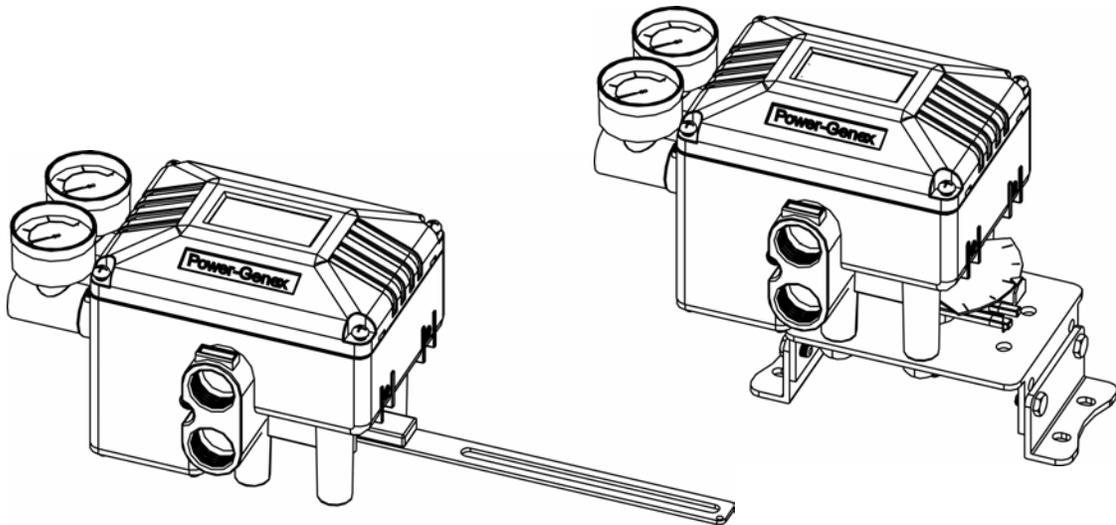


# INSTRUCTION MANUAL

## SMART POSITIONER ESL & ESR SERIES



## **Smart Valve Positioner**

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## Smart Valve Positioner

### 1. Features

- Auto-Calibration for optimum valve conditions
  - Precise control performance and high dynamic response
  - Easy operation with four-key pads and full text graphical LCD
  - Single and double acting
  - Low air consumption due to piezo electric microvalve
  - Pressure regulator built-in to eliminate variations in supply air pressure
  - Problem-free characteristics on a very small actuator
  - High resistance against shock and vibration
  - Mounting on linear actuators according to IEC 534
  - Mounting on rotary actuators according to VDI / VDE 3845
- Options
    - Position transmitter (4...20mA output signal)
    - Two alarm limits (Min., Max)
    - Gauge block with two stainless steel pressure gauges
    - Explosion proof type (Exd IIB T6, Exia IIB T6)
    - HART communication (FSK)



### 2. Specifications

Input signal	4~20mA DC
Voltage drop	8.5V DC @ 20mA (425Ω)
Min. / Max. current	3.6mA / 50mA
Air supply pressure	1.4...7.0bar (20...100psi)
Media characteristic	Filtered compressed dry and non-oiled air
Output pressure	0...100% supply air pressure / single or double action
Shut-off value	Range 0...5% of position signal
Air consumption	0.08 m <sup>3</sup> /h at 1.4bar (20psi) supply
Humidity limits	<90% RH, non-condensing
Stroke / Angle	5...80mm (max. up to 150mm) / 40...90° (max. up to 100°)
Adjustable speed	1...200 (lowest 1, highest 200)
LCD indication	4-digit LCD indicator
Scan time	2μs
Valve action	Position 0...100% / direct action (DA) / reverse action (RA)
Characteristic curve	Linear, E.Q. percentage 1:25 or 1:50 Linearity ≤0.3% / sensitivity ≤0.2% / hysteresis ≤0.2%
Temperature limits	Operation: -20...+70□
Protection class	IP66, intrinsic safety (Exia), Flameproof (Exd)
Case material	Aluminum diecast
Pneumatic connections	Rc 1/4 or 1/4 NPT
Electrical connections	2 x G 1/2 or 1/2 NPT
Weight	2.3 kg (with pressure gauge block)



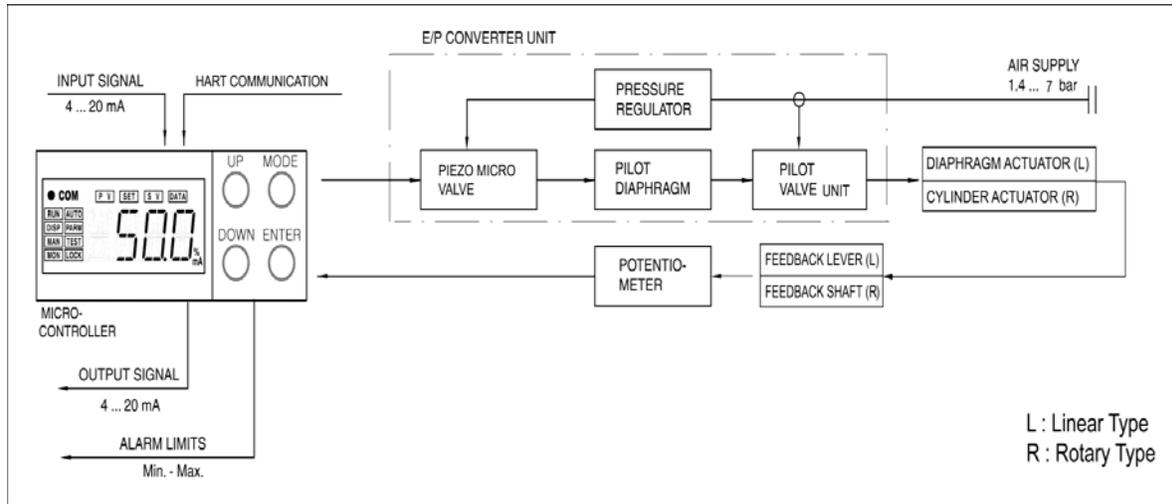
ESL (linear type)



ESR (rotary type)

## Smart Valve Positioner

### 3. Principle of Operation

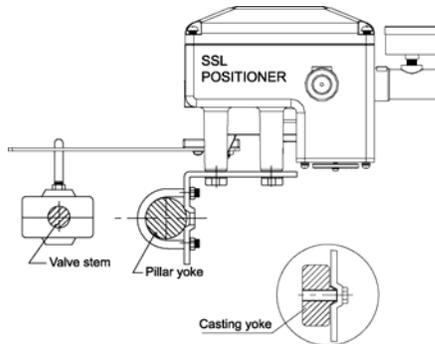


- ① Input signal (4...20mA) is supplied into the piezo microvalve by passing through the controller in the control unit.
- ② Supply air (1.4...7.0bar) is supplied into the piezo microvalve by passing through the pressure regulator in the E/P converting unit.
- ③ Due to the piezo-electric effect, the piezo microvalve generates the pneumatic output signal in proportion to the voltage level coming from the controller.
- ④ Pneumatic output signal is amplified by the pilot diaphragm and operates the poppets in the pilot valve.
- ⑤ Supply air (1.4...7.0bar) is supplied into the actuator by the movement of these poppets.
- ⑥ Position feedback from the feedback shaft goes into the potentiometer.
- ⑦ Potentiometer generates the feedback signal, which goes into the controller.
- ⑧ If the feedback signal equals the input signal supplied into the positioner, the controller doesn't send the signal to the piezo microvalve so as to stop the supply air from going into the actuator. But, if these two signals are different, the controller continues to send the signal to the piezo microvalve unit they become equal.
- ⑨ As options, the position transmitter (4...20mA output signal) and / or two limit switches (open, close) can be built-in.

