) Dead band	• Changes the deviation where the dead band is applied.	-
(700) Valve opening characteristics	• Changes the valve opening characteristics by selecting linearity, equal%, quick open or user settings.	-
(800) PID constant	• Changes the controlling performance of the positioner.	-
(900) Alarm 1	• Changes the actuator opening which receives alarm output 1.	Available as an option
(A00) Alarm 2	• Changes the actuator opening which receives alarm output 2.	Available as an option
(b00) Analog output	• Changes the analog output type between proportional and reversal outputs.	Available as an option
(C00) Calibration	• Provides zero point / span adjustment, automatic PID constant, balance current adjustment and input current calibration.	-

\*1: Change of dead band (parameter code: 600) or valve characteristics (parameter code: 700) may prevent the positioner from satisfying the “■Specifications”.



# Workflow of IP8101 Positioner Setup

The workflow of IP8101 smart positioner from setup to initial adjustment is shown below. Follow this flow when performing setups and adjustments of the positioner.

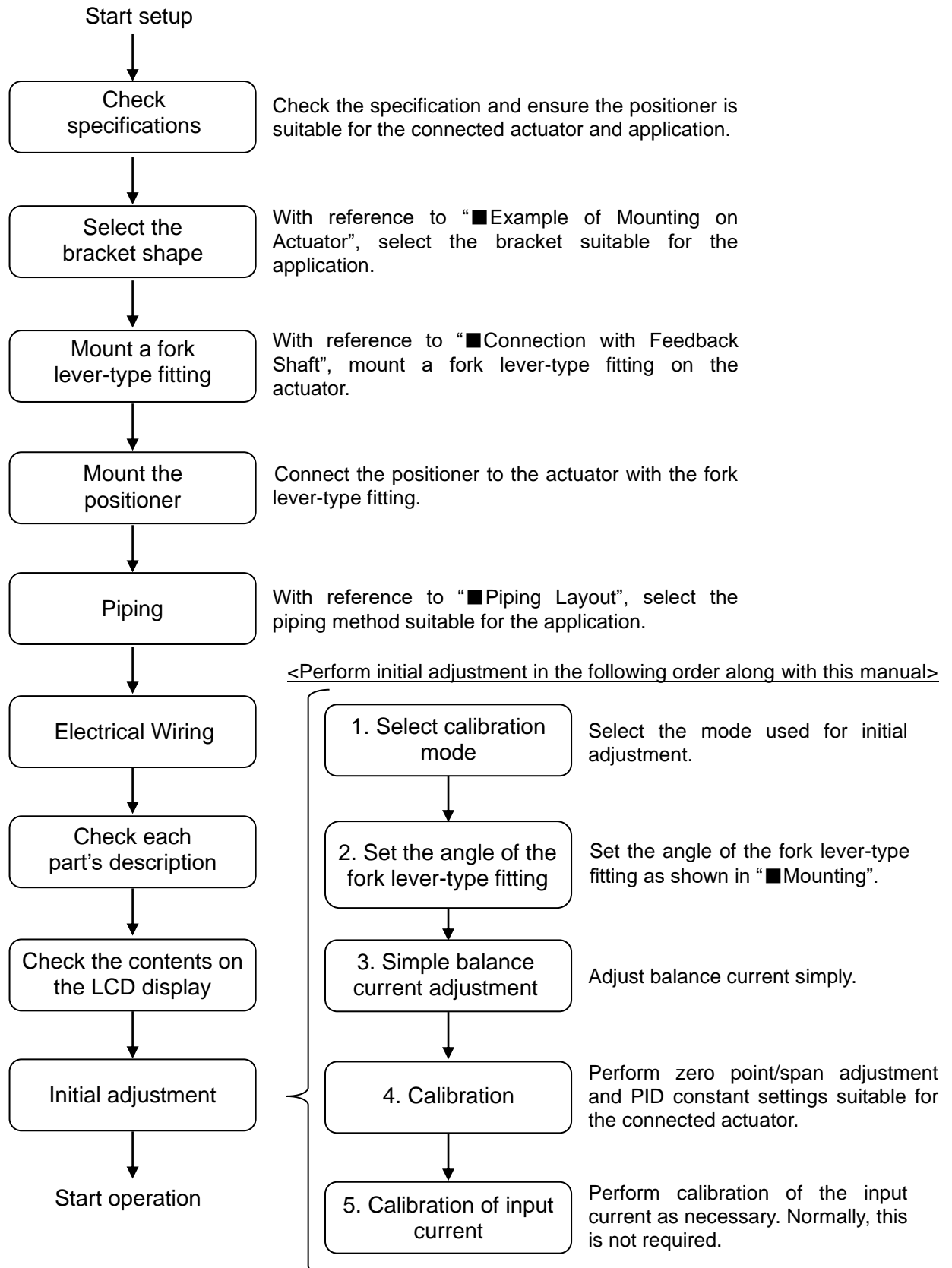


Fig.2

## Operating Principle

When the input current (4 to 20mA DC) increases, the current which is applied to the coil of the torque motor (12) through the input, operation and output processing circuits (8) changes, causing the armature (13) to start rotating with the fulcrum of the leaf spring (11). Along with this, a gap is created between nozzle (6) and flapper (5), and nozzle back pressure decreases.

As a result, the exhaust valve (7) inside of pilot valve (1) moves to the right, pressure at OUT1 increases and pressure at OUT 2 decreases, causing actuator (14) to move. The motion of actuator (14) is transmitted through the fork lever-type fitting, feedback shaft (10) and angle sensor (9). The displacement processing output circuit (8) then matches the input current to the corresponding output position.

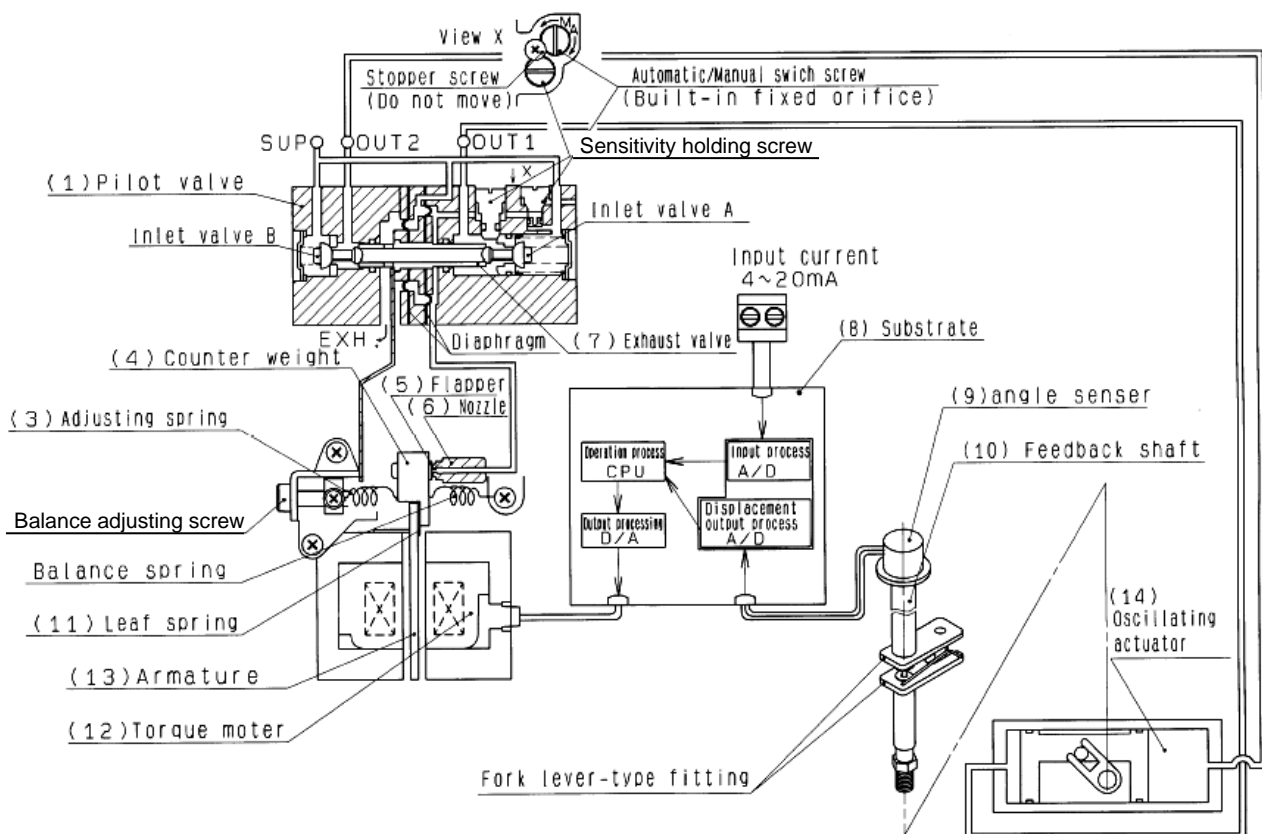


Fig. 3

## How to Operation

B

IP8101 positioner can be operated by two methods, by the operation button (mode, up, down) installed in the positioner and HART communication (option). Refer to this operation manual for the operation with operation button and refer to "HART communication function" in the operation manual separately for the HART communication.

# Mounting

## ⚠ Warning

1. Confirm the positioner is securely and firmly mounted onto the actuator.
2. Be careful not to get a finger caught when matching mounting positions.

## ⚠ Caution

1. Be sure to keep the necessary space available for maintenance work (piping, wiring, adjustment, etc.) in your setup location.
2. Cut off the pressure supply to ensure compressed air is discharged from the positioner and actuator completely before starting mounting.
3. When removing the positioner from the actuator and mounting it onto another actuator, malfunctions may occur due to its remained initial constant. Therefore, when it is mounted onto other actuators, transmit the input signal while cutting the air supply, and be sure to perform Simple balance current adjustment through the calibration mode (parameter code: C20). Then apply the air while biAS is indicated on the LCD and perform the Simple balance adjustment (parameter code: C20) and calibration (parameter code: C30).

B

### ■ Example of Mounting on Actuator

IP610, IP6100 and IP8100 offer interchangeability in mounting pitch with IP8101 smart positioner. Therefore, it is possible to apply a bracket for IP610, IP6100 and IP8100 for mounting\*1. However, if IP6100 is replaced with this positioner and accessory H (with an external scale plate) is selected, it is necessary to lower the position of the fork lever-type fitting.

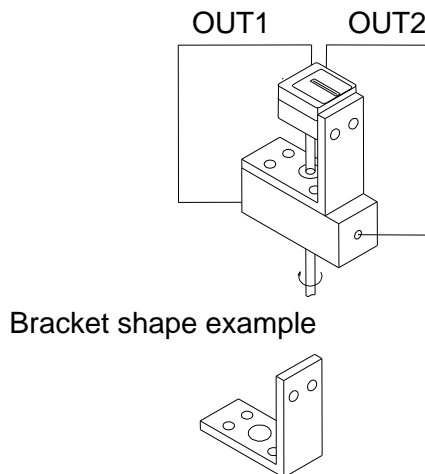


Fig. 4 Example of Screw Mounting to the Side of the Positioner

Mount using the hole on the side face of the positioner and on the top of the actuator.

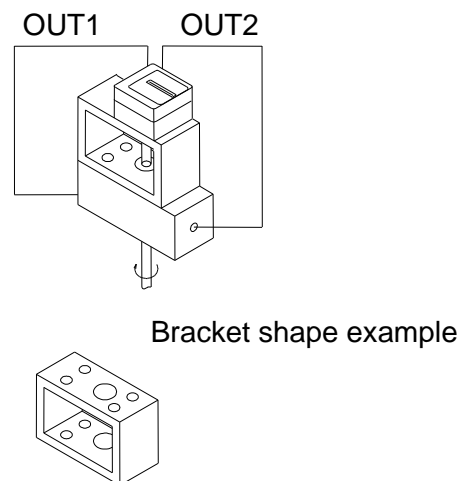


Fig. 5 Example of Screw Mounting to the Back of the Positioner

Mount by using the holes on the back of the positioner and the top of the actuator.

\*1: IP610 and IP6100 have the same mounting pitch as IP8101, but a different mounting height. Watch for interference between the bracket mounting screw and bottom face of the positioner body.

## ■ Connection with Feedback Shaft

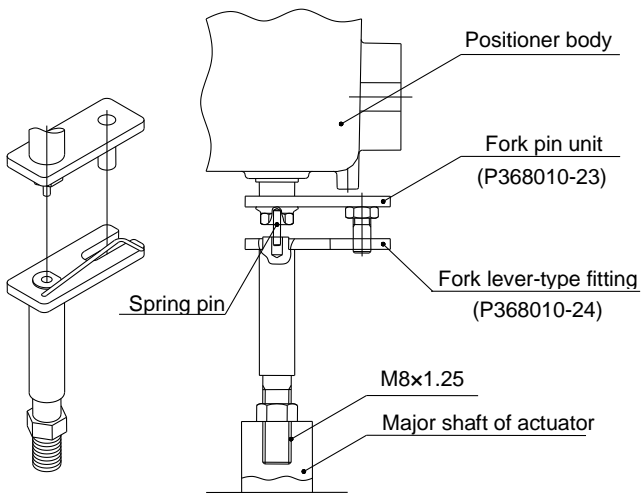


Fig.6

- (1) Screw in a fork lever-type fitting to the major shaft of actuator and adjust its height to avoid interference with the fork pin unit.
- (2) Adjust the angle of the fork lever-type fitting to avoid interference with the positioner body while the actuator is fully opening from a fully-closed condition \*2.
- (3) Mount so that the feedback shaft of the positioner and major shaft of actuator are almost aligned (where the spring pin at the end of the feedback shaft engages with a hole at the end of the fork lever-type fitting axis).

Back View of Positioner Body

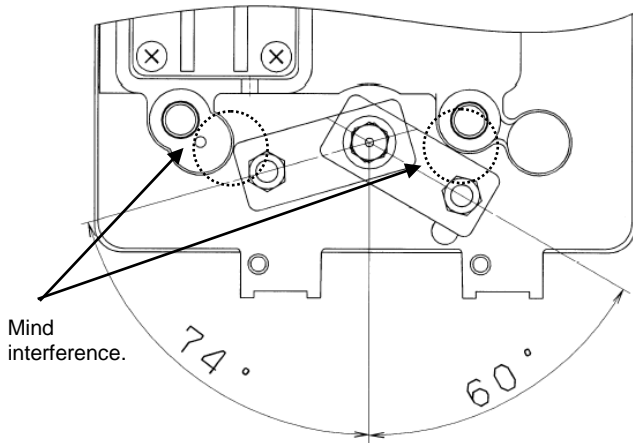


Fig.7

\*2: Fig. 7 shows the details of how to adjust the fork lever angle. Adjust the fork lever angle to avoid interference with the positioner foot when the positioner fork pin unit rotates along with the actuator. Also, the effective angle of the positioner angle sensor is  $\pm 60^\circ$ , and the fork lever-type fitting has to be fixed to remain within that range. The angle can be checked by following the instructions in “2. Adjustment of fork lever-type fitting angle” of “■ Initial Adjustment”.

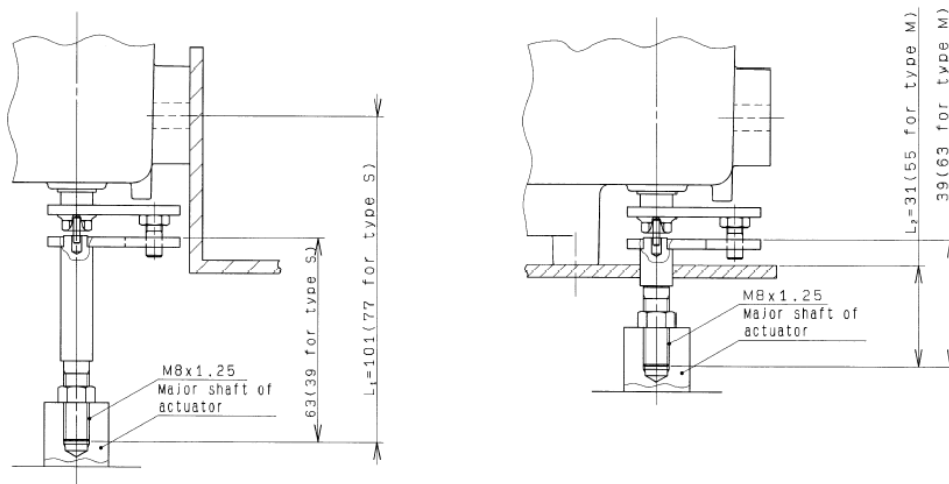
\*3: Pay attention not to apply a strong impact to a feed back shaft of the positioner when the shaft is connected to a fork lever-type fitting. The angle sensor might be damaged due to the strong impact. Do not apply any impact when the positioner and actuator are connected. B

■ Fork Lever-Type Fitting

Since the IP8101 has two means of being mounted, two different kinds of fork lever-type fittings are provided, which are mounted in different ways, depending on the bracket mounting method.

Table 4

Description	Part no.
Fork lever-type fitting M	P368010-24
Fork lever-type fitting S	P368010-25



Example of side mounting using fork lever-type fitting M

Example of back mounting using fork lever-type fitting S.

Fig. 8

For side mounting, the mounting dimensions of fork lever-type fitting M can be adjusted to be interchangeable with IP610. For back mounting, the mounting dimensions of fork lever-type fitting S can be adjusted to be interchangeable with IP610.

■ Body cover

2 types of body cover unit can be selected. These can be ordered for replacement. Cover with window to check LCD is optional.

E

Table 5

LCD check window	Part No.
No window(Standard)	P565010-308
With window(Optional)	P565010-327

## Piping

### Warning

Do not touch near the actuator axis when supplying air after piping.

### Caution

1. Perform sufficient pipe flushing and remove cutting chips, oil and dust from the piping to prevent foreign matter from entering the positioner.
2. When connecting an SMC fitting to an air connection port (SUP, OUT1, OUT2), apply a tightening torque of 12 to 14Nm. The tightening torque must be suitable for the tube fitting in use.

#### ■ Double Acting Actuator

Perform piping on the positioner and actuator in the following manner. Also, when piping in cases where the actuator rotates clockwise with the appropriate parameter setting (dir) (direct operation)\*<sup>1</sup>. For the piping layout, refer to “Double acting” in Table 6.

- (1) Connect the pressure supply piping to the positioner SUP port.
- (2) Connect the OUT1 port of the positioner to the air port of the double acting actuator (which rotates clockwise as pressure increases) and the OUT2 port of the positioner to the air port of the double acting actuator (which rotates counterclockwise as pressure increases).

#### ■ Single Acting Actuator

Perform piping of the positioner and actuator in the following manner. Also, when piping in cases where the actuator axis is located at the end of counterclockwise rotation with a spring force and the actuator rotates clockwise with appropriate parameter setting (dir) (direct operation)\*<sup>1</sup>. For the piping layout, refer to “Single acting” in Table 6.

- (1) Connect the pressure supply piping to the positioner SUP port.
- (2) Connect the positioner OUT1 port to single acting actuator air port.
- (3) Plug the OUT2 port.

\*1: The positioner operating direction can be changed by the parameter settings (parameter code: 200). For parameter details, refer to “■ Parameter Code Details”. At such times, changing the piping is unnecessary. The settings described in this section decide the operating direction via the appropriate parameter settings (dir).

■ Piping Layout

Table 6

	Single action	Double action	
Normal operation	<p>Actuation: The actuator main shaft turns clockwise when the input current increases.</p> <p>OUT2: Plug</p>	<p>Actuation: The actuator main shaft turns clockwise when the input current increases. (Normal action using the reverse actuation drive unit).</p> <p>OUT1: Plug</p>	<p>Actuation: The actuator main shaft turns clockwise when the input current increases.</p>
Reverse operation	<p>Actuation: The actuator main shaft turns counter-clockwise when the input current increases. (Reverse actuation using the normal actuation drive unit).</p> <p>OUT1: Plug</p>	<p>Actuation: The actuator main shaft turns counter-clockwise when the input current increases.</p> <p>OUT2: Plug</p>	<p>Actuation: The actuator main shaft turns counter-clockwise when the input current increases.</p>

# Electrical Wiring

## Warning

1. Be sure to perform electrical wiring with the input current turned off.
2. Be sure to use a ground terminal and perform electrical construction following relevant local regulations.
3. Do not touch around the actuator axis when applying an input current after electrical wiring.
4. Use an input current source (4 to 20mA DC) with a secure 12V DC or greater voltage as close as possible to the input current terminal to avoid voltage drops.
5. Please see “**■**ATEX Intrinsic Safety Type of Explosion Protected Construction (52-IP8101-0□4-□-M). C

### ■ Without Output Function (IP8101-030 and IP8101-033)

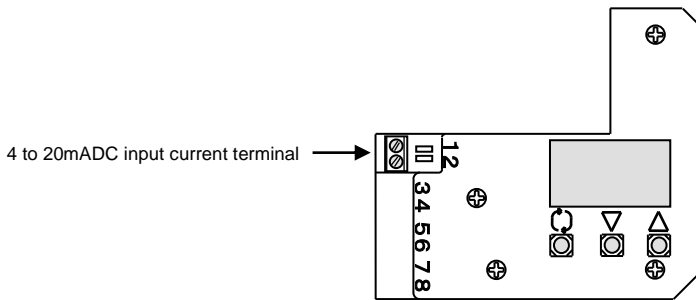


Fig. 9

- (1) Remove the positioner body cover.
- (2) Connect the input current wiring from an adjusting meter (controller) following Fig. 9\*<sup>1</sup>.

### ■ With Output Function (IP8101-032 and 52-IP8101-034)

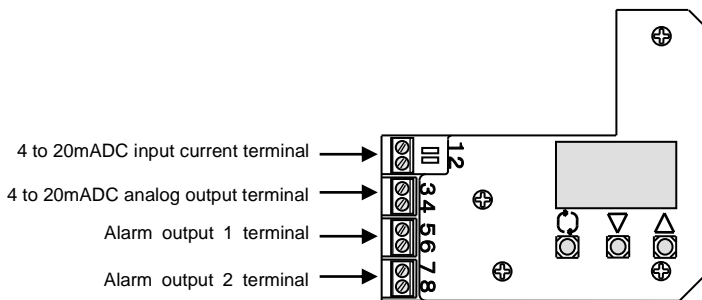


Fig. 10

- (1) Remove the positioner body cover.
- (2) Connect input current wiring from an adjusting meter (controller) and each output wiring following Fig 10\*<sup>1</sup>.

\*1: For the wiring details, refer to “**■**Electrical Wiring”.



## ■Electrical Wiring

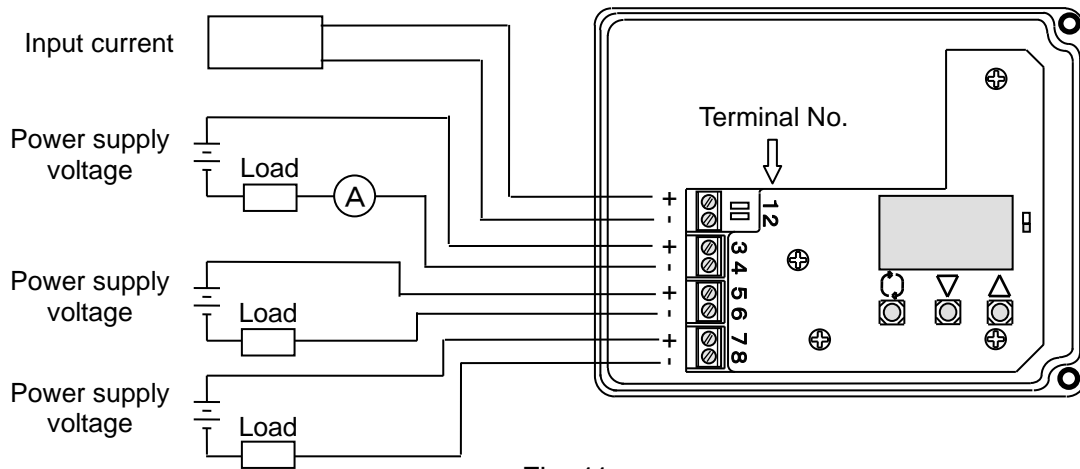


Fig. 11

Table 7

Terminal no.	Description	Electric wire diameter	Remarks
1	4 to 20mA DC input current	It corresponds to the 0.14~1.5mm <sup>2</sup> stranded wire and AWG26-14.	Minimum input current of 3.85mA DC is required for operation.
2			
3	Analog output*2		Output range: 3.85 to 24mA DC
4			
5	Alarm output 1*3		—
6			
7	Alarm output 2*3		—
8			
HART	HART communication	—	—

\*2: Calculate the maximum load resistance compatible with analog output from the specifications table (Table 2) and following equation (Common for both non-explosion protected specification and intrinsic safety type of explosion protected construction specification).

<Ex.: Analog output>

Power supply voltage of  $24\text{V DC}$ ,

Load resistance =  $(24\text{V DC} - 10\text{V DC}) / 24\text{mA DC} = 583\Omega$  (Up to 0 to 583  $\Omega$ )

\*3: Alarm output for non-explosion protected specification requires 10mA DC or more to operate the main circuit of the internal switch, and it should be 40mA DC or less to protect the internal resistance circuit. Therefore, use a power supply voltage and load resistance with a load current of 10 to 40mA DC when the output is on.

<Ex.: Alarm output 1>

Power supply voltage  $24\text{V DC}$  and load resistance  $1\text{k}\Omega$  (+ internal resistance 350  $\Omega$ ),

Load current =  $24\text{V DC} / (1\text{k}\Omega + 350\Omega) = \text{Approx. } 18\text{mA DC}$

\*4: Determination of load resistance of alarm output for intrinsic safety type of explosion protected construction specification.

<Ex.: Alarm output 1>

Power supply voltage  $24\text{V DC}$ ,

Load current =  $24\text{V DC} - 5\text{V DC} / 3.15\text{mA DC} = 6080\Omega$  (Up to 0 to 6.08k  $\Omega$ )

# ATEX Intrinsic Safety Type of Explosion Protected Construction

C

## Warning

1. A positioner must be energized only after wiring via a barrier.
2. Use a linear resistance type barrier based on intrinsically safe parameter for the input circuit.
3. If a positioner is used as intrinsic safety type of explosion protected construction for ATEX, connect it only to the intrinsically safety electric circuit with the following maximum value.  
Parameter (current circuit):  $U_i \leq 28V$ 、 $I_i \leq 100mA$ 、 $P_i \leq 0.7W$ 、 $C_i \leq 12.5nF$ 、 $L_i \leq 1.5mH$
4. This positioner becomes ATEX intrinsic safety type of explosion protected construction when its part number is selected as 52-IP8101-034-\*\*\*. The basic type (IP8101-030-\*), output function type (IP8101-032), and HART communication type (IP8101-033) must not be used in a place with an explosion risk.
5. Positioner has an aluminium alloy enclosure. When used in a potentially explosive atmosphere requiring the use of category 1G equipment, the apparatus must be installed so that, in the event of rare incidents, an ignition source due to impact or friction is excluded.
6. Do not use it in a non-hazardous area where air leakage would cause a risk.
7. If a positioner is used in a hazardous area, speed of the actuating part should be 1m/s or less. The actuator should not have hunting.
8. Make sure to use a grounding terminal, and grounding should be performed based on an electric work policy in each region.
9. The temperature at a positioner surface should not be increased more than the temperature rate by direct sunshine.
10. To maintain explosion protected construction, the electric circuit should not be changed.
11. Safety Barriers used in the positioner supply circuit must be linear resistive output type barriers, in accordance with the I.S. Parameters given in the specifications (see Table 1).
12. Explosion protected cable gland supplied for M20X1.5 electrical connections (for 52-IP8101-034-\*-M) is approved to ATEX II 2GD, but subsequently tested by the notified body in accordance with ATEX II 1GD during certification of the 52-IP8101 positioner.

