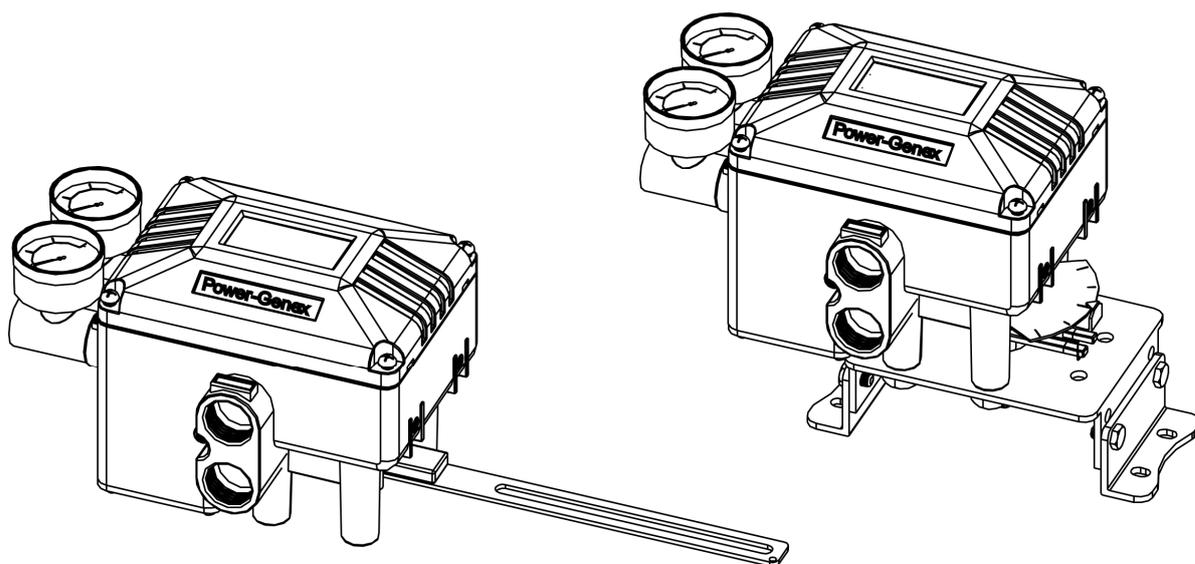


INSTRUCTION MANUAL

SMART VALVE POSITIONER SSL & SSR SERIES



- I N D E X -

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Power-Genex SSL & SSR series are the smart valve positioners which were designed with advanced operating mechanism and can achieve the smartest control with various setting functions for optimum valve conditions

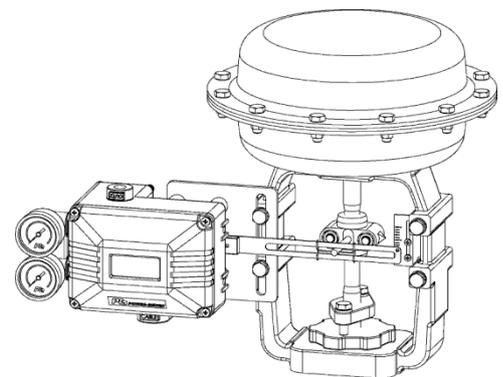
1. Features

- 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)
 - 2 x alarm limit (Min., Max)
 - Gauge block with two stainless steel pressure gauges
 - Explosion proof type (Exd IIB T6, Exia IIC T6)
 - HART communication (FSK)

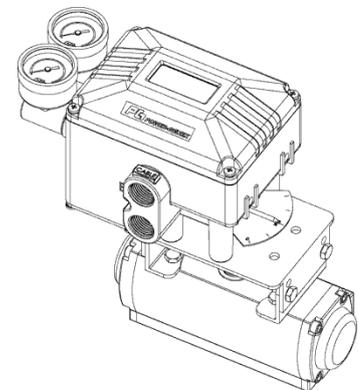


2. Specifications

Input signal	4 - 20mA @ 24VDC
Voltage drop	8.5V DC @ 20mA (425Ω)
Min. / Max. current	3.6mA / 50mA
Required load voltage ($\approx \Omega @ 20mA$)	Without HART: 8.5V ($\approx 425\Omega$) With HART: 9.2V ($\approx 460\Omega$)
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 capacity	6.6 kg/h = 5.4N ^m /h = 3 scfm @ supply air of 1.4bar (20psi)
Air consumption	< 0.04 kg/h
Humidity limits	<90% RH, non-condensing
Stroke / Angle	5...80mm (max. up to 150mm) / 40...90° (max. up to 100°)
Adjustable speed	1...1000 (lowest 1, highest 1000)
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 °C
Protection class	IP66, intrinsic safety (Exia), Flameproof (Exd)
Case material	Aluminum diecast
Pneumatic connections	Rc 1/4 (1/4 NPT)
Electrical connections	2 x G 1/2 (1/2 NPT)
Weight	2.5 kg

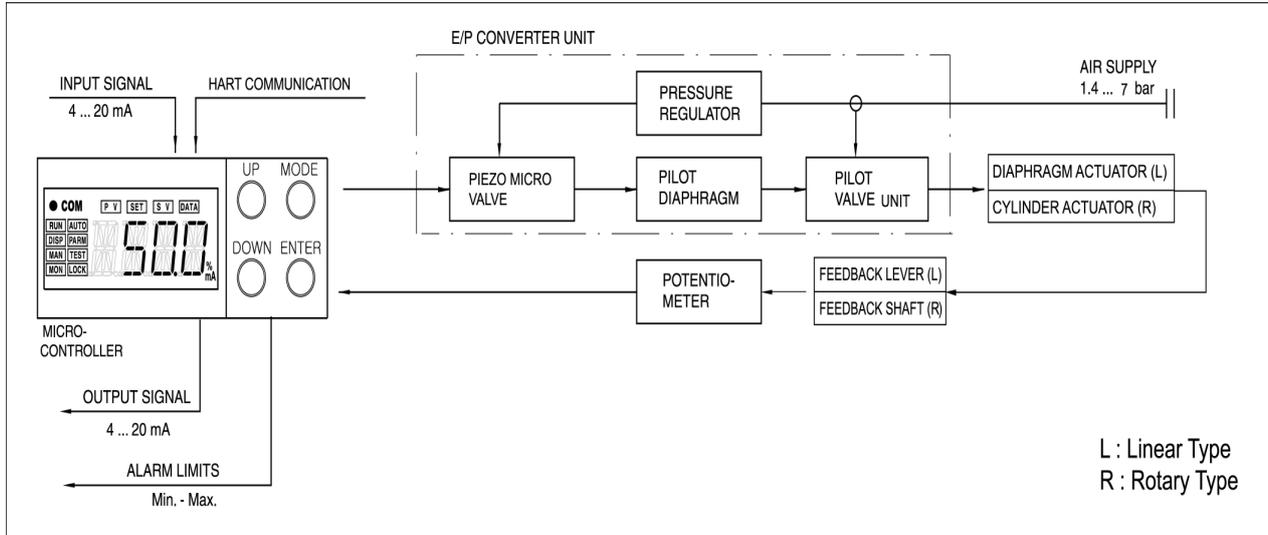


SSL (linear type)



SSR (rotary type)

3. Principle of Operation



- ① Input signal (4-20mA) supplied is transmitted to the piezo microvalve by passing through the micro-controller in the control unit.
- ② Supply air (1.4-7.0bar) is transmitted to 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 micro-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 is transmitted to the potentiometer.
- ⑦ This potentiometer generates the feedback signal, which is transmitted to the micro-controller.
- ⑧ If the feedback signal equals the input signal supplied into the positioner, the micro-controller doesn't send the signal to the piezo microvalve any more so as to stop the supply air from delivering to the actuator. But, if these two signals are different, the micro-controller continues to send the signal to the piezo microvalve unit until they become equal.
- ⑨ As options, the position transmitter (4-20mA output signal) and / or two limit switches (open, close) can be built-in for position feedback.