**Smart Valve Positioner**

**5. Mounting ESL Positioner (linear type)**

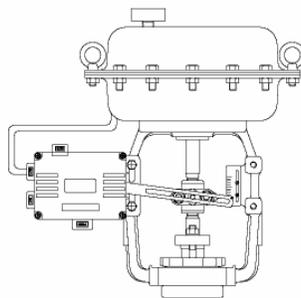
- ① It is necessary to make the mounting bracket for the yoke of the control valve you have.  
(For reference, we provide the following a Namur type bracket for IEC534 and a flat type bracket at customers' request)



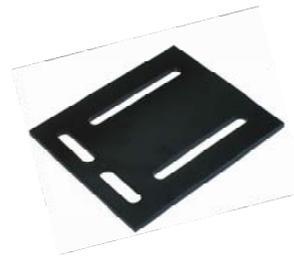
Mounting with Namur type bracket



Namur type bracket

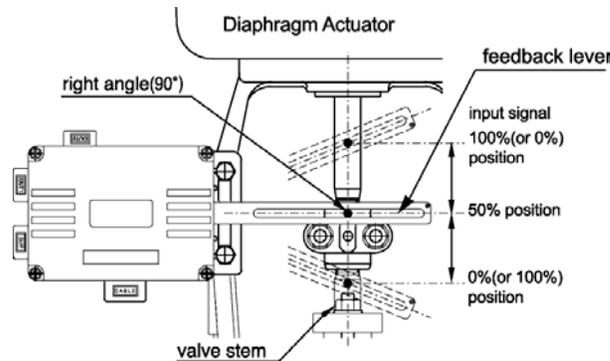


Mounting with a flat type bracket



Flat type bracket

- ② As shown below, fix the positioner at position where the angle between the valve stem and the feedback lever becomes about 90° when the input signal is set to 12mA(50%).



- ③ Stroke range for the best performance should be 5~80mm (optional 70~150mm) and the operation angle of the feedback lever should be less than Max. 45° to carry out accuracy and linearity perfectly.

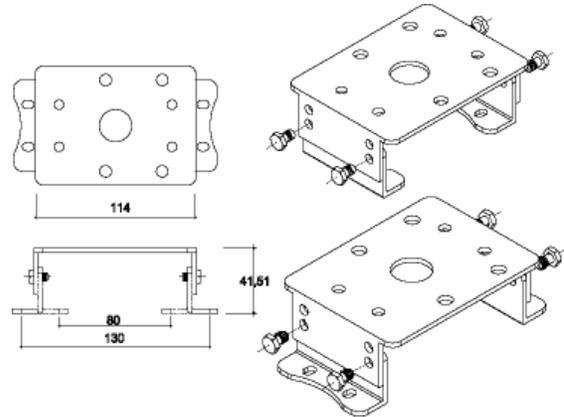
**▲** As the maximum operating angle of the feedback lever is 45°, be sure that a feedback lever doesn't reach the feedback lever stopper on the back of the positioner when a valve moves 0 to 100%. If it reaches, move the positioner off from the valve yoke stem.

## Smart Valve Positioner

### 6. Mounting ESR Positioner (rotary type)

ESR positioner basically has the NAMUR shaft and it can be directly mounted to the top pinion (VDI/DE 3845) of the pneumatic rotary actuator with the following multi-size bracket supplied as option. A user can re-assemble it for 80x30x20, 80x30x30, 130x30x20, and 130x30x30 according to requirements as shown below.

Namur Standard	Bracket Height
80 × 30 × 20 (H)	41mm
80 × 30 × 30 (H)	51mm
130 × 30 × 20 (H)	41mm
130 × 30 × 30 (H)	51mm

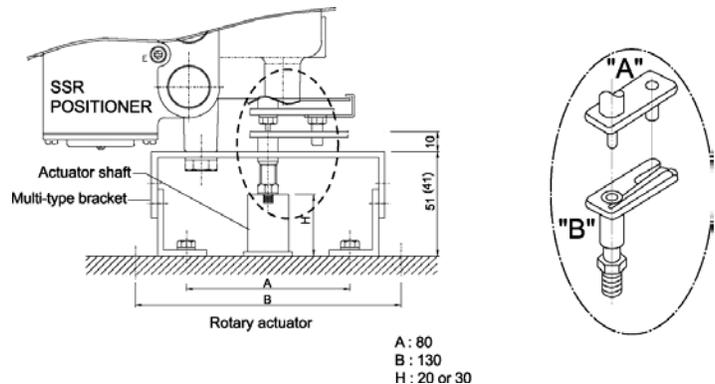


**▲ Multi-size bracket is assembled for 80 × 30 × 20 as a standard factory setting.**

After assembling the bracket according to requirements and confirming the starting rotation direction (0%) of the pneumatic actuator, mount the positioner and the bracket as advised below.

#### 6-1] Mounting with fork lever type

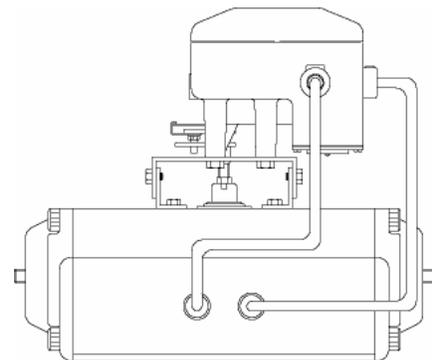
- 1) Mount the multi-size bracket. And insert a fork lever "B" into the actuator output shaft as shown to the right so that it can be placed about 10mm from the bracket.
- 2) Mount the positioner on the multi-size bracket and make a feedback lever shaft "A" placed in the orifice of a fork lever "B" so that they are in alignment with the actuator output shaft.
- 3) Fix the positioner to the multi-size bracket with enclosed M8 bolts.
- 4) Turn and set the indicator so that it can be placed at the starting rotation direction (0%). And fix "B" of the fork lever by turning a nut so that it cannot be loosened.



#### 6-2] Mounting with Namur type

Mount the positioner shaft to the actuator output shaft directly as shown to the right.

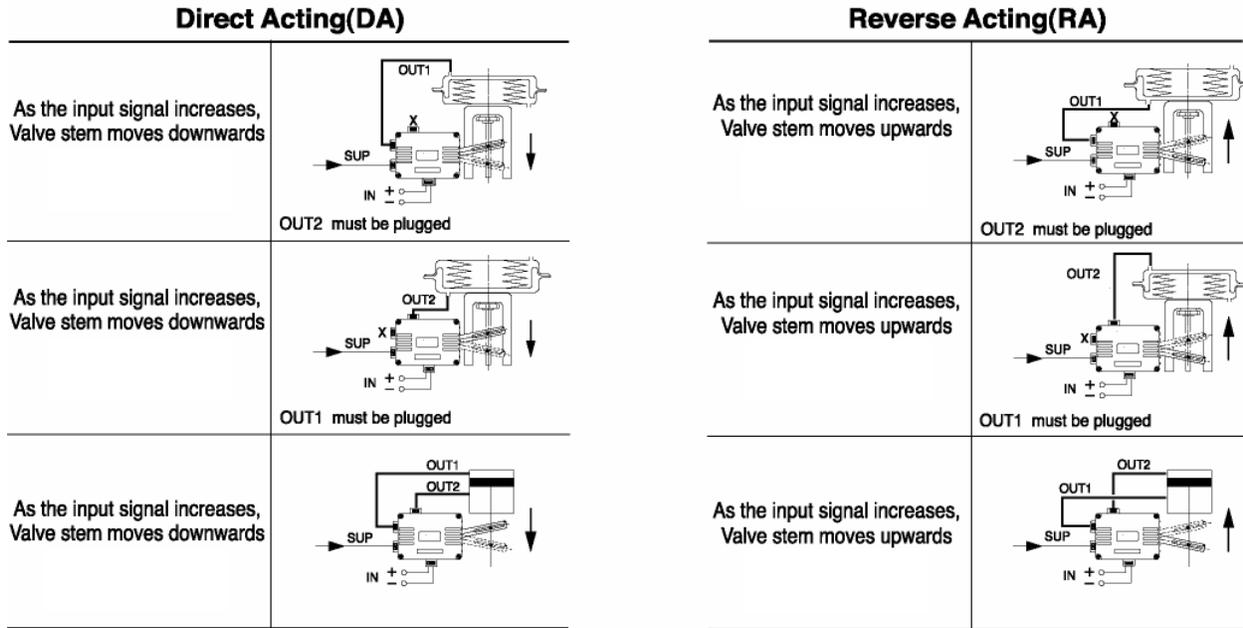
**▲ Be sure that the starting rotation direction of the actuator accords with the rotation direction of the positioner.**



