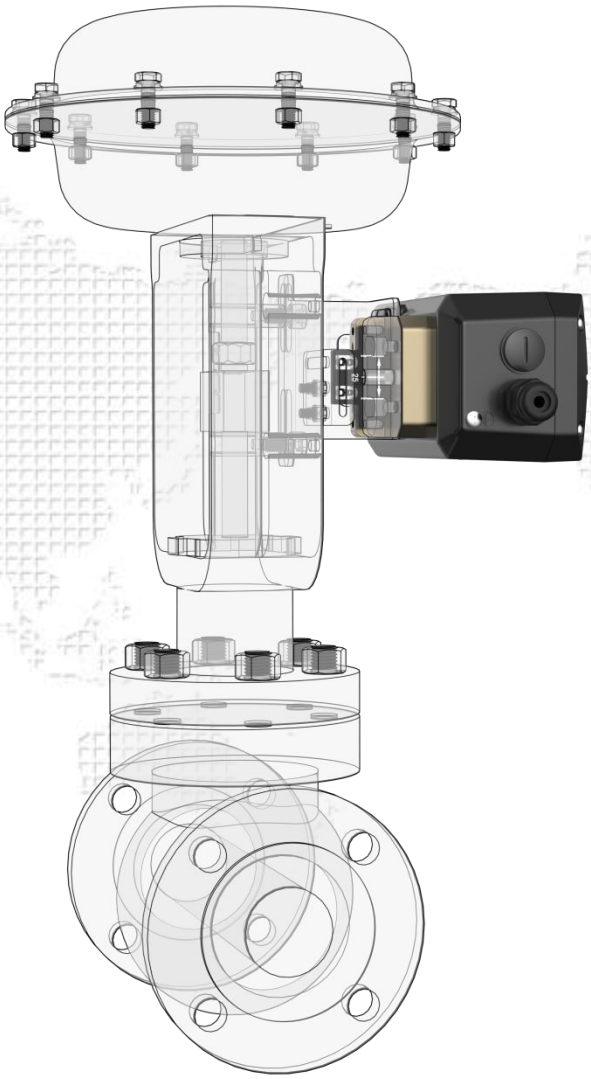
POWERFLOW
Expertise in flow control



智能阀门定位器
IP7000 系列使用说明书

Intelligent Valve Positioner IP7000 Series User's Manual

（安装使用前请详细阅读使用说明书）

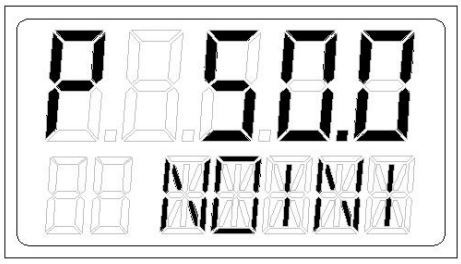
Contents

1. Overview

IP7000 series intelligent valve positioner is mounted on pneumatic actuators. It's used to control air intake and exhaust of the pneumatic actuators to drive the valve position to the set point by calculating both data from 4-20 mA DC signal and feedback position.

2. One-key automatic initialization

1. Please read the installation instructions in **chapter 7** before installing the positioner. Install the positioner according to the installation requirements described. Please pay attention to some installation points. For example, confirm the initial position of the feedback axis of the positioner or remote sensor before installation. Do not turn the feedback axis 360° during installation. For the positioner of normal linear type, make the upper plane of the positioner housing at a right angle to the main stem of the valve. Within the valve stroke range, the rotation angle of the positioner feedback lever meets the installation requirements.
2. After installing the positioner on the valve, connect the air source and electrical cables. Ensure that the air source pressure can fully open the valve. Power on the positioner by inputting a 4-20mA signal.
3. After the positioner is powered on, Positioner is in the uninitialized state before initialization. When LCD displays the sign **NOINI,** interface displays percentage value of sensor in the top line. As shown below.

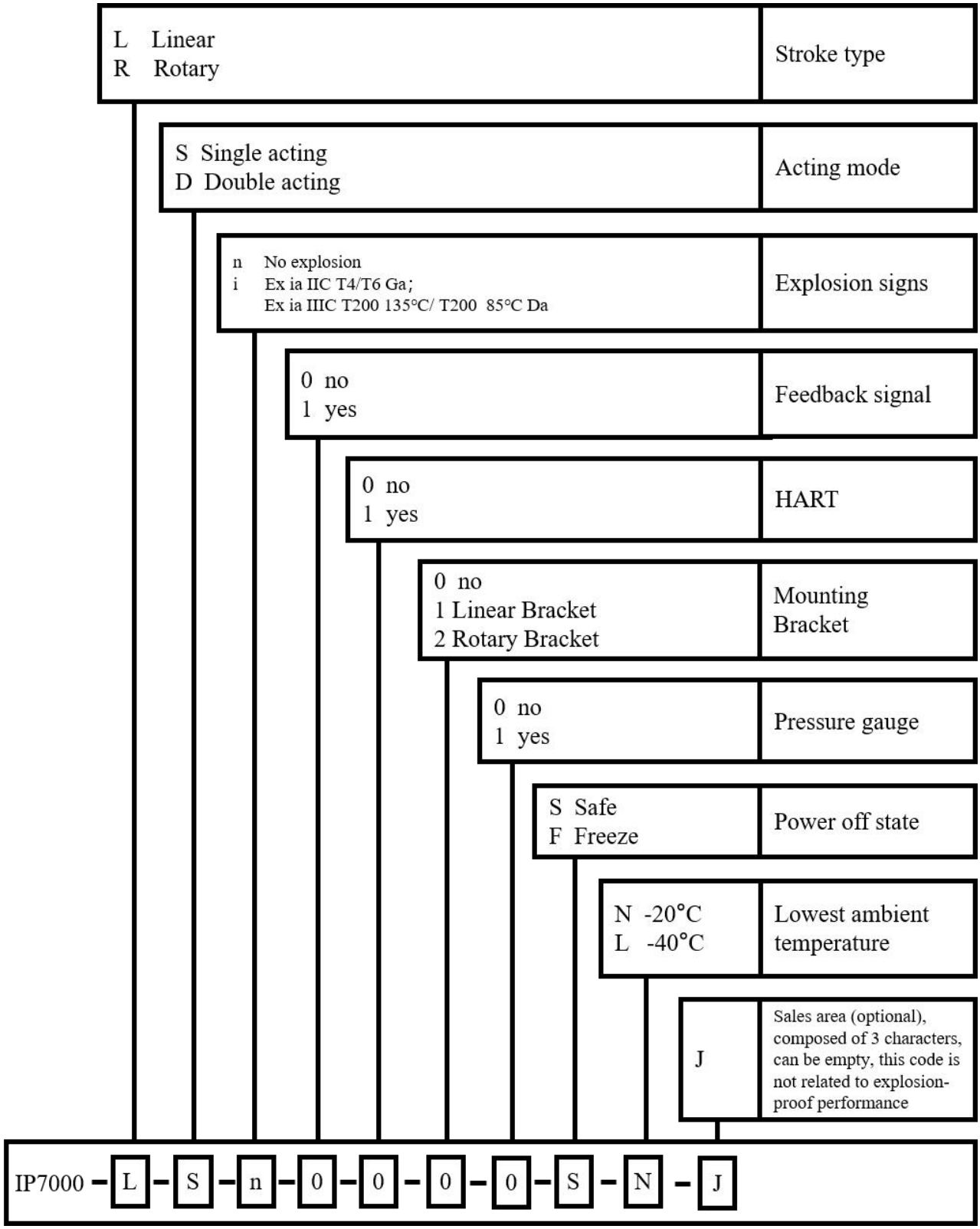


In this state, pressing [▼][▲] buttons can open and close valve. Open and close valve fully, and observe the percentage value of sensor displayed on the interface. Ensure that within the entire valve stroke range, the sensor percentage value changes monotonically. Otherwise, it is necessary to re-adjust the installation position. In addition, the minimum and maximum percentage difference of the sensor is required to be greater than 15%.