F

D

D

## ■ATEX Intrinsic Safety type of Explosion Protected Construction

IP8101 type smart positioner has an explosion protected construction which was approved by DEKRA, a notified body for explosion protected certification, as ATEX compliant intrinsic safety type of explosion protected construction. Please pay full attention when it is used as an explosion protected construction specification.

H

## ■Explosion Protected Construction Rate

The 52-IP8101 model is compliant with the ATEX Directive 2014/34/EU, Intrinsically Safe type of Construction, to II 1G Ex h ia II C T4-T6 Ga classification,  $T4/T5 -20^{\circ}C \leq Ta \leq 80^{\circ}C$   $T6 -20^{\circ}C \leq Ta \leq 60^{\circ}C$  according to EN IEC 60079-0:2018, EN 60079-11:2012 AND EN ISO 80079-36:2016, EN ISO 80079-37:2016.

F

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J

## ■Wiring

If 52-IP8101 type smart positioner is used as a intrinsic safety type of explosion protected construction, a barrier must be set at **non-hazardous area** like Fig. 12, and each positioner must have wiring via the barrier. For wiring the positioner 52-IP8101-034-\*-**M/2/5**, the attached cable gland (M20x1.5) should be used for the electrical entry (see Fig. 13). Except for the positioners 52-IP8101-034-\*-**M/2/5**, a cable gland that has the same explosion protected construction rate or better as those positioners.

E

F

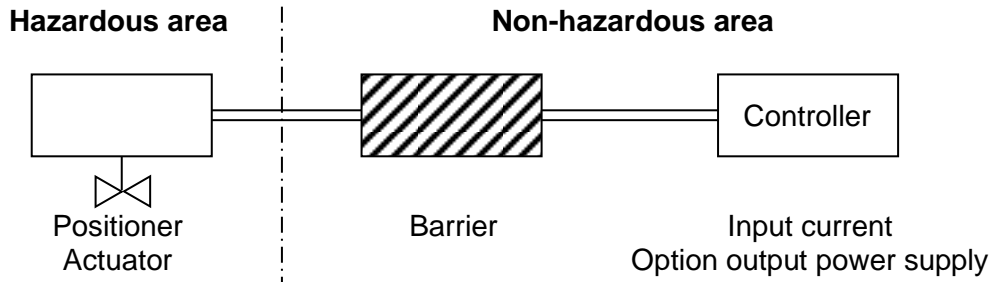


Fig. 12

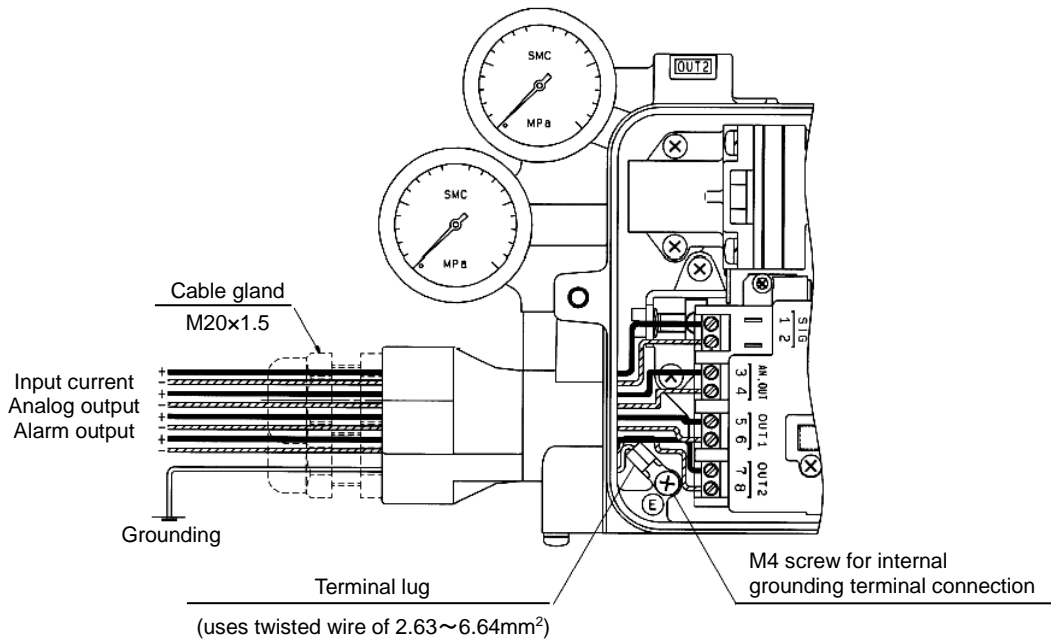


Fig. 13

■Barrier

A user should select a barrier suitable to each function. For an input circuit, use a barrier that is linear resistance type based on intrinsically safe parameters. SMC verifies operation of IP8101 type smart positioner with the barrier shown on Table 8.

G  
L

Table 8

	Manufacturer	Model	Remark
For input current (for non-HART communication)	PEPPERL+FUCHS Inc.	KFD2-SCD2-Ex1.LK KFD2-SCD2-Ex2.LK	-
For input current (for HART communication)		KFD2-SCD2-Ex1.LK KCD2-SCD-Ex1	-
For analog output		KFD2-STC4-Ex1	-
For alarm output		KFD2-SOT3-Ex2	Transistor output passive type
		KFD2-ST3-Ex2	Transistor output active type
		KFD2-SR2-Ex2.W	Relay output

## Description of Components

Fig.14 shows a description of each component.

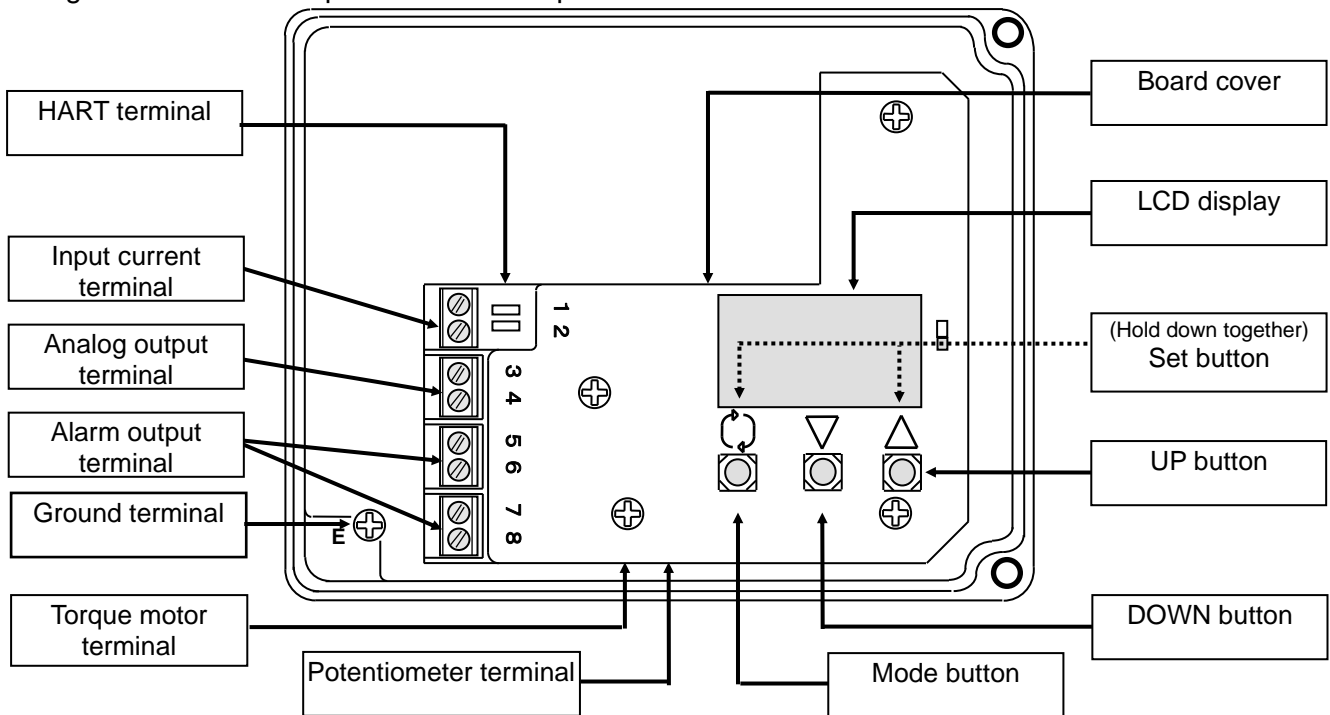


Fig. 14

## Contents of LCD Display

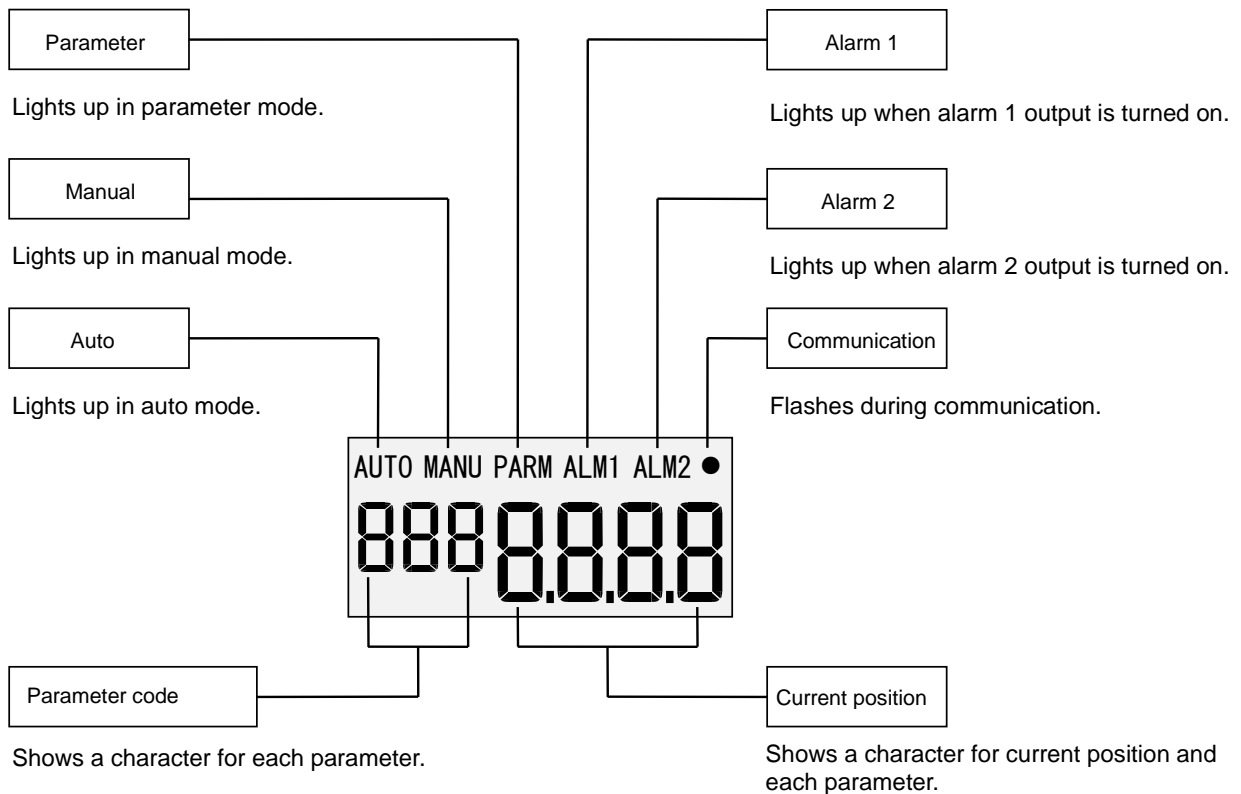


Fig. 15

# Initial Adjustment

## ⚠ Warning

Pay attention to your surroundings when performing the initial adjustment because it causes the positioner to automatically move the actuator.

### ■ Change of Parameters for Initial Operation

When an input current of 4 to 20mA DC is initially applied after purchasing\*<sup>1</sup>, the LCD shows “Not calibrated” (not CAL) because no adjustment is performed after mounting and transferring to auto mode is unavailable (Fig. 20)\*<sup>2</sup>. Perform the initial adjustment according to the following procedure. The initial adjustment is performed by applying an optional input current of 4 to 20mA DC\*<sup>3</sup>. During adjustment, errors may occur. In such cases, hold down the set button (⌂+Δ) for 1sec. or longer to return to the previous calibration mode, and then continue the adjustment referring to the “■ Error Code List”.

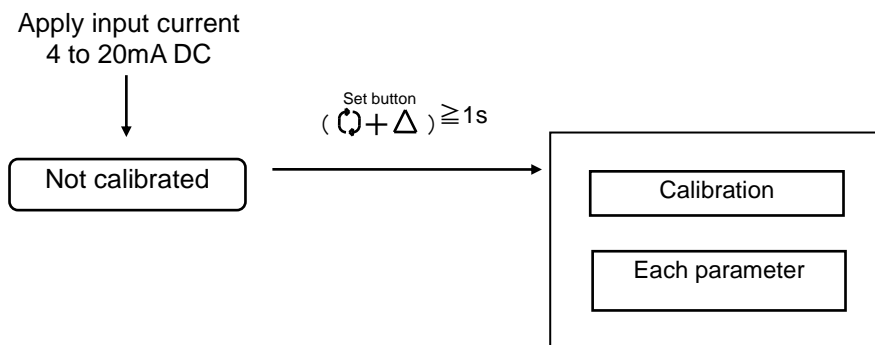


Fig. 16

\*1: For the electric wiring, refer to “■ Electrical Wiring”.

\*2: Until the initial adjustment is complete, the positioner can have each parameter setting, but cannot be operated.

\*3: Do not change the input current during the parameter adjustment.


### ■ Initial Adjustment

#### 1. Selection of calibration mode


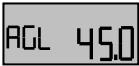
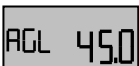
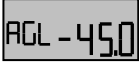

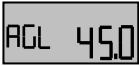
Calibration mode selection used in sections 2 to 5.

	Procedure	LCD
1	Hold down the set button (⌂+Δ) for 1sec. or longer to enter parameter mode from the uncalibrated state (not CAL).	not CAL
2	Press the Down or Up button (▽ or Δ) to select calibration (CAL) and continue to hold down the set button (⌂+Δ).	COD CAL

2. Adjustment of fork  
lever-type fitting angle

	Procedure	LCD
3	Select the parameter used in section 2 to 6 by pressing the Down or Up button ( $\nabla$ or $\Delta$ ) and holding down the set button ( $\odot + \Delta$ ) for 1sec or longer.	

Adjust the angle of the fork lever-type fitting connected to the positioner fork pin unit. Confirm that the actuator operates within -60 to 60 on the LDC display\*<sup>4</sup>.

	Procedure	LCD
1	Apply the input current and supply pressure, press Down or Up button ( $\nabla$ or $\Delta$ ) in calibration mode to select the angle (AnGL), and then hold down the set button ( $\odot + \Delta$ ) for 1sec or longer.	
2	The output of OUT1 is 0MPa* <sup>5</sup> and the actuator is located at its end position. Confirm the LCD displays a number between -60 and +60, and that there is no interference between the actuator and body.	
3	Rotate the pilot valve unit auto/manual switching screw approx. 1/8 turn to the manual side paying attention to the actuator rotation* <sup>6</sup> .	
4	OUT1 output reaches its maximum and the actuator is located at its end position opposite the one in clause 2. Confirm the LCD shows a number between -60 and +60, and that there is interference between the actuator and body.	
5	If the LCD displays bars (----), which means +/-60 is exceeded, at both ends, readjust the fixed position of the fork lever-type fitting.	
6	After confirmation, rotate the auto/manual switch screw to the auto position and tighten it securely. Then, keep pressing a mode button ( $\odot$ ) for 1sec. or more to return to calibration mode selection screen.	

- \*4: The positioner standard stroke is a rotational angle of 60 to 100°. Actuators with a rotating angle of less than 60° or over 100° are not available.
- \*5: A Description of pressure gauges mounted on the positioner are as shown in Fig. 17.

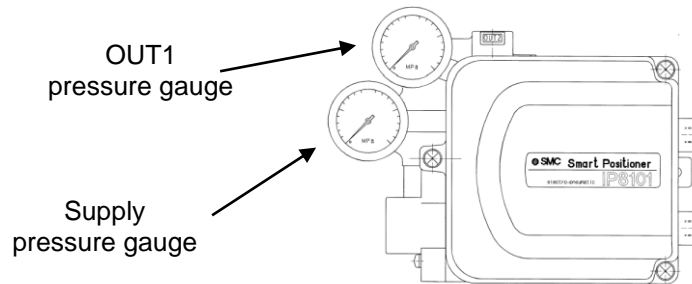


Fig. 17

- \*6: Auto and manual mode can be switched by rotating the pilot valve unit auto/manual switch screw to the manual (M) side as shown in Fig. 18. A small stopper screw in the top is to prevent loosening and must not be tampered with or loosened. Also, a sensitivity holding screw is set prior to factory shipment and must not be accidentally rotated.

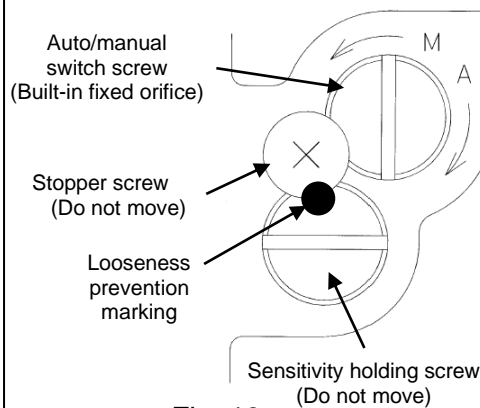


Fig. 18

- Be sure to normally tighten the screw to the auto side (A) when the positioner is operated with an input current.
  - Supply pressure and the OUT1 output are connected by rotating the Auto/Manual changeover screw towards M.
- Manual stroke adjustment of the diaphragm valve and single acting actuator can be adjusted by using the supply pressure setting reducing valve. Mode switching is available by approx. 1/8 turn. Keep the rotation within 1/4 to 1/8 turn.

3. Simple balance current adjustment

Adjust the torque motor balance current simply.

	Procedure	LCD
1	Press the Down or Up button (▽ or △) in calibration mode to select zero adjust (0AdJ), and then hold down the set button (↻+△) for 1sec. or longer.	
2	The LCD displays go (Go) for confirmation. Confirm there are no hazardous conditions due to starting the actuator, and then press and hold down the set button (↻+△) for 1sec. or longer.	
3	The LCD displays bias (biAS). Check the pressure gauge reading at the OUT1 port, and if it is any value other than 0MPa, rotate the balance adjusting screw counterclockwise until the reading reaches 0MPa*7.	
4	Rotate the adjusting screw clockwise gradually checking the pressure gauge reading of the OUT1 port. When the exhaust sound changes and OUT1 pressure begins to increase, stop rotating the balance adjusting screw at the position before OUT1 pressure reaches the supply pressure.	
5	Press and hold down the mode button (↻) for 1sec. or longer to return to the calibration (CAL) mode selection screen.	

\*7: For the balance adjusting screw position, refer to Fig. 19. Adjustments must be made with a flat blade driver. Counterclockwise rotation decreases pressure and clockwise rotation increases pressure.

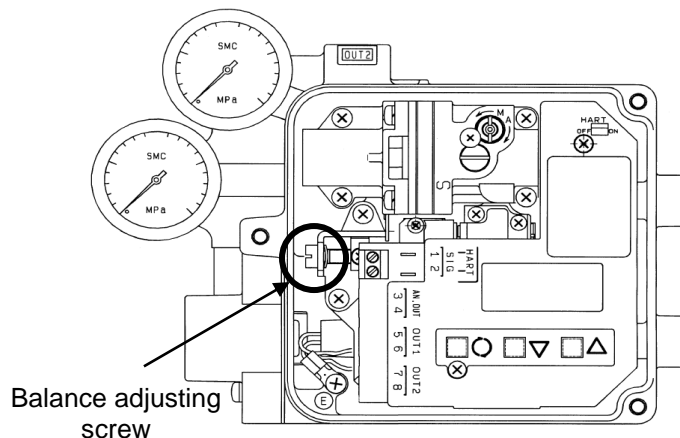


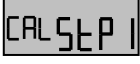




Fig. 19



#### 4. Calibration

Automatically perform zero point / span adjustment and PID constant \*8.

	Procedure	LCD
1	Press the Down or Up button ( ▽ or Δ ) in calibration mode to select calibration (CAL), and press and hold down the set button ( Ⓢ + Δ ) for 1 sec. or longer.	
2	The LCD displays go (Go) for confirmation. Confirm there are no hazardous conditions due to the actuator startup, and then press and hold down the set button ( Ⓢ + Δ ) for 1sec. or longer*9.	
3	Zero point and span adjustment begins, and the actuator performs steps 1 (StP1) to step 3 (StP3) automatically*10.	
4	After the actuator stops, check the LCD. If it shows good (Good), calibration the (CAL) mode selection screen automatically returns and adjustment is finished.	 

\*8: Actuators which take 1 sec. or more per degree after beginning to move can not normally be provided with span adjustment. Such actuators cannot be combined with this positioner, and this fact should be noted.




#### Warning

\*9: When the button is pressed, the actuator is fully opened or closed, so avoid touching the actuator or positioner to prevent injuries. Also, the actuator operates during adjustment and neither it nor the positioner should be touched until adjustment is completely finished.

\*10: Adjustment might take up to 2min. Actual time will vary depending on the actuator capacity.

**Readjust according to the following procedure if the LCD dose not display good (Good) after the adjustment, which means it has not been performed correctly.**

<LCD displays high (HI) or low (Lo) \*11>

	Procedure	LCD
1	When the LCD displays high (HI) or low (Lo), rotate the balance adjusting screw until the LCD displays good (Good) *12,*13.	
2	Press and hold down the set button (⊙+Δ) for 1sec. with good (Good) indicated, and go back to step 3 (StP3) for readjustment.	
3	If the LCD displays good (Good), the calibration (CAL) mode selection screen returns automatically, and adjustment has been completed.	




\*11: 1 to 6 bars (-) are displayed to the side of high (HI) or low (Lo). The number of bars tells how close the current adjustment is to good (Good); Six bars is closest, and one bar is furthest. Rotate the balance adjusting screw clockwise for high (HI) and counterclockwise for low (Lo) until good (Good) displays. When the balance adjusting screw is turned, bars (----) show up to check the adjustment condition. Do not turn the balance adjusting screw until the condition is decided.

B

\*12: If the actuator angle is outside of 50+/-2%, the LCD displays bars (----). Do not rotate the balance adjusting screw until verification is complete.

\*13: Bars (----) continue to display until verification is complete. If the button is pressed before verification, the LDC displays a busy message (bUSy).

<Hunting occurs>

	Procedure	LCD
1	If hunching occurs during adjustment, the PID constant is adjusted to automatically eliminate it.	
2	After hunting has been eliminated, automatically check the balance current.	
3	If the LCD displays good (Good), check the code displayed after 3sec. *14.	

\*14: Perform adjustments while referring to the check code list.

## 5. Input current calibration

Normally, input current dose not need to be calibrated. If input values (S value) have a displacement in auto mode after the above adjustment, input current of 4 to 20mA DC can be calibrated.

	Procedure	LCD
1	Press the Down or Up button ( $\nabla$ or $\Delta$ ) in calibration mode to select signal-zero (S-O).	
2	Apply an input current of 4mA DC and press and hold down the set button ( $\odot$ + $\Delta$ ) for 1sec. or longer.	
3	The LCD displays go (Go) for confirmation. To implement calibration, press and hold down the set button ( $\odot$ + $\Delta$ ) for 1sec. or longer again.	
4	LCD bars (----) are displayed during calibration.	
5	LCD displays pass (PASS) after calibrating the input current has been completed, and the calibration (CAL) mode selection screen returns automatically.	
6	Keep pressing the Down or Up button ( $\nabla$ or $\Delta$ ) in calibration mode and select signal-finish (S-F).	
7	Apply an input current of 20mA DC and press and hold down the set button ( $\odot$ + $\Delta$ ) for 1sec. or longer.	
8	The LCD displays go (Go) for confirmation. To implement calibration, press and hold down the set button ( $\odot$ + $\Delta$ ) for 1sec. or longer again.	
9	LCD continues to display bars (----) during calibration.	
10	The LCD displays pass (PASS) after the input current has been calibrated, and the calibration (CAL) mode selection screen returns automatically.	

# Mode Change on LCD

## ■ Mode Change

According to Fig. 20, press the mode button (  $\odot$  ), UP button (  $\Delta$  ), DOWN button (  $\nabla$  ) and set button (  $\odot + \Delta$  ) to change operation mode.

## ■ Parameter Functioning in Manual Mode

For the position indication (P value), zero / span setting (parameter code: 400) functions as it is.

## ■ Reflection of Changed Content in Parameter mode

The changed content is reflected at the time when the mode moves from parameter to manual, and then moves to auto mode \*1.