## Smart Valve Positioner

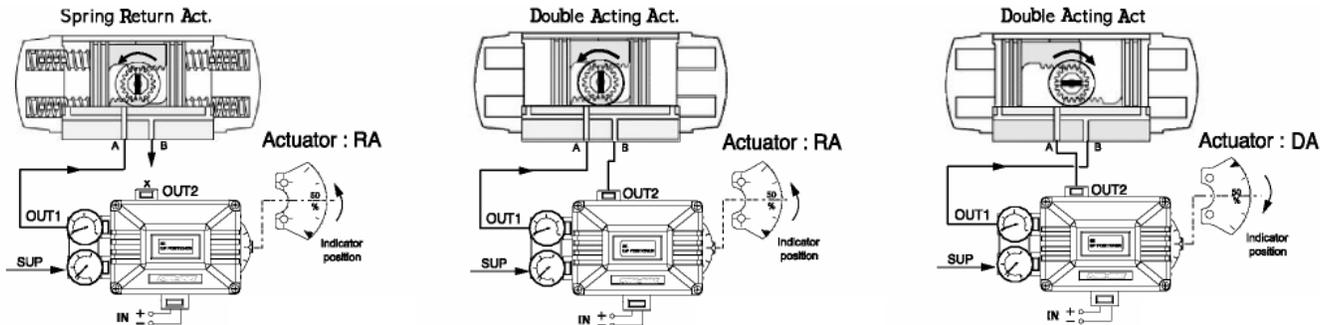
### 7. Air Connections

#### 7-1] ESL (linear type)



#### 7-2] ESR (rotary type)

Confirm the rotating direction of the actuator and connect the airlines as below.

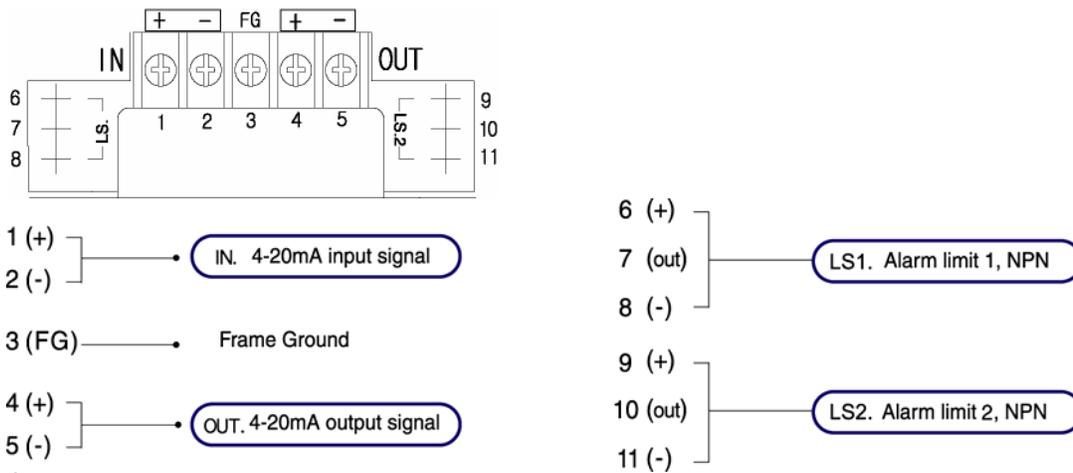


	Spring Return	Double Acting
Reverse Acting	Out 1 : piped, Out 2 : plugged	Out 1 : piped to Actuator port A, Out 2 : piped to Actuator port B
Direct Acting	Out 1 : plugged, Out 2 : piped	Out 1 : piped to Actuator port B, Out 2 : piped to Actuator port A

- ⚠ ① The air filter regulator should be installed before the positioner.
- ② Supply air should not contain any oil, water, and moisture.
- ③ It is recommended that the pressure of the air filter regulator is set about 10% higher than the used pressure of the actuator.

## Smart Valve Positioner

### 8. Electrical Connections



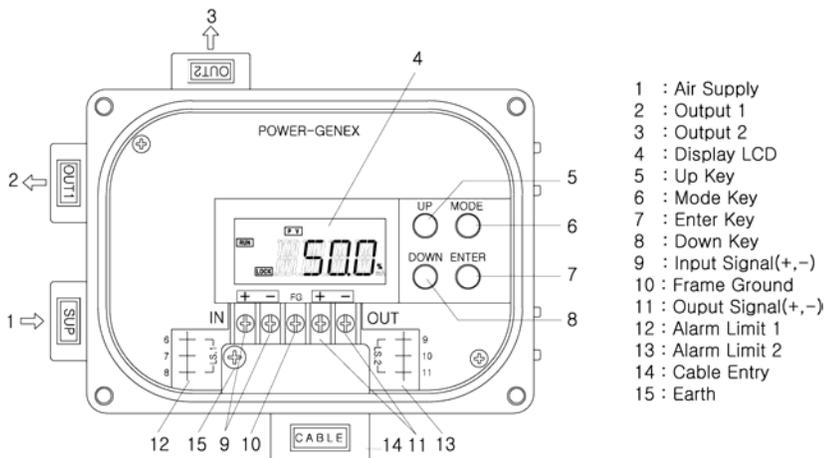
**⚠ CAUTION:** 1. Always check that the electrical load is within the range stated on the nameplate. Failure to remain within electrical ratings may result in damage to or premature failure of the electrical switches, sensors or transmitter electronics.  
2. Always confirm if + and - of input and output signals are connected properly.

**⚠ CAUTION:** When opening the positioner cover at humid places, more attention is required. This may cause the serious malfunction of the control board.

### 9. Performing Quick Auto-Calibration

Quick Auto Calibration provides a good function that a user can set the positioner at the field easily and fast without unlocking its configuration. Please be advised that this function is limited only to setting of Span and P-Gain.

**⚠ For setting of other parameters except Span and P-Gain, LOCK should be unlocked first.**



- **MODE:** This is to go into the main menu.
- **ENTER:** This is to program the selected main menu.
- **UP:** This is to move a higher menu from a present menu and to change parameters and setting values.
- **DOWN:** This is to move a lower menu from a present menu and to change parameters and setting values.

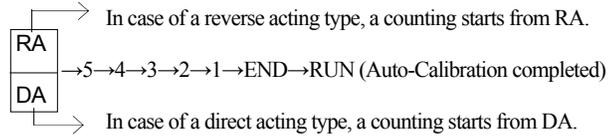
**⚠ Checkpoints before performing Auto-Calibration**

- a) Check if any oil, particles, water, and moisture are contained in supply air.
- b) Check if the pressure of the air filter regulator is set properly.
- c) Check if the operation of the actuator is Direct Acting (DA) or Reverse Acting (RA).
- d) Check if the feedback lever or shaft of the positioner is mounted properly.
- e) Check if + and - for input and output signals are connected properly.

## Smart Valve Positioner

### 9-1] Quick Auto-Calibration

Supply 4...20mA input signal and push MODE for more than 5 seconds.



**▲ Time required for this Quick Auto-Calibration is a little different according to the control valves, but it generally takes about 2~3 minutes. In case of a large-sized actuator, more time is required to wait.**

### 9-2] Span Adjustment (SPAN)

SPAN can be adjusted after Auto Calibration is completed.



Push DOWN for more than 5 seconds, and SPAN will be displayed.

Push ENTER, and 100.0 will be blinking. Adjust SPAN by pushing UP / DOWN.

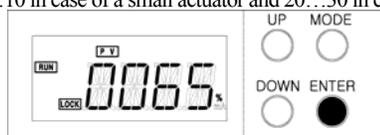
After SPAN reaches a desired position, push MODE two times, and RUN mode will be performed.

Note) Above 98.5% is just an example to explain. This value can be different according to adjustment.

- ▲**
1. Keep pushing UP or DOWN, and SPAN will be increased or decreased. 0.1% will be increased or decreased by every pushing.
  2. It is essential to re-adjust SPAN in case of ESL positioner (linear type). But it is optional in case of ESR positioner (rotary type) that operates 90° . If necessary, set it as advised above.

### 9-3] P-Gain Adjustment (proportional control)

Be sure if the valve works properly after Auto Calibration. If there happens any hunting, decrease P-Gain. If there happens any oscillation, increase P-Gain. It is recommended to increase or decrease 5...10 in case of a small actuator and 20...30 in case of a large actuator.



Push UP for more than 5 seconds, and P-GN will be displayed.