4. The actuator type has been set before the positioner leaves the factory. The user only needs one-key operation to execute the automatic initialization (**INITA**) function to complete the matching of the valve. In the initial interface (**NOINI**) or manual / automatic mode interface, press and hold [O] button for approx. 3s to run the automatic initialization. After the initialization is completed, **FINSH** is displayed on the LCD, press [↩] button to exit. After exiting, the system enters the manual mode interface, press [↩] button again to switch to the automatic mode. At this time, the user can control the valve position through the 4-20mA signal.

For some reasons, the system will display an error message in the function option line during the automatic initialization process and the automatic initialization will be interrupted. Descriptions of error messages and solutions are showed in chapter 8.3.3.

3. Selection and ordering data



4. Technical data

Shell material	Aluminum
Set-point signal	4-20mA DC, no-load voltage: 15-24V DC
Minimum working current	3.8mA
Input resistance	120Ω
Ambient temperature	Normal version for non-explosion-proof: -20°C ~ +80°C Optional version for non-explosion-proof: -40°C ~ +80°C Normal version for explosion-proof: -20°C ~ +80°C（T4），-20°C ~ +40°C（T6） Optional version for explosion-proof: -40°C ~ +80°C（T4），-40°C ~ +40°C（T6） The device display will be dull or not displayed below -20°C.
Gas source requirement	ISO 8573-1 ● Solid particle size and density Class 3 ● Dew point Class 3 ● Oil content Class 3
Vibration resistance	0.15mm,10Hz-60Hz,20 cycle/axis 20m/ s²,60Hz-500Hz,20 cycle/axis Recommended range for control valve≤ 20 m/s²，no resonance peak
Supply pressure	0.14~0.7MPa
Flow	● Input air 2 bar 4.8 Nm³/h 4 bar 8.0 Nm³/h 6 bar 11.2 Nm³/h ● Exhaust air(Safe) 2 bar 5.9 Nm³/h 4 bar 9.8 Nm³/h 6 bar 13.7 Nm³/h ● Exhaust air (Freeze) 2 bar 6.6 Nm³/h 4 bar 11.1 Nm³/h 6 bar 15.6 Nm³/h
Steady state air consumption	⩽0.4 L/min
Basic error	⩽1.0%
Hysteresis error	⩽1.0%

Electrical connection	1/2NPT (default) or M20x1.5, please contact with sales for other thread specifications
Pneumatic connection	1/4NPT (default) or G1/4, please contact sales for other thread specifications
Weight	2.0 kg
Protection class	IP69K
Explosion signs	Ex ia IIC T4/T6 Ga；Ex ia IIIC T_{200} 135℃/ T_{200} 85℃ Da；

Electrical parameters for intrinsic safety:

loop name	Maximum input voltage Ui（V）	Maximum input current Ii（mA）	Maximum input power Pi（W）	Maximum internal equivalent parameters	
				Ci（nF）	Li（mH）
4~20mA setting	28	93	0.66	approximately zero	
4~20mA output	28	93	0.66	approximately zero	

Special restricted use conditions:

1）Operating temperature range:

Minimum operating ambient temperature: -40℃。

The relationship between the maximum operating ambient temperature and temperature group/maximum surface temperature is shown in the table below:

maximum operating ambient temperature（℃）	temperature group/maximum surface temperature
+80℃	T4/T_{200}135℃
+40℃	T6/T_{200}85℃

2）When the product is installed in a location requiring EPL Ga classification, the user must take effective measures to prevent the ignition hazard caused by impact or friction on the product's casing.

3）At least the following measures should be taken to prevent the accumulation of electrostatic charges on the product casing:

a Control the relative humidity of the environment to minimize the generation of static electricity.

b Do not dry rub or blow the surface of the product casing to prevent the risk of ignition due to static electricity.

4）The associated device should preferably use an isolating safety barrier; if a zener safety barrier is chosen, it should comply with the requirements of the GB 3836.15-2024 standard regarding the grounding of intrinsically safe circuits.

Notes:

The installation, use, and maintenance of the product should comply with both the product manual and the following relevant standards:

GB/T 3836.13 ─ 2021 Explosive atmospheres—Part 13: Equipment repair, overhaul, reclamation and modification

GB 3836.15─2024 Explosive atmospheres─Part 15: Specification of electrical installations design, selection and erection

GB 3836.16 ─ 2024 Explosive atmospheres—Part 16: Specification of electrical installations inspection and maintenance

GB/T 3836.18─2024 Explosive atmospheres—Part 18: Intrinsically safe electrical systems

GB 15577─2018 Safety regulations for dust explosion prevention and protection

GB 50257─2014 Code for construction and acceptance of electric equipment on fire and explosion hazard electrical equipment installation engineering