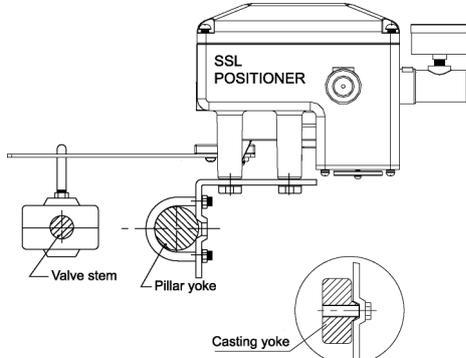
4. How to Order



Description	Code	Description	Code
Actuator Operation:	L: Linear type R: Rotary type	Position Feedback:	N: None O: Position transmitter (4...20mA output signal) L: 2 x alarm limits M: O+L
Protection Class:	F: Flameproof (Exd IIB T6) I: Intrinsic safety (Exia IIC T6) W: Weatherproof to IPIP66	HART Communication	N: None H: HART communication
Feedback Lever: - Linear Type	A: Stroke (5...65mm) B: Stroke (10...85mm) C: Stroke (up to 150mm)	Connection Threads: (pneumatic – electrical)	3: Rc 1/4 – G1/2 (standard) 4: NPT 1/4 – NPT 1/2 5: Rc 1/4 – M20 x 1.5
- Rotary Type	F: Fork lever (standard) N: Namur shaft (direct mounting)	Mounting bracket:	N: None L: DIN / IEC 534 (for SSL) R: DIN VDI / VDE3845 (for SSR)
Pressure Gauges:	1: 6 bar (90psi) 2: 10 bar (150psi)		

5. Mounting the SSL Positioner (linear type)

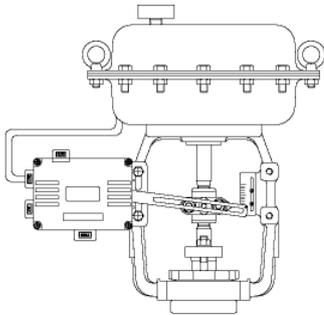
- ① It is necessary to make the mounting bracket suitable for the yoke of the control valve.
(For reference, the following NAMUR type bracket for IEC534 and flat type bracket are included as option. See 4. How to Order on page 4 and select a required bracket)



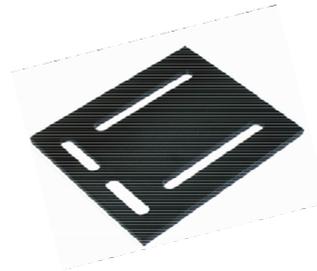
Mounting with NAMUR type bracket



NAMUR type bracket

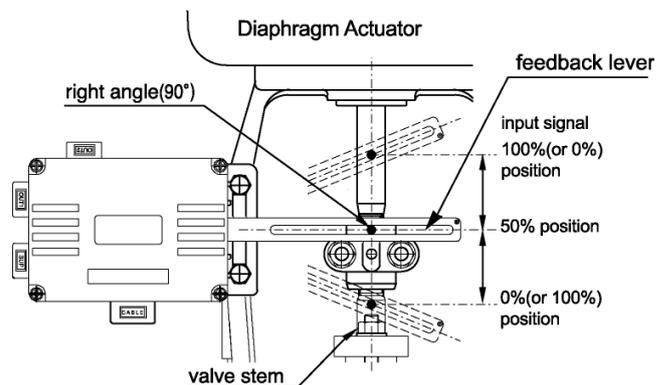


Mounting with a flat type bracket



Flat type bracket

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



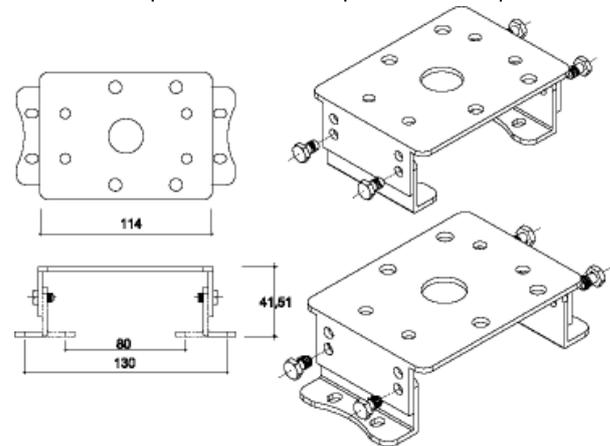
- ③ The stroke range for the best performance should be 5~80mm (optional 70~150mm) and the operation angle of the feedback lever should be less than Max. 45° to carry out accuracy and linearity perfectly.

⚠ 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.

6. Mounting the SSR Positioner (rotary type)

The SSR positioner basically has the NAMUR shaft and it can be directly mounted to the top pinion (VDI/VDE 3845) of the pneumatic rotary actuator with the following multi-size bracket supplied as option. This multi-size bracket can be re-assembled for 80x30x20, 80x30x30, 130x30x20, and 130x30x30 according to requirements as shown below. For 130x30x50, please describe a special note in a purchase order.

80 ×30×20 (H)
80×30×30 (H)
130×30×20 (H)
130×30×30 (H)
130×30×50 (H) on request

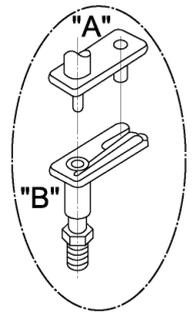
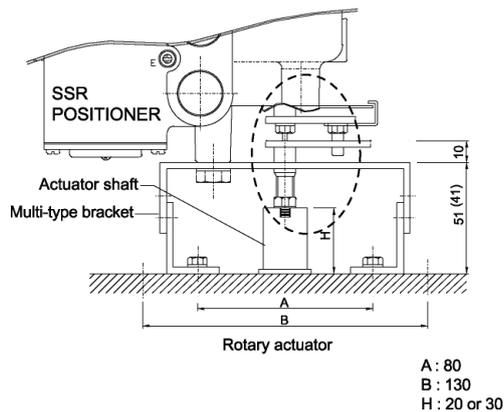


▲ The multi-size bracket is assembled for 80×30×20 as a standard factory setting.

After assembling the bracket 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 off 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.

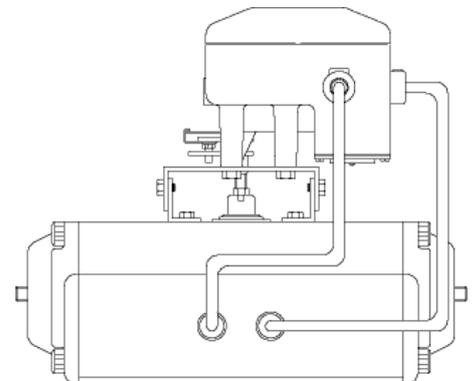


- 3) Fix the positioner to the multi-size bracket with enclosed M8 bolts.
- 4) Turn and set the indicator so that it can be placed at the starting rotation direction (0%). And fix "B" of the fork lever by turning a nut so that it cannot be loosened.

6-2] Mounting with NAMUR type

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

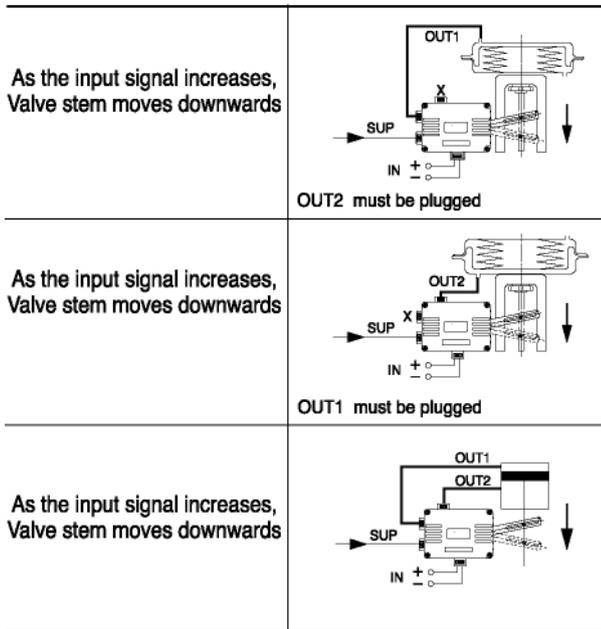
▲ Be sure that the starting rotation direction of the actuator accords with the rotation direction of the positioner. See page 7.



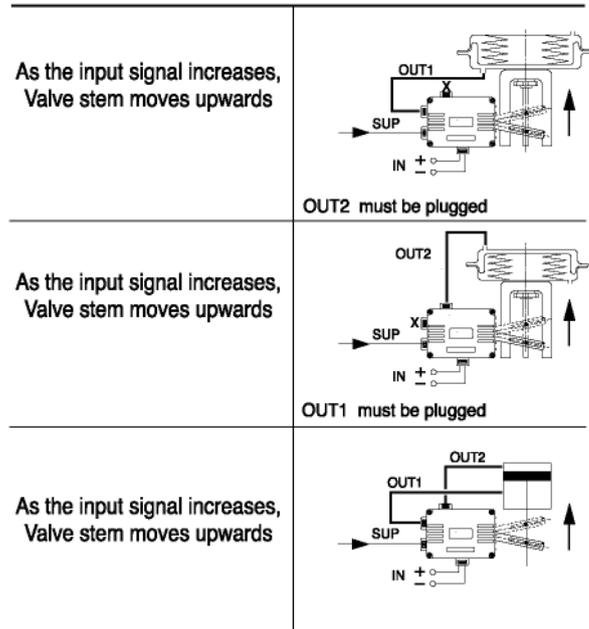
7. Air Connections

7-1] SSL (linear type)

Direct Acting(DA)