Push ENTER, and the first cipher will be blinking. Adjust value by pushing UP / DOWN. Push MODE one more time, and the setting ciphers will be moved to second or third.

After adjusting to a desired value, push ENTER two times, and RUN mode will be displayed.

Note) Above 72% is just an example just to explain. This value can be different according to adjustment.

**▲ P-Gain value may be different according to the size and condition of the actuator. As the micro controller precisely calculates it, if there is not any big change in value, no modification is necessary.**

### 9-4] RA / DA Adjustment (reverse / direct acting)

RA (Reverse Acting) is a standard factory setting. Auto Calibration will be performed, even though the airlines are connected wrongly. If the rotation of the actuator doesn't match with the input signals, re-install Output 1 and 2 of the airlines and re-perform Auto Calibration.

**Smart Valve Positioner**

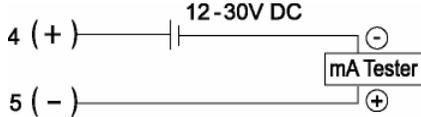
**9-5] Measuring Position Feedback (4...20mA output signal)**

▲ Input signal should be provided for measurement of output signal.

**1] With mA Calibrator**

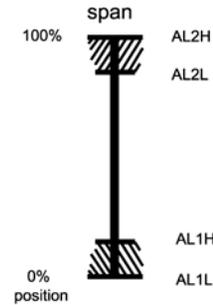
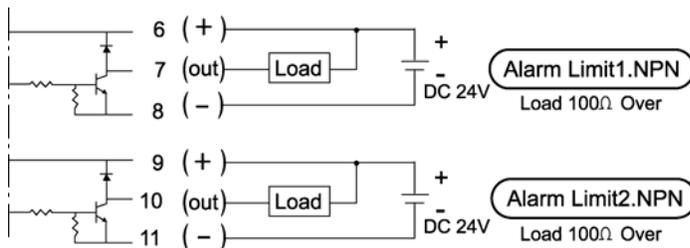
Select MEASUREMENT and connect + to 4 and - to 5 (See page 8).

**2] With Multimeter Tester**



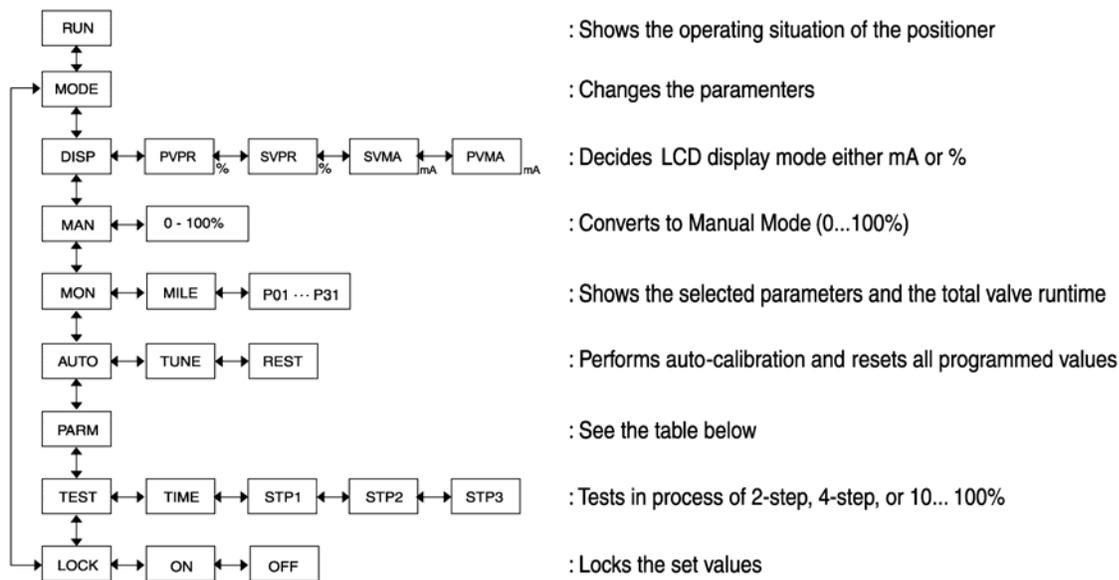
- ▲ 1. Be sure that the power supply of DC 12 - 30V is supplied.
- 2. ZERO / SPAN of position feedback will be automatically set after Auto-Calibration is completed.

**9-6] Setting Alarm Limits**



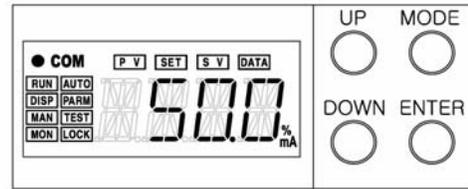
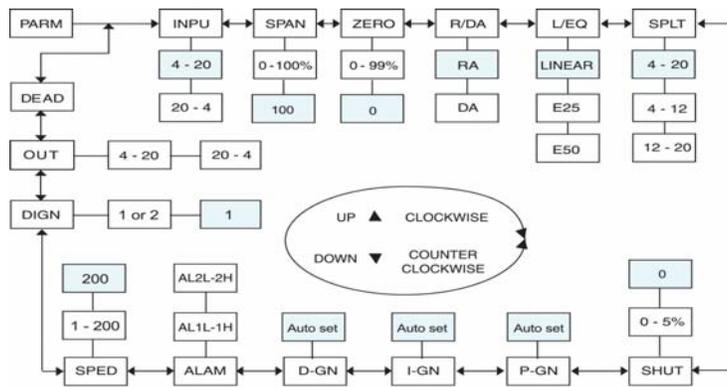
▲ Be sure that the power supply of 24V DC is supplied.

**10. Parameters Diagram Lay-out [Main parameters]**



## Smart Valve Positioner

### [Sub-Parameters]



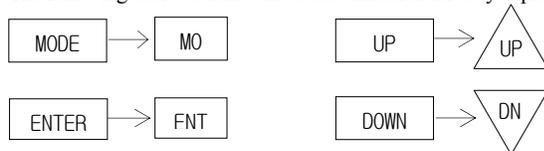
LCD Display  
● COM : Hart communication(FSK)

: Initial Parameter Values

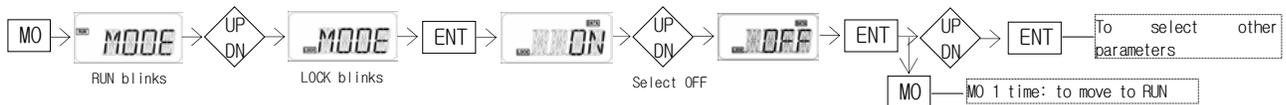
Parameters	Descriptions	Functions	Initial Values
INPU	Input signal	4...20mA or 20...4mA	4...20mA
SPAN	Span adjustment	0...100%	100%
ZERO	Zero adjustment	0...99%	0%
R / DA	RA / DA	Reverse or direct acting	Reverse acting (RA)
L / E.Q.	Linear / E.Q. %	Linear, E.Q. % (1:25 or 1:50)	Linear
SPLT	Split range	4...12mA or 12...20mA	4...20mA
SHUT	Shut-off	Valve shut off at 0...5%	0%
P-GN	P-Gain	Proportional gain value	Auto setting
I-GN	I-Gain	Integral gain value	Auto setting
D-GN	D-Gain	Differential gain value	Auto setting
ALAM	Alarm limit low, high	AL1L/AL1H, AL2L/AL2H	0...10%, 90...100%
SPED	Speed control	1...200	200
DIGN	Display digit	Movement to one or two decimal places	1

## 11. Setting Parameters

The following abbreviations will be used hereafter for easy explanation.