5. Connection description

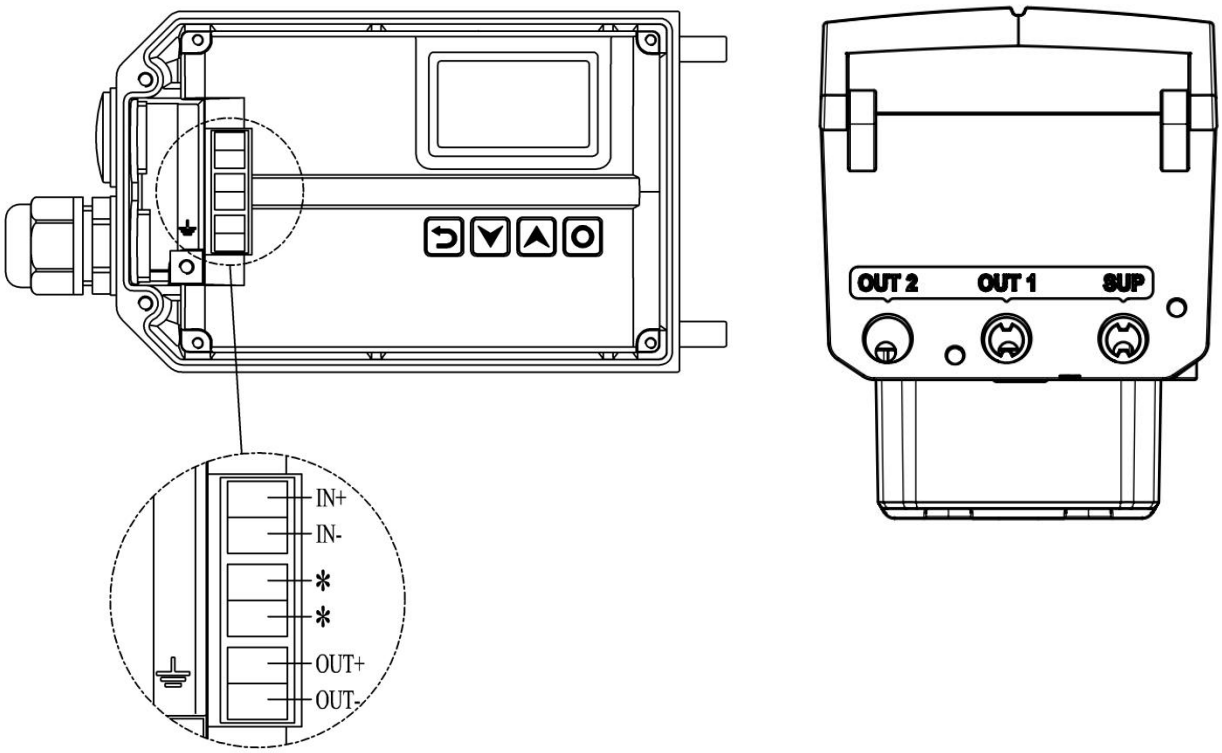


Figure 1. Connection description

Electrical Connection	Description
IN+	4-20 mA set-point signal +
IN-	4-20 mA set-point signal -
OUT+	Feedback signal module 18-30 V DC +
OUT-	Feedback signal module 4-20 mA output
*	The two interfaces are connected with each other, and the device is in low impedance mode. (In low impedance mode,

Pneumatic Connection	Description
SUP	Air supply enter
OUT1	Pilot air outlet 1
OUT2	Pilot air outlet 2, used for double acting type.

	the HART communication function will be disabled.)

Remarks: For the separate type of the positioner, OUT1 and OUT2 are blocked and not used.

NOTES:

- **Electrical cables must use shielded twisted pair or shielded wires. Connect one end of the cable shielding layer to the ⏚ screw inside the casing, and the other end to the ground. So that the device is effectively grounded to prevent electromagnetic interference.**
- **Keep electrical cables away from strong magnetic fields.**
- **Must install or remove the electrical cable when the device is powered off.**
- **If the input signal has attenuation and the user does not require HART communication function, try to set to low impedance mode. Connect the two undefined electrical interfaces marked with * in Figure 1 to each other through one wire to make the positioner in low impedance mode.**
- **If the split range control function of the positioner is to be used, a DC signal isolator must be used to convert one 4-20mA setting signal into two 4-20mA setting signals, and then connect them to two positioners respectively. Set the positioner to low impedance mode.**

HART communication wiring:

Connect the two signal wires of the HART modem or HART communicator to the positive and negative poles of the 4-20 mA setting signal.