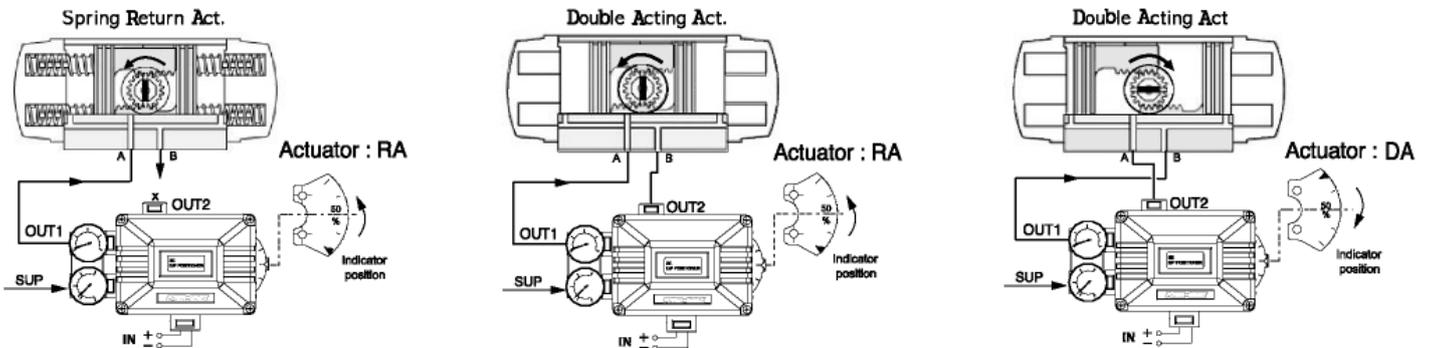


Reverse Acting(RA)



7-2] SSR (rotary type)

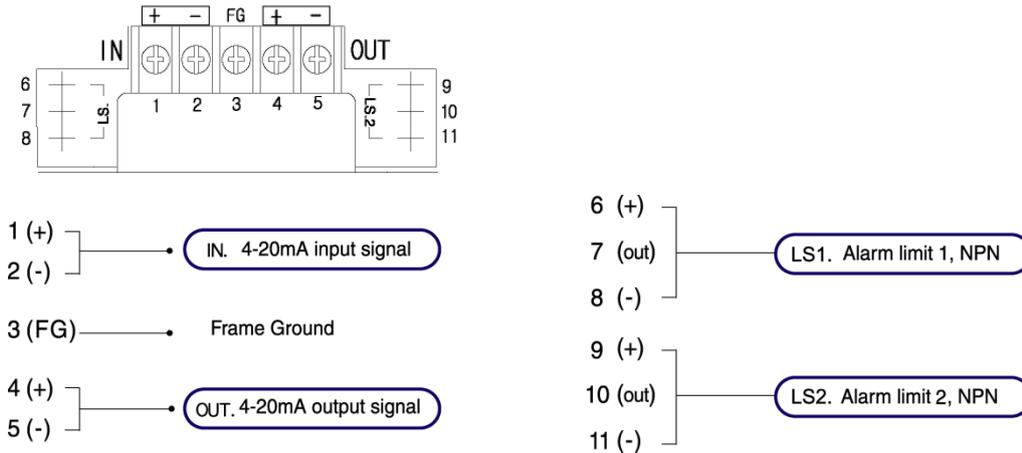
Confirm the rotating direction of the actuator and connect the airlines as below.



	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 recommendable that the pressure of the air filter regulator is set about 10% higher than the used pressure of the actuator.

8. Electrical Connections



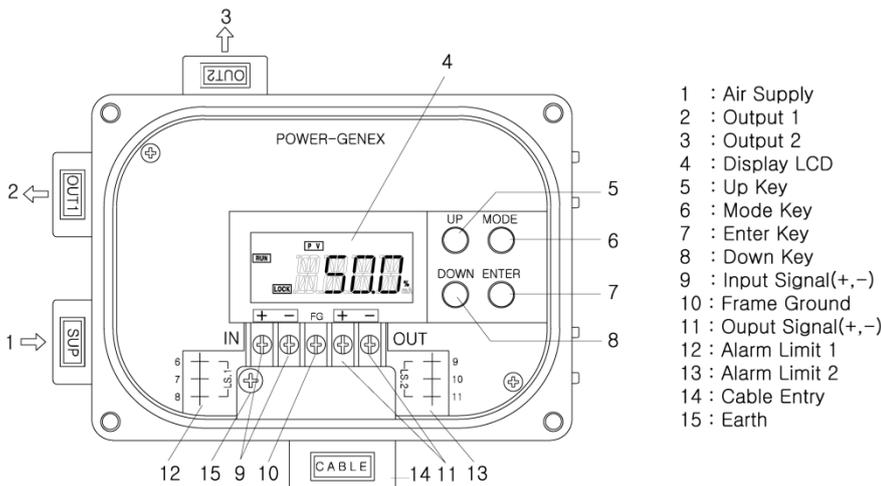
- ⚠ CAUTION:**
1. Always check that the electrical load is within the range stated on the nameplate. Failure to remain within electrical ratings may result in damage to or premature failure of the electrical switches, sensors or transmitter electronics.
 2. Always confirm if + and - of input and output signals are connected properly.
 3. When opening a positioner cover at a humid place, more attention is required. This may cause the serious malfunction of the control board.

- ⚠ Note that HART wires should be connected to terminals 1 and 2 together with input signal. For reference, there is no distinction in + and – between HART wires.**

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. But this function is limited only to the setting of Span and P-Gain.

- ⚠ For setting of other parameters except Span and P-Gain, LOCK should be set to Off first. See 11-1 on page 12.**



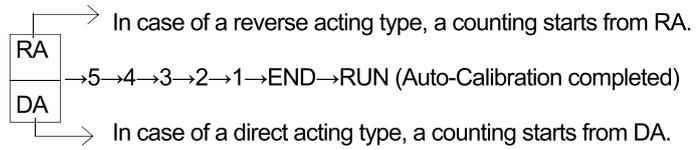
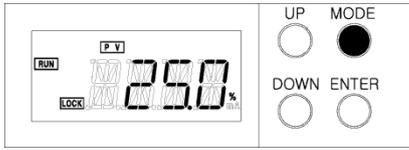
- **MODE:** This is a button to go into and back to the main menu.
- **ENTER:** This is a button to select the menu and the parameter and to save the value.
- **UP:** This is a button to move a higher menu from a present menu and to change parameters and set values.
- **DOWN:** This is a button to move a lower menu from a present menu and to change parameters and set values.

⚠ Checkpoints before performing Auto-Calibration

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

9-1] Quick Auto-Calibration

Supply 4...20mA input signal and push the MODE button for 5 seconds.

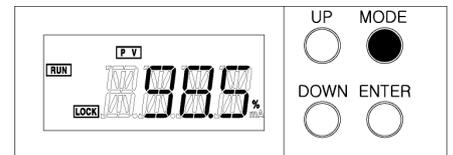
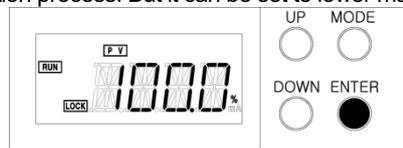
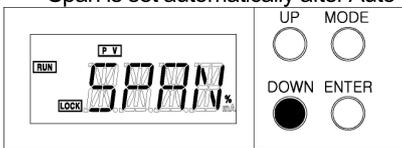


⚠ Time spent for this Auto-Calibration process is a little different according to sizes of the control valves and the pneumatic actuators, but it generally takes about 2~3 minutes. In case of a large-sized actuator, more time is required to wait.

⚠ If DATA blinks on LCD after an auto-calibration process, see 14. Error Codes Table on page 21.

9-2] Span Adjustment (SPAN)

Span is set automatically after Auto-Calibration process. But it can be set to lower manually.



Push the DOWN button for 5 seconds and SPAN will be displayed.

Push the ENTER button, and 100.0 will blink. Change this value by pushing the UP / DOWN button.

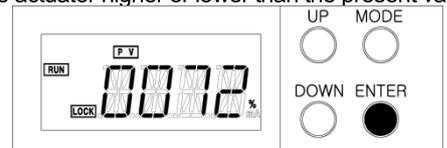
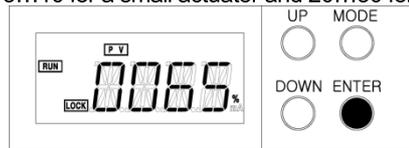
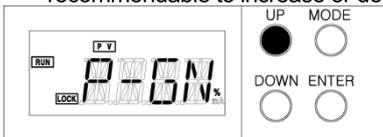
After SPAN reaches a desired position, push the MODE button 2 times, and the RUN mode will be performed.

Note) 98.5% shown above is just an example to explain how to set Span manually.

⚠ Keep pushing the UP / DOWN button, and SPAN will increase or decrease fast. For reference, 0.1% will increase or decrease by each pushing.