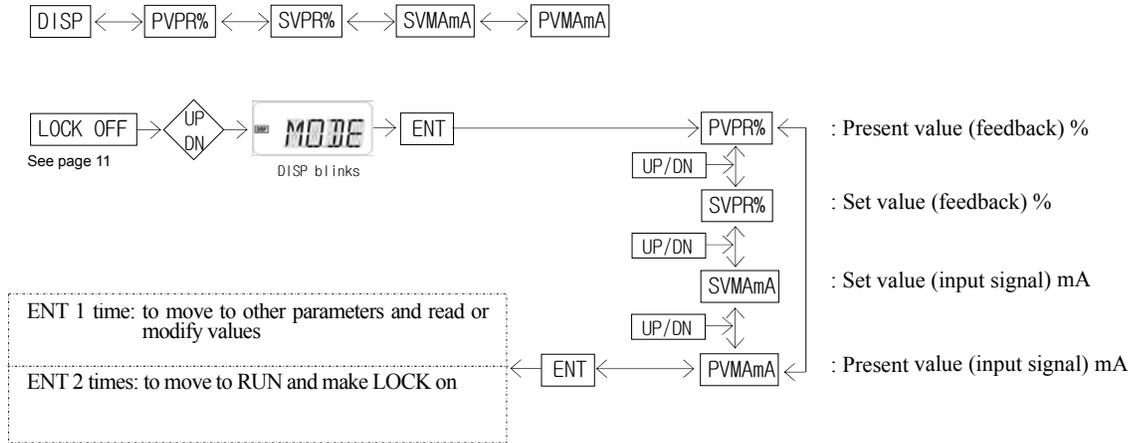
### 11-1] On and Off of LOCK



- ⚠ ① LOCK ON: This secures all selected parameters.
- ② LOCK OFF: It is necessary to set LOCK off in order to read or modify the selected parameters.
- ③ Quick Auto-Calibration, Span, P-Gain can be set without LOCK off (see page 7 – 8).
- ④ When the input signal is supplied and LOCK becomes off, if the input signal is not supplied, LOCK will be maintained.
- ⑤ Note that all parameters cannot be read or modified while LOCK is on.

## Smart Valve Positioner

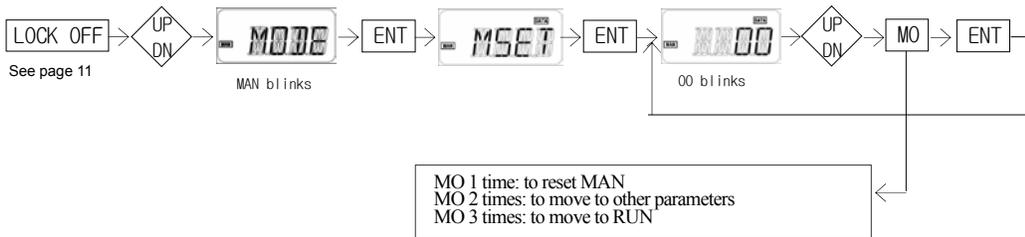
### 11-2] Selecting Display DISP



**▲ PVPR% comes first as an initial value.**

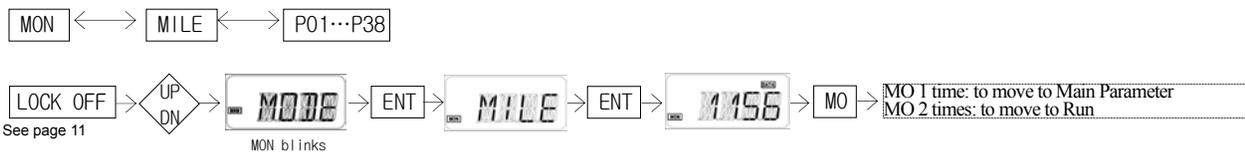
### 11-3] Manual Mode MAN (default: 100)

This is to operate a control valve 0 ~ 100% manually.



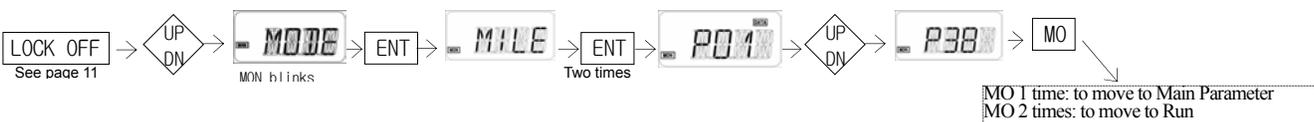
### 11-4] Monitor Mode MON

All parameters can be read (total valve runtime is also recorded).



**▲ ① Above 1156 is just for example and it means that the valve has been working for 11,560 hours because 1 corresponds to 10 hours.**

**② It is possible to describe maximum 99,990 (9999 x 10), that is, 4,166 days (11.4 years). After this, data will be counted from 0000.**



**▲ From P01 to P38 are data for a factory setting. So the user does not have to care about these data.**

**Smart Valve Positioner**

**11-5] Auto Calibration Mode** AUTO

This is to perform Auto-calibration and Reset.



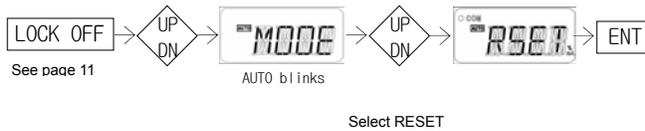
**11-5-1] Performing Auto Calibration**



- ▲ ① RA is a standard factory setting. Even though the air lines are connected for DA (direct acting), Auto-Calibration will detect this automatically and start for DA.
- ② Check if the valve works properly according to 4...20mA input signal. If not, change the output ports (OUT 1 and 2) of the positioner and re-perform Auto-Calibration.
- ③ In case that the air lines are connected for reverse acting (RA), the counting is 5-RA-4-3-2-1 END. In case that the air lines are connected for direct acting (DA), it is 5-DA-4-3-2-1 END.

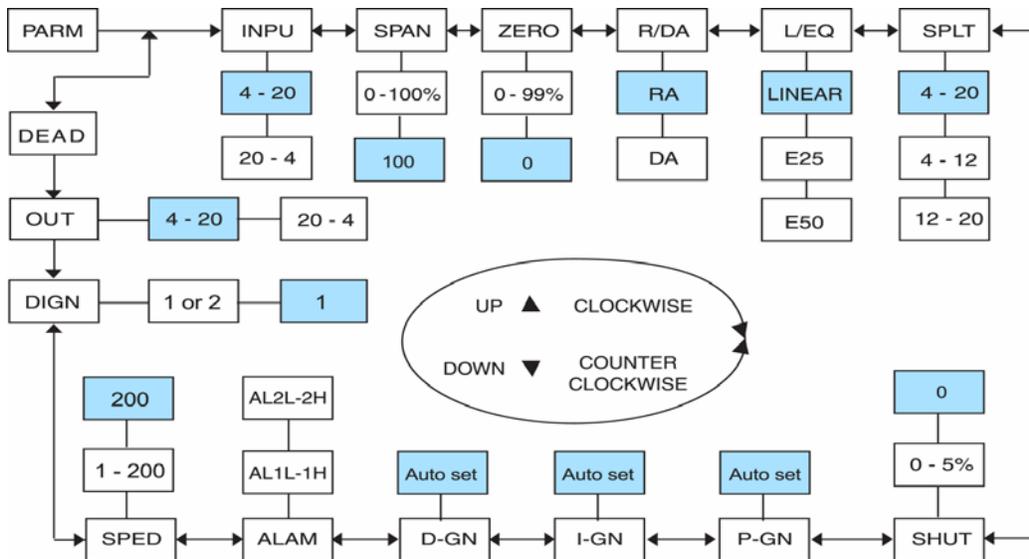
**11-5-2] Initializing Parameters (RESET)**

All parameters have the defaults from the factory.

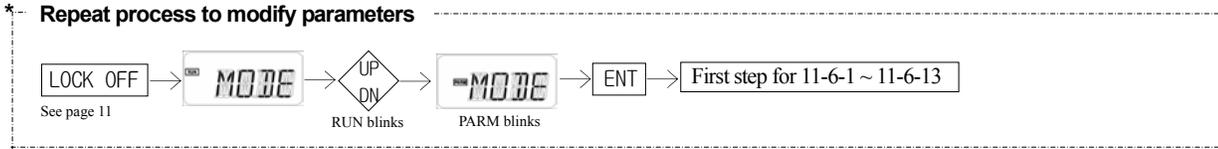


**11-6] Sub-Parameters**

There are many useful sub-parameters under these main parameters. It is possible to control the valve more precisely with them.

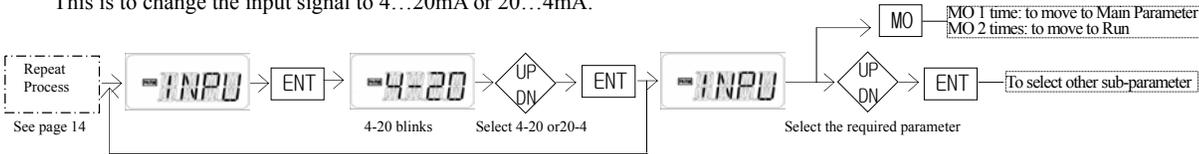


▲ Colored sub-parameters under main parameters are the factory settings. They will be restored to the defaults (factory settings) after RESET.