6. Dimension

6.1. Mechanical dimension

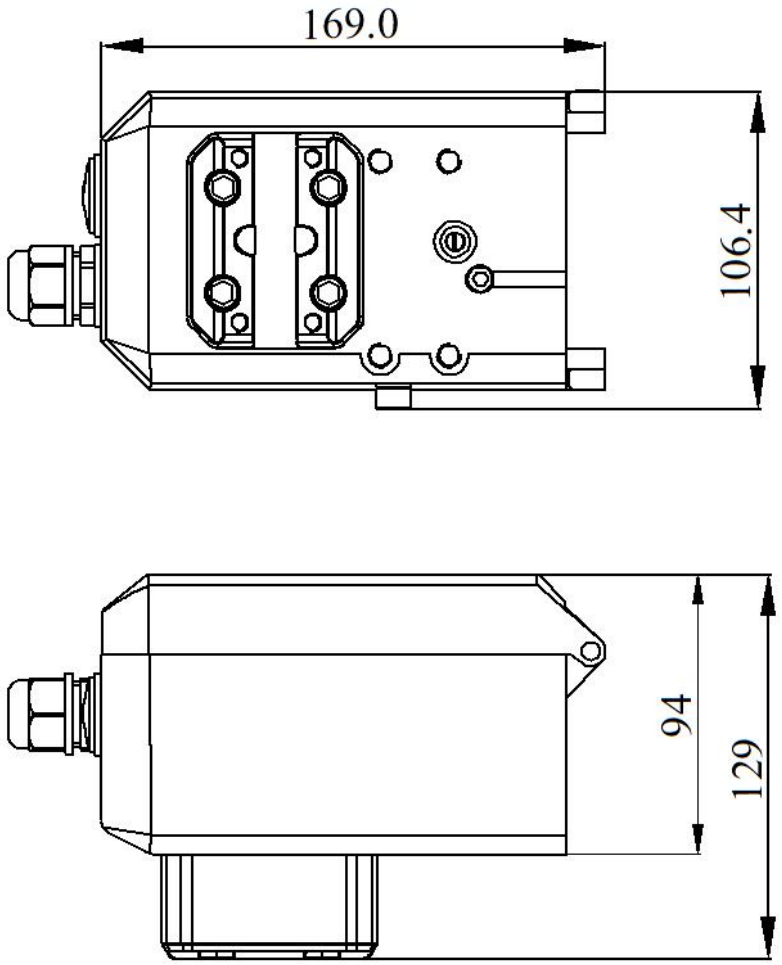


Figure 2. Mechanical dimension

6.2. Mounting bracket dimension

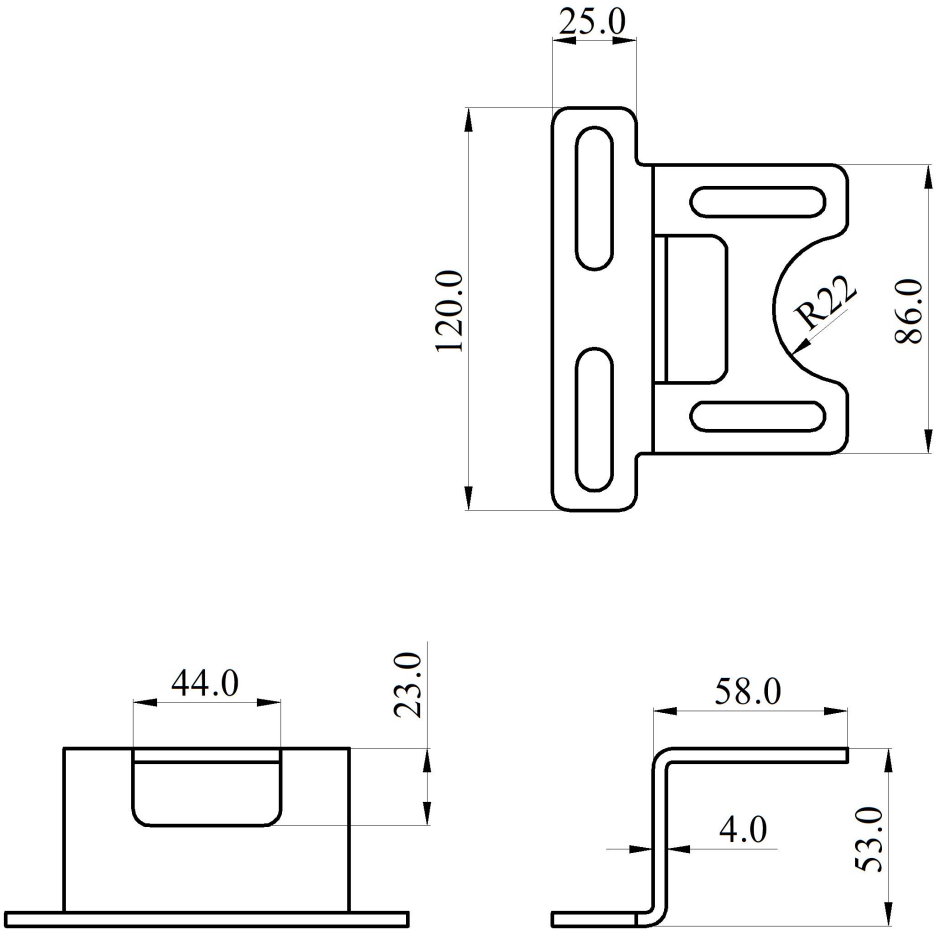


Figure 3. Normal linear mounting bracket

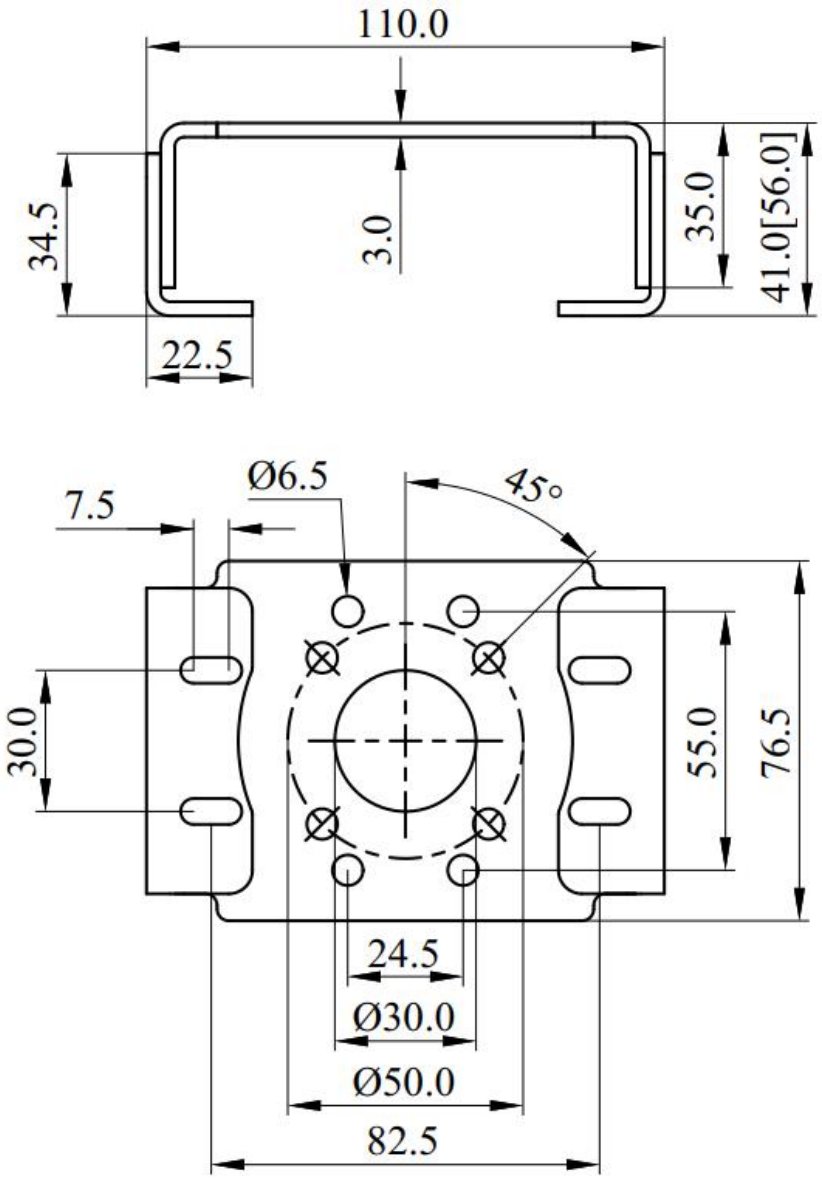


Figure 4. Rotary mounting bracket (Type A)

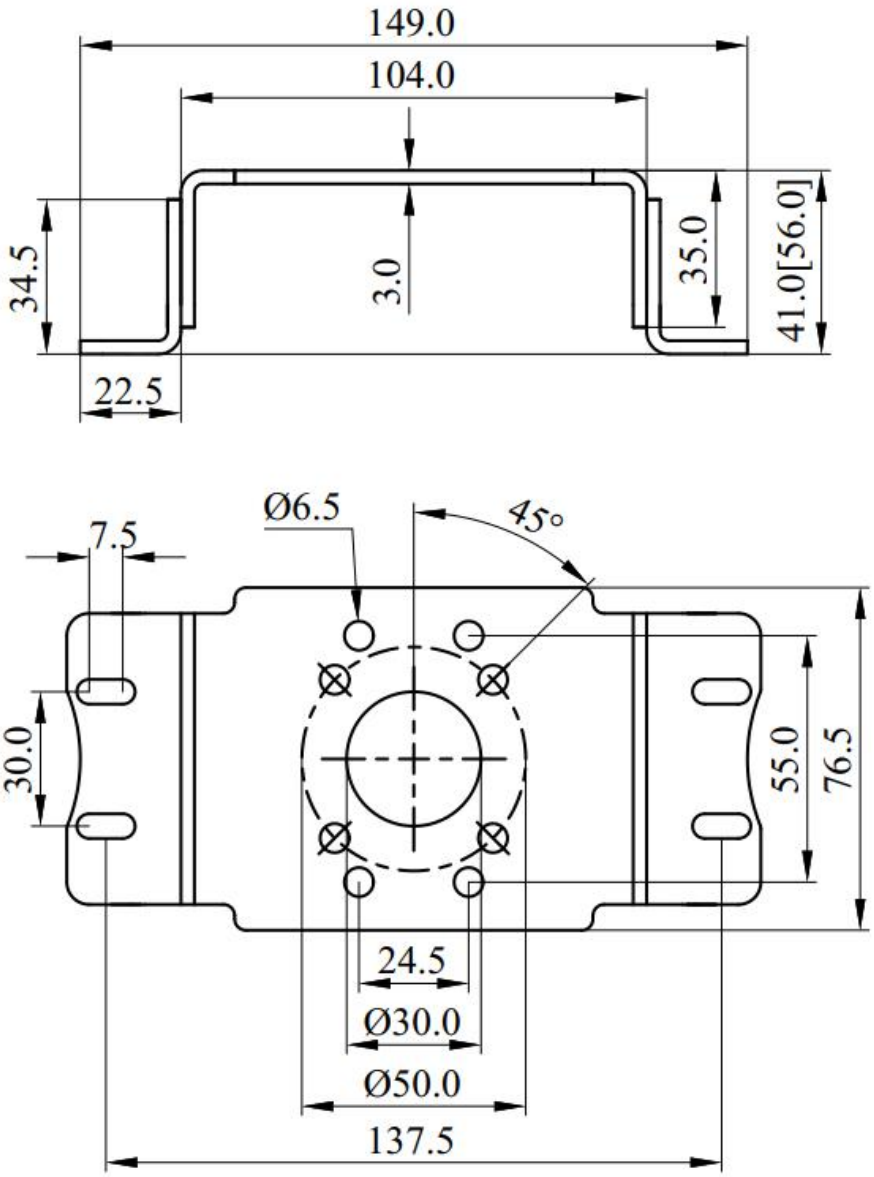


Figure 5. Rotary mounting bracket (Type B)