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

If the positioner suffers from hunting after Auto-Calibration process, decrease P-Gain. If it suffers from oscillation, increase P-Gain. It is recommendable to increase or decrease 5...10 for a small actuator and 20...30 for a large actuator higher or lower than the present value.



Push the UP button for 5 seconds and P-GN will be displayed.

Push the ENTER button, and the number of the first cipher will blink. Adjust value by pushing the UP / DOWN button. Push the MODE button one more time, and the blinking number will be moved to the second or third position.

After adjusting to a desired value, push the ENTER button 2 times, and the RUN mode will be displayed.

Note) 72% shown above is just an example just to explain how to set P-Gain manually.

⚠ P-Gain value may be set differently according to the size and working condition of the actuator. As a micro-controller built on a control board precisely calculates it, if there is not any big change in value, no modification is required.

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

RA (Reverse Acting) is a standard factory setting. Even though the airlines are connected wrongly for a direct acting actuator with a reverse acting actuator, the SSL / SSR positioners detects this wrong connection automatically and perform the Auto-Calibration process for a reverse acting actuator. But if the rotation of the actuator doesn't match with input signal, re-install Output 1 and 2 of the airlines and re-perform Auto Calibration. See page 7.

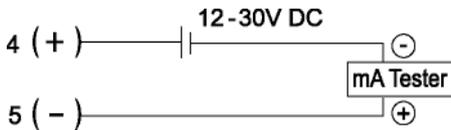
9-5] Measuring Position Feedback (4...20mA output signal)

⚠ Be sure that input signal is supplied for measurement of output signal.

1] With mA Calibrator

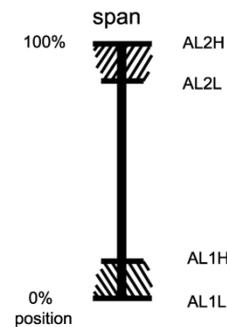
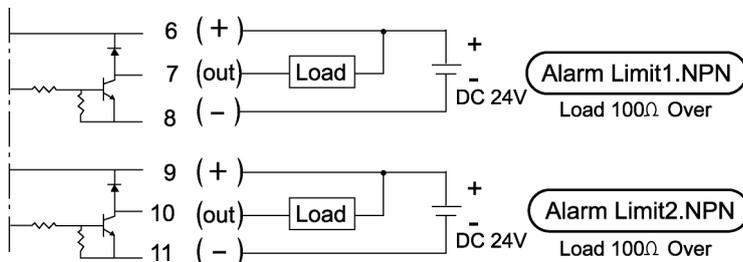
Select the MEASUREMENT option in the calibrator and connect + to 4 and – to 5 (See page 8).

2] With Multimeter Tester



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

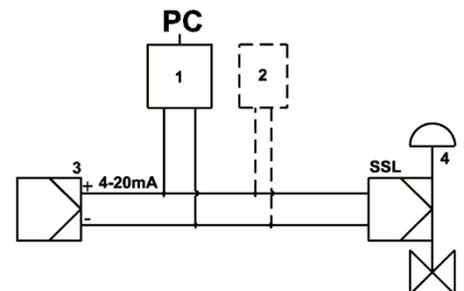
9-6] Setting Alarm Limits



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

9-7] HART Connection

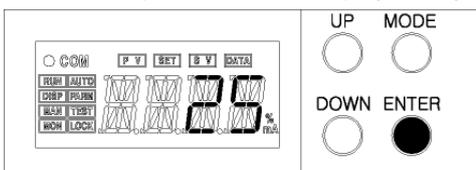
1. FSK modem
2. Hand-held communicator
3. Controller / control (supervisory) station
4. Control valve



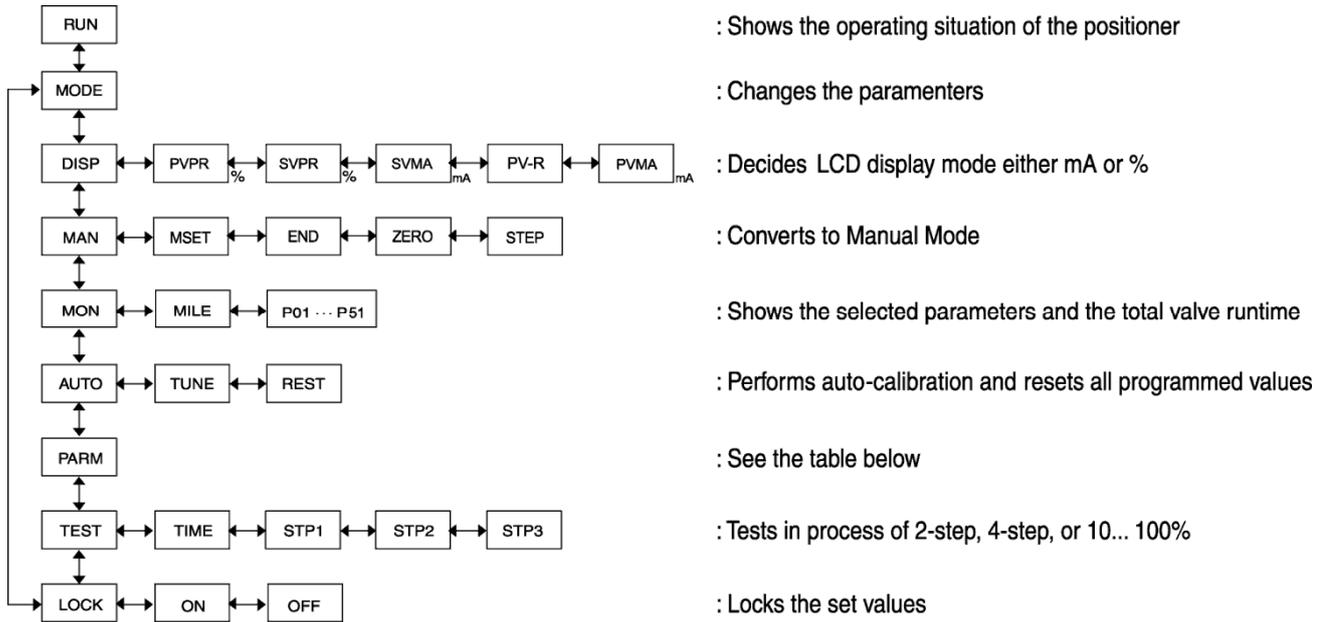
⚠ Note that HART wires should be connected to terminals 1 and 2 together with input signal. For reference, there is no distinction in + and – between HART wires.

9-8] Confirming Ambient Temperature

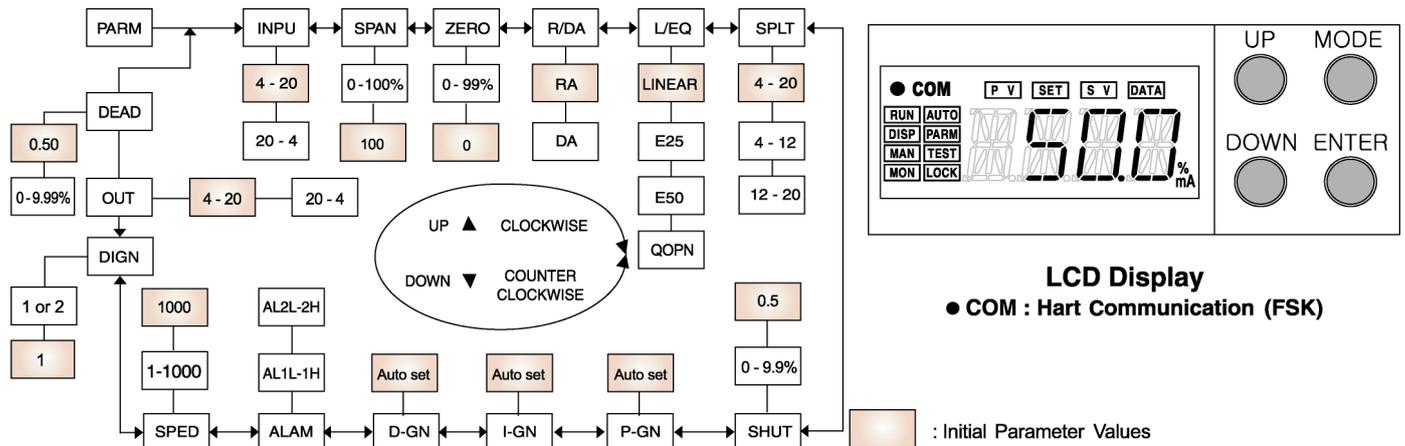
Supply 4...20mA input signal and push the ENTER button, and the ambient temperature (°C / centigrade) will be displayed. This ambient temperature will be displayed only while ENTER button is pushed.