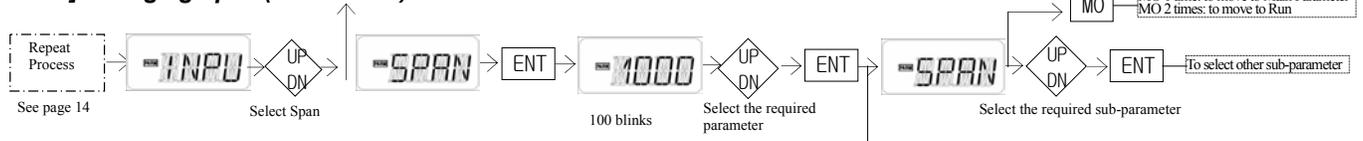


### 11-6-1] Changing Input Signal (default: 4-20mA)

This is to change the input signal to 4...20mA or 20...4mA.



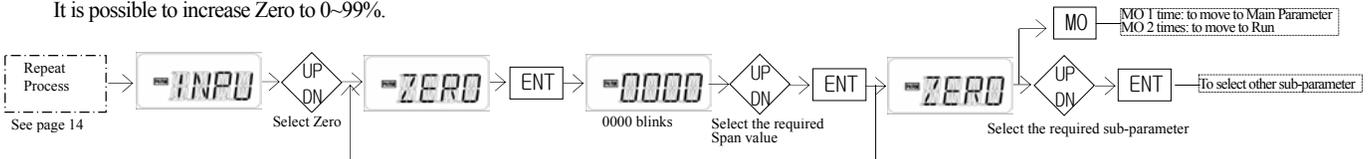
### 11-6-2] Changing Span (default: 100)



- ⚠ ① Be sure that 20mA input signal is supplied first for modification.
- ② Push DN 1 time, and Span will decrease 0.1%. Keep pushing DN, and Span will decrease fast by 0.1%.
- ③ If Span is decreased too much, push UP so that it can reach a desirable point.

### 11-6-3] Changing Zero (default: 0)

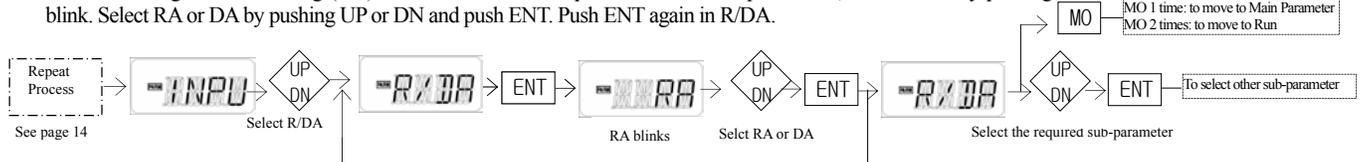
It is possible to increase Zero to 0~99%.



- ⚠ Be sure to perform Auto-Calibration first and change Zero. For example, if a valve is normally close and Zero is increased to 10%, the fluid corresponding to 10% of Span will flow in spite of close at 4mA. On the contrary, if a valve is normally close type, push UP, and Zero will increase. If a valve is normally open type, push DN, and Zero will decrease.

### 11-6-4] Selecting Direct Acting (DA) Reverse Acting (RA) (default: RA)

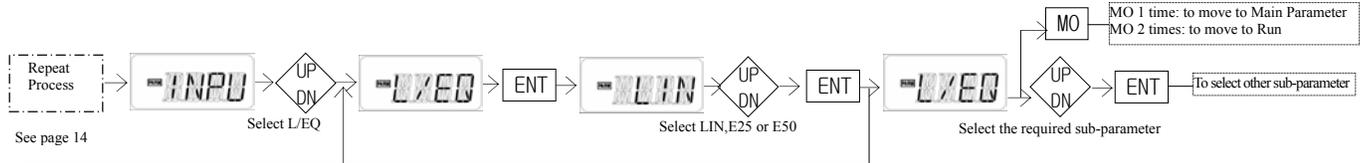
This is to change to direct acting (DA). As INPUT is the first parameter from sub-parameters, select R/DA by pushing UP or DN. Push ENT, and RA will blink. Select RA or DA by pushing UP or DN and push ENT. Push ENT again in R/DA.



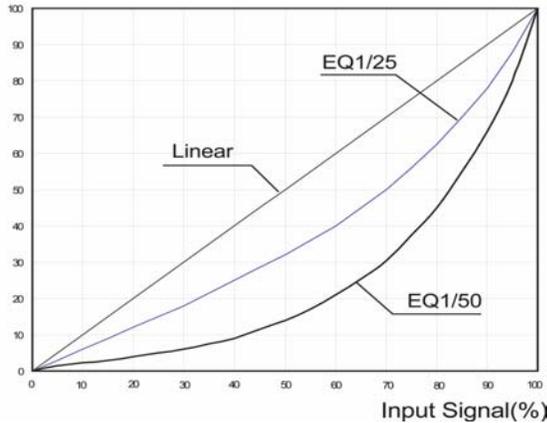
## Smart Valve Positioner

### 11-6-5] Linear, EQ% Characteristic (default: linear)

Select the required characteristic curve between Linear or EQ 1/25 or EQ1/50 (see the below characteristic curve). As INPUT is the first parameter from sub-parameters, select L/EQ by pushing UP or DN. Push ENT, and LIN will blink. Select LIN or EQ by pushing UP or DN and push ENT. Push ENT again in L/EQ.

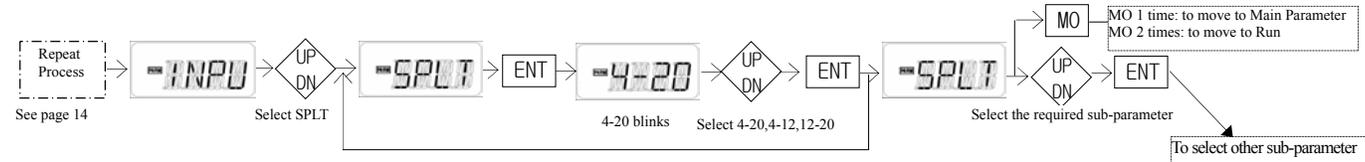


Stroke (%)



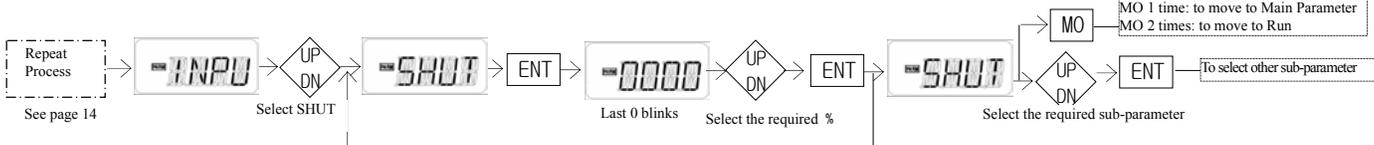
### 11-6-6] Split Range (default: 4-20)

This is to change the input signal to 4-12mA or 12-20mA.



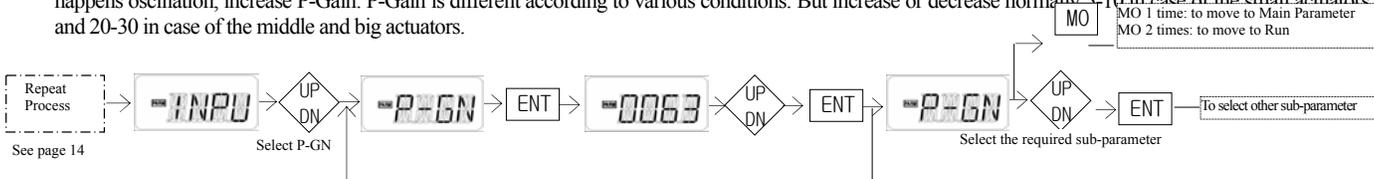
### 11-6-7] Shut-Off Control (default: 0)

This is to keep a valve close completely. A valve shut-off can be 0~5% with this parameter.