6.3. Dimension of magnet

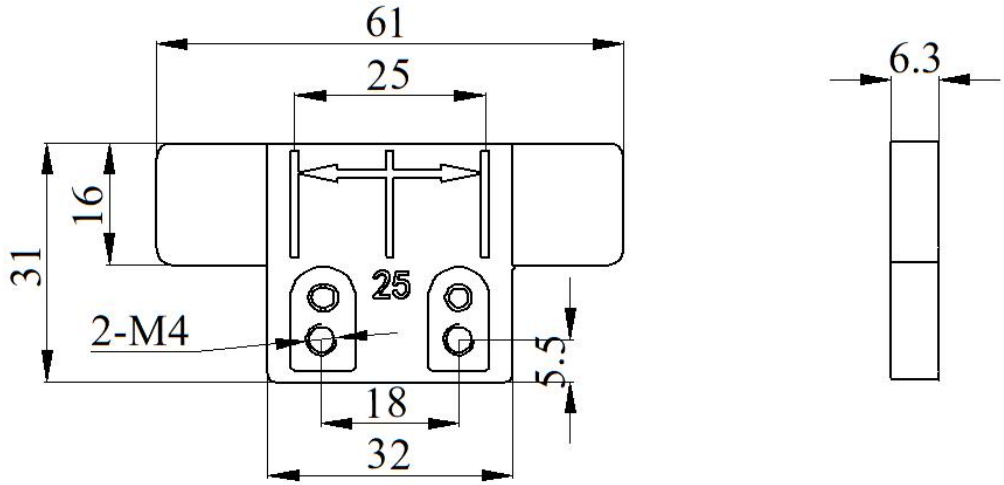


Figure 6. 25mm magnet（stroke range:10-25mm）

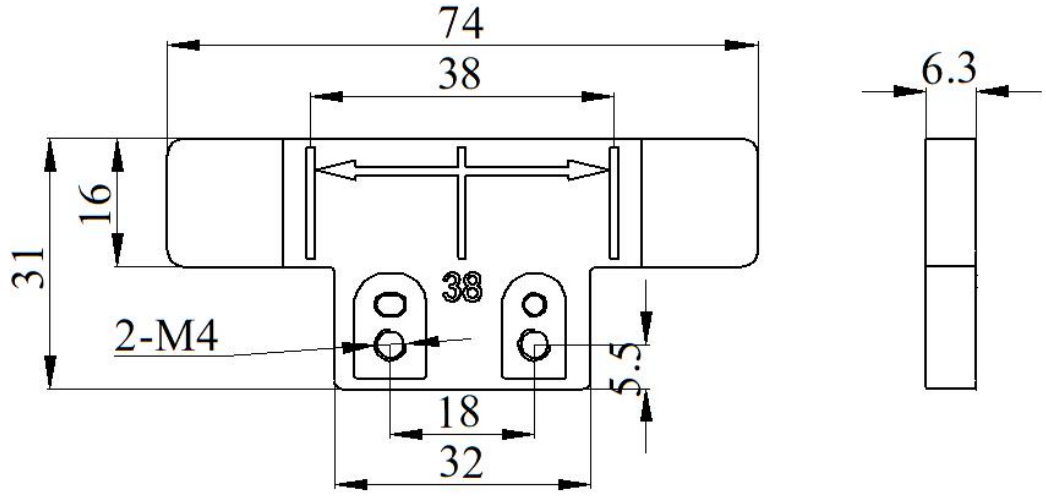


Figure 7. 38mm magnet（stroke range:25-38mm）

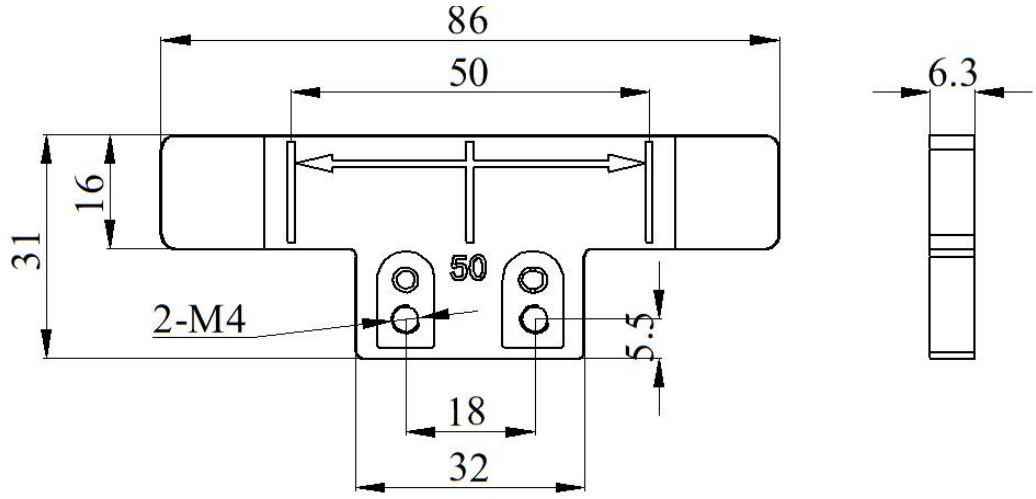


Figure 8. 50mm magnet（stroke range:38-50mm）

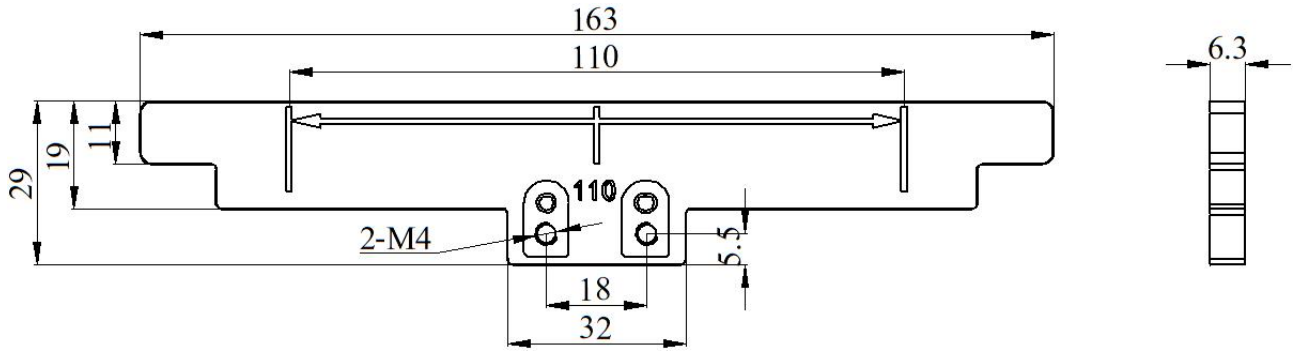


Figure 9. 110mm magnet（stroke range:50-110mm）

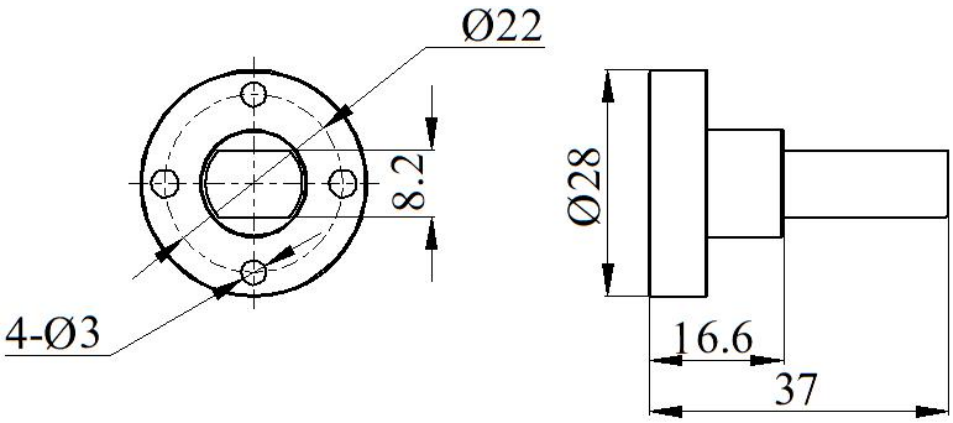


Figure 10. Rotary stroke magnet

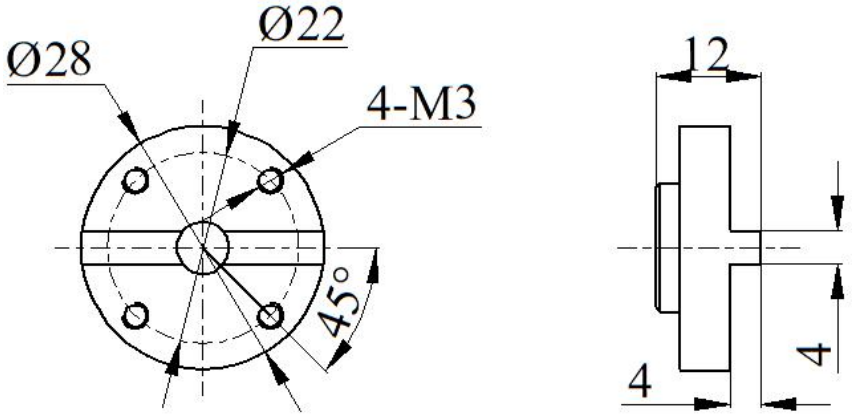


Figure 11. Connector for rotary stroke magnet

7. Installation

7.1. Linear stroke

Linear actuator mounting components			
No.	**Name**	**Amount**	**Note**
①	Non-contact magnet	1	Select a specific magnet based on the valve stroke
②	Magnet mounting bracket	1	Adjust and fix the position of the magnet
③	M6 hexagon socket screw	2	M6×10 fixed magnet mounting bracket
④	M6 spring washer	2	Prevent screw loosening
⑤	M4 cross screw	2	M4×10 fixed magnet
⑥	M4 spring washer	2	Prevent magnet loosening
⑦	Linear stroke mounting bracket	1	Connect positioner and actuator
⑧	M8 hexagon head bolts	2	M8×10
⑨	M8 spring washer	2	Prevent bolts loosening
⑩	M8 flat washer	2	Protect contact surface