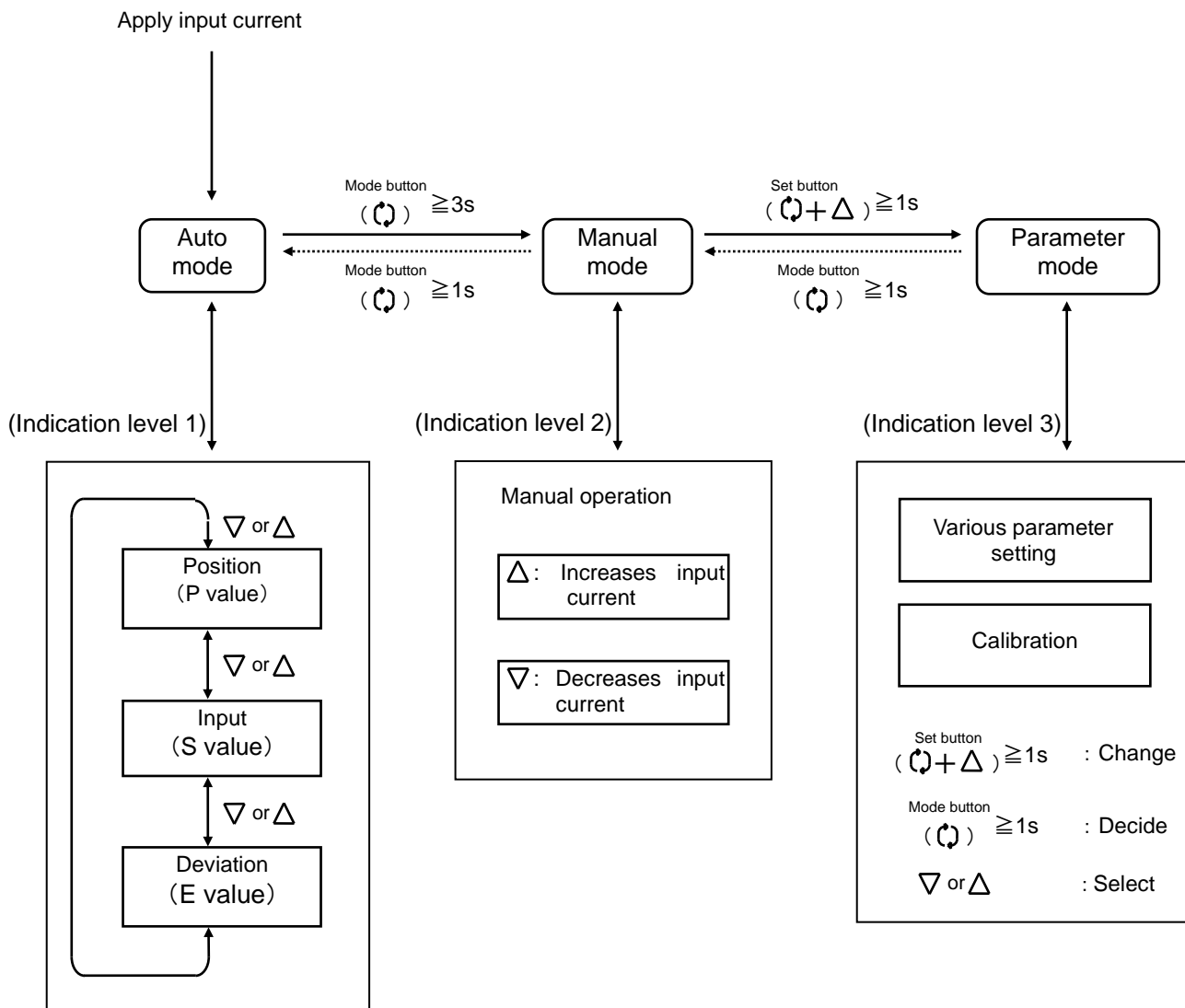


Fig. 20

\*1: If the input current is cut off during the parameter change, the setting value during the change will be deleted. In that case, be sure to return to the parameter mode after restarting the potisioner, and check if the set value is changed. If not, set the value again.

B

## Auto Mode Operation

### ■ Auto Mode

Use an auto mode if controlling an actuator by an input current as a smart positioner.

### ■ Display Switching Method at Auto Mode

LCD display can be switched as follows according to Fig. 21 with the auto mode\*<sup>1</sup>.

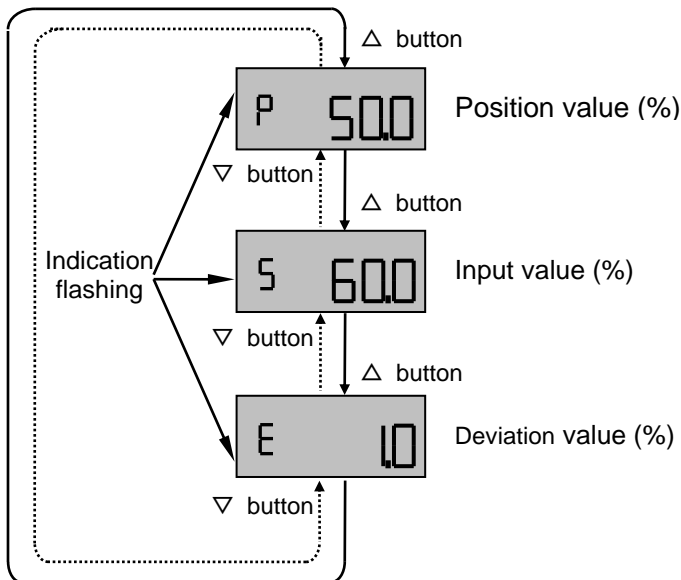


Fig. 21

\*1: Position value (P value) and input value's (S value) indication range is as follows.

P value : -100 to 200  
S value : -50 to 150

## Manual Mode Operation

As it is shown in Fig. 22, the opening of an actuator can be voluntarily controlled by using the down -button and up-button ( $\nabla$  or  $\Delta$ ) in manual mode. While pressing the down -button or the up -button ( $\nabla$  or  $\Delta$ ), the display shows an input value (the target setting value for the actuator). When the button is released, the display shows the position value of the actuator (actual actuator's opening) at that time.

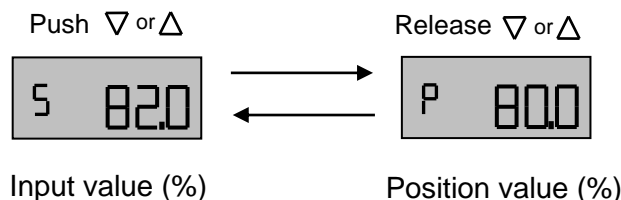


Fig. 22

Up-button: Increases an input value by 1.0% per push  
Down-button: Decreases an input value by 1.0% per push

When each button is pressed for a while, an input value is continuously increased/ decreased by 1.0% for 3sec. After the 3sec., the input value will be increased/ decreased continuously by 2.0%.

# Setting Parameters

## Parameter Code

- (1) When an input current is entered for the first time, only the parameter mode can be selected. According to "Initial Adjustment", calibrate the positioner.
- (2) After (1), the auto mode is displayed first when an input current is entered.
- (3) The parameter code is shown in Fig. 23. The standard product (without any option) has 8 setting items. The product with option output has 11 setting items. Select the parameters in order with the down-/ up -button (▽ or △).
- (4) Parameters stop with parameter codes flashing, and the codes can be changed by pressing the set button (⌂+△) for 1sec. or more. Push the down -/ up-button (▽ or △) to modify a value. After the value is decided, push the mode button (⌂) to go back to the parameter code flashing status\*1.
- (5) To enter the lower hierarchy, press the set button (⌂+△) for 1sec. or more. To go back, press the mode button (⌂) for 1sec. or more, to display a sub menu.
- (6) See the next page, "Parameter Code Detail" for detail of parameter codes.

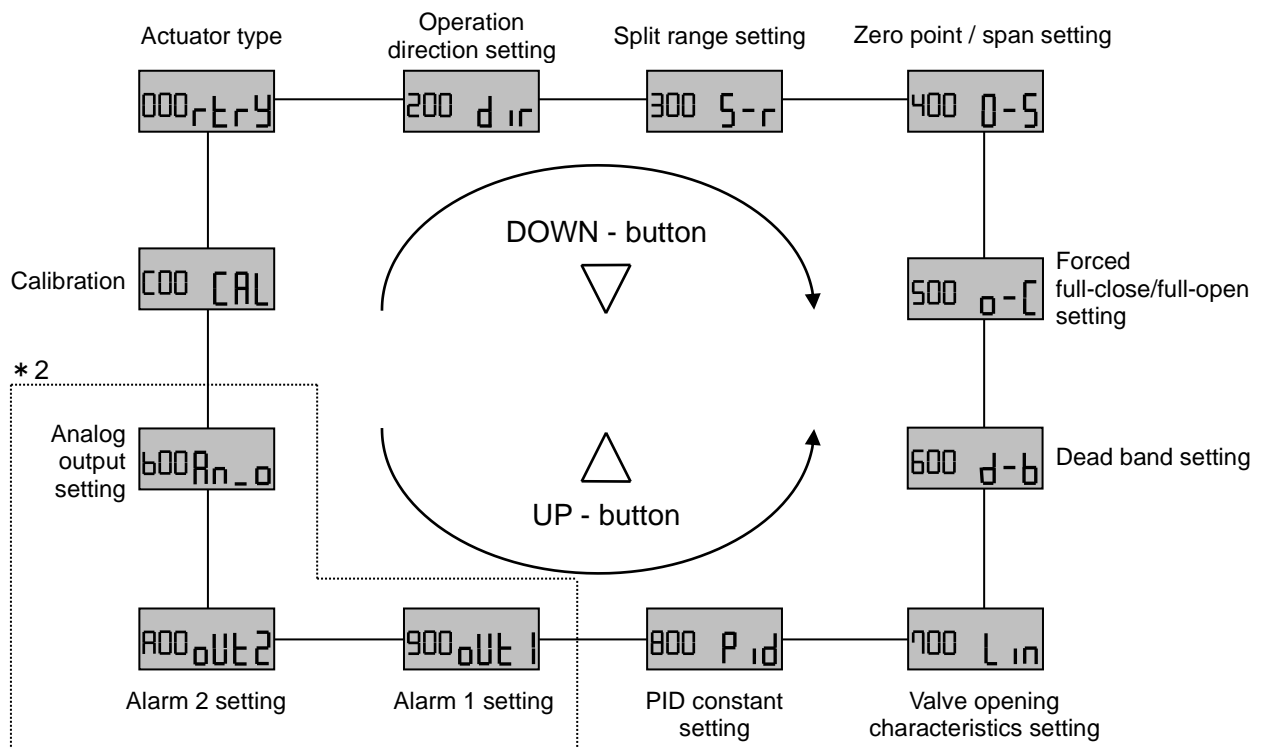


Fig. 23

Set button (⌂+△): to change a code

Mode button (⌂): to set the code

Down-button and up-button (▽ or △): to select parameter

\*1: See "How to Change Values" for modifying a value.

\*2: The parameter surrounded by a broken line in Fig. 23 will not be shown for the standard type (IP8101-0 \* 0) or the product with HART communication (IP8101-0 \* 3).

■ Parameter Code Detail

(000) Actuator type

Displays “rotary (rtry)”. This parameter is fixed when shipped, and cannot be modified.

(200) Operation direction setting

“Direct”<sup>\*3</sup> (dir) or “Reverse”<sup>\*4</sup> (rvS) can be selected. The default when shipped is “direct (dir)”.

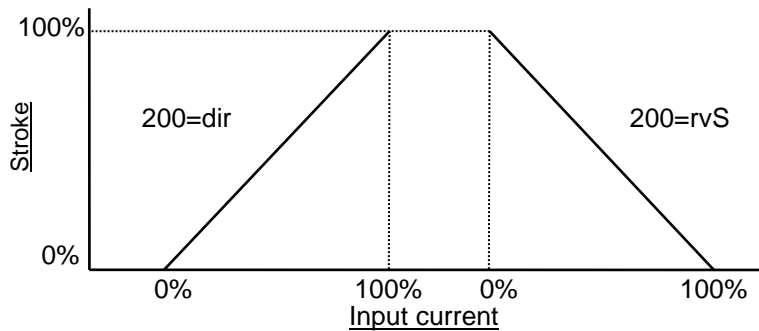


Fig. 24

When the operation direction is modified, it is reflected on each item in accordance with Table 9.

Table 9

Operation direction	Input current (mADC)	Input value (S value) (%)	Position value (P value) (%)	Actuator opening (degree)	Analog output (mADC)
Direct (dir)	4-20	0-100	0-100	0-90	4-20
Reverse (rvS)	4-20	0-100	100-0	90-0	20-4

\*3: Direct direction means an actuator’s operation direction which is determined by air output from “OUT 1” port on the positioner’s body.

\*4: Reverse direction means an actuator’s operation direction which is determined by air output from “OUT 2” port on the positioner’s body.

(300) Split range setting

The split range can be selected by setting ON or OFF. The default when shipped is OFF. If ON is selected, the lower limit (310) (input current range between 0.0 and 80.0%) and the upper limit (320) (input current range between 40.0 to 125.0%) can be set. The default value when shipped is (310) = 0.0%, and (320) = 100.0%. However, the lower limit (310) and the upper limit (320) setting cannot be established unless the following is satisfied.

$$“(320) - (310)” \geq 40.0 \%$$

Example of connecting 2 units of IP8101 (unit 1 & unit 2) if (200)= (dir) is selected:

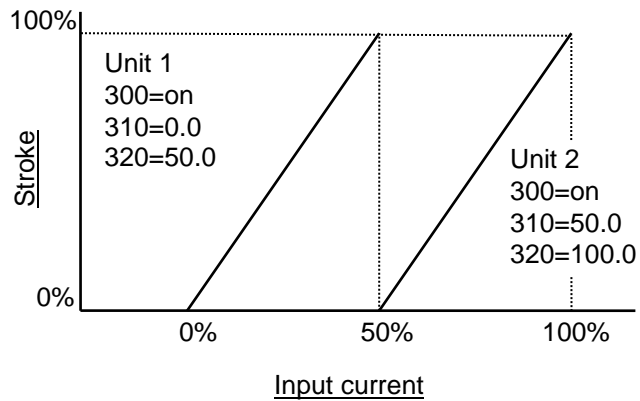


Fig. 25

If the input current range is modified by setting the split range, an input value (S value) is shown with determination of the modified range as 100%. With the settings of (300) = ON, (310) = 0.0, and (320) = 50.0, it is reflected to each item as shown on Table 10.

Table 10

Split range setting	Input current (mADC)	Input value (S value) (%)	Position value (P value) (%)	Actuator opening (degree)	Analog output (mADC)
OFF	4-20	0-100	0-100	0-90	4-20
1/2 split	4-12	0-100	0-100	0-90	4-20



(400) Zero point / span setting

The zero point / span setting can be selected by setting ON or OFF. The default when shipped is OFF. If ON is selected, the lower limit (410) (stroke range between -20.0 and 60.0%) and the upper limit (420) (stroke range between 40.0 to 120.0%) can be set. The default value when shipped is (410) = 0.0%, and (420) = 100.0%. However, the lower limit (410) and the upper limit (420) setting cannot be established unless the following is satisfied.

$$\text{Span to be set : “(420) - (410)”} \geq 60.0 \%$$

Example with 400=ON, 410= 10.0, and 420= 90.0 when (200)=dir is selected:

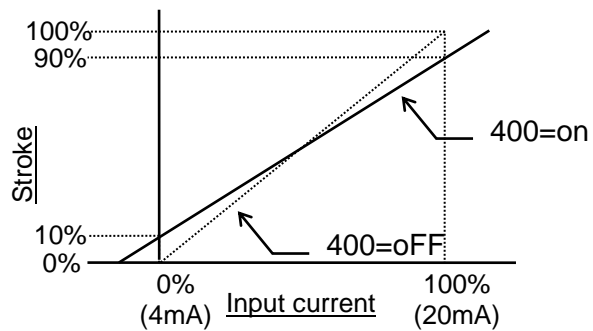


Fig. 26

When this zero point / span setting is conducted, a position value (P value) is shown with determination of the set span as 0-100%. With the settings of (400) = ON, (410) = 0.0, and (420) = 66.6, it is reflected to each item as shown on Table 11.

Table 11

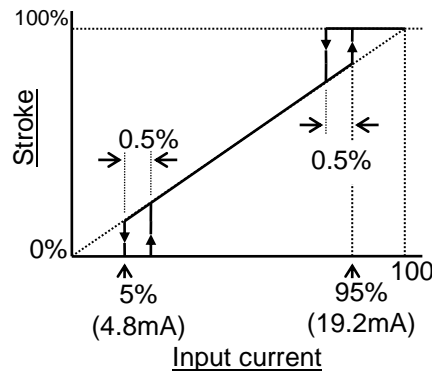
Operation direction	Input current (mADC)	Input value (S value) (%)	Position value (P value) (%)	Actuator opening*5 (degree)	Analog output (mADC)
Direct (dir)	4-20	0-100	0-100	0-60	4-20
Reverse (rvS)	4-20	0-100	100-0	60-0	20-4

\*4: The actuator opening of 90 degrees is taken as an example here.

(500) Forced fully-close/  
fully-open setting \*6

The forced fully-closed / fully-open operation can be selected by setting ON or OFF. The default at shipping is ON. If ON is selected, the fully-closed setting (510) (input current range between -0.0 and 10.0%) and the fully-open setting (520) (input current range between 90.0 to 100.0%) can be set. The default value at shipping is (510) = 0.5%, and (520) = 99.5%.

(Ex.a) Select (200) = dir when  
(510) = 5.0 and (520) = 95.0



(Ex.b) Select (200) = rvS when  
(510) = 5.0, (520) = 95.0

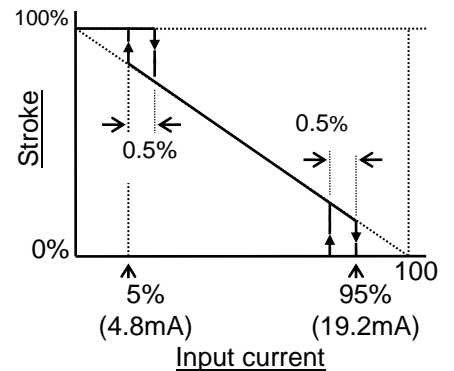


Fig. 27

The forced fully-close/ fully-open setting will follow the input value (S value). The position value (P value) will have no influence on the setting.

\*6: If forced fully-close/ fully-open is set for a small actuator, it may cause a very fast actuator movement. In that case, set the forced fully-close/ fully-open setting at OFF.

(600) Dead band setting

Dead band setting is available. Dead band setting makes the operation near the target value gentle because the integration time (I constant) will be cleared, and that makes stability improved. Dead band can be set in the range between 0.0 and 10.0%. The default value at shipping is 0.0%.

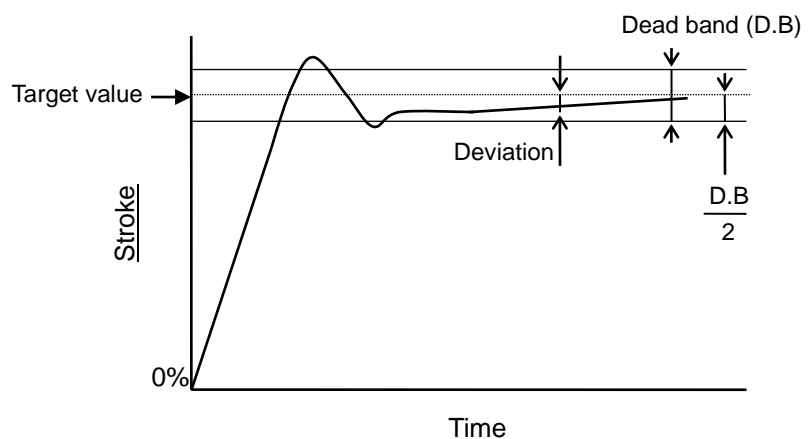


Fig. 28

(700) Valve opening characteristics setting

Valve opening characteristic can be selected from the following.

- (700) = Lin Linear  
 $Y=X$
- (710) = EP25 Equal percentage 1:25 (R=25)  
 $Y=(R^{X-1}-0.04)\times 1/0.96$
- (720) = EP50 Equal percentage 1:50 (R=50)  
 $Y=(R^{X-1}-0.02)\times 1/0.98$
- (730) = qo25 Quick opening 25:1 (R=25)  
 $Y=(1-R^X)\times 1/0.96$
- (740) = qo50 Quick opening 50:1 (R=50)  
 $Y=(1-R^X)\times 1/0.98$
- (750) = USEr User's definition [11 polygonal line settings]

The default value at shipping is (700) = (Lin) Linear. When user's definition (USEr) is set, the following 11 data can be set\*7. However, the setting range is between -20.0 and 120.0%.

- (750) Input current 0% position = 0.0% (Default value)
- (751) " 10% position = 1.0% ( " )
- (752) " 20% position = 4.0% ( " )
- (753) " 30% position = 9.0% ( " )
- (754) " 40% position = 16.0% ( " )
- (755) " 50% position = 25.0% ( " )
- (756) " 60% position = 36.0% ( " )
- (757) " 70% position = 49.0% ( " )
- (758) " 80% position = 64.0% ( " )
- (759) " 90% position = 81.0% ( " )
- (75A) " 100% position = 100.0% ( " )

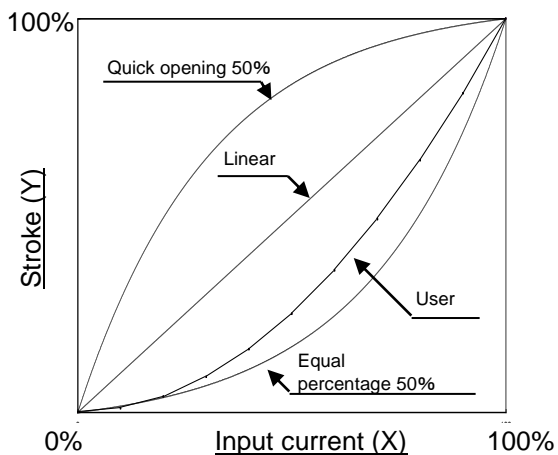


Fig. 29

\*7: Be sure to set all 11 data items.

(800) PID constant setting

PID constant setting is available \*8. Moreover, PID constant can have simple adjustment with 21 steps. The simply adjusted PID constant will change against the detail setting in the rate shown on Table 12 \*9. If more detail adjustment is necessary, calculate a PID constant for simple adjustment based on the ratio on Table 12. With the results, change a value of the detail setting. If these set values are all initialized when automatic calibration is performed.

PID constant for direct (Dir) direction

(811) Proportional gain setting; 0.001 to 9.999

(812) Integrated time setting; 0.000 to 9.999 \*11

(813) Differentiation time setting; 0.000 to 9.999 \*11

PID constant for reverse (ruS) direction

(821) Proportional gain setting; 0.001 to 9.999

(822) Integrated time setting; 0.000 to 9.999 \*11

(823) Differentiation time setting; 0.000 to 9.999 \*11

Simple adjustment for PID constant (EASy)

(831) Proportional gain setting; -10 to 10

(832) Integrated time setting; -10 to 10

(833) Differentiation time setting; -10 to 10

Table 12

	Amount of change when set value is increased/ decreased by 1	
	Set value is 0 or more	Set value is less than 0
Prop. gain	±10%	±10%
Integ. time	±50%	±10%
Deffer. time	±10%	±10%

\*8: When automation calibration is performed, PID constant is automatically set. Change the PID constant if necessary.

\*9: The indication of the detail setting will not change even if the simple adjustment is modified.

\*10: The simple adjustment and the detail setting will interfere with each other. Set the simple adjustment at 0 if the detail setting is conducted.

\*11: The function of integrated operation and differentiation operation is inactivated when integrated time and differentiation time are set at "0.000".

(900) Alarm 1 setting

Alarm 1 can be selected by setting ON\*<sup>12</sup> or OFF. The default at shipping is OFF. In addition, an alarm can be selected from the following with ON selected.

$$(910) = \begin{cases} \text{Lower limit alarm (Lo)} \\ \text{Upper limit alarm (UP)} \end{cases}$$

The default value at shipping is the lower limit alarm (Lo). The alarm (920) (actuator position range between -20.0 to 120.0%) can be set. The default value at shipping is (920) = 0.0%. The setting for alarm 1 will follow the position value (P value). The input value (S value) will have no influence over the setting.

\*12: When an alarm is output, which will be indicated on a LCD indicator. See "■Contents of LCD Display" for detail.

(A00) Alarm 2 setting

Alarm 2 can be selected by setting ON\*<sup>13</sup> or OFF. The default at shipping is OFF. In addition, an alarm can be selected from the following with ON selected.

$$(A10) = \begin{cases} \text{Lower limit alarm (Lo)} \\ \text{Upper limit alarm (UP)} \end{cases}$$

The default value at shipping is the upper limit alarm (UP). The alarm (A20) (actuator position range between -20.0 to 120.0%) can be set. The default value at shipping is (A20) = 100.0%. The setting for alarm 2 will follow the position value (P value). The input value (S value) will have no influence over the setting.

\*13: When an alarm is output, which will be indicated on a LCD indicator. See "■Contents of LCD Display" for detail.

Alarm mode	Alarm output operation
Upper alarm (UP)	
Lower alarm (Lo)	

Fig. 30

(b00) Analog output setting \*14

“Proportional output (inC)” or “Reversed output (dEC)” can be selected. When proportional output (inC) is selected, analog output will increase along with the increase of an actuator’s stroke. When reversal output (dEC) is selected, analog output will decrease along with the increase of an actuator’s stroke. The default value at shipping is (b00) = (inC).

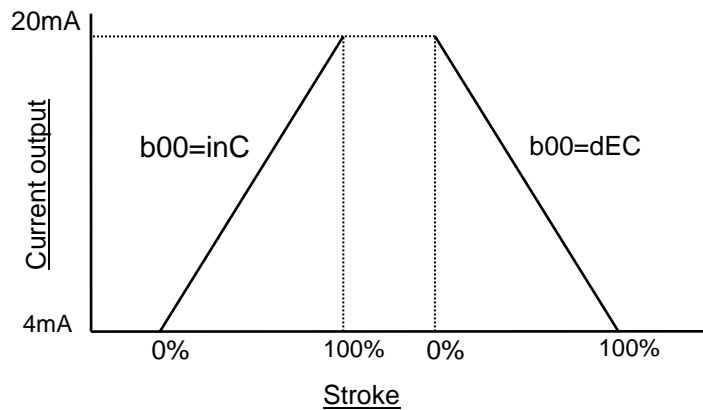


Fig. 31

Setting for analog output will follow the position value (P value). Input value (S value) will have no influence over the setting \*15.

\*14: Note that once the input current is cut-off, analog output value that was previously indicated before the cut-off will be maintained.

\*15: Even if a split range function is utilized, output will be 4 to 20mADC regardless of the customer’s applicable range.

B

## (C00) Calibration

The following can be performed: angle adjustment for a fork lever (AnGL), balance current adjustment (0Adj), automatic calibration (CAL), input current adjustment (S-0) & (S-F), confirmation of balance current (bAL), and span adjustment (SPn).

### (C10) Angle adjustment

A mounting angle of a fork lever-type fitting can be adjusted. Referring to the LCD indication, the fully-closed position / fully-open position of an actuator should be adjusted to be between -60 to 60.

### (C20) Simple adjustment for balance current

Balance current for a torque motor can be adjusted. After rotating a balance adjustment screw until a pressure gauge for OUT 1 indicates 0MPa, rotate the adjustment screw until pressure starts increasing again.

### (C30) Calibration

A fully-closed position and a fully-open position of a mechanical valve can be automatically adjusted\*<sup>16</sup>. Also, PID constant can be automatically set\*<sup>17</sup>.