10. Parameters Diagram Lay-out [Main Parameters]



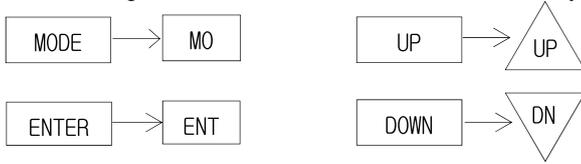
[Sub-Parameters]



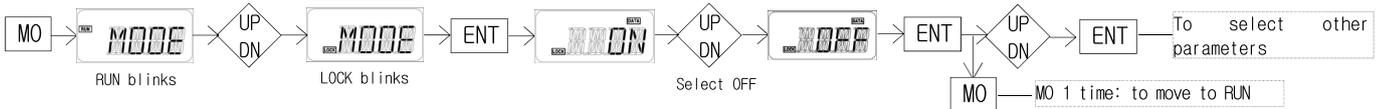
See	Parameters	Descriptions	Functions	Initial Values
11-6-1	INPU	Input signal	4...20mA or 20...4mA	4...20mA
11-6-2	SPAN	Span adjustment	0...100%	100%
11-6-3	ZERO	Zero adjustment	0...99%	0%
11-6-4	R / DA	RA / DA	Reverse or direct acting	Reverse acting (RA)
11-6-5	L / E.Q. / QOPN	Linear , E.Q. %, Quick Open	Linear, E.Q. % (1:25 or 1:50), Quick Open	Linear
11-6-6	SPLT	Split range	4...12mA or 12...20mA	4...20mA
11-6-7	SHUT	Shut-off	Valve shut off at 0...9.9%	0.5%
11-6-8	P-GN	P-Gain	Proportional gain value	Auto setting
11-6-9	I-GN	I-Gain	Integral gain value	Auto setting
11-6-10	D-GN	D-Gain	Differential gain value	Auto setting
11-6-11	ALAM	Alarm limit low, high	AL1L/AL1H, AL2L/AL2H	0...10%, 90...100%
11-6-12	SPED	Speed control	1...1000	Auto setting
11-6-13	DIGN	Display digit	Movement to one or two decimal places	1
11-6-14	OUT	Output signal	4...20mA or 20...4mA	4...20mA
11-6-15	DEAD	Dead band	Set dead band to 0...9.99%	0.5%

11. Setting Parameters

The following abbreviations will be used hereafter for easy explanation.



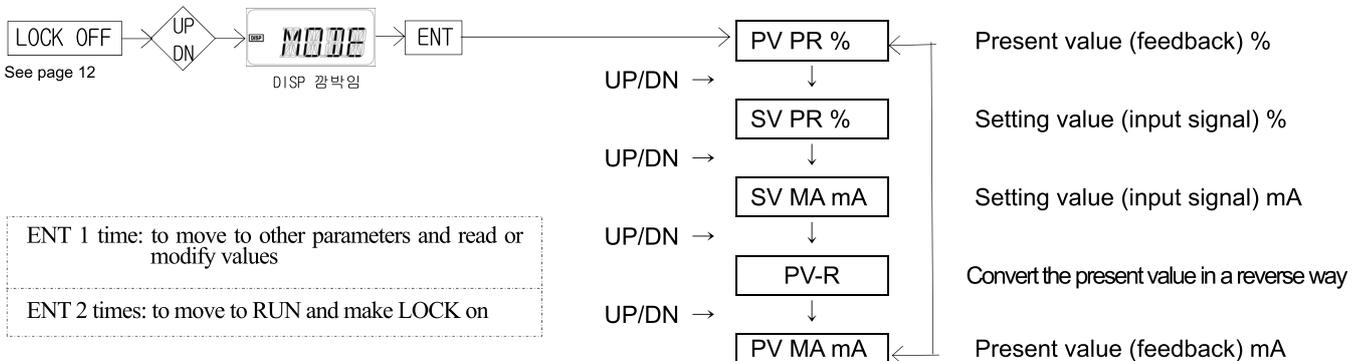
11-1] On and Off of LOCK



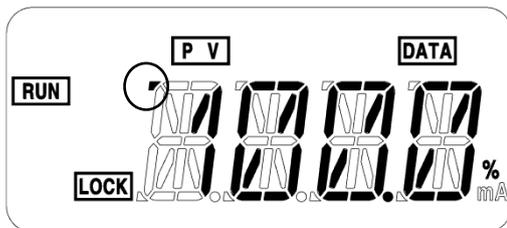
- ⚠ ① **LOCK ON:** This parameter secures all saved values.
- ② **LOCK OFF:** It is necessary to set LOCK off in order to read or modify the selected parameters and the saved values.
- ③ **Quick Auto-Calibration, Span, P-Gain** can be set without LOCK off (see page 7 – 8).
- ④ If input signal is not supplied, the LOCK function will be maintained.
- ⑤ Note that all parameters can be neither read nor modified while LOCK is on.

11-2] Display Mode DISP

The present value (PV) or the setting value (SV) is displayed and % or mA can be selected. The setting value stands for input signals. In case that the control valve is a direct acting type and it is necessary to display the feedback values in a reverse way, select PV-R.

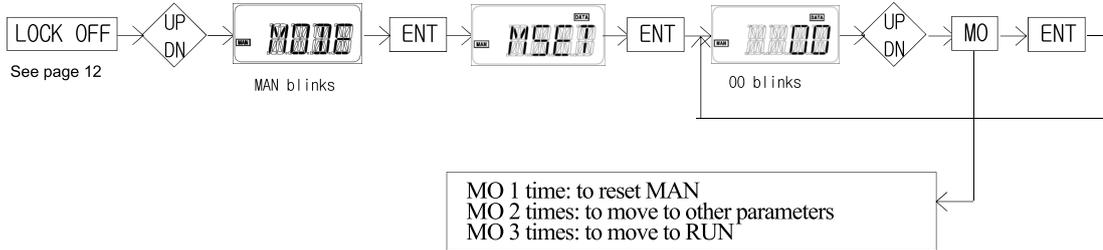


⚠ If PV-R is selected, one point is displayed on LCD. (See the circle of the below picture)



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

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

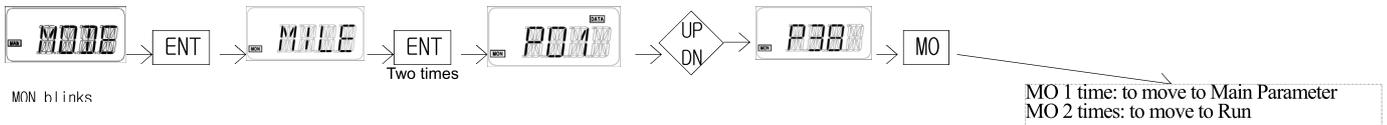


11-4] Monitor Mode MON

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.



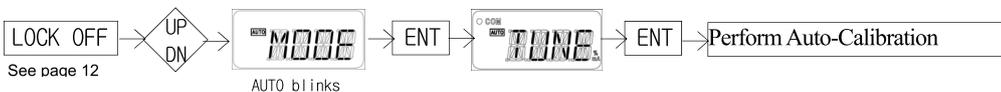
- ⚠ From P01 to P38 are data for a factory setting. So the user does not have to care about these data.

11-5] Auto Calibration Mode AUTO

This is to perform Auto-calibration and Reset.



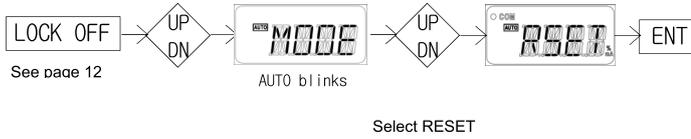
11-5-1] Performing Auto Calibration



- ⚠ 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 RA-5-4-3-2-1 END. In case that the air lines are connected for direct acting (DA), it is 5-RA-DA-4-3-2-1 END.

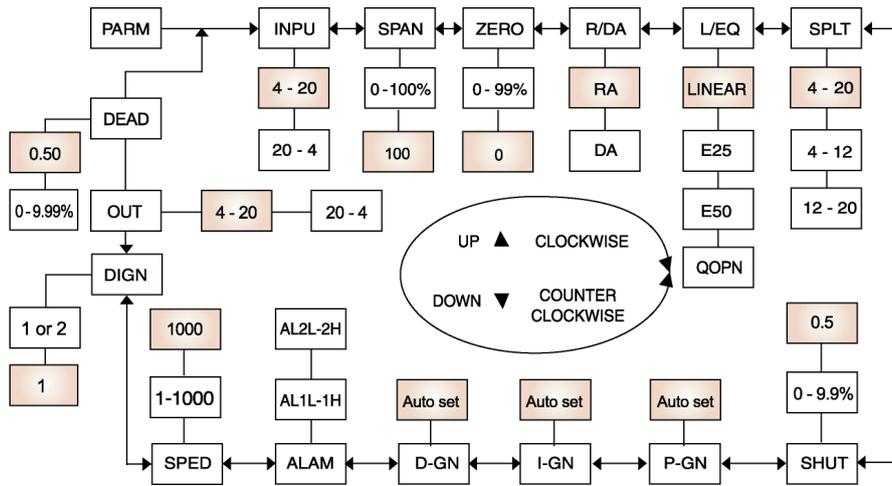
11-5-2] Initializing Parameters (RESET)

All parameters have the defaults from the factory.