1. Install the magnet mounting bracket onto the valve stem, and pre-tighten the magnet corresponding to the stroke on the bracket. If there is no mounting hole on the valve stem, a fork plate can be added at the valve stem position to assist in installation. Install the linear stroke mounting bracket onto the valve.

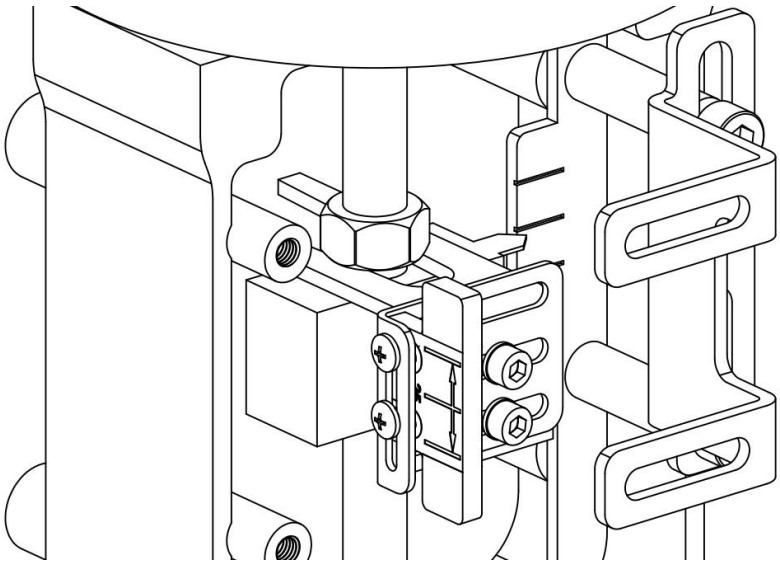


Figure 12. Installation of linear stroke mounting bracket and magnet bracket

2. Fix the positioner onto the mounting bracket and adjust its relative position to the magnet on both sides. It is required that the distance from the magnet to both sides of the chute be the same, as shown in the figure below. The depth of the magnet buried into the chute (D value)

should be between 10mm and 15mm.

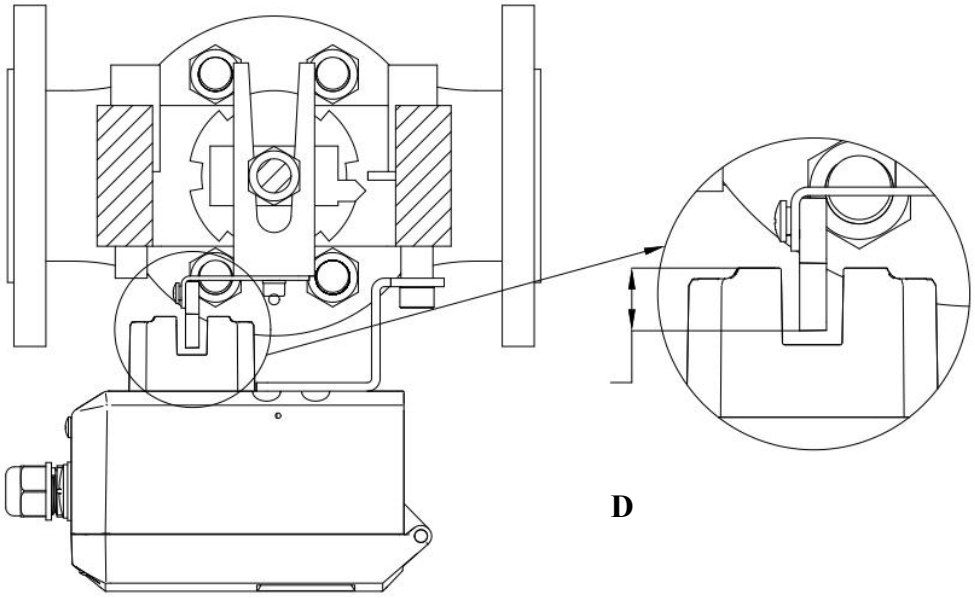


Figure 13. Installation of positioner and linear actuator

3. Adjust the vertical position of the magnet relative to the positioner. Directly vent the actuator cylinder to open the valve to 50%. At this point, adjust the position of the magnet so that its center is also aligned with the center of the slide groove on the back of the positioner. It is also required that the magnet be installed parallel to the valve stem.