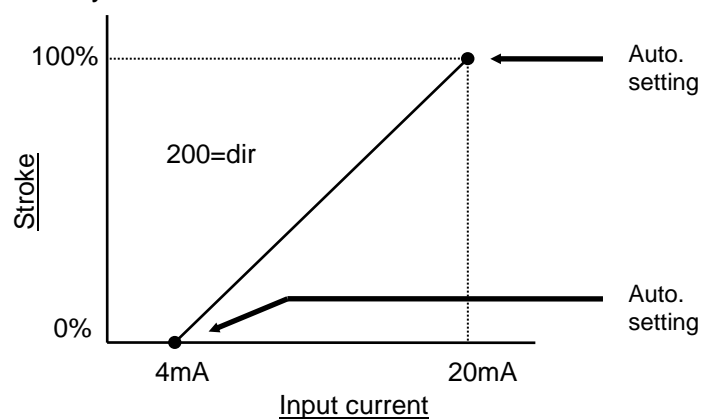


Fig. 32

### (C40) & (C50) Input current adjustment

Input current of 4mADC and 20mADC can be calibrated. Confirm the input value (S value) in the auto mode, and adjust it if 4mADC=0 and 20mADC=100 cannot be achieved. This adjustment is not necessary in general.

### (C60) Confirmation of balance current

Adjustment of balance current can be confirmed. If adjustment is good (Good), the balance current is adjusted correctly. If adjustment is high (HI) or low (Lo), the balance current needs to be adjusted again.

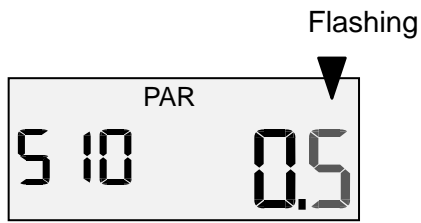
### (C70) Span adjustment

Zero point / span for a positioner can be adjusted. PID constant will not be set unlike automatic calibration (C30). This adjustment is useful when zero point / span needs to be adjusted again with the PID constant set before.

\*16: If operation direction is changed by exchanging piping of OUT1 and 2 with each other after calibration, calibrate a positioner again.

\*17: See "■ Improved Controllability" if hunting with a PID constant set by calibration needs to be performed.

■ How to Change Values



The flashing digit can be changed.

△ button: to increase a value

▽ button: to decrease a value

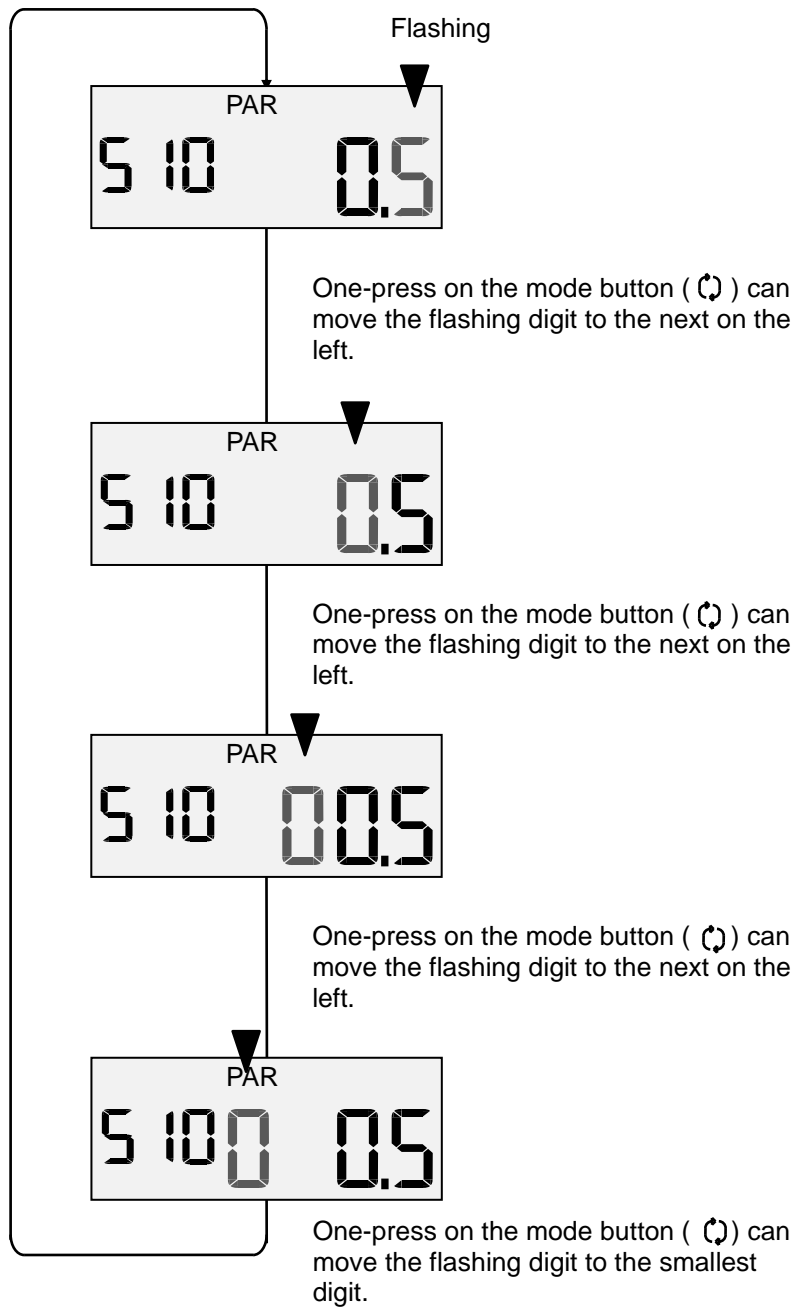


Fig. 33



## Parameter Setting Procedure

(000) Actuator type

This parameter is fixed when shipped out of the factory. User can not change it.

(200) Operation direction setting

Customer can select direct (dir) or reverse (rvs).

	Procedure	LCD display
1	Hold down the set button ( $\text{C} + \Delta$ ) for 1sec. or longer to enter the parameter change mode.	
2	Select direct operation (dir) or reversed operation (rvs) by Down or Up button ( $\nabla$ or $\Delta$ ).	
3	Hold down the mode button ( $\text{C}$ ) for 1sec. or longer.	

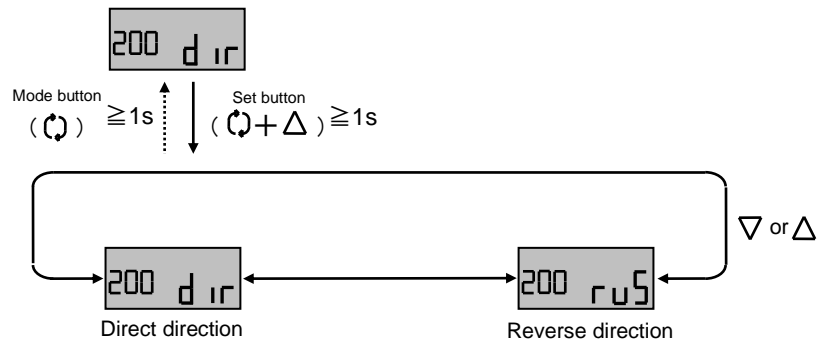


Fig. 34

(300) Split range setting

Possible to select split range mode (on), non split range mode (oFF), and set values when split range mode is selected.

	Procedure	LCD display
1	Hold down the set button ( $\text{C} + \Delta$ ) for 1sec. or longer to enter the parameter change mode.	
2	Select split range mode (on) or non split range mode (oFF) with Down or Up button ( $\nabla$ or $\Delta$ ).	
3	When split range mode (on) is selected, enter the value change mode with the set button ( $\text{C} + \Delta$ ). When non split range mode (oFF) is selected, hold down the mode button ( $\text{C}$ ) to settle the mode.	

	Procedure	LCD display
4	<Hereafter, only when (on) is set> For lower limit setting with (310), hold down set button (⏏+Δ) for 1sec. or more. After value starts flashing, change value within the range of 0.0 to 80.0%. After changing, hold down mode button (⏏) for 1sec. or longer to set the value.	
5	Hold down Down or Up button (▽ or Δ) for 1sec. or longer. As setting lower limit in clause 4 above, set the upper limit within the range of 40.0 to 125.0% with (320). After changing, hold down mode button (⏏) for 1sec. or longer to set the value.	
6	Hold down the mode button (⏏) for 1sec. or longer. Hold down again for 1sec. or longer after interval.	

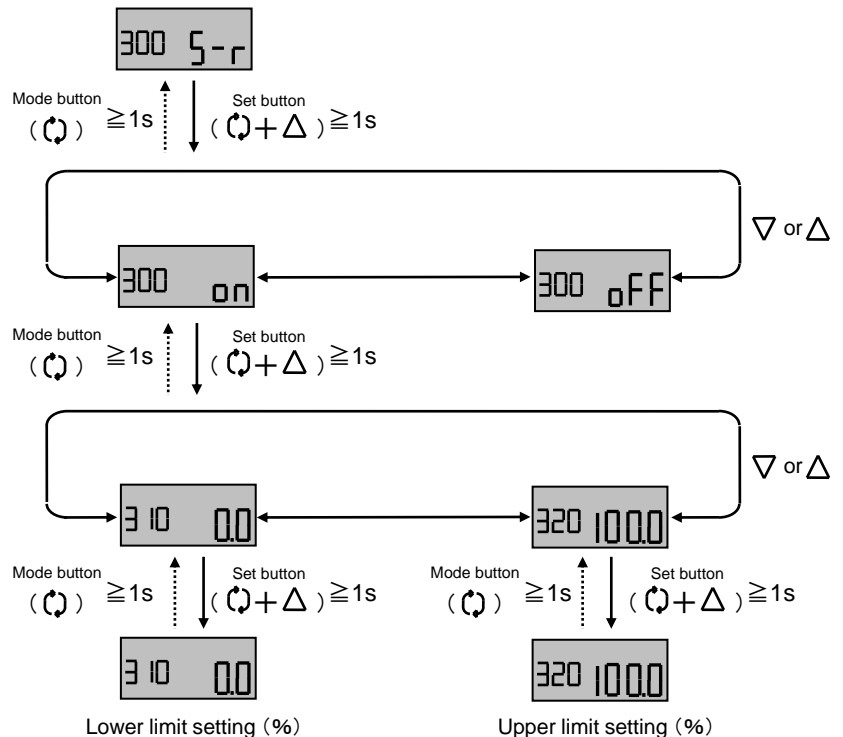


Fig. 35

(400) Zero point / span setting

Possible to select zero point / span mode (on) and non-zero point / span mode (oFF), also change the set value during zero point / span mode.

	Procedure	LCD display
1	Hold down set button (↻+Δ) for 1sec. or longer to move on to parameter change mode.	
2	Select zero point / span mode (on) or non zero point / span mode (oFF) by Down or Up button (▽ or Δ).	
3	Hold down set button (↻+Δ) for 1sec. or longer during zero point / span mode to move on to value change mode. When selecting non zero point / span mode (oFF), hold down mode button (↻) for 1sec. or longer to set the value.	
4	<Hereafter, only when (on) is set> For setting the lower value with (410), hold down set button (↻+Δ) for 1sec. or longer to change the value within the range of -20.0 to 60.0% after the value flashing. After changing, hold down mode button (↻) for 1sec. or longer to set the value.	
5	Hold down Down or Up button (▽ or Δ) to set the upper limit within the range of 40.0 to 120.0% with (420) as setting lower limit with in clause 4 above. Hold down mode button (↻) for 1sec. or longer to set the value.	
6	Hold down the mode button (↻) for 1sec. or longer. Hold down again for 1sec. or longer after interval.	

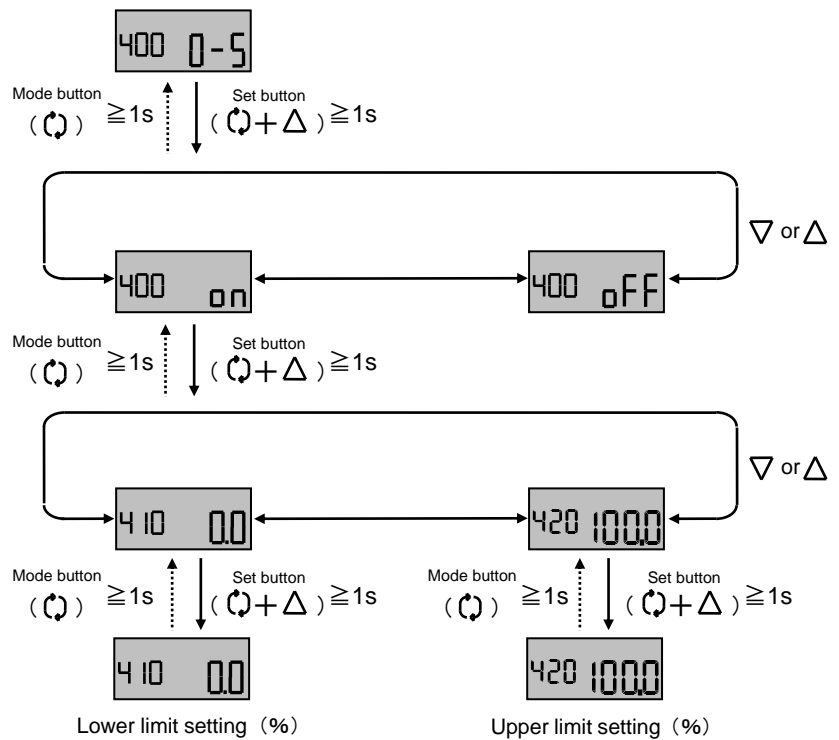


Fig. 36

(500) Forced fully close/  
fully open setting

Forced fully close / fully open is selectable. (on) when the mode is set. (oFF) when the mode is not selected. When selected, set value can be changed.

	Procedure	LCD display
1	Hold down set button (C)+Δ for 1sec. or longer to start parameter change mode.	500 0- [
2	Select forceful fully close / fully open mode (on) or not (oFF) with Down or Up button (▽ or Δ).	500 on
3	When during the mode is selected, hold down set button (C)+Δ for 1sec. or longer to start value change mode. When (oFF) mode is selected, hold down mode button (C) for 1sec. or longer to set the value.	500 on
4	<Hereafter, only when (on) is set> To set lower limit with (510), hold down set button (C)+Δ for 1sec. or longer. After values start to flash, change the value within the range of 0.0 to 10.0%. After changing, hold down mode button (C) to set the value.	5 10 0.0

	Procedure	LCD display
5	Hold down Down or Up button ( $\nabla$ or $\Delta$ ). As clause 4 above, change the upper limit with (520) within the range of 90.0 to 100.0%. After changing, hold down mode button ( $\odot$ ) to set the value.	
6	Hold down the mode button ( $\odot$ ) for 1sec. or longer. Hold down again for 1sec. or longer after interval.	

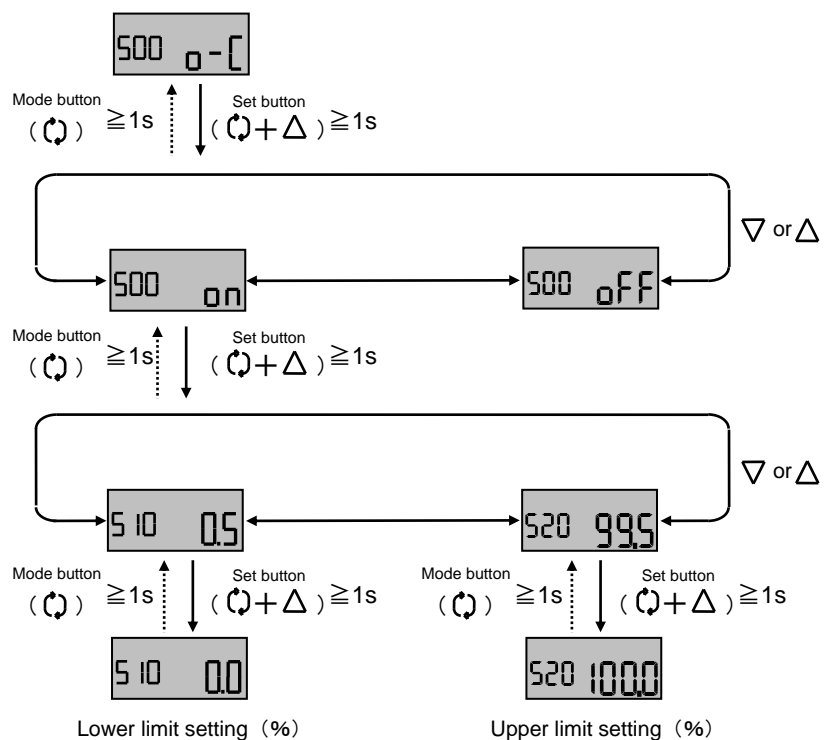


Fig. 37

(600) Dead band setting

Set dead band (d-b).

	Procedure	LCD display
1	Hold down the set button ( $\odot + \Delta$ ) for 1sec. or longer to start parameter change mode.	
2	Hold down the set button ( $\odot + \Delta$ ) for 1sec. or longer. After values start flashing, change the value within the range of 0.0 to 10.0%. After changing, hold down the mode button ( $\odot$ ) for 1sec. or longer to set the value.	
3	Hold down the mode button ( $\odot$ ) again for 1sec. or longer to set the mode.	

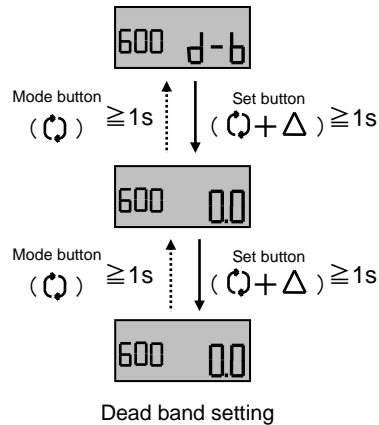


Fig. 38

(700) Valve opening characteristic setting

Valve opening characteristic can be set. The characteristic is plotted by 11 points as specified by user.

	Procedure	LCD display
1	Hold down the set button (C+Δ) for 1sec. or longer to start parameter change mode.	
2	Select from the following by Down or Up button (▽ or Δ). - Linear (Lin) - Equal percent 25 (EP25) - Equal percent 50 (EP50) - Quick opening 25 (qO25) - Quick opening 50 (qO50) - User (USEr)	
3	When selecting other than user (USEr), hold down mode button (C) for 1sec. or longer to select. To select user (USEr), hold down set button (C+Δ) for 1sec. or longer to start value change mode.	
4	<Hereafter, only when user (USEr) is selected> For user specification setting, hold down the set button (C+Δ) with input current parameter for 1sec. or longer. After values start flashing, change the value within the range of -20 to 120.0%. After changing, hold down mode button (C) for 1sec. or longer to set the value.	

	Procedure	LCD display
5	Hold down Down or Up button ( $\nabla$ or $\Delta$ ) to set remaining 10 inputs as in clause 4.	
6	Hold down the mode button ( $\odot$ ) for 1sec. or longer. Hold down again for 1sec. or longer after interval.	

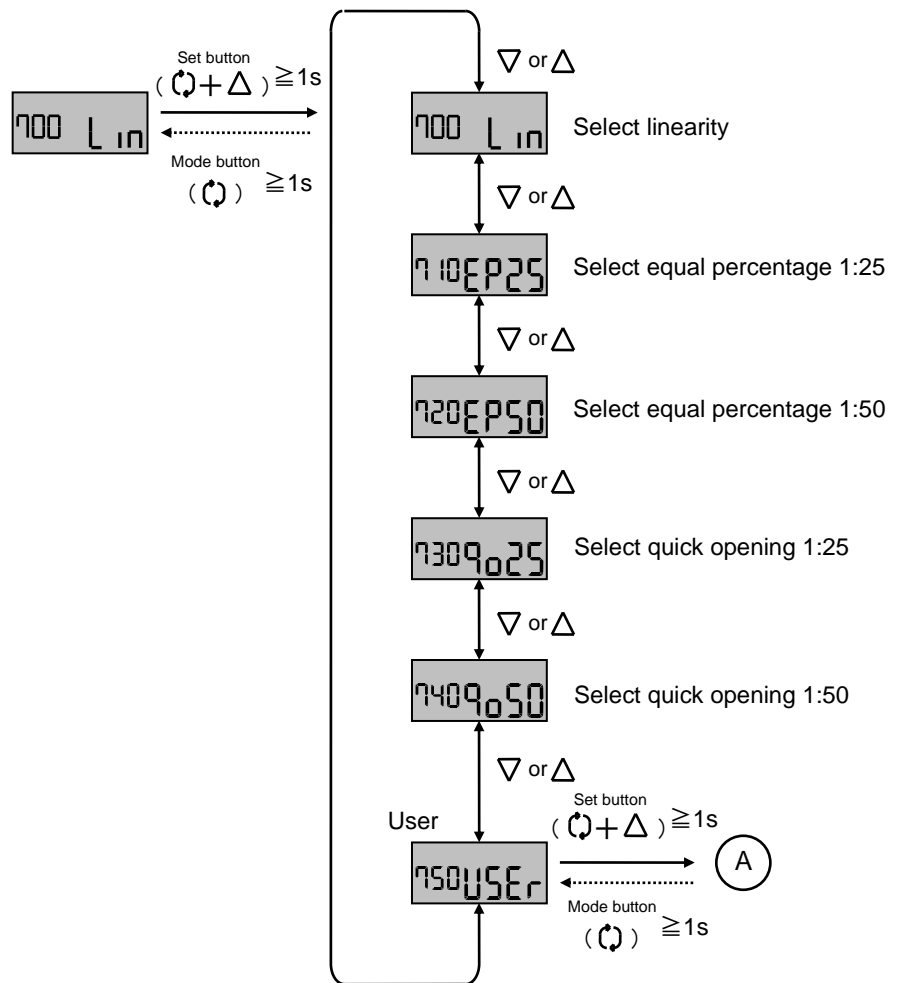


Fig. 39

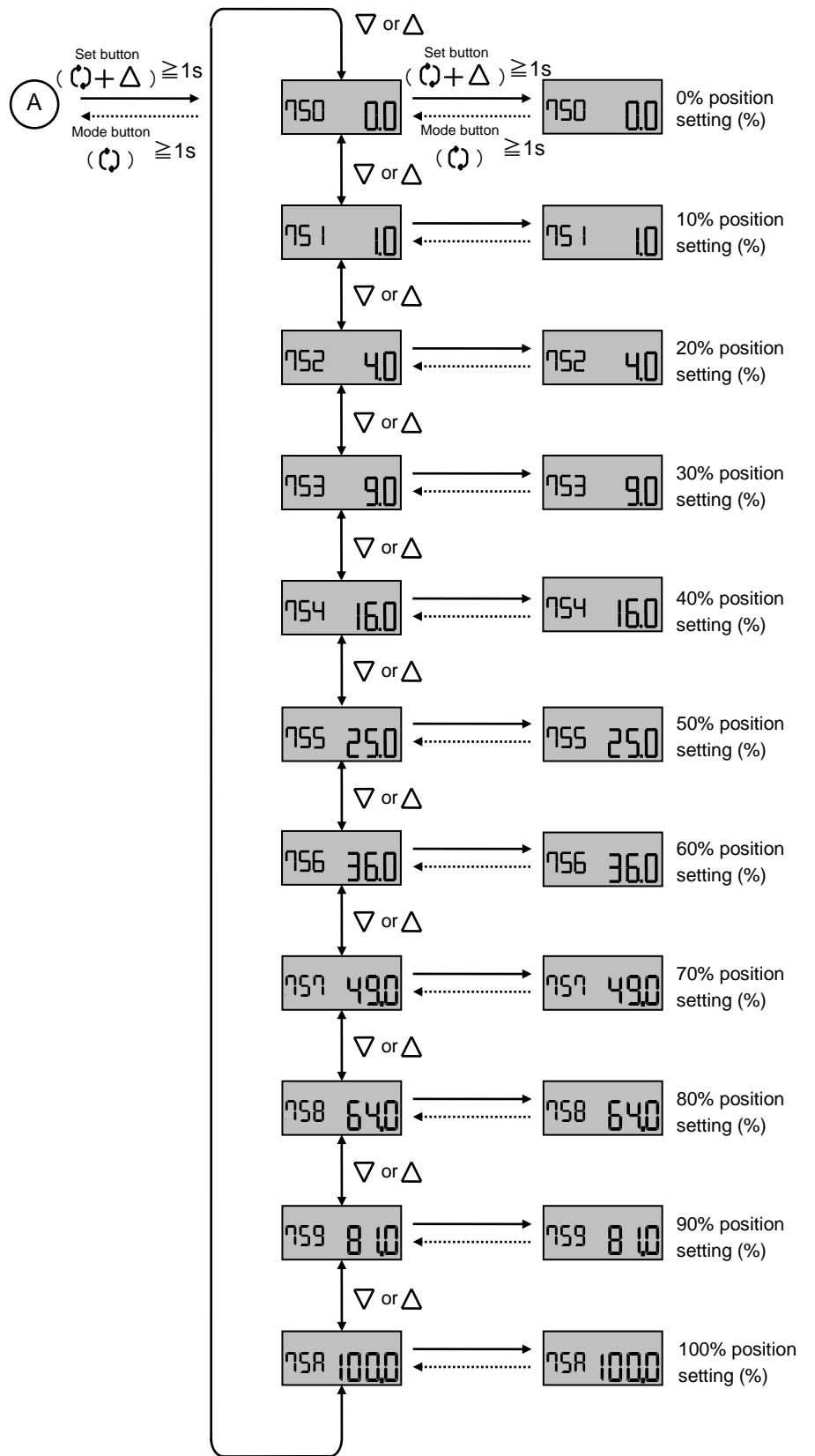


Fig. 39-1



(800) PID constant setting

PID constant setting is possible. Direct direction (Dir) and reverse direction (ruS) are settable individually. Easy adjusting is also possible. For adjustment, see “■ Improved controllability”.

< (810/820) PID constant of detail setting >

Although PID constant is automatically adjusted during span adjustment, direct direction (Dir) and reverse direction (ruS) are settable individually.

	Procedure	LCD display
1	Hold down the set button (↻+Δ) for 1sec. or longer to start parameter change mode.	800 P id
2	Select (Dir) by Down or Up button (▽ or Δ). Hold down set button (↻+Δ) for 1sec. or longer to start value change mode.	810 d ir
3	To set proportional gain (P constant) with (811), hold down the set button (↻+Δ) for 1sec. or longer. After values start to flash, change the value within the range of 0.001 to 9.999. After changing, hold down the mode button (↻) for 1sec. or longer to set the value.	8114.400
4	Hold down Down or Up button (▽ or Δ). As setting proportional gain (P constant) in clause 3 above, set integral time (I constant) within the range of 0.000 to 9.999 with (812), and set differential time (D constant) within the range of 0.000 to 9.999 with (813).	8120.100
5	Hold down the mode button (↻) for 1sec. or longer to return to parameter change mode	8130.250
6	Hold down Down or Up button (▽ or Δ) to select reverse direction (ruS). Hold down the set button (↻+Δ) for 1sec. or longer to start value change mode.	820 ruS
7	Repeat clause 3 to 5 to set PID constant as setting direct direction (Dir).	8214.400
8	Hold down the mode button (↻) for 1sec. or longer. Hold down again for 1sec. or longer after interval.	820 ruS

< (830) Easy adjustment of PID constant >

Possible to change PID constant. Setting has to be zero if adjustment is not necessary.