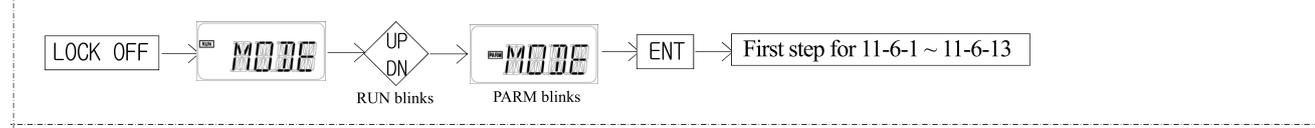
11-6] Sub-Parameters

The SSL / SSR have useful sub-parameters for various options.



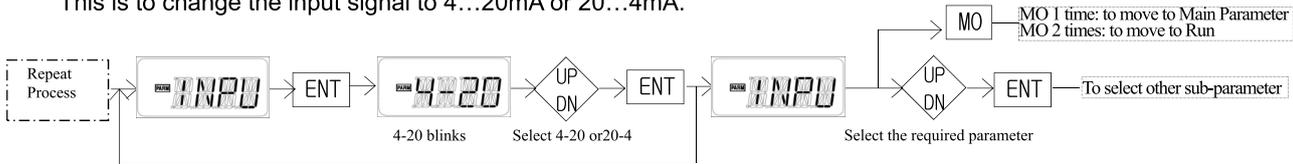
⚠ Colored sub-parameters under main parameters are the factory settings. They will be restored to the defaults (factory settings) after RESET.

* Repeat process to modify parameters

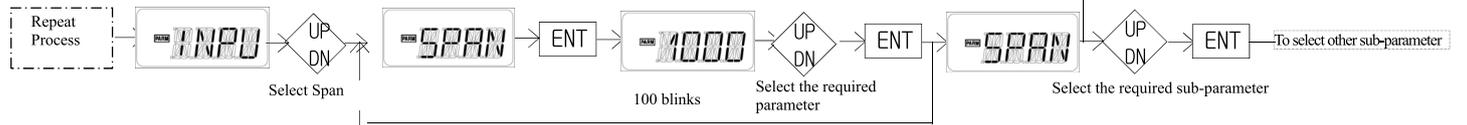


11-6-1] Changing Input Signal (default: 4-20mA)

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



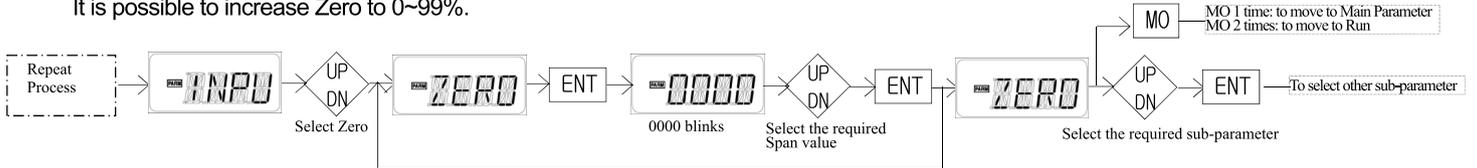
11-6-2] Changing Span (default: 100)



- ⚠ ① Be sure that 20mA input signal is supplied before modification.
- ② Push DN one time, and Span will decrease 0.1%. Keep pushing DN, and Span will decrease fast by 0.1%.

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

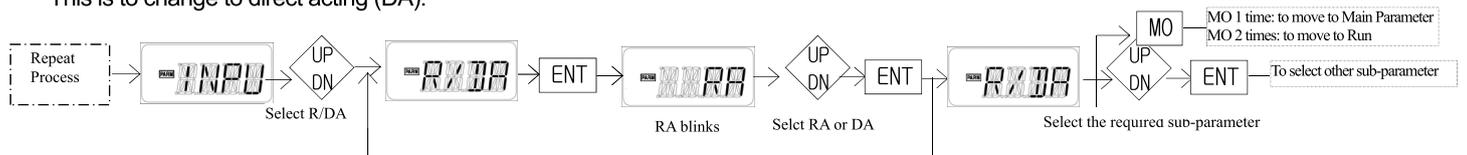
It is possible to increase Zero to 0~99%.



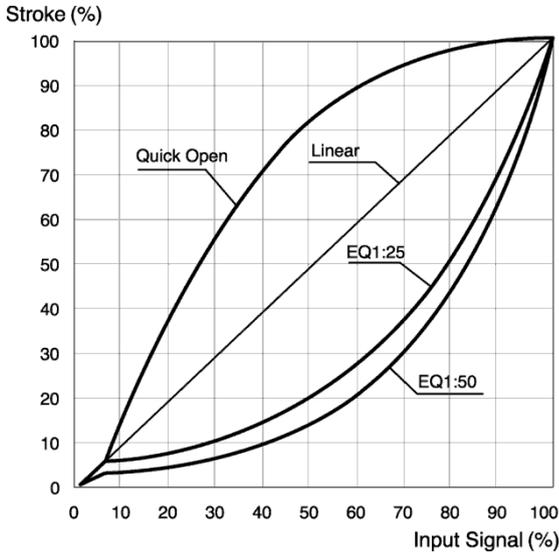
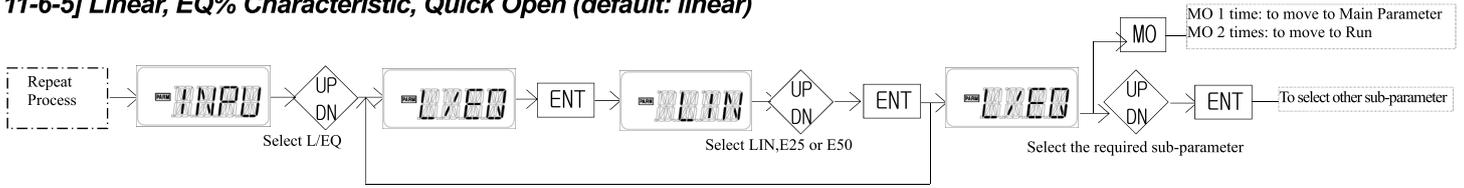
- ⚠ Be sure to perform Auto-Calibration first and change Zero. For example, if a valve is normally close and Zero is increased to 10%, the fluid corresponding to 10% of Span will flow in spite of close at 4mA. On the contrary, if a valve is normally close type, push UP, and Zero will increase. If a valve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

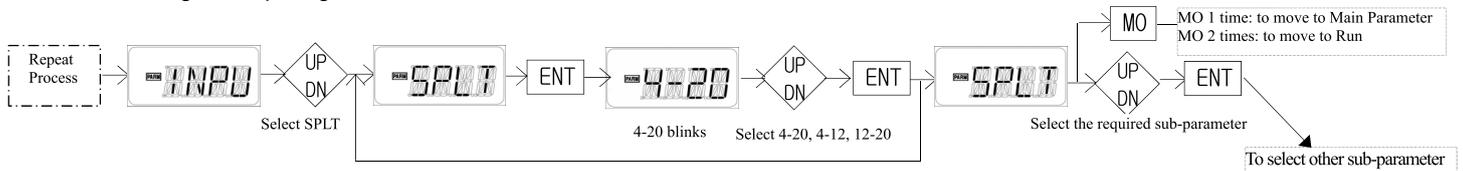


11-6-5] Linear, EQ% Characteristic, Quick Open (default: linear)



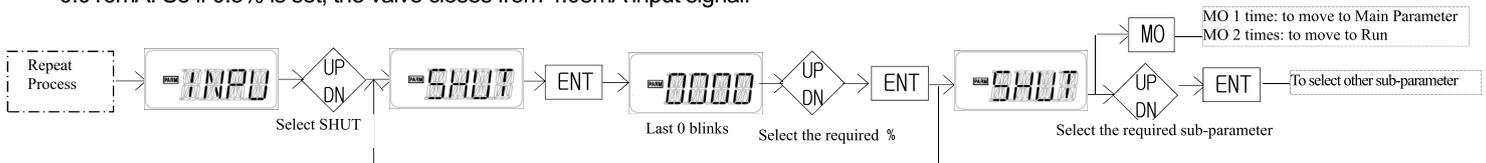
11-6-6] Split Range (default: 4-20)

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



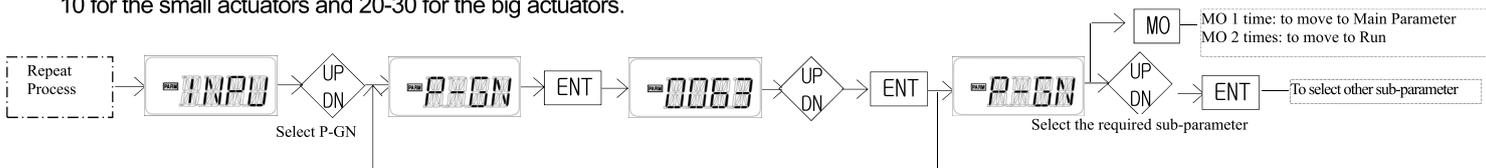
11-6-7] Shut-Off Control (default: 0)

This is a good safety parameter to keep a valve close completely and tightly. It can be adjusted to 0 – 0.99%. For information, 0.1% stands for 0.016mA. So if 0.5% is set, the valve closes from 4.08mA input signal.