### 11-6-8] P-Gain (proportional gain)

If Auto-calibration is performed, a micro processor calculates P-Gain in consideration of sizes of the control valve and the actuator and some variables. Therefore, the modification is not necessary. But, if it is required, do it as advised below. For information, if there happens hunting, decrease P-Gain. If there happens oscillation, increase P-Gain. P-Gain is different according to various conditions. But increase or decrease normally 5-10 in case of the small actuators and 20-30 in case of the middle and big actuators.

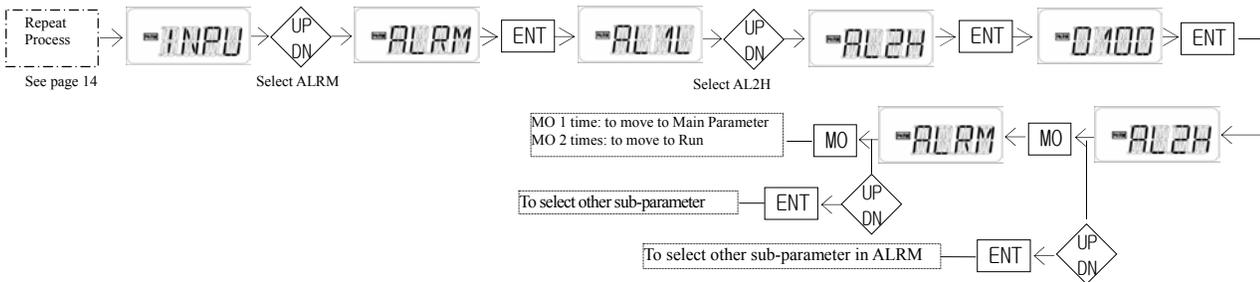


**▲ Push ENT, and the first place number blinks. Modify the value by pushing UP/DN. Push MO one by one in order to move to ten, hundred place.**

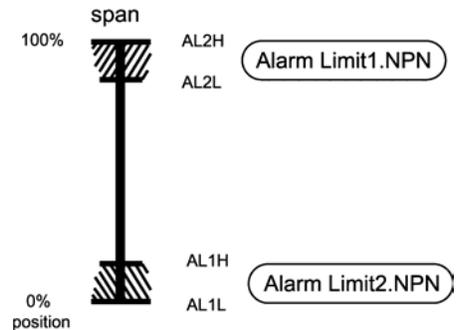
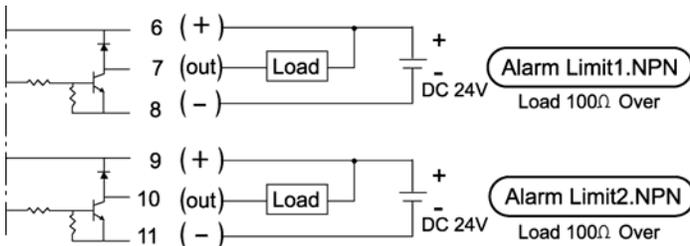


**Smart Valve Positioner**

□ **Setting AL2H**



**Setting Alarm Limits**

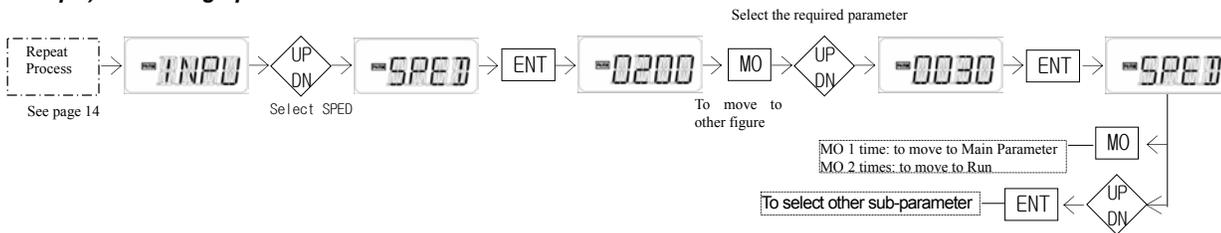


▲ Be sure that the power supply of 24V DC is supplied.

**11-6-12] Speed Control (default: 200)**

This is to control the speed of the control valve and the actuator. 200 is maximum and 1 is minimum.

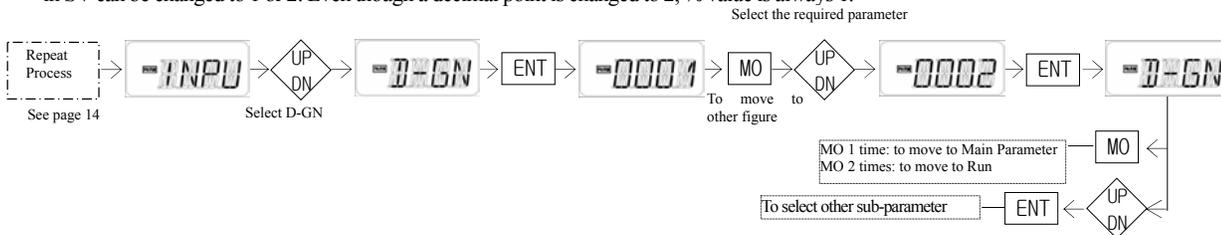
**Example) Decreasing Speed Control to 30**



▲ In case that the air volume booster is used, it is recommendable to set the speed to more than 2000.

**11-6-13] Changing Figure on LCD**

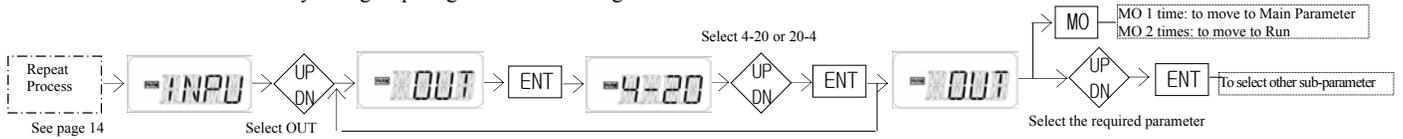
SV is set for a first decimal point (1) as standard display. This is to change it to a second decimal point (2). By the way, please be informed that only mA value in SV can be changed to 1 or 2. Even though a decimal point is changed to 2, % value is always 1.



**Smart Valve Positioner**

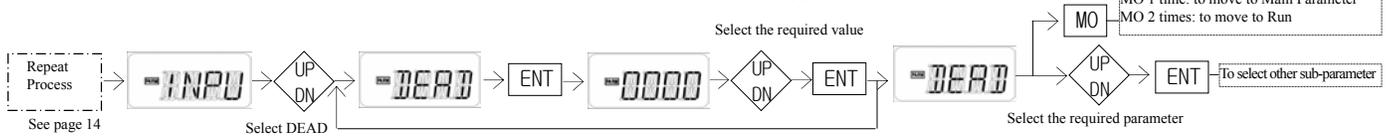
**11-6-14] Setting Feedback Signal (default: 4...20mA)**

4...20mA is a standard factory setting output signal. This is to change it to 20...4mA.



**11-6-15] Setting Dead Band (default: 0000)**

This is to set Dead Band to 0-1% when a difference between SV and PV continues to happen.