	Procedure	LCD display
1	Hold down set button (⌚+Δ) for 1sec. or longer to start parameter change mode.	800 P id
2	Select easy (EASy) by Down or Up button (▽ or Δ). Hold down set button (⌚+Δ) for 1sec. or longer to start changed constant select mode.	830EASy
3	Select the constant to be changed by Down or Up button (▽ or Δ). Then, Hold down set button (⌚+Δ) for 1sec. or longer to start the value change mode.	831 0
4	Change the value with Down or Up button (▽ or Δ). Hold down mode button (⌚) for 1sec. or longer to set the value.	831 0
6	Change other constant if necessary.	830EASy
7	Hold down the mode button (⌚) again for 1sec. or longer to set the mode.	800 P id

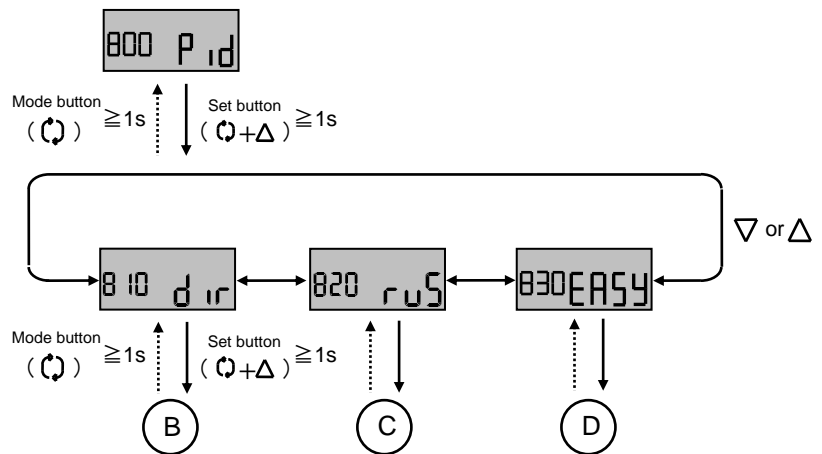


Fig. 40

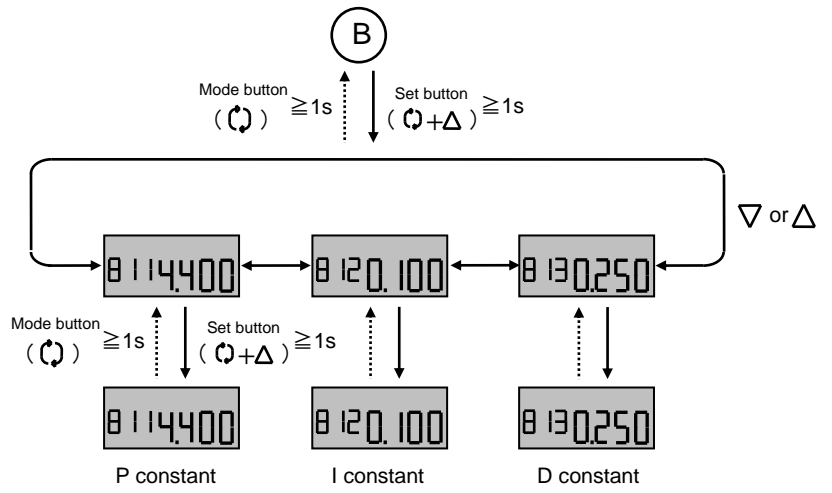


Fig. 40-1

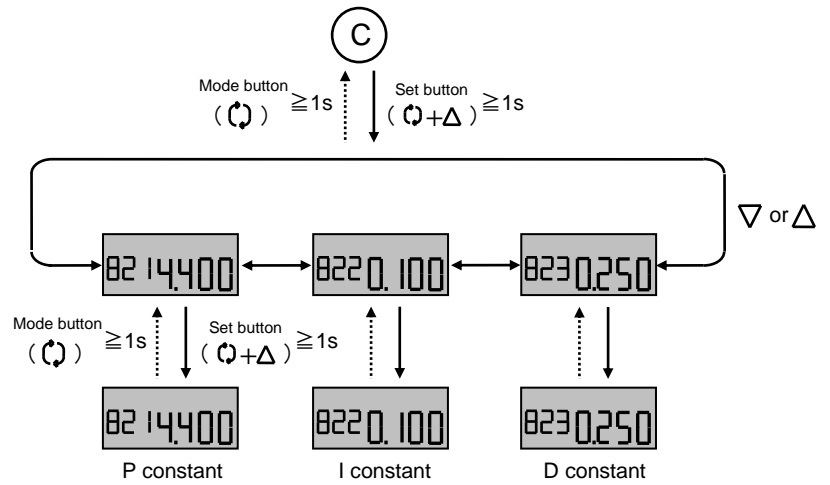


Fig. 40-2

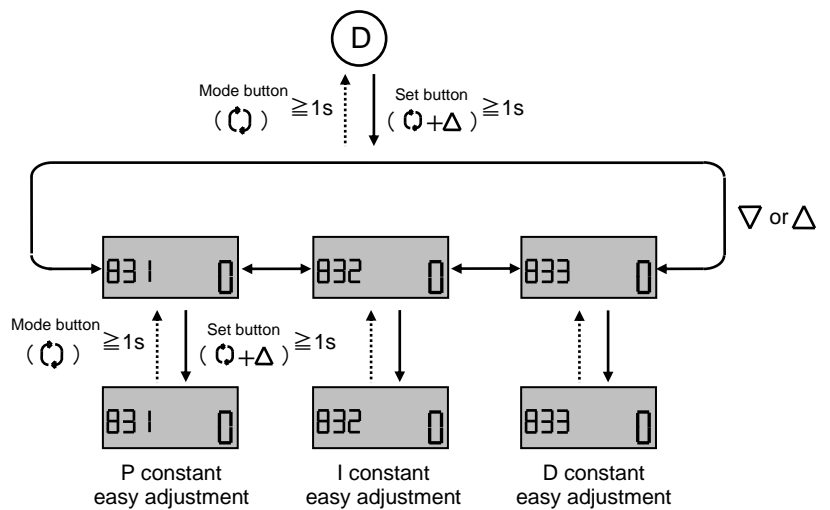


Fig. 40-3

(900) Alarm 1 setting

Possible to select set alarm 1 mode (on), non-alarm mode (oFF), and change the set value if alarm 1 mode is selected.

	Procedure	LCD display
1	Hold down the set button (⏏+△) for 1sec. or longer to start parameter change mode.	
2	Select alarm mode (on) or non-alarm mode (oFF) by Down or Up button (▽ or △).	
3	To select non-alarm mode (oFF), hold down the mode button (⏏) for 1sec. or longer. To select alarm mode, hold down set button (⏏+△) to start the mode for set details.	
4	<Hereafter, only when (on) is set> Select the limiter mode by Down or Up button (▽ or △), and hold down set button (⏏+△). Select by Low (Lo), up (UP) and hold down the mode button (⏏) for 1sec. or longer to set the mode.	
5	Select alarm mode by Down or Up button (▽ or △). Hold down set button (⏏+△) for 1sec. or longer. After the value starts flashing, change the value within the range of -20 to 120.0%. After changing, hold down mode button (⏏) for 1sec. or longer to set the value.	
6	Hold down the mode button (⏏) for 1sec. or longer. Hold down again for 1sec. or longer after interval	

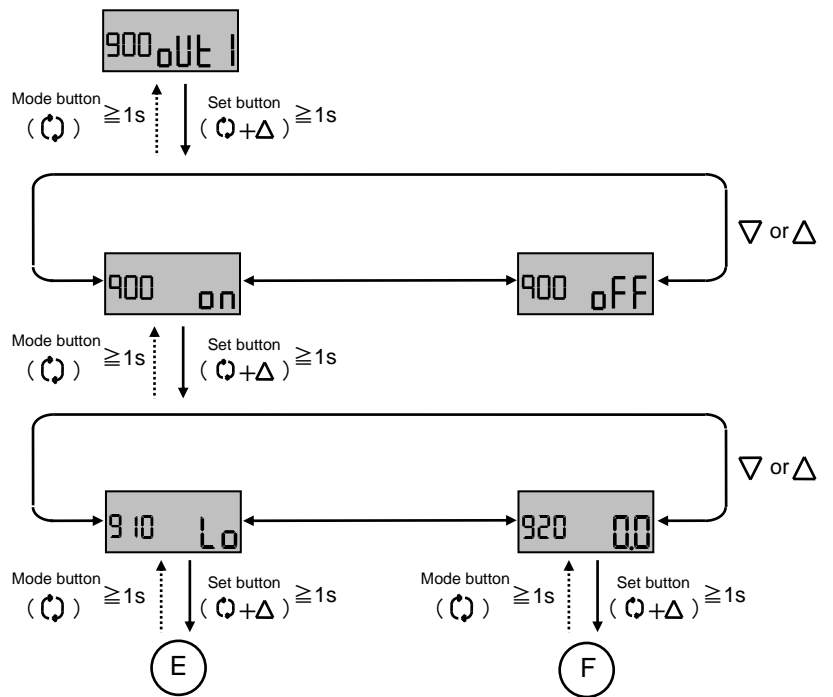


Fig. 41

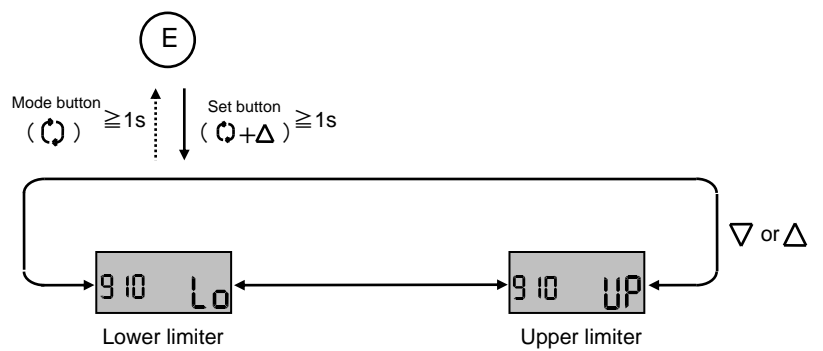


Fig. 41-1

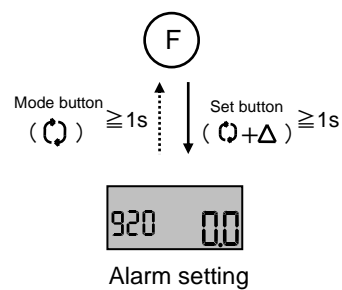


Fig. 41-2

(A00) Alarm 2 setting

Possible to select set alarm 2 mode(on), non-alarm mode(oFF), and change the set value if alarm 2 mode is selected.

	Procedure	LCD display
1	Hold down the set button (⏏+△) for 1sec. or longer to start parameter change mode.	
2	Select alarm mode (on) or non-alarm mode (oFF) by Down or Up button (▽ or △).	
3	To select non-alarm mode (oFF), hold down the mode button (⏏) for 1sec. or longer. To select alarm mode, hold down set button (⏏+△) to start the mode for set details.	
4	<Hereafter, only when (on) is set> Select the limiter mode by Down or Up button (▽ or △), and hold down set button (⏏+△). Select by Low (Lo), up (UP) and hold down the mode button (⏏) for 1sec. or longer to set the mode.	
5	Select alarm mode by Down or Up button (▽ or △). Hold down set button (⏏+△) for 1sec. or longer. After the value starts flashing, change the value within the range of -20 to 120.0%. After changing, hold down mode button (⏏) for 1sec. or longer to set the value.	
6	Hold down the mode button (⏏) for 1sec. or longer. Hold down again for 1sec. or longer after interval	

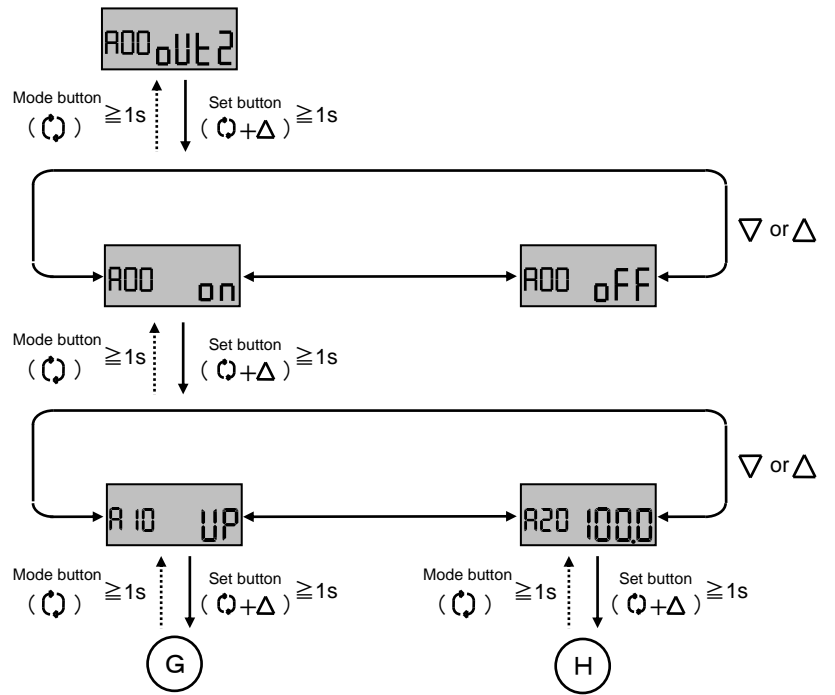


Fig. 42

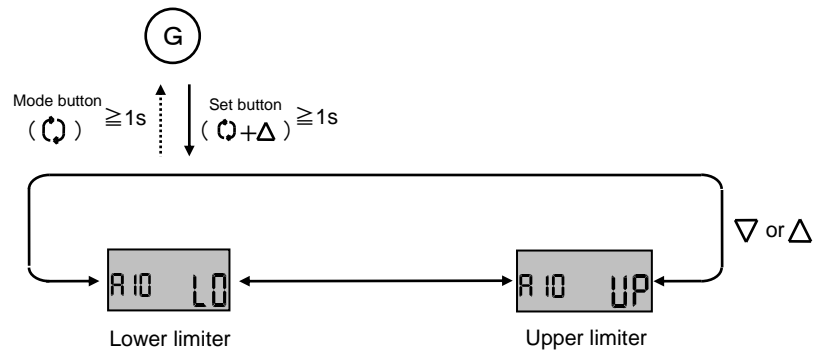


Fig. 42-1

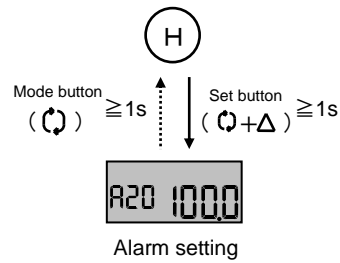


Fig. 42-2

(b00) Analog output setting

Possible to select analog output proportional output (inC) and reversed output (dEC).

	Procedure	LCD display
1	Hold down the set button (Ⓢ+Δ) for 1sec. or longer to start parameter change mode.	b00 An_o
2	Select proportional output (inC) or reversed output (dEC) by Down or Up button (▽ or Δ) .	b00 inC
3	Hold down the mode button (Ⓢ) for 1sec. or longer to set output mode.	b00 inC

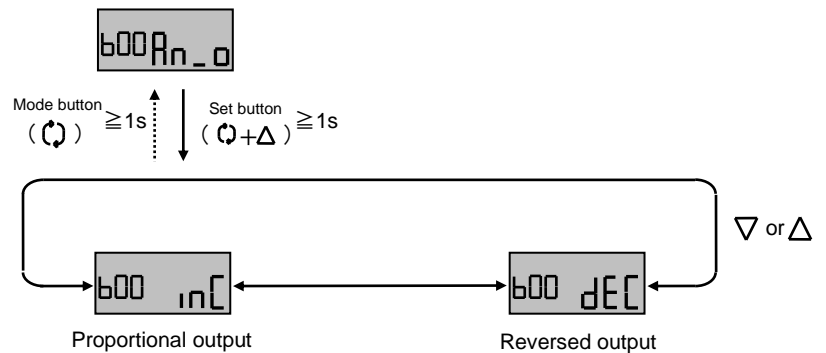


Fig. 43

(C00) Calibration

Possible to check the fork lever mount position, balance current, zero point / span adjustment, and input current calibration.

<(C10) Angle adjustment\*18>

Adjust the mount angle of fork lever fitting.

\*18: For adjustment procedure, see "(2) Angle adjustment of fork lever fitting" of "■ Initial Adjustment".

<(C20) Simple balance current adjustment\*19>

Adjust the balance current of the torque motor.

\*19: For adjustment procedure, see "(3) Simple balance current adjustment" of "■ Initial Adjustment".

<(C30) Calibration\*20>

Adjust zero-span and PID constant automatically.

\*20: For adjustment procedure, see "4. Calibration" of "■ Initial Adjustment".









<(C40/C50) Input current calibration \*21>

4mADC and 20mADC of input current can be calibrated. This is not necessary usually.

\*21: For adjustment procedure, see "5. Input current calibration" of "■ Initial Adjustment".

<(C60) Balance current confirmation \*22, \*23>

Check the torque motor balance current adjustment condition. If adjustment is good (Good), balance current is correctly adjusted. If high (HI) or low (Lo), readjustment is necessary so that the balance current condition becomes good (Good).

	Procedure	LCD display
1	Hold down Down or Up button ( $\nabla$ or $\Delta$ ) at calibration mode. After selecting balance (bAL), hold down the set button ( $\odot + \Delta$ ) for 1sec. or longer.	
2	Go (Go) is displayed for confirmation. After confirming that it is not dangerous even if the actuator operate, hold down the set button ( $\odot + \Delta$ ) *24.	
3	During balance current confirmation, bar (----) is displayed.	
4	After the actuator stop operating, LCD display is switched from bar (----). When good (Good) is displayed, balance current is correctly adjusted. If high (HI) or low (Lo) is displayed, readjust the current value by rotating the balance adjusting screw *25, *26.	 
5	Press the mode button ( $\odot$ ) to return calibration mode selection display.	

\*22: This adjustment becomes available only after initial adjustment.

\*23: This function may not work due to hunching if user change PID constant.

### Warning

\*24: The actuator operate abruptly after holding down the button. Do not touch the actuator and positioner.

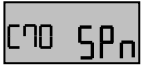


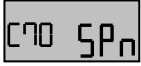
\*25: See fig.19 for the balance adjusting screw location.

\*26: 1 to 6 bars (-) are displayed to the side of high (HI) or low (Lo). The number of bars tells how close the current adjustment is to good (Good); Six bars is closest, and one bar is furthest. Rotate the balance adjusting screw clockwise for high (HI) and counterclockwise for low (Lo) until good (Good) displays. When the balance adjusting screw is turned, bars (----) show up to check the adjustment condition. Do not turn the balance adjustment screw until the condition is decided.

B

< (C70) Span adjustment \*27 >

Adjust zero point / span. Unlike automatic calibration of (C30), PID constant automatic setting is not performed. PID set once remains valid. This function is used when only zero-span adjustment is necessary.

	Procedure	LCD display
1	Hold down Down or Up button ( $\nabla$ or $\Delta$ ) at calibration mode to select span (SPn). Hold down the set button ( $\text{C}$ ) + $\Delta$ ) for 1sec. or longer.	
2	Go (Go) is displayed for confirmation. It is necessary to ensure no danger because the actuator operates. Then, hold down the set button ( $\text{C}$ ) + $\Delta$ ) for 1sec. or longer.	
3	Zero-span adjustment starts. Operates from step 1 (StP1) to step 2 (StP2) automatically.	
4	As adjustment is completed, display automatically returns to calibration (CAL) mode.	

\*27: This adjustment becomes operable only after initial adjustment.