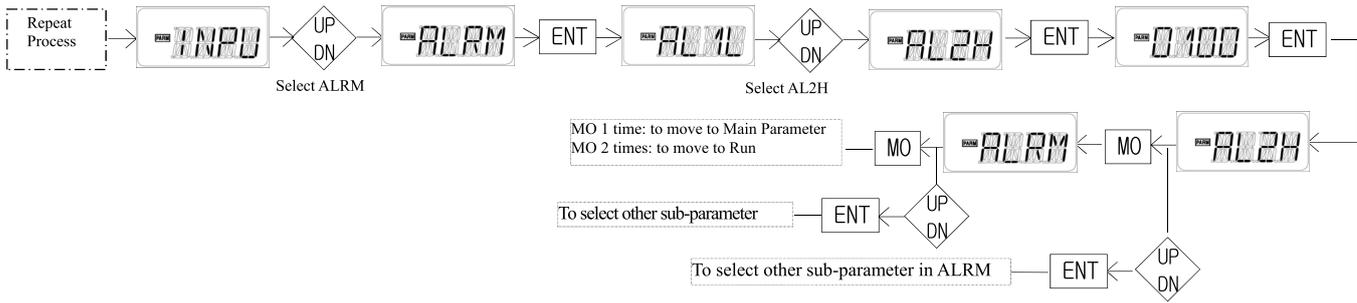
11-6-8] P-Gain (proportional gain)

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

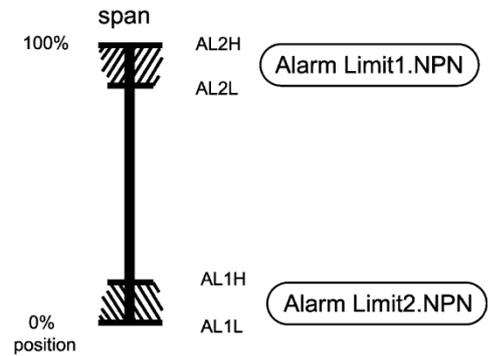
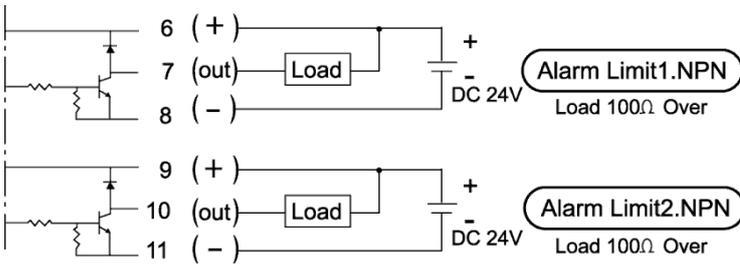


▲ Push the ENT button, and the first place number blinks. Modify the value by pushing the UP/DN button. Push MO one by one in order to move to ten or hundred place.

④ **Setting AL2H**



Wiring Diagram of Alarm Limits

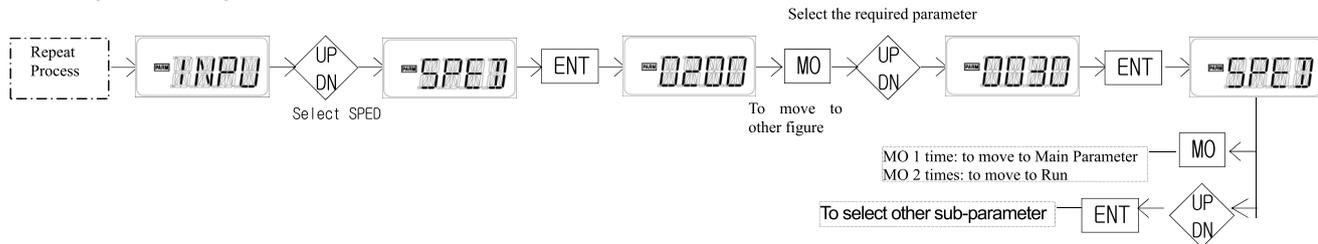


⚠ Be sure that the 24VDC power supply is supplied.

11-6-12] Speed Control (default: 1000)

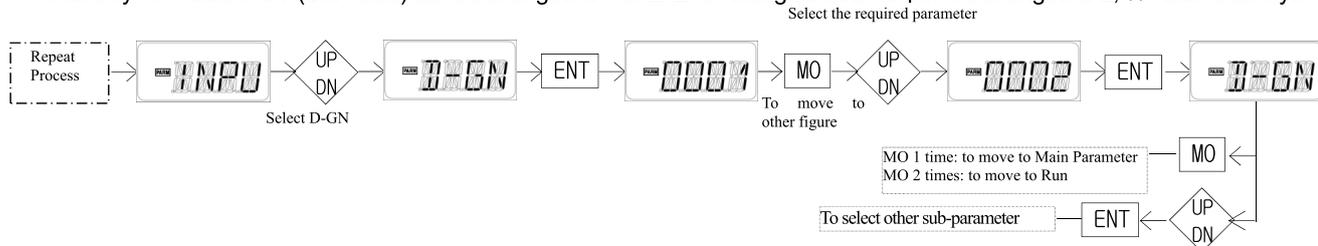
This is to control the speed of the control valve and the actuator. This speed is set automatically according to the valve condition.

Example) Decreasing Speed Control to 30



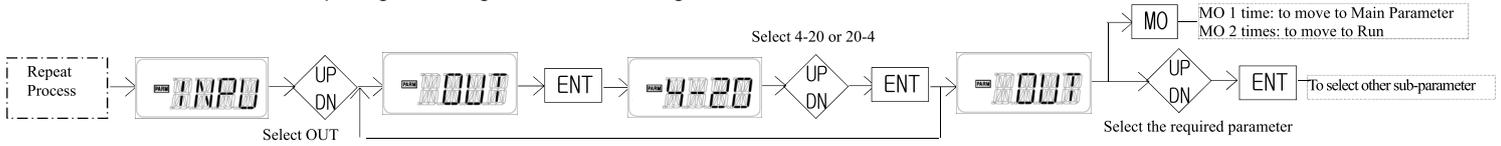
11-6-13] Changing Figure on LCD

SV (Set Value) is set for a first decimal point (1) as a standard display but it can be changed a second decimal point (2). Please be informed that only mA value in SV (Set Value) can be changed to 1 or 2. Even though a decimal point is changed to 2, % value is always 1.



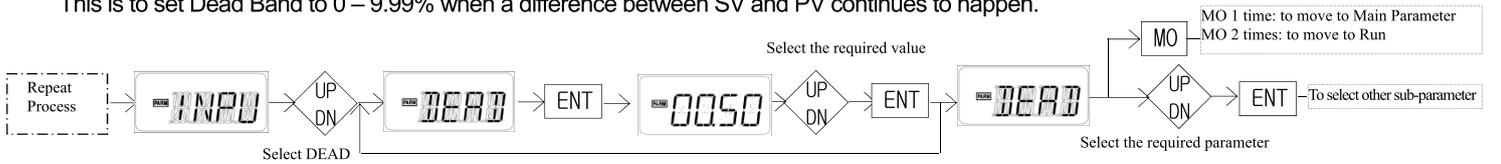
11-6-14] Setting Feedback Signal (default: 4...20mA)

4...20mA is a standard output signal setting but it can be changed to 20...4mA.



11-6-15] Setting Dead Band (default: 00.50)

This is to set Dead Band to 0 – 9.99% when a difference between SV and PV continues to happen.

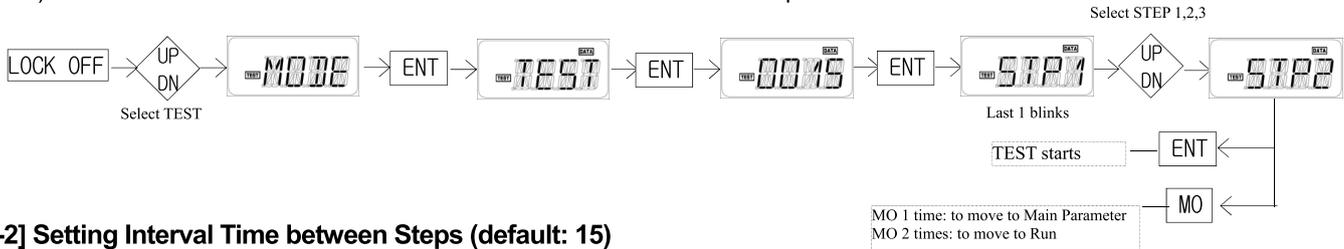


⚠ Dead band is set to 0.5% (displayed as 00.50) as a standard factory setting. For reference, 00.50 on LCD corresponds to 0.5% and 01.00 corresponds to 1%. This can be set to Max. 9.99% (9.99).