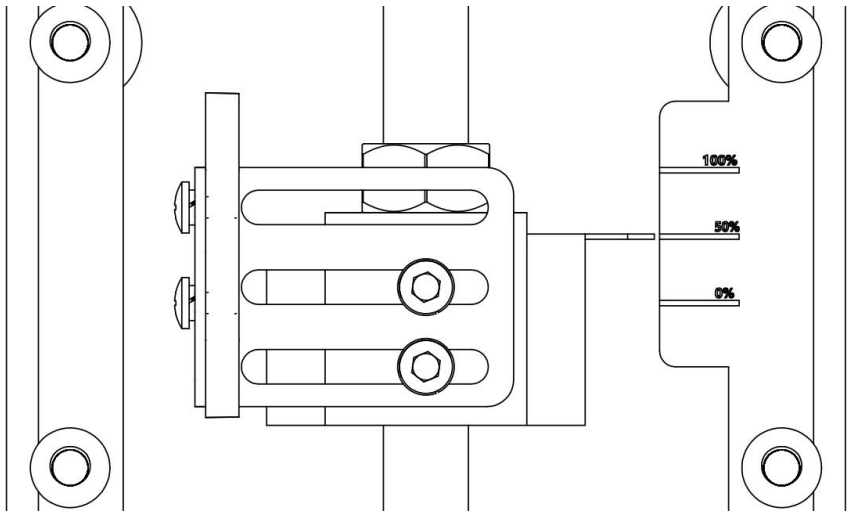


Figure 14. Directly vent the actuator cylinder to open the valve to 50%

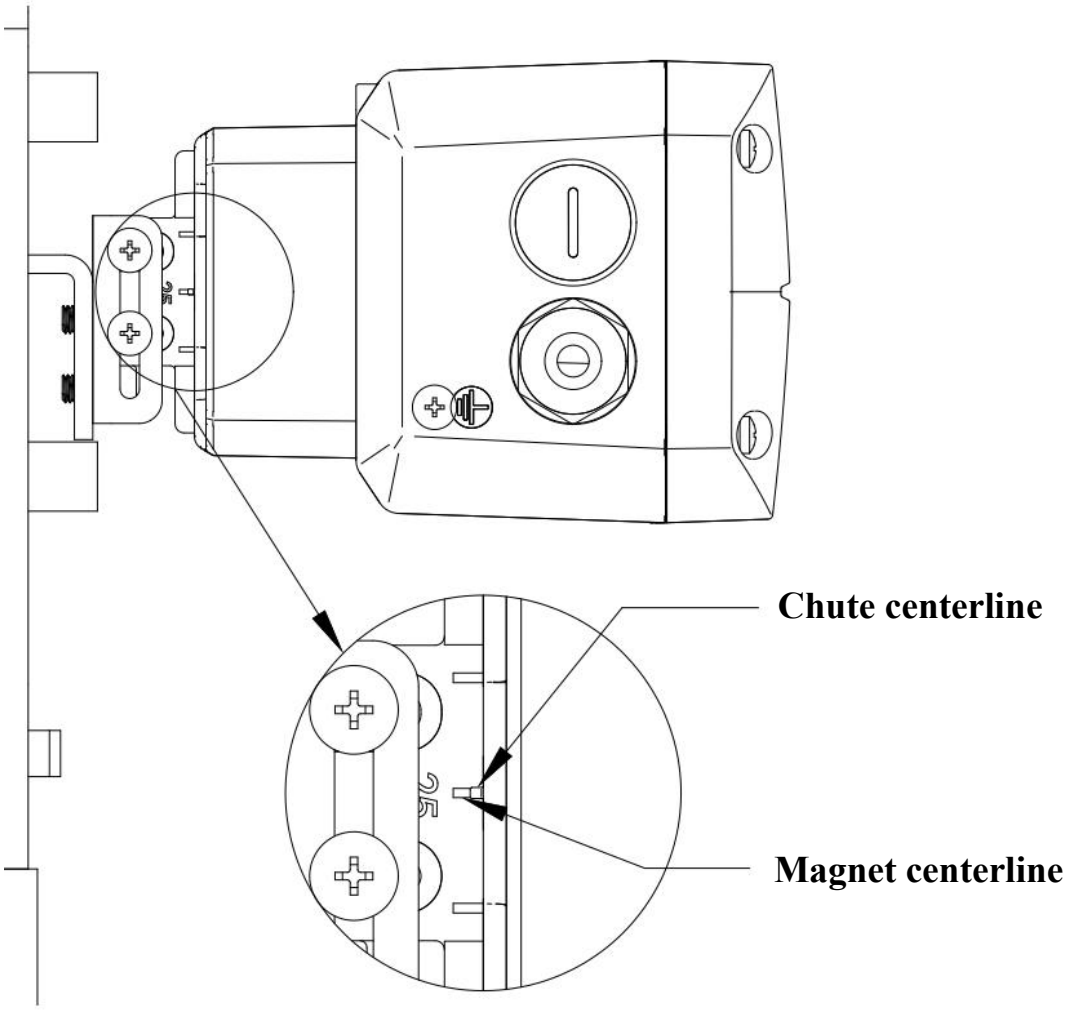


Figure 15. Align the center line of the magnet with the center line of the chute

7.2. Rotary stroke

Rotary actuator mounting components			
No.	**Name**	**Amount**	**Note**
①	Rotary stroke connector	1	Connect the magnet and the actuator
②	Rotary stroke magnet	1	Actuator compatible with 80°-100°
③	Rotary stroke mounting bracket	1	Compatible for actuators in different specifications.
④	M6 flat washer	4	Protect contact surface
⑤	M6 spring washer	4	Prevent screw loosening
⑥	M6 hexagon socket screw	5	M6×10 fixed positioner, rotary stroke connector
⑦	M5 hexagon socket screw	4	M5×8 fixed mounting bracket
⑧	M5 spring washer	4	Prevent screw loosening

⑨	M5 flat washer	4	Protect contact surface
⑩	M4 cross screw	4	M4×10 fixing magnet

1. Fix the rotary stroke connector onto the actuator. Insert the connecting piece into the slot of the actuator shaft and tighten it with an allen screw. Ensure that the connecting piece and the valve do not rotate relative to each other during valve movement.

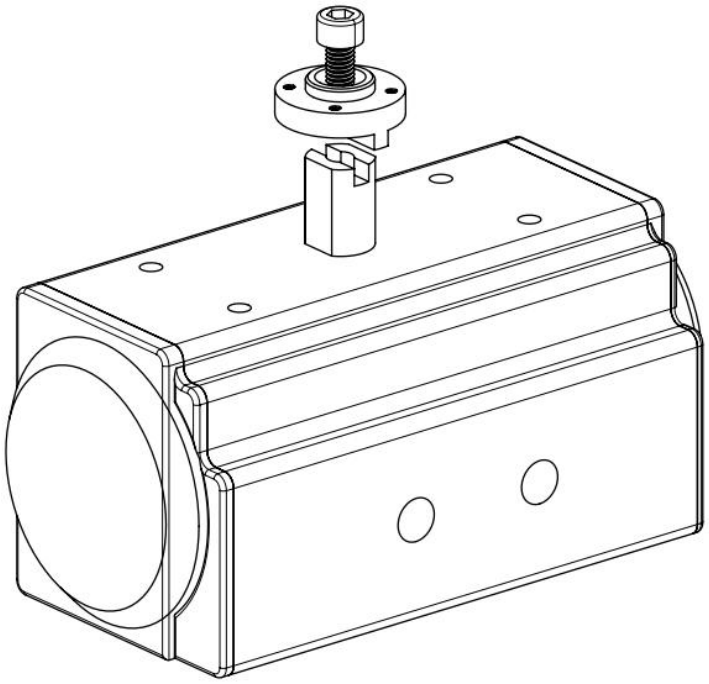


Figure 16. Install the rotary stroke connector

2. Install the rotary stroke magnet in the direction shown in the schematic diagram. It is required that the two flat surfaces on the side of the magnet should be at a 45° angle to the edge of the positioner slot that is about to be installed. Note that the initial installation direction of the magnet varies depending on the rotation direction of the valve. It is required that when the valve is at 50% open, the warning label should face left.