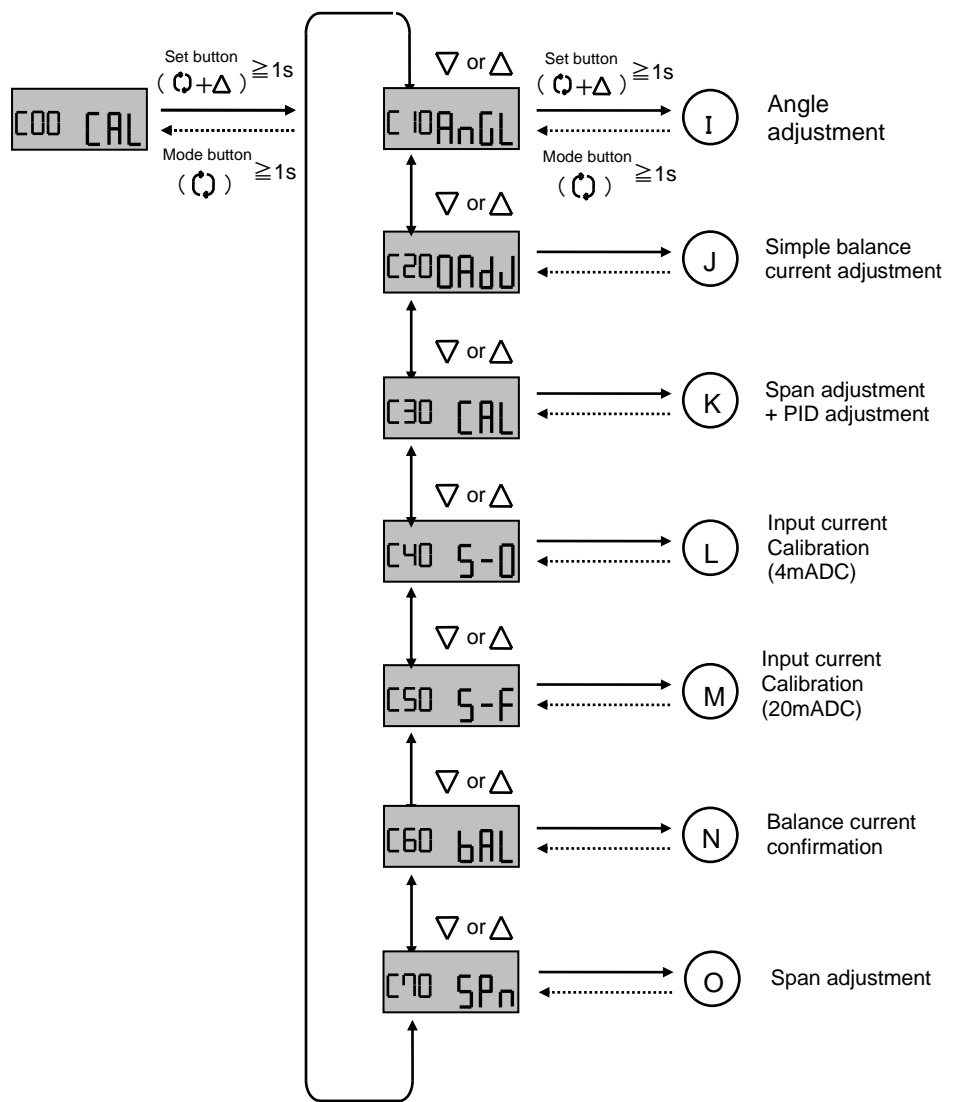


Fig. 44

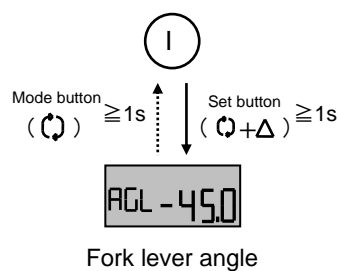


Fig. 44-1

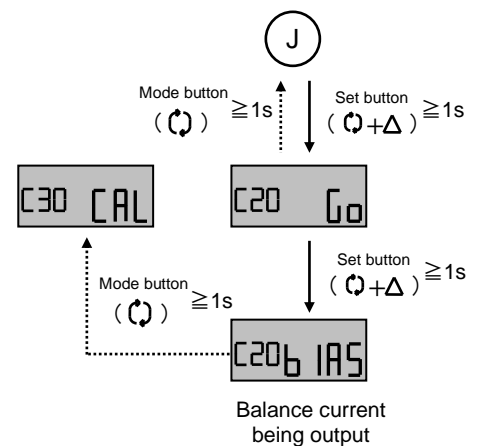


Fig. 44-2

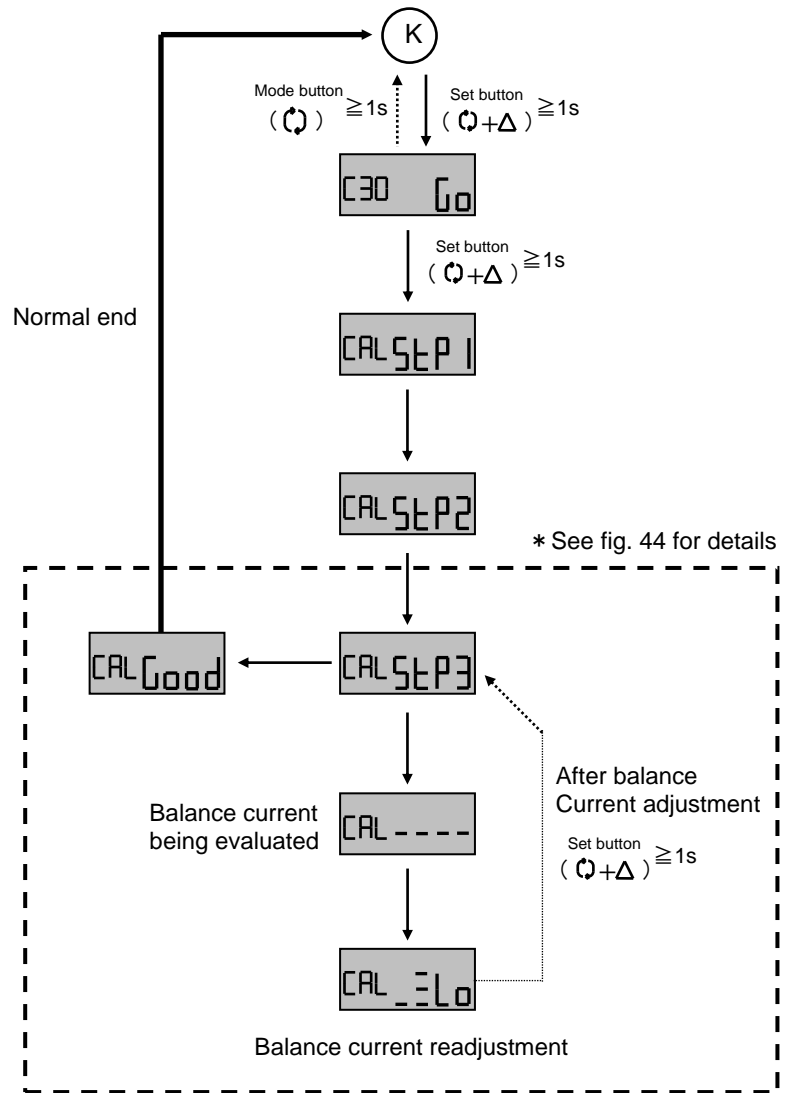


Fig. 44-3

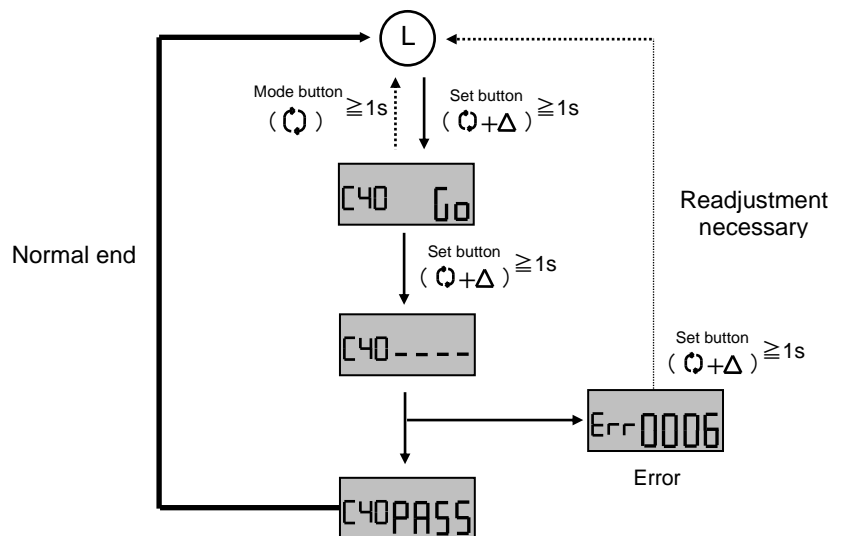


Fig. 44-4

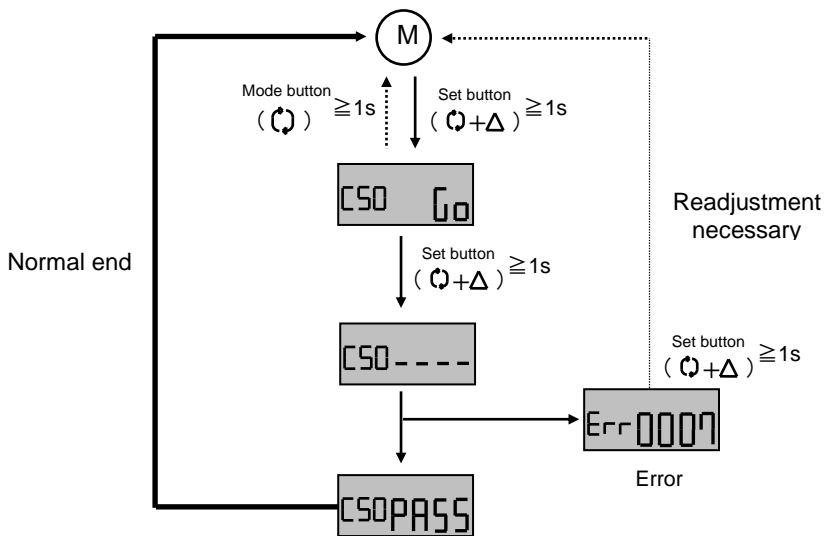


Fig. 44-5

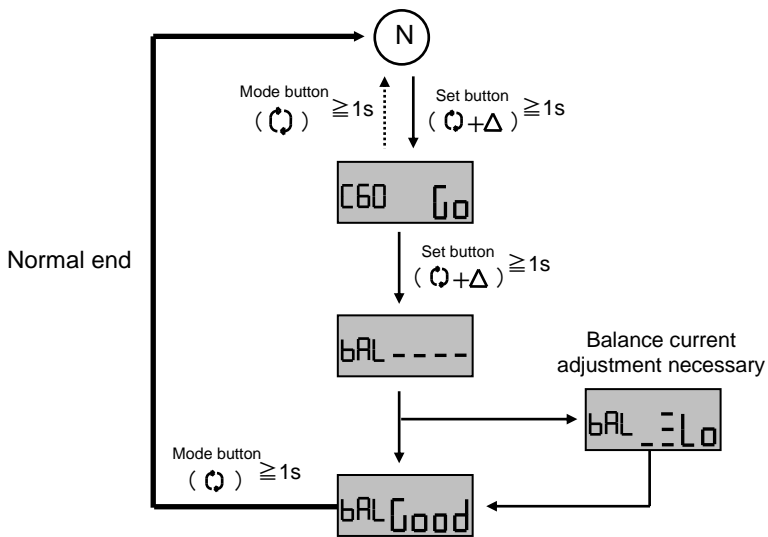


Fig. 44-6

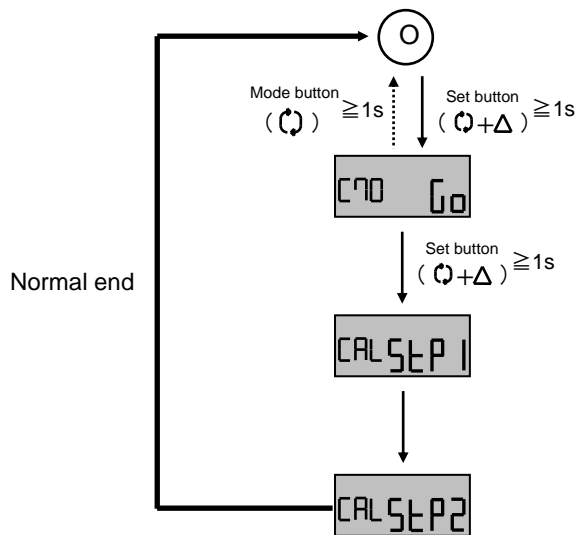


Fig. 44-7

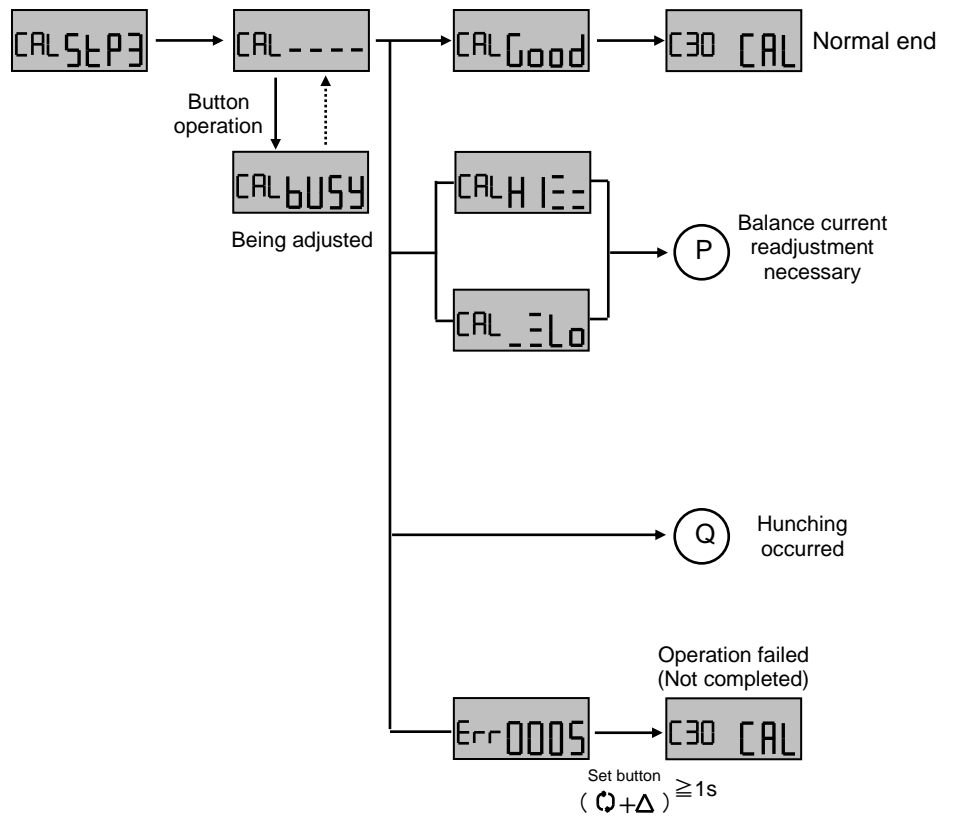


Fig. 45

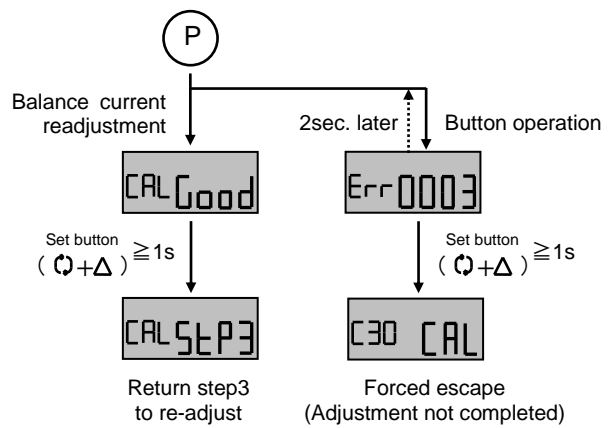


Fig. 45-1

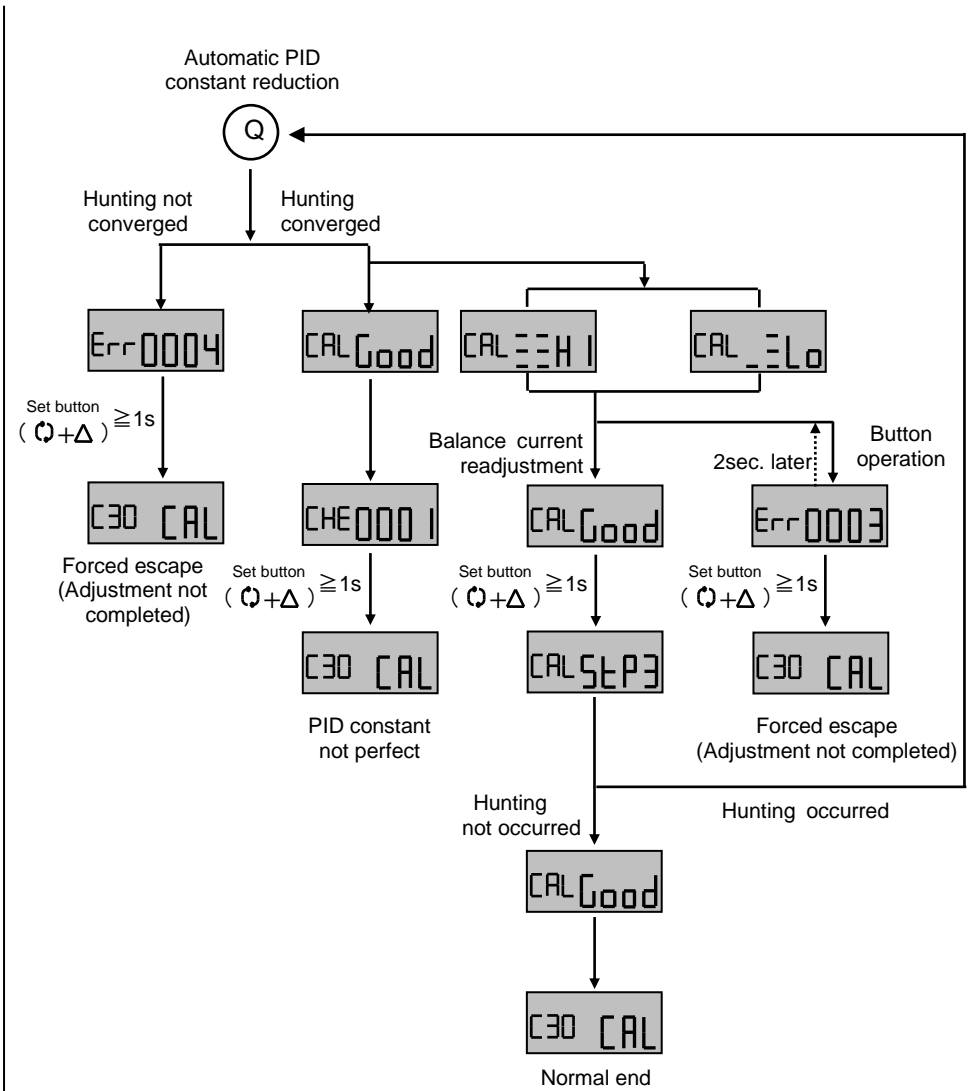


Fig. 45-2

■ Parameter Setting Default Value List

Table 13 shows the parameter default values set at shipment. Please refer the table below when you repeat setting change and want to default the setting.

Table13

Parameter		Set items			
Parameter item	Details	Setting assigned	Status	Set value 1	Set value 2
(000) Actuator type	-	Not changeable	-	-	
(200) Operating direction	-	-	dir	-	
(300) Split range setting	-	oFF	-	0.0	100.0
(400) Zero-span setting	-	oFF	-	0.0	100.0
(500) Forced fully close/open	-	on	-	0.5	99.5
(600) Dead band	-	-	-	0.0	-
(700) Valve open degree characteristic	-	-	Lin	-	-
	(User set value)			0.0 1.0 4.0 9.0 16.0 25.0 36.0 49.0 64.0 81.0 100.0	
(800) PID constant setting	Proportional gain (P constant)	-	-	0.150	
	Integral time (I constant)	-	-	0.100	
	Differential time (D constant)	-	-	0.250	
	Easy adjustment (All constant)	-	-	0	
(900) Alarm 1 setting		OFF			
(A00) Alarm 2 setting		OFF			
(b00) Analogue output setting		-	inC		



### ■ Operation Procedure Panel on PCB Cover

As Fig. 46 shows, on PCB cover, the operation flow from “000 Actuator type” to “C00 Calibration” is described in simplified form for customer’s reference. For details of each parameter setting, see “■ Parameter Code Detail” in this operation manual. Keep the manual accessible for reference.

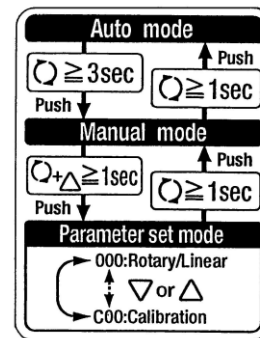


Fig. 46

## Improved Controllability

PID constant of this positioner is automatically set during calibration. However, operation speed is delayed or controllability becomes unstable due to the used actuator size. These symptoms can be improved by changing PID constant. When adjustment is made, please refer the table below to keep the specified range so that the operation does not become unstable.

Table14

Symptom	Adjustment method	Caution
Time to reach target value is slow	① Increase the easy adjustment integral time (I constant) by one level within the range that overshoot does not occur*1. ② Increase the easy adjustment proportional gain (P constant) by one level within the range that undershoot*2 does not occur to the valve characteristic.	-Overshoot may occur -Hunting*3 may occur
Hunting occurred	Decrease easy adjustment of proportional gain (P constant) and integral time (I constant) level by level.	-Operation might be delayed
Stick-slip occurs during control	Decrease easy adjustment proportional gain (P constant) and differential time (D constant) level by level.	-Operation might be delayed

\*1: The position temporarily exceed the target value when the input current is supplied.

\*2: Value temporarily falls below the target value after overshoot.

\*3: Position is not well controlled to the target value, and the actuator open degree repeat too large and too small.

# Scale Plate Adjustment

## ⚠ Caution

- (1) Attention should be taken not to have finger caught between the indicator and scale plate during position adjustment of the scale plate.
- (2) Scale plate edge is sharp. Attention should be taken.

- (1) After adjusting the positioner zero/span, mount the scale plate to DA surface (Direct operation) or RA (Reversed operation) in correct direction (See Fig. 47).
- (2) Stop the actuator open degree in the middle (50% of positioner input current), and adjust the indicator position so that the indicator position match with gauge at 50% (See Fig. 48). If indicator position does not match with 50% of the gauge even if adjusted, adjust the fork lever unit angle correctly referring “■Initial Adjustment” \*1.
- (3) Confirm if the indicator indicate 0% and 100% of the gauge at the start and end of the actuator. If it does not, loosen the cross recessed socket head screw for mounting to the dial using a spanner, then slide the scale plate (See Fig. 49, 50).

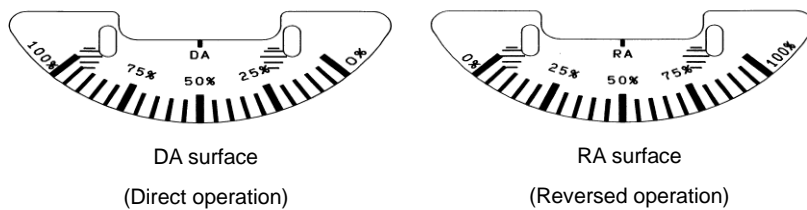


Fig. 47

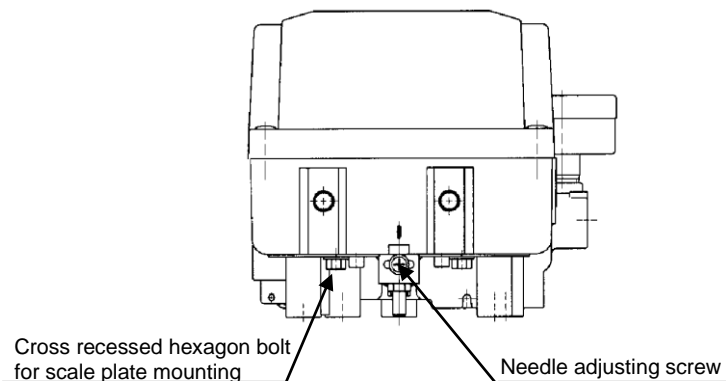


Fig. 48

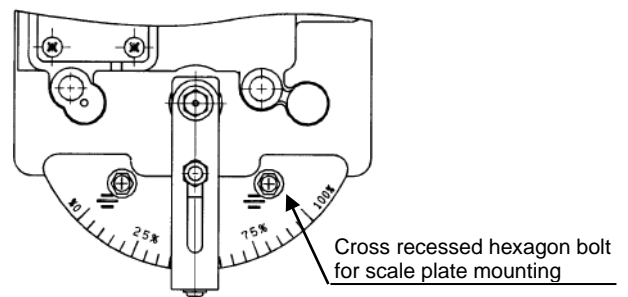


Fig. 49

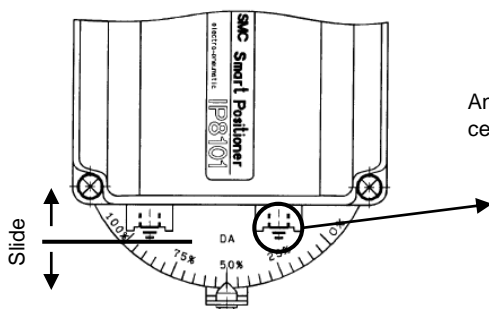


Fig. 50

Angle becomes 90° when center lines are in line.

\*1: If the fork lever-type fitting angle is adjusted after calibration, adjust the span (parameter code: C70).

## Maintenance and Check

### Warning

- ① After installation, repair and disassembling, connect compressed air and perform a proper function test and leak test. If bleed noise is louder than the initial state or operation is abnormal, stop operation and check if installation is proper or not. Modification of electrical construction is prohibited due to maintaining Explosion-Protected construction function.

### Caution

- ① Check if supply air is clean. Inspect compressed air cleaning system periodically and maintain keep condition to always get supply clean air so that dust, oil and humidity which cause malfunction and failure do not enter the equipment.
- ② If handled improperly, compressed air can be dangerous. Maintenance and replacement of unit parts should be performed only by trained and experienced personnel for instrumentation equipment as well as following the product specifications.
- ③ Check the positioner once a year. When you find excessively worn diaphragm, O-ring and other seals or any unit that has been damaged replace with new units. Treatment at an early stage is especially important if the positioner is used in a place of severe environment like coastal area.
- ④ Before removing the positioner for maintenance or replacing unit parts after installation, make sure the supply pressure is shut off and all residual air pressure is released from piping.
- ⑤ When the fixed orifice is clogged with carbon particles or others, remove the pilot valve unit Auto/Manual switch screw (built-in fixed orifice) and clean it by inserting a  $\phi 0.2$  wire into the aperture. If it must be replaced with new one, stop the supply pressure and remove the stopper screw of the pilot valve unit.
- ⑥ The pilot valve unit (P565010-303) should be replaced in accordance with the following instructions. As a standard, it should be replaced every 3 years.
  1. Shut off the supply pressure and input current to the positioner.
  2. Remove the body cover unit with a phillips head screwdriver.
  3. Loosen the 4 pieces of the M4 screws fixing the pilot valve unit and remove it.
  4. After the pilot valve unit has been removed, it should be reassembled in the order of 3 to 1.
- ⑦ Check air leak from piping which compressed air flows. Air leak from air piping could deteriorate characteristics. Air is normally discharged from a bleed port, but this is a necessary air consumption based on the construction of the positioner, and is not an abnormality if the air consumption is within the specified range.

## Caution on Handling

### ■ Operation

#### Warning

- ① If the system is supposed to be in danger because of failure of the positioner, prepare the system with a safety circuit to avoid danger.
- ② Do not place electrical wiring in hazardous places while energized.

#### Caution

- ① To prevent risks while pressure is supplied, do not touch areas surrounding driving components such as actuators and valves.
- ② Be sure to mount the body cover unit when using the positioner. IP 65 cannot be guaranteed if the mounting condition of the body cover is incorrect. To achieve IP capability, tighten the screws with the appropriate torque (2.8 to 3.0Nm)
- ③ Balance current will change depending on the positioner orientation and supply pressure. Adjust the balance current (parameter code: C60) every time the orientation and supply pressure changes.
- ④ Adequately flush the inside of the piping before arranging it to prevent foreign substances like chips from intruding into the positioner.
- ⑤ If the input current is shut off during use, the output of OUT1 will become 0MPa and the output of OUT2 will reach its maximum regardless of the operating direction of the parameter mode (parameter code: 200), whether direct or in reverse.
- ⑥ If reverse operation is selected in parameter mode (parameter code: 200), when power supply is turned off, OUT1 output will become 0MPa and the positioner will start moving toward input current 20mADC direction.
- ⑦ Immediately after the input current has been applied, it may take some time until the positioner begins to operate.
- ⑧ Depending on the parameter's setting, the actuator will erratically extend when an input current of 4mA DC is applied.
- ⑨ The actuator opening might be unstable when a booster relay is used.
- ⑩ Although the operating direction can be changed by a parameter setting, the piping should usually be replaced in such cases. In addition, when reverse mode (parameter code: 200) is used, OUT1 output will become 0MPa and the actuator moves in the direction of input current 20mA DC once the power supply has been shut off.
- ⑪ When replacing piping to change the operating direction, be sure to perform span adjustment (parameter code: C70).
- ⑫ Be sure to use grounding to prevent noise from interrupting input current and static electricity from breaking the positioner.
- ⑬ There is a capacitor for noise prevention between FG terminal (case) and each input / output terminal of the positioner respectively. Therefore, avoid conducting withstand voltage test or insulation resistance test between these terminal and case.

## ■ Handling

### Caution

- ① Avoid giving impact to the body and torque motor of positioner, and giving excessive force to armature because it leads to failure. Handle with care during transport and operation.
- ② When the positioner is used in places subject to vibrations, it is recommended that a tie wrap be used to prevent the lead wires from breaking.
- ③ If the positioner is left unused at the operation site for an extended period, ensure the body cover unit is fitted, and mount a plug on the wiring and piping ports. If the atmosphere is of high temperature or high humidity, take measures to avoid condensation inside. The condensation control measures must be taken thoroughly for export shipment.
- ④ When removing the positioner from the actuator and mounting it onto another actuator, malfunctions may occur due to its remained initial constant. Therefore, when it is mounted onto other actuators, transmit the input signal while cutting the air supply, and be sure to perform Simple balance current adjustment through the calibration mode (parameter code: C20). Then apply the air while biAS is indicated on the LCD and perform the Simple balance adjustment (parameter code: C20) and calibration (parameter code: C30).

B

## ■ Air Supply

### Caution

- ① Use dehumidified and dust-removed clean air as the supplying air source.
- ② Positioner has fine paths in it. Therefore please use clean air which is dehydrated and filtered, and also avoid employing Lubricator which causes malfunction. In addition, it is recommended to use a mist separator as an air-cleaning equipment.
- ③ Avoid using compressed air containing chemicals, synthetic fluid including organic solvent, salinity, and corrosive gas as it may cause malfunction.
- ④ If atmosphere is below freezing point, take measure to avoid condensation.

F

## ■ Environment

### Caution

- ① Do not use in an environment where the product is exposed to corrosive gas, chemicals, salt water, water or steam.
- ② If the positioner is used under temperature outside of the specification, the sealing materials deteriorate quicker and also the positioner may not operate normally.

## Troubleshooting, Error Code and Check Code

### ■ Troubleshooting

If the positioner malfunctions, take countermeasures in accordance with the troubleshooting measures listed in Table 15.