12. Self-Test Mode

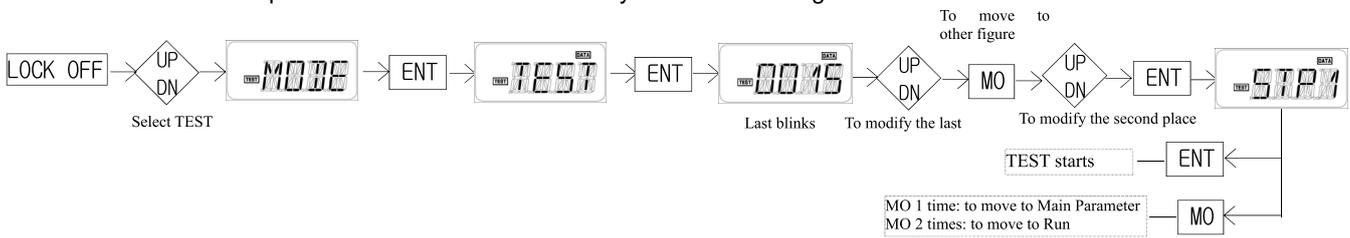
12-1] This is to test a control valve automatically regardless of input signals.

- 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 at the factory but it can be changed.

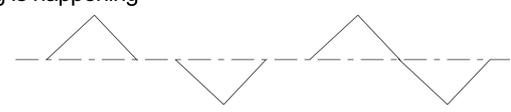
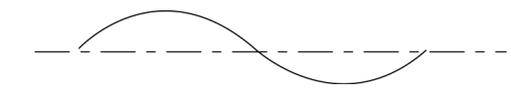


13. Error Codes Table

- ① Push a MODE button, select MON and push a ENTER button.
- ② CHEK is displayed on LCD. Push a ENTER button again.
- ③ Check the error codes by pushing UP / DOWN buttons. (for example ER5)
- ④ See the below error codes, check problems and perform auto-calibration again.

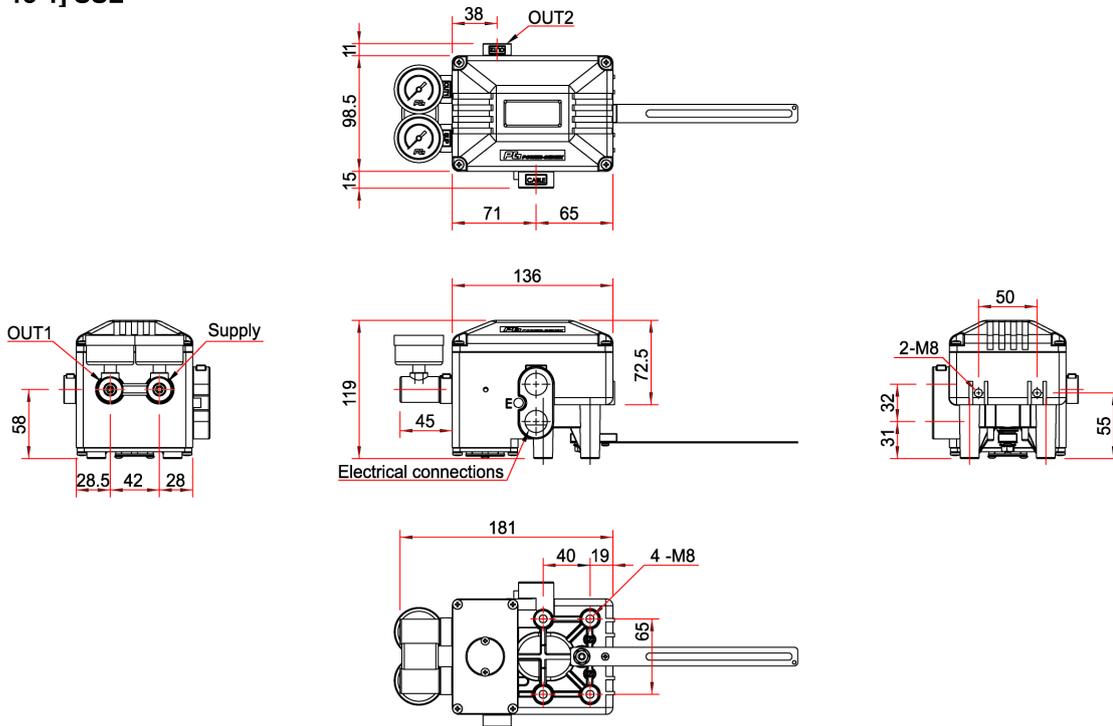
	Error Code	Description
1	ER0	· Input signal is below 3.7mA.
2	ER1	· Input signal is over 20.5mA.
3	ER2	· Air is not supplied or a supply air pressure is too low.
4	ER3	· Air is not supplied.
5	ER4	· Valve friction is very strong. And it affects operation of the valve positioner.
6	ER5	· Air is not supplied.
7	ER6	· Air is not supplied.

14. Troubleshooting

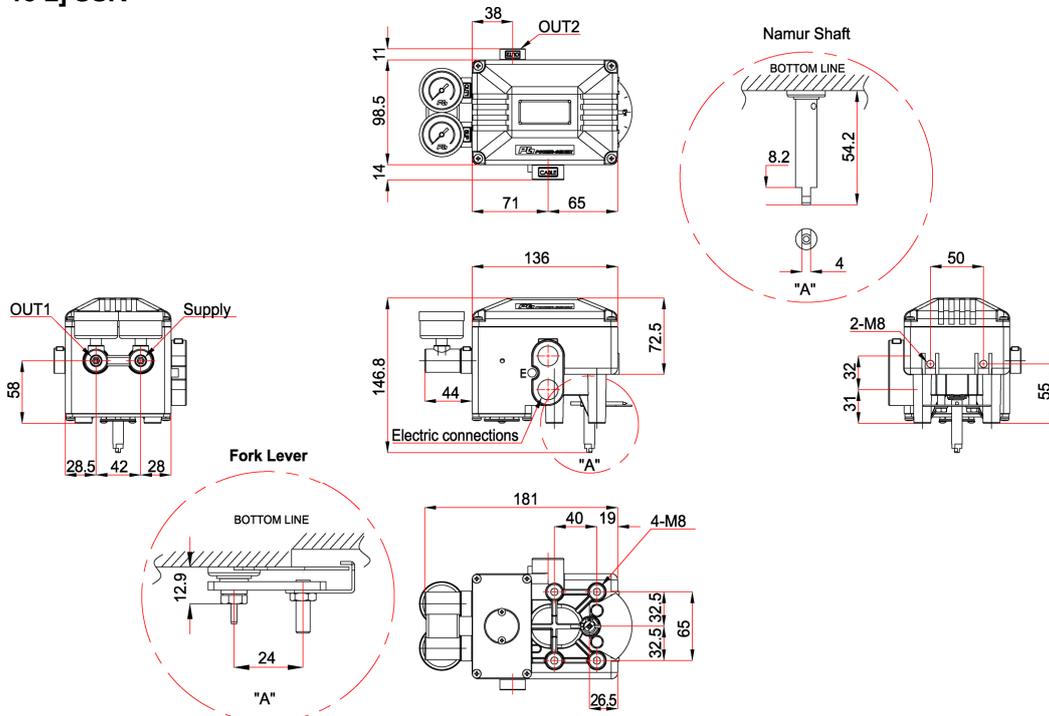
	Problem	Solution
1	The count-down during auto-calibration process stops at Step 4.	The angle between the SSL positioner and the valve stem is too small. Increase this angle so that it may be more than minimum 5°.
2	When the input signal is supplied, "INFT" appears on LCD and then disappears.	The input signal is too low or too high. The input signal should be supplied in the range of Min. 3.8 to Max. 20.5mA.
3	The SSL / SSR positioner is exposed to strong electromagnetic waves.	As the SSL / SSR positioner is the electronically-operated positioner, it may not work properly due to strong electromagnetic waves.
4	Hunting is happening Target 	In case that the valve moves up and down drastically from Target and returns to Target in a very short time, decrease P-Gain value.
5	Oscillation is happening Target 	In case that the valve moves up and down like a wave from Target and returns to Target, increase P-Gain value.
6	The input signal is supplied but any characters and any numbers don't appear on LCD.	Check and re-connect + and - of input signal properly.

15. Drawings

15-1] SSL



15-2] SSR



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