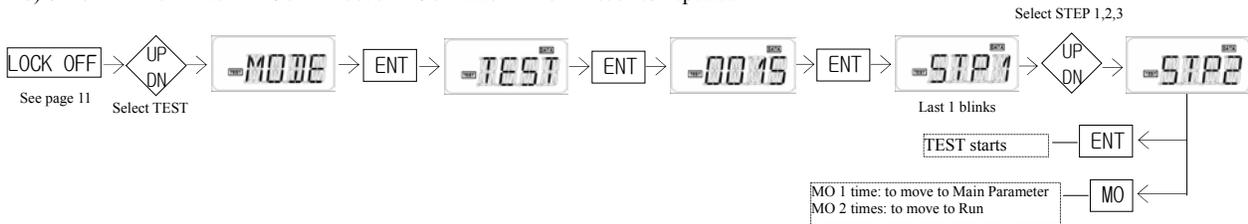


**▲ Dead band is set to 0% as a standard factory setting. When it is needed to be changed, 0001 on LCD corresponds to 0.1% and 0099 corresponds to 1%. This can be set to max. 1%.**

**12. Self-Test Mode**

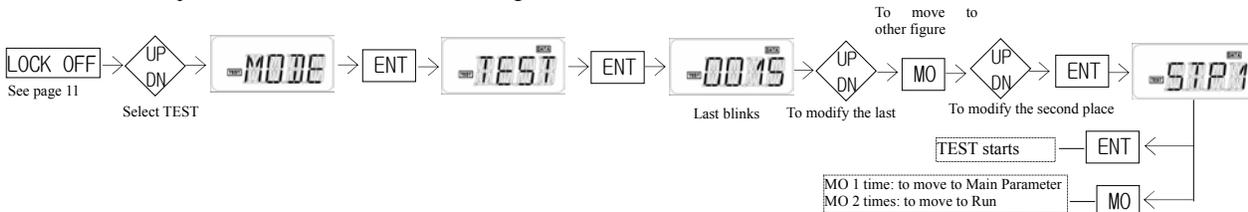
**12-1] This is to test a control valve automatically regardless of input signal.**

- A) STP1: 0 → 50 → 100% → 50 → 0% Test repeated
- B) STP2: 0 → 25 → 50 → 75 → 100% → 75 → 50 → 25 → 0% Test repeated
- C) STP3: 1 → 10 → 20.....90 → 100% → 90.....20 → 10 → 0% Test repeated

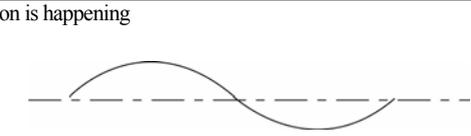


**12-2] Setting Interval Time between Steps (default: 15)**

Interval time between steps is set to 15 seconds and it can be changed.

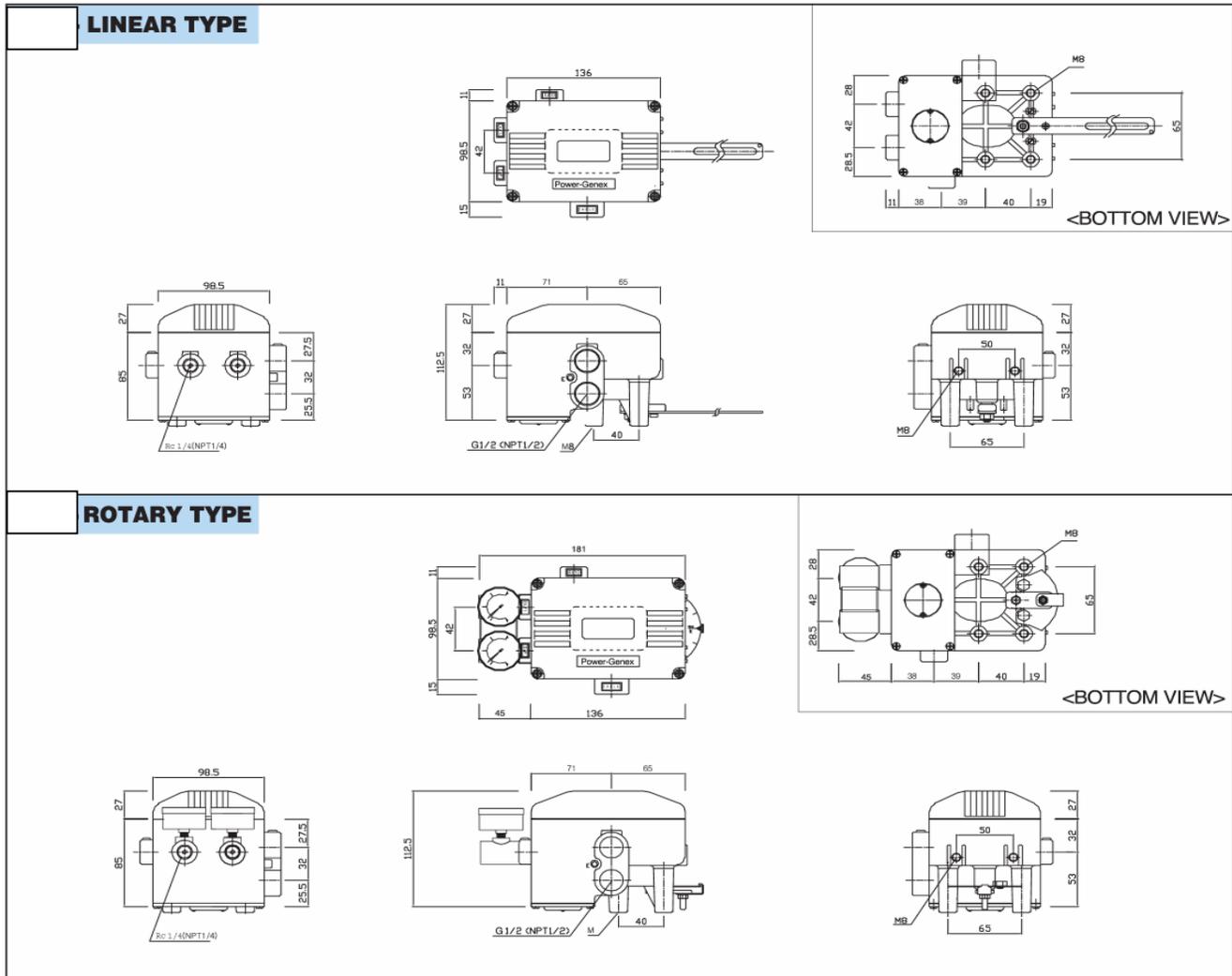


13. Troubleshooting and Notes

NO.	Problem	Solution
1.	Counting stops at “4” during Auto-Calibration process	Angle between a positioner and a valve stem is too small. Increase this angle. (available angle: more than Min. 5°)
2.	When input signal is supplied, “INFT” appears and then disappears.	Input signal is too low or too high. (signal rating: Min./Max.: 3.8 ~ 20.5mA)
3.	Air volume booster is installed.	After setting the speed to more than 2000 and performing Auto-Calibration, set an air volume booster by turning a screw. (See 11-6-12 on page 17)
4.	Speed controller is installed on air lines.	Make a speed controller pass supply air without adjusting and perform Auto-Calibration.
5.	Supply of input signal (4-20mA) is different from movement of the actuator.	Change the air lines with each other that are connected out 1 and 2 of the positioner and re-perform Auto-Calibration. (See page 7)
6.	It is necessary to change output signal.	Output signal can be set to 4-20mA or 20-4mA. (See page 11-6-14 on page 18)
7.	Positioner is exposed to strong electromagnetic waves.	As these ESL & ESR series are the electronic positioners, they may not work properly due to strong electromagnetic waves.
8.	Hunting is happening Target 	In case that input signal is supplied and the valve moves up and down drastically from Target and returns to Target in a very short time, decrease P-Gain value. (See 9-3 on page 9)
9.	Oscillation is happening Target 	In case that input signal is supplied, the valve moves up and down like a wave from Target and returns to Target, increase P-Gain value. (See 9-3 on page 9)
10.	Input signal is supplied but any characters and numbers don't appear on LCD.	Check and re-connect + and - of input signal properly. (See 8 on page 8)

### Smart Valve Positioner

#### 14. Drawings

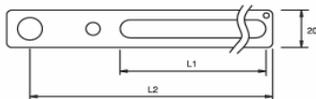


#### ACCESSORIES

unit : mm

##### LINEAR FEEDBACK LEVER

TYPE	STROKE	L1	L2
A	5 - 40	132.5	62.5
B	5 - 80	194	122
C	60 - 150	251	115

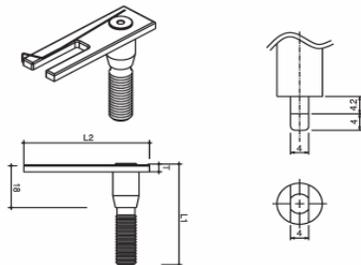


##### ROTARY FEEDBACK LEVER

TYPE	L1	L2	T
F	132.5	62.5	3.0
N	NAMUR SHAFT		

Fork Lever(F)

Namur Shaft(N)



##### ROTARY MULTI-TYPE BRACKET

TYPE	H
80 x 30 x 20H	41
80 x 30 x 30H	51
130 x 30 x 20H	41
130 x 30 x 30H	51