Table 15

Error	Possible cause	Countermeasure	Reference page
No LCD display	- Input current is disconnected.	-Check that wires are connected to the positioner.	15,16
	-There is no output from the input current power supply.	-Check the output current of the input current generator.	15,16
	-An out-of-range input current power is being supplied.	-Apply the correct input current power.	5
	-Others	-Contact SMC representatives (To check boards and etc.).	-
No air is output from the OUT1 or OUT2 ports. (Does not move at all.)	-Supplied pressure is incorrect.	-Check the supply pressure setting of the regulator.	5, 13,14
	-No input current is being supplied.	-Apply the correct input current (4 to 20 mA DC) .	15,16
	-Air is leaking from the piping.	-Check the piping and fitting to stop leaks.	66-⑧
	-Operation mode is different.	-Change the operation mode(auto, manual mode).	27
	-Fixed orifice and nozzle are clogged.	-Inspect and clean the pilot valve.	9-Fig.3 66-⑦
	-Balance current is not adjusted.	-Adjust the balance current.	56
	-Others	-Contact SMC representatives.	-
Low accuracy (Linearity, hysteresis)	-Span adjustment has not been performed.	-Perform the span adjustment.	57
	-Dead band value is high.	-Change the dead band with the parameter mode.	44,45
	-Supply pressure is improper. (Supply pressure is low)	-Check the regulator's supply pressure setting, set the proper pressure per actuator.	5
	-Supply pressure is fluctuating.	-Check the regulator supply pressure.	-
	-Positioner mounting threads have loosened.	-Ensure that the positioner mounting threads have not loosened.	10 to 12
	-Positioner and actuator are improperly connected.	-Check the connection between the positioner and actuator.	10 to 12
	-Input current system is unstable.	-Adjust the input current system. -Calibrate the input current with the parameter mode.	26
	-Others.	-Contact SMC representatives.	-

Error	Possible cause	Countermeasure	Reference page
Low sensing	- Input current resolution is faulty.	- Check the input current system.	5, 15
	-Actuator's sliding resistance is large.	-Reduce the sliding resistance to as little as possible. -Operate only the actuator and check the stick-slip movement. If this movement cannot be recovered, it's beyond the capacity of this positioner.	-
	-Dead band value is high.	-Change the dead band with the parameter mode.	44,45
	-Operation takes time due to the actuator's large capacity.	-Wait until the actuator fills with air.	-
	-Others.	-Contact SMC representatives.	-
Hunting problem	-Actuator is uncalibrated.	-Calibrate the actuator with the parameter mode.	20 to 26
	-PID constant after calibration is improper due to use of a special valve.	-Change the PID constant with the parameter mode.	48 to 50
	-There is play in the mounting of the feed back shaft and actuator.	-Eliminate the play and properly mount them.	10 to 12
	-The input current itself is unstable.	-Check the input current system. -Ground properly.	15,16 67-⑫
	-Rotation resistance of the actuator is significant due to ground and piston packing.	-Reduce rotation resistance as much as possible.	-
Large air consumption	-Air is leaking from the piping.	-Check the piping, and stop the leakage.	66-⑧
	-Air is leaking from the positioner. (due to a seating failure of the pilot valve.)	-Replace the pilot valve unit.	66-⑦
	-Others.	-Contact SMC representatives.	-
Automatic calibration is unavailable	- Fork lever fixing nuts are loose.	-Tighten fixing nuts after fork lever angle has been adjusted.	11,21,22
	-The angle of the fork lever is in excess of -60/+60 degrees on both ends of the actuator.	-Refer to "2, fork lever angle adjustment" in "■Initial Adjustment", and securely adjust the angle to +/-60degrees or less.	21,22
	-The rotation angle of the actuator is below 60 degrees or in excess of 100 degrees.	-The standard positioner stroke is from 60 to 100 degrees. Use it within 60 to 100 degrees.	5

## ■ Error Code List

Table 16 shows errors detected while the positioner is being adjusted. When errors are detected during adjustment, adjust the settings again in accordance with the countermeasure.

Once an error has been detected, it is possible to reset it to the mode before the detection with the set button (  $\odot + \Delta$  ). However, unless the calibration is performed again and properly completed, it will not shift to auto mode with error codes 0001, 0002 and 0005.

Table 16

Error No.	Error	Possible cause	Countermeasure
0001	Actuator operation error	<ul style="list-style-type: none"> <li>-Pressure has not been supplied.</li> <li>-No piping has been connected to the actuator.</li> <li>-Simple balance adjustment (parameter code: C20) has not been performed.</li> <li>-The potentiometer output line is broken.</li> <li>-Torque motor line is broken.</li> </ul>	<ul style="list-style-type: none"> <li>-Supply pressure.</li> <li>-Check the positioner and actuator piping.</li> <li>-Perform a simple balance adjustment (parameter code:C20) .</li> <li>-Check that the potentiometer output and torque motor line are not broken (see Fig. 14), and that the terminal has been connected.</li> <li>-Calibrate it again after checking the above. (parameter code: C30) .</li> </ul>
0002	Wrong fork lever installation angle	<ul style="list-style-type: none"> <li>-the fork lever installation angle is out of the adjustable range from -60 to 60 (parameter code: C10).</li> <li>-The fork lever is loose.</li> <li>-The actuator rotation angle is out of the standard stroke range (from 60 to 100 degrees).</li> </ul>	<ul style="list-style-type: none"> <li>-Readjust the angle (parameter code: C10). See “2. Fork lever angle adjustment” in “ ■ Initial Adjustment”.</li> <li>-Correctly tighten the fork lever fixing nut.</li> <li>-Ensure that the rotation angle of the actuator is within 60 to 100 degrees. If it’s out of the above range, reselect the actuator.</li> <li>-Calibrate the positioner again after checking the above points (parameter code: C30).</li> </ul>



Error No.	Error	Possible cause	Countermeasure
0003	Failed adjustment of balance current	The balance current has not been adjusted to be good (Good), but the positioner has been set after STEP3.	-Adjust the balance adjusting screw to correct the balance current (See Fig. 19).
0004	Hunting does not subside.	-The size of actuator is small. -Inside of the piping is choked (with something such as a speed controller).	-Stop hunting with the PID constant setting (parameter code: 800) . See "■Improved Controllability".
0005	Impossible to check the balance current	-simple balance adjustment (parameter code: C20) has not been performed.	-Recalibrate the positioner (parameter code: 30) after performing a simple balance adjustment (parameter code: C20). -If the set value of the dead band (parameter code: 600) is changed, return the set value to 0.
0006	Input current adjustment error (4mA DC)	-Input current deviates widely from 4mA DC.	-Check that the Input current is 4mA DC.
0007	Input current adjustment error (20mA DC)	-Input current deviates widely from 20mA DC.	-Ensure that the input current is 20mA DC.

B

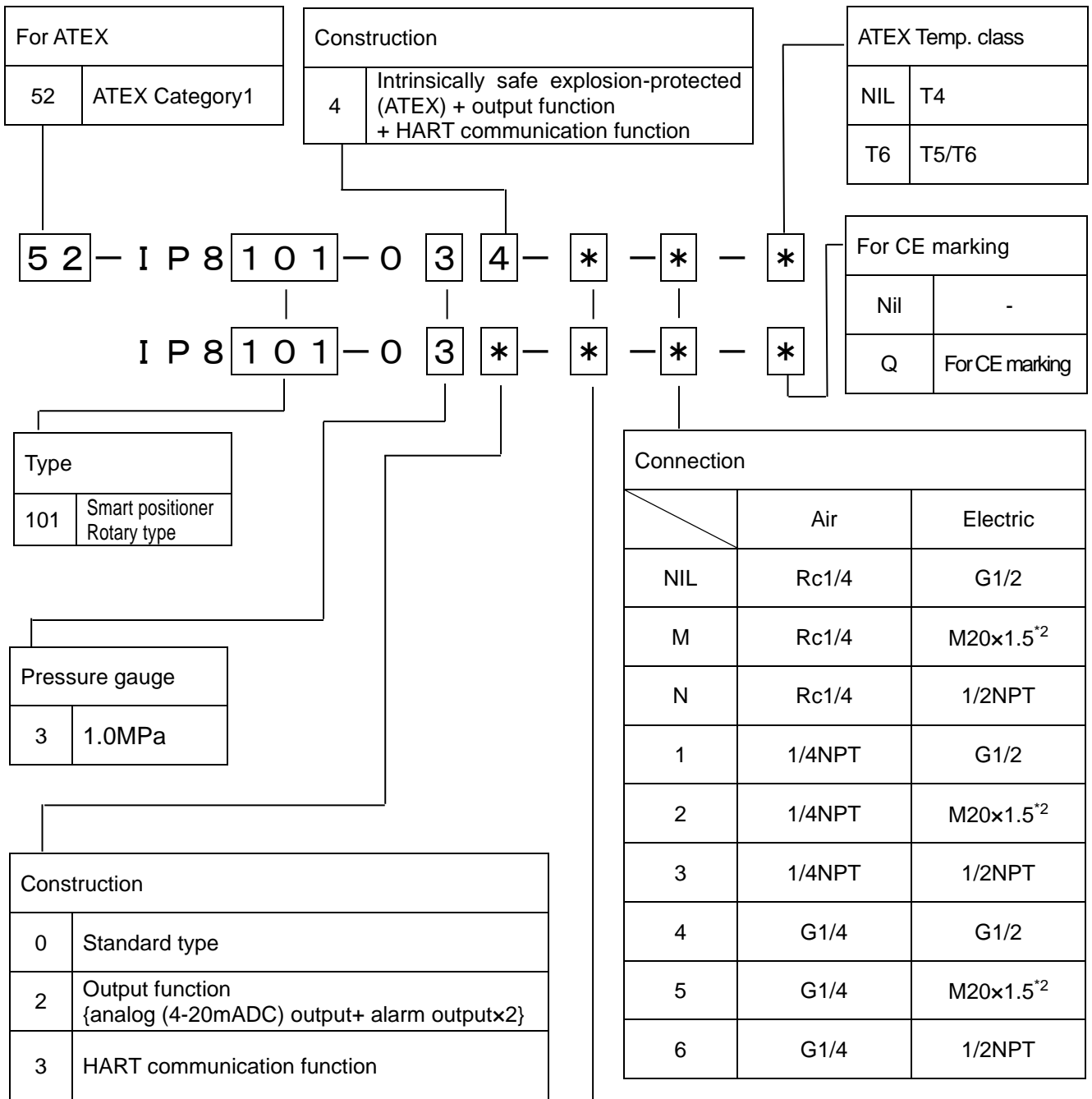
### ■Check Code List

Table 17 shows check codes detected during positioner calibration. When hunting is detected during calibration, it automatically performs PID constant adjustment, subsides hunting and checks the balance current. If a check code is detected after the calibration, check it in accordance with the following countermeasures. The display returns to Calibration (parameter code: C30) by pressing the set button (◀+△).

Table 17

Check code	Check point	Possible cause	Countermeasure
0001	Hunting detection	-The actuator is too small. -The piping is choked. (with something such as a speed controller.)	-Switch to auto mode, change the input current, and confirm that the actuator is hunting. If hunting is occurring, stop it with a PID adjustment (parameter code: 800). See "■Improved Controllability".

# How to Order



For ATEX	
52	ATEX Category1

Construction	
4	Intrinsically safe explosion-protected (ATEX) + output function + HART communication function

ATEX Temp. class	
NIL	T4
T6	T5/T6

52-IP8101-034-\*-\*-\*  
IP8101-03\*-\*\*--\*\*--\*\*

For CE marking	
Nil	-
Q	ForCE marking

Type	
101	Smart positioner Rotary type

Pressure gauge	
3	1.0MPa

Construction	
0	Standard type
2	Output function {analog (4-20mADC) output+ alarm outputx2}
3	HART communication function

Connection		
	Air	Electric
NIL	Rc1/4	G1/2
M	Rc1/4	M20x1.5*2
N	Rc1/4	1/2NPT
1	1/4NPT	G1/2
2	1/4NPT	M20x1.5*2
3	1/4NPT	1/2NPT
4	G1/4	G1/2
5	G1/4	M20x1.5*2
6	G1/4	1/2NPT

Accessory*1	
Nil	No accessory
C	Fork lever-type fitting M [Long type (M8x1.5)]
D	Fork lever-type fitting S [Short type (M8x1.5)]
H	External scale plate
W	With body cover window

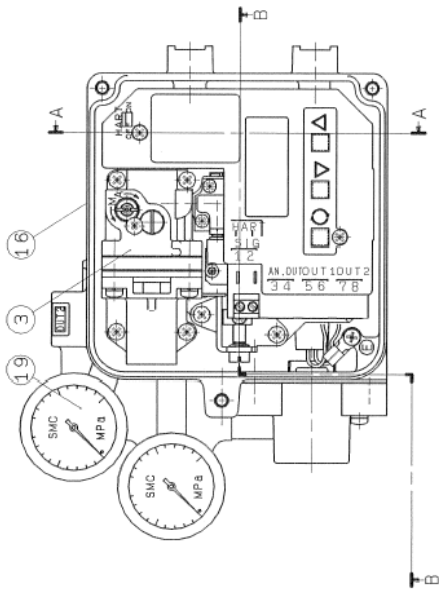
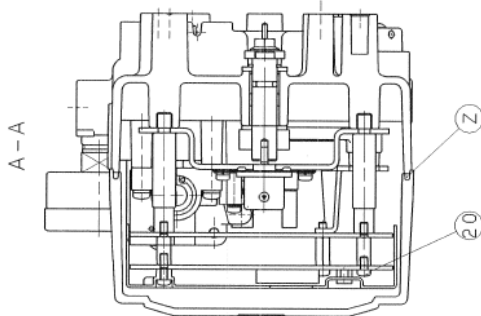
\*1 : If two or more accessories are required, the part numbers should be made according to alphabetical order.

<Ex>IP8101-030-CHW

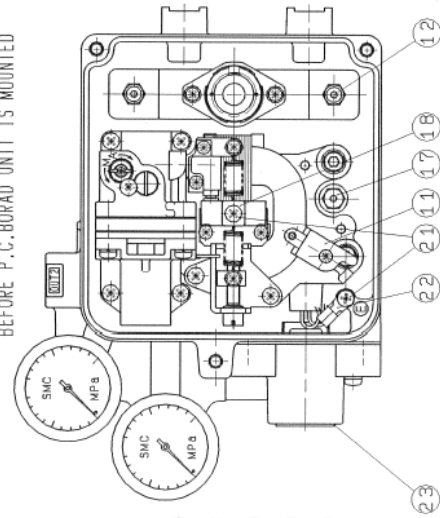
\*2 : When "52-" ATEX type specify symbol "M", "2", "5", Blue cable grant is equipped for electric connection..

# Drawing

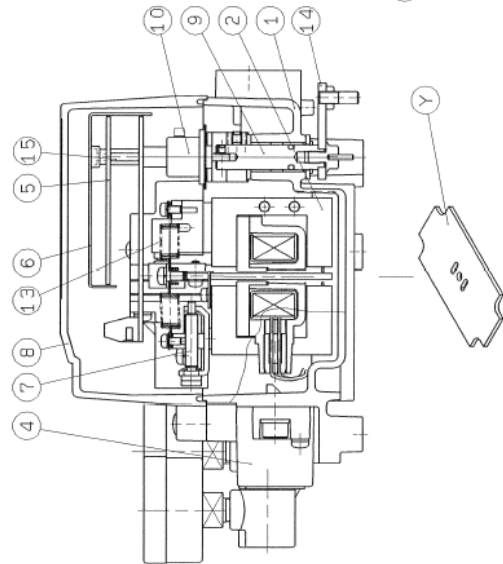
ITEM	PART NO	PART NAME	MATERIAL	QTY
Z	P56501013	COVER SEAL	CR	1
Y	P56501012-3	BASE SEAL	OZONE-FREE NBR	1
23		CAP F	POLYETHYLENE	1
22		TERMINAL LUG	ALUMINIUM	1
21		MACHINE SCREW AND WASHER ASSEMBLY	STAINLESS STEEL	2
20		MACHINE SCREW	STAINLESS STEEL	2
19	G43-* -01	PRESSURE GAUGE		2
18		SPRING HOLDER	STAINLESS STEEL	1
17		POLE(B)	BRASS	1
16		SPECIFICATION LABEL	POLYESTER	1
15		P.C.BORAD SPACER	BRASS	4
14	P368010-23	FORK PIN UNIT		1
13		BALANCE SPRING UNIT		1
12		POT BASE BRACKET UNIT		1
11		P.C.BORAD BRACKET UNIT		1
10		POTENTIOMETER UNIT		1
9		FEEDBACK SHAFT R		1
8		BODY COVER UNIT		1
7		ZERO ADJUST UNIT		1
6		P.C.BORAD COVER UNIT		1
5		P.C.BORAD UNIT		1
4		TERMINAL JOINT UNIT		1
3	P565010-303	PILOT VALVE UNIT		1
2		TORQUE MOTOR UNIT		1
1		BODY UNIT		1



BEFORE P.C.BORAD UNIT IS MOUNTED



B - B

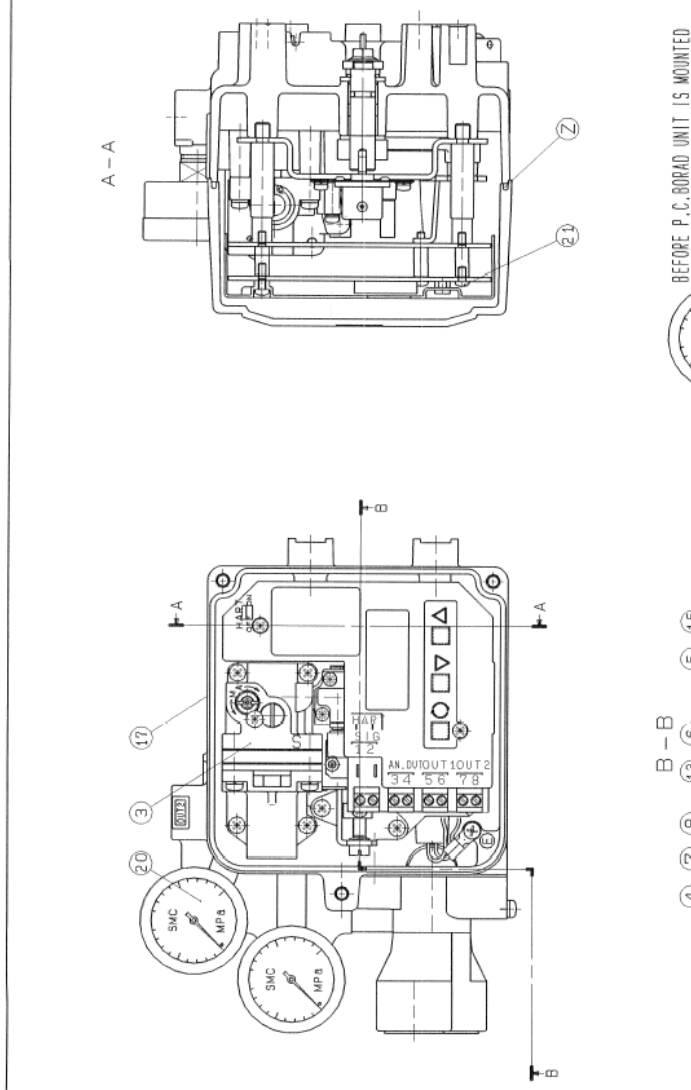


③, ④, ⑤, ⑥, ⑦, ⑧, ⑨, ⑩, ⑪, ⑫, ⑬, ⑭, ⑮, ⑯, ⑰, ⑱, ⑲ CAN BE ORDERED FOR THE REPAIR. (ORDER NUMBER:KT-IP8101)  
⑲ CAN BE ORDERED TOO.

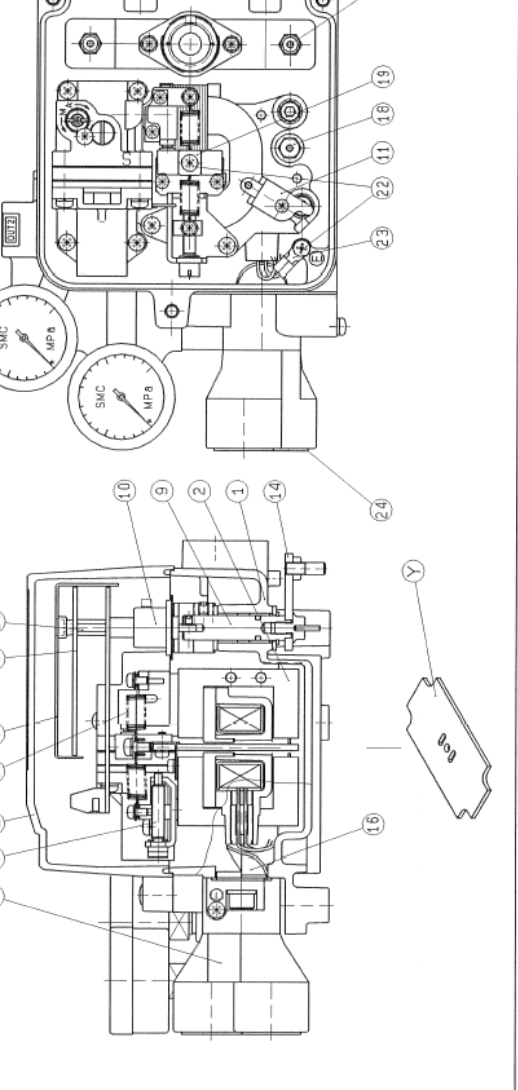
SMART POSITIONER  
CONSTRUCTION (ROTARY TYPE)

IP8101-0\*0

ITEM	PART NO	PART NAME	MATERIAL	QTY
Z	P56501013	COVER SEAL	CR	1
Y	P56501012-3	BASE SEAL	OZONE-FREE NBR	1
24		CAP F	POLYETHYLENE	2
23		TERMINAL LUG	ALUMINIUM	1
22		MACHINE SCREW AND WASHER ASSEMBLIES	STAINLESS STEEL	2
21		MACHINE SCREW	STAINLESS STEEL	2
20	G43-**-01	PRESSURE GAUGE		2
19		SPRING HOLDER	STAINLESS STEEL	1
18		POLE(B)	BRASS	1
17		SPECIFICATION LABEL	POLYESTER	1
16		LEAD WIRE GUARD	POLYETHYLENE	1
15		P.C. BOARD SPACER	BRASS	4
14	P368010-23	FORK PIN UNIT		1
13		BALANCE SPRING UNIT		1
12		POT BASE BRACKET UNIT		1
11		P.C. BOARD BRACKET UNIT		1
10		POTENTIOMETER UNIT		1
9		FEEDBACK SHAFT R UNIT		1
8		BODY COVER UNIT		1
7		ZERO ADJUST UNIT		1
6		P.C. BOARD COVER UNIT		1
5		P.C. BOARD UNIT		1
4		W JOINT G UNIT		1
3	P565010-303	PILOT VALVE UNIT		1
2		TORQUE MOTOR UNIT		1
1		BODY UNIT		1

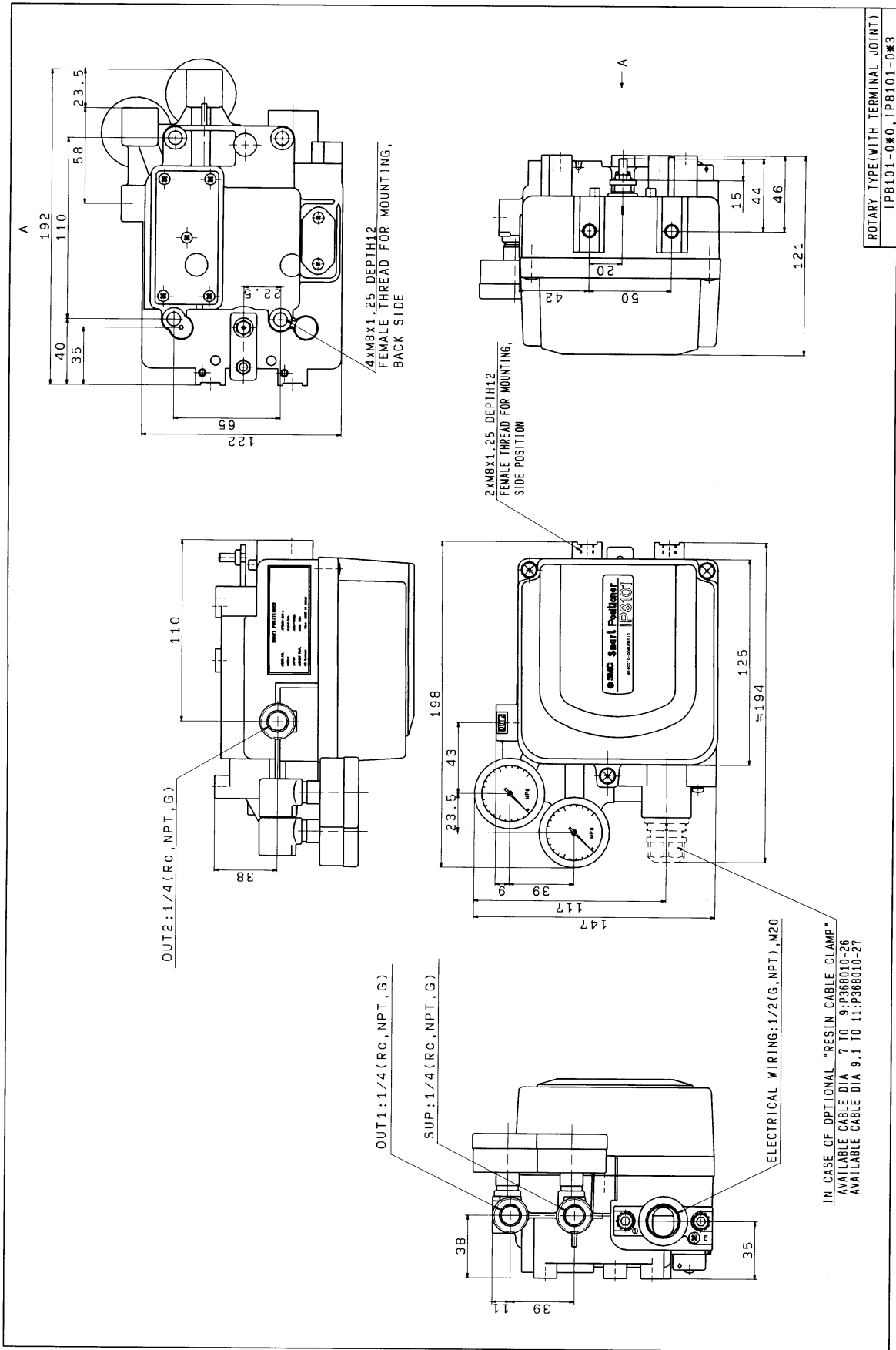


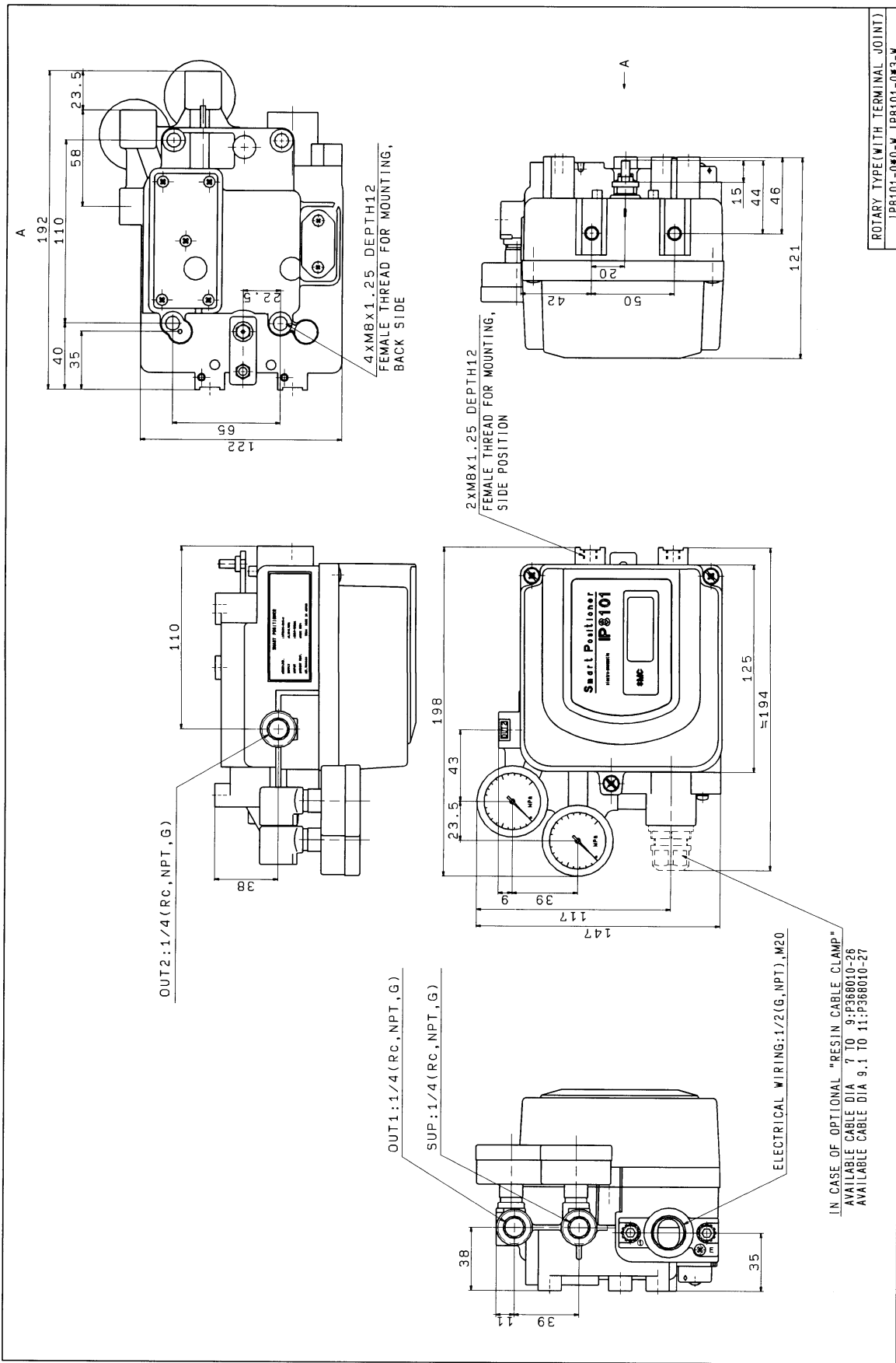
③, ⑭, ⑲, AND ⑳ CAN BE ORDERED FOR THE REPAIR. (ORDER NUMBER:KT-IP8101)  
 ⑳ CAN BE ORDERED TOO.

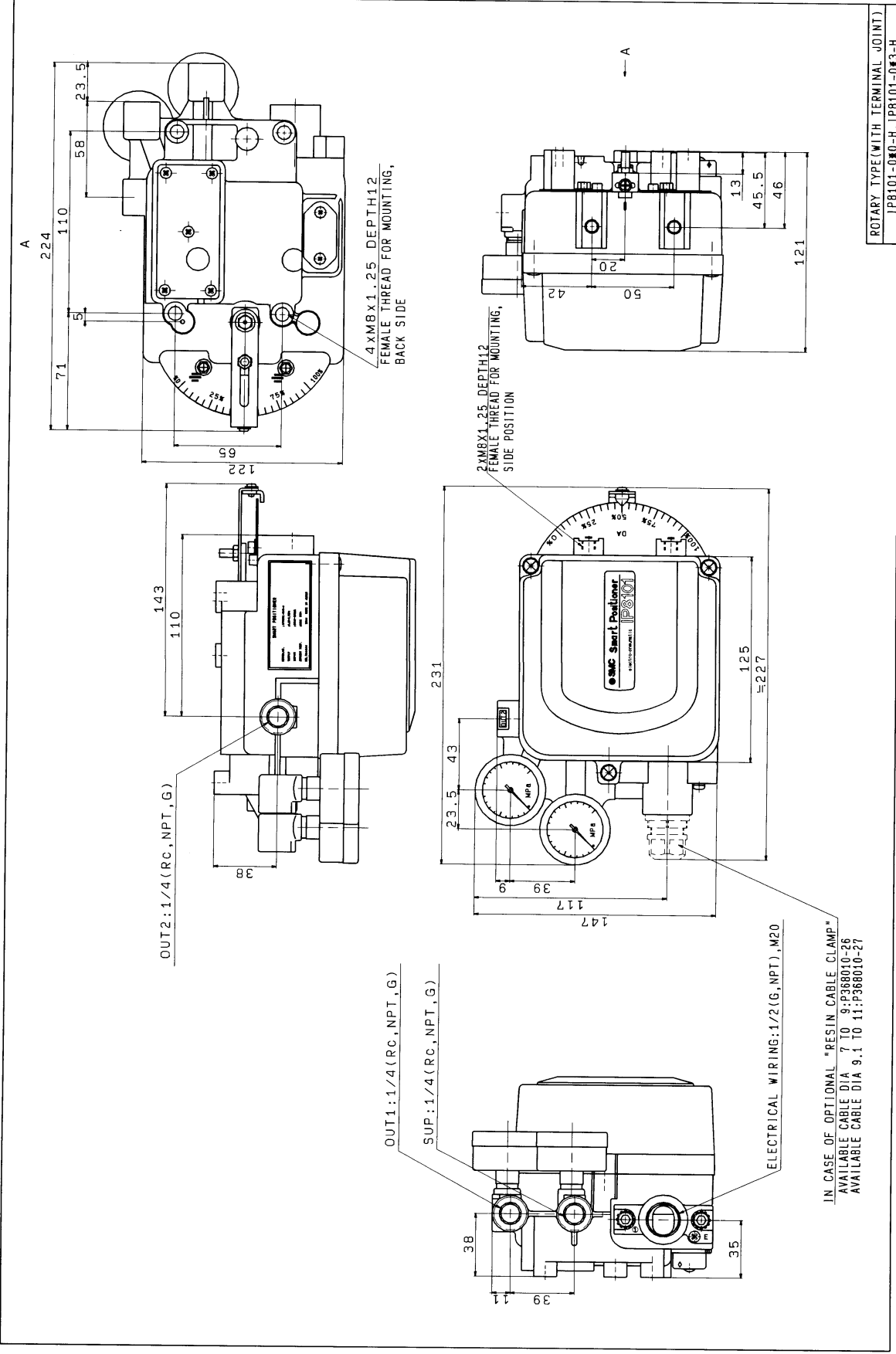


SMART POSITIONER  
 CONSTRUCTION DRAWING (ROTARY TYPE)

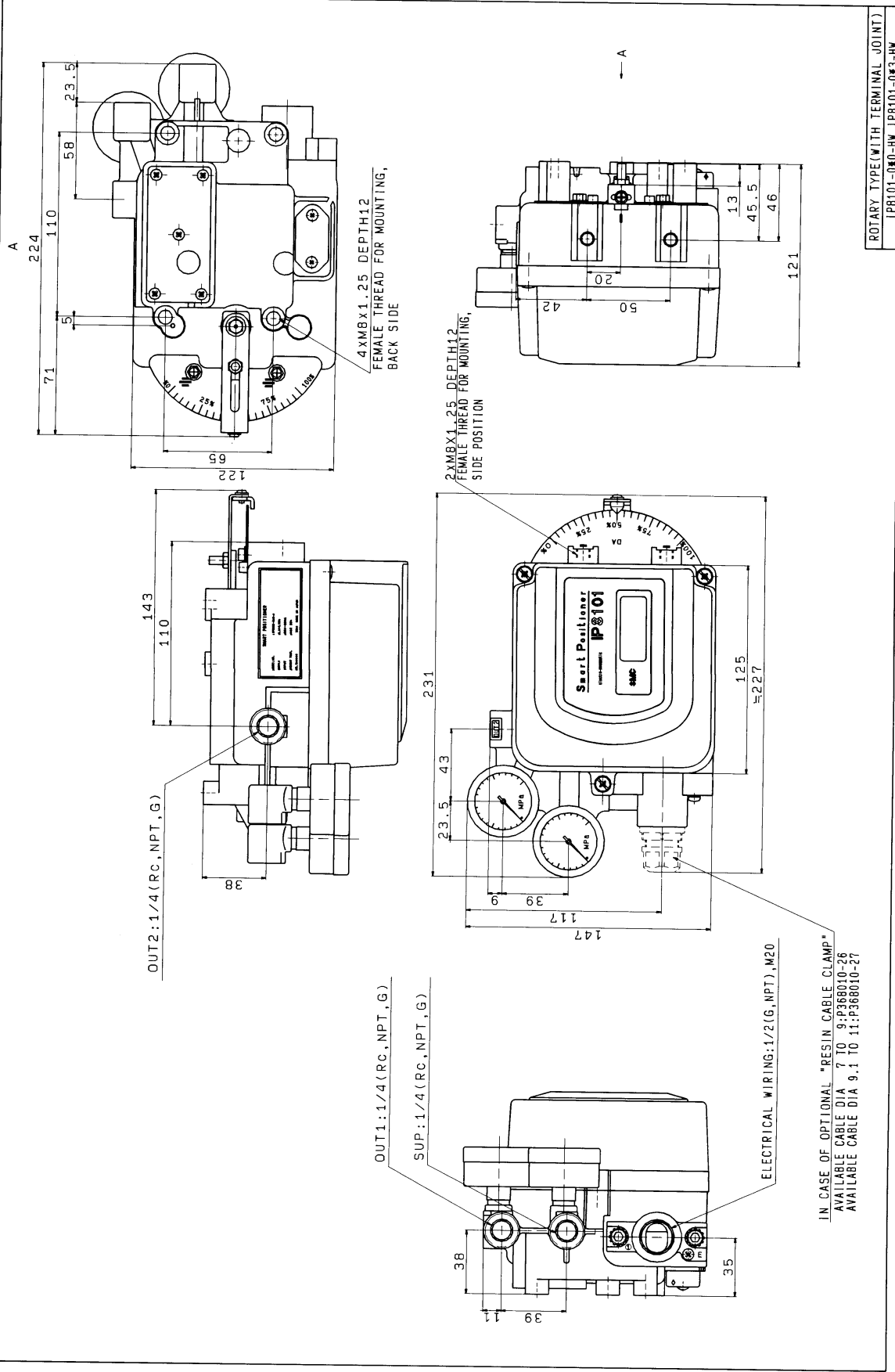
IP8101-0※2



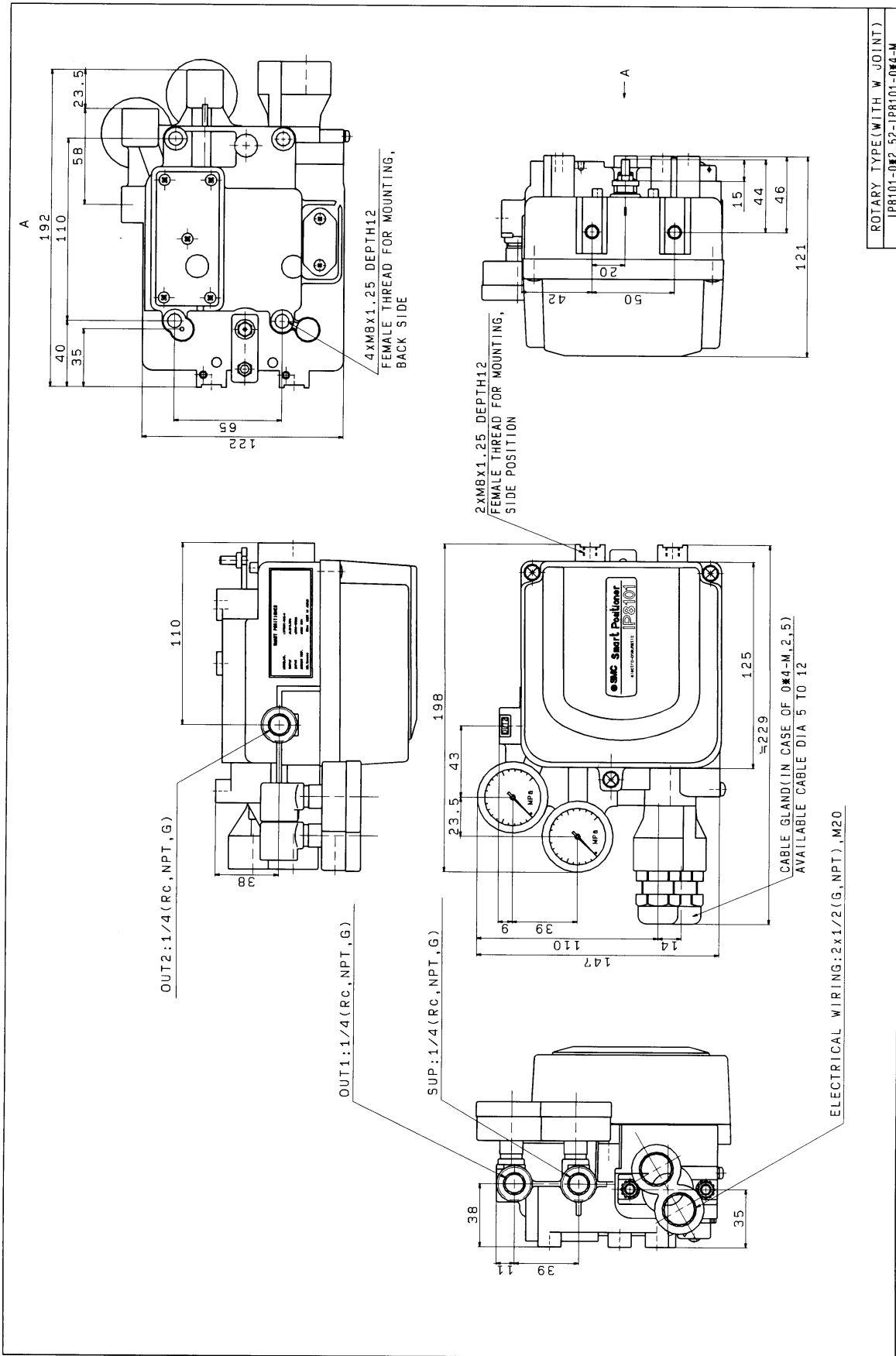




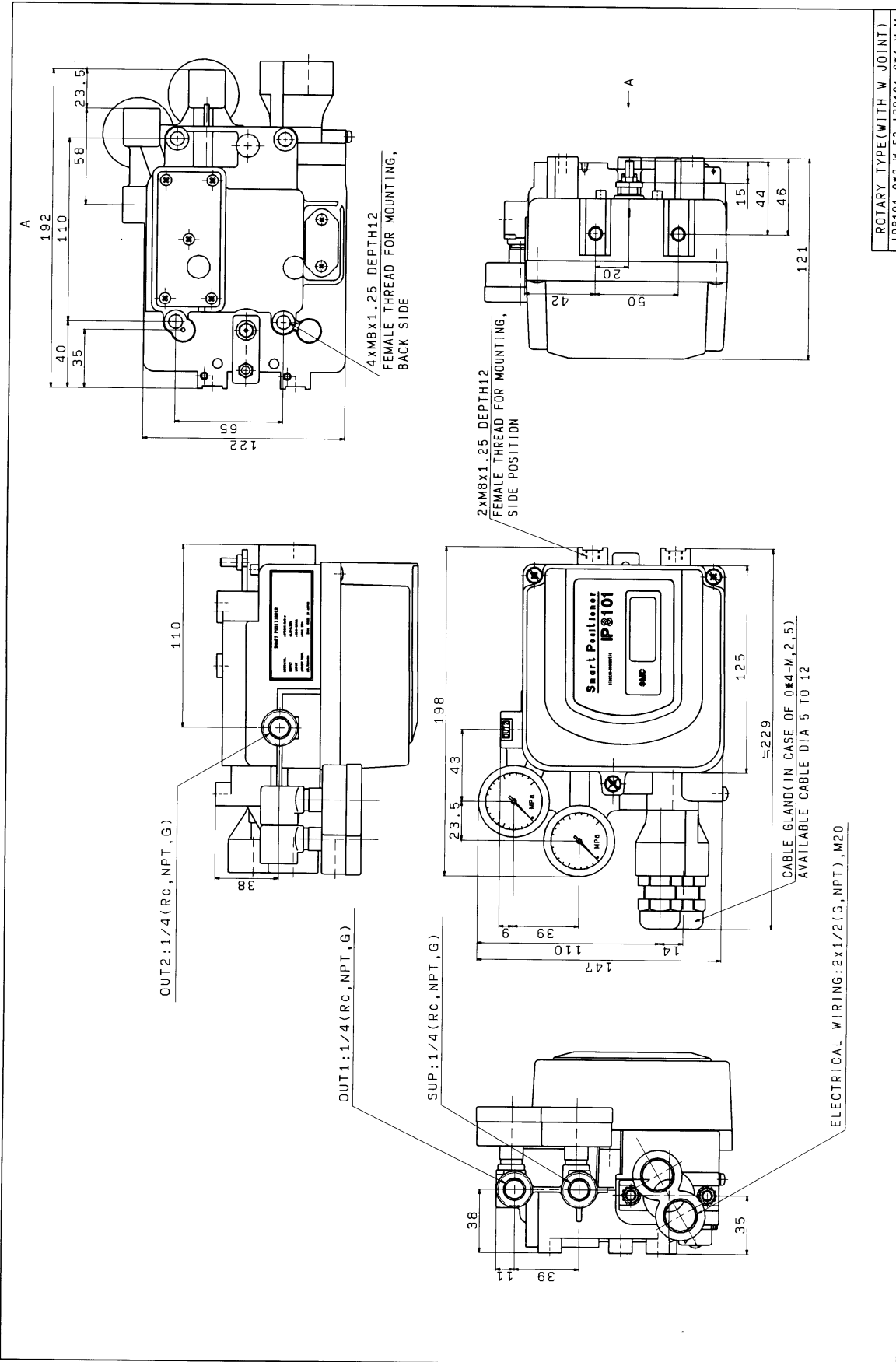
IN CASE OF OPTIONAL "RESIN CABLE CLAMP"  
 AVAILABLE CABLE DIA 7 TO 9:P368010-26  
 AVAILABLE CABLE DIA 9.1 TO 11:P368010-27



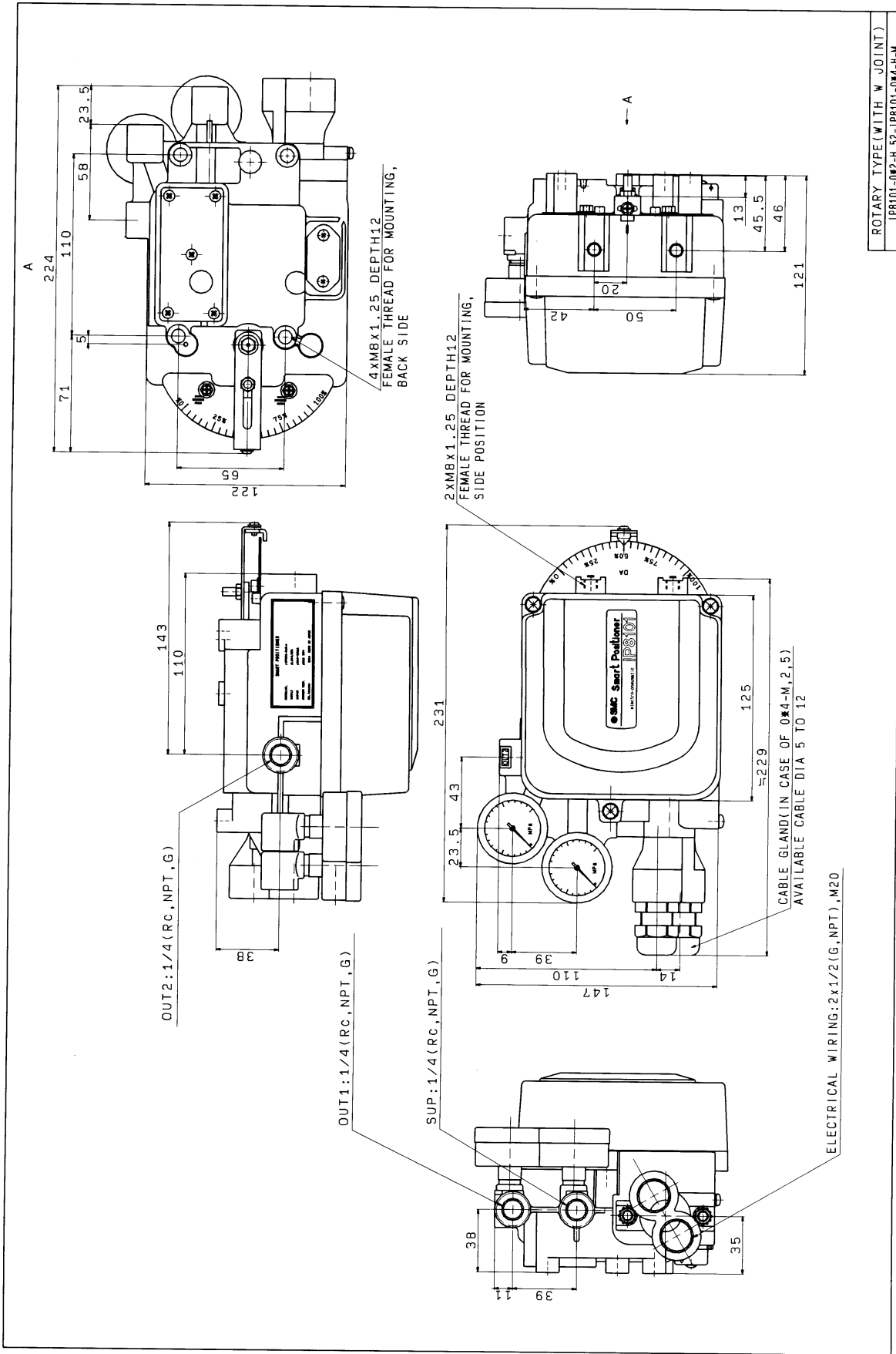


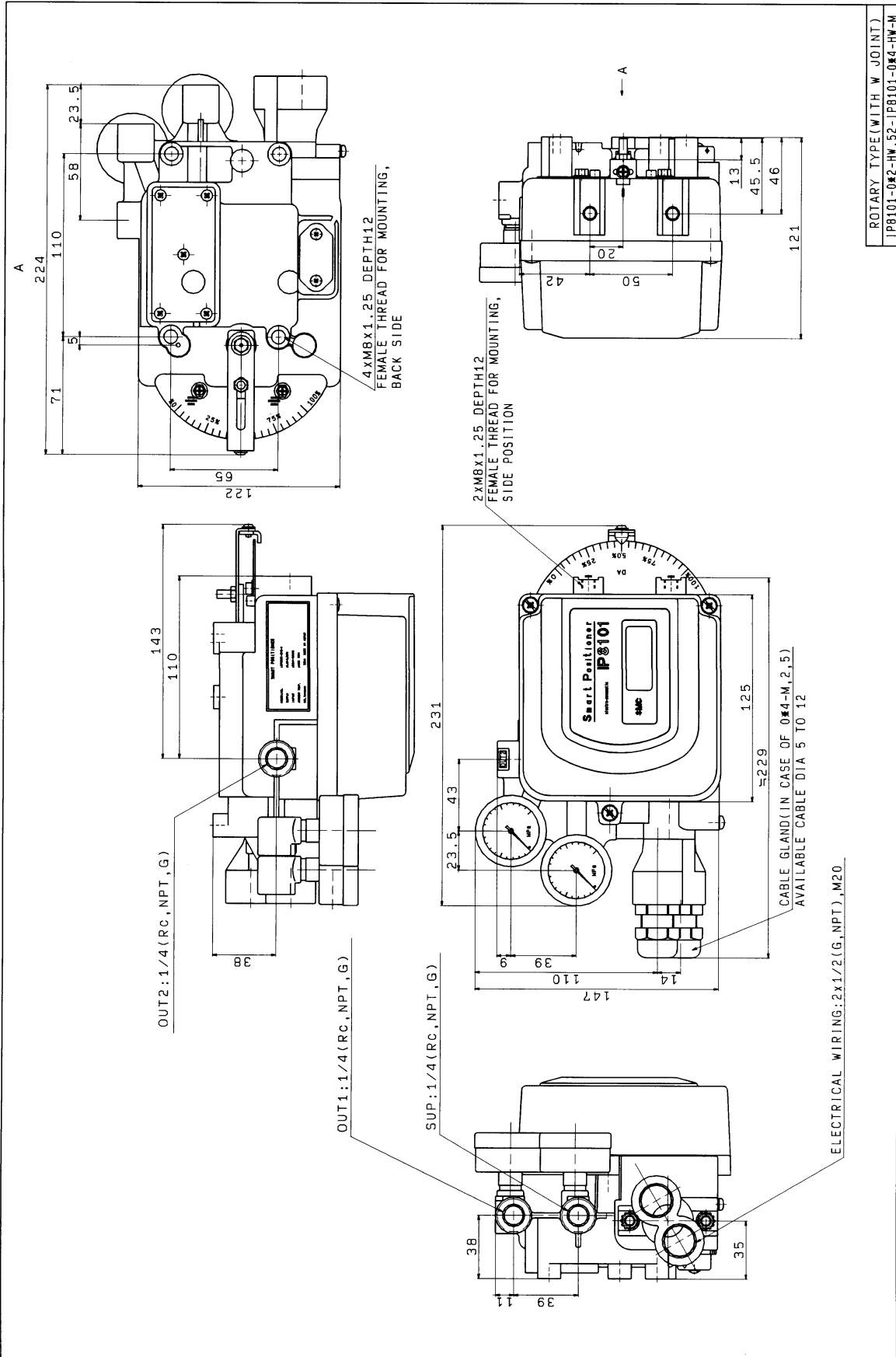


ROTARY TYPE (WITH W JOINT)  
 IP8101-0K2, 52-IP8101-0K4-M



ROTARY TYPE (WITH W JOINT)  
 IP8101-0\*2-W, 52-IP8101-0\*G-W-M





#### Revision history

A	26.9.2005	Address change
B	30.3.2006	Add the "How to Operation"
C	28.11.2006	Add the ATEX item
D	28.08.2007	Change the temp. range
E	30.7.2008	Change the "How to order" by adding the kind of screw
F	27.10.2009	Change of "Compressed Air Cleaning Equipment"+ Add the "Electric wire diameter"
G	14.5.2010	"Compressed Air Cleaning Equipment" was deleted +Error in writing was corrected.
H	10.7.2020	Change of "Approval No."
I	25.12.2020	Change of Page22.
J	23.3.2021	Change of ATEX marking
K	24.5.2024	Change of Safety Instructions
L	30.8.2024	Change of Table 8

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Note: Specifications are subject to change without prior notice and any obligation on the part of the manufacturer.  
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