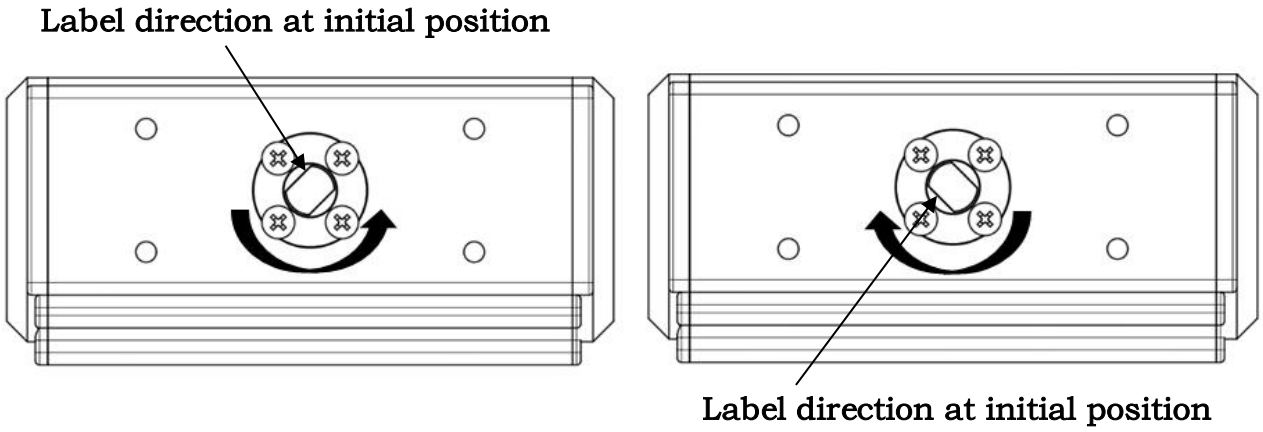


Figure 17. Install the rotary stroke magnet at the initial position of the valve

3. Install and secure the rotary stroke mounting bracket, positioner, and actuator as shown in the figure.

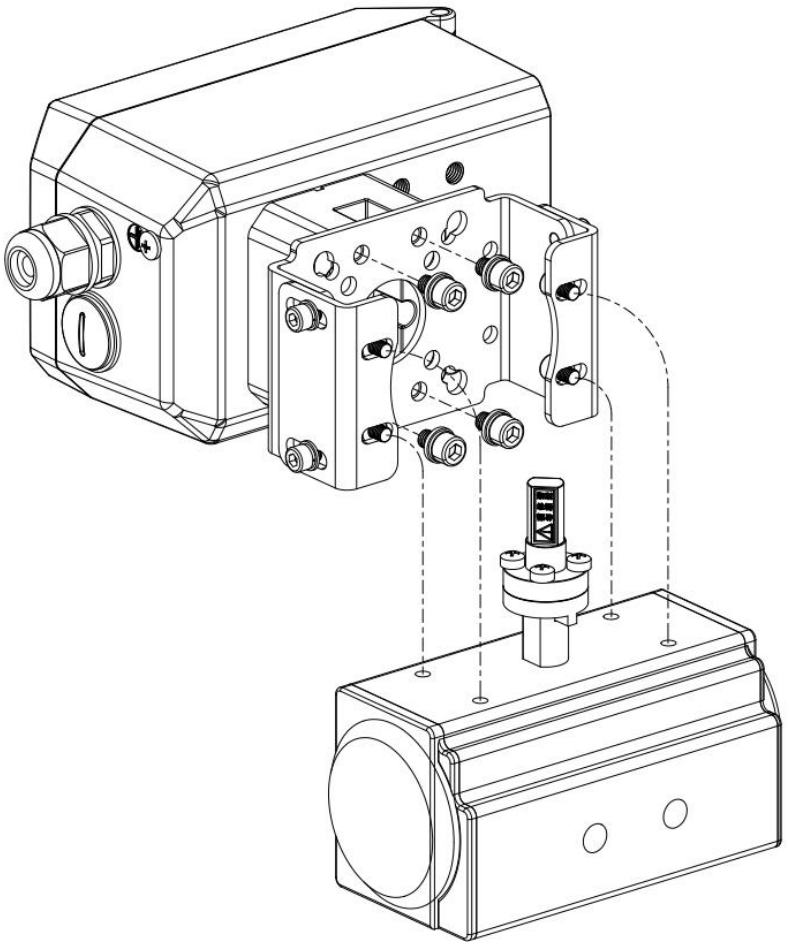


Figure 18. Installation of rotary stroke mounting bracket

4. Adjust the height of the bracket by tightening the fixing screws on both sides of the bracket. It is required that the magnet be positioned at the center of the sliding slot on the back of the positioner, and the depth of embedding of the magnet should be between 10mm and 15mm.

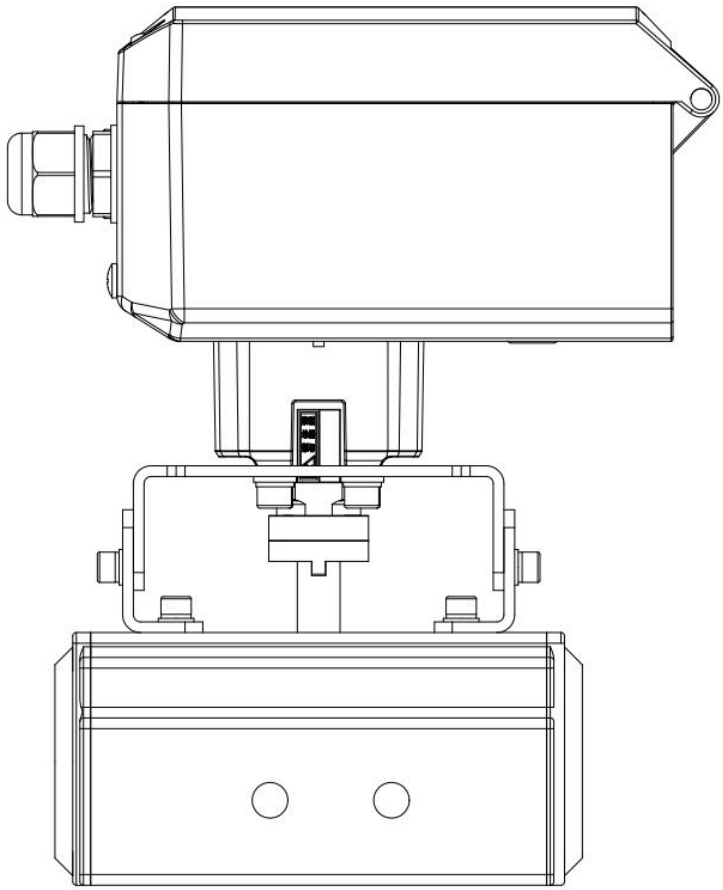


Figure 19. Adjust the height of the mounting bracket

7.3. Installation notes

- Do not install the positioner near high-magnetic equipment!
- The materials of the magnet assembly have been specially selected to provide a long-term stable magnetic field. However, like any magnet, the magnet assembly must be handled with care. Placing other high-magnetic magnets in close proximity to the device (less than 25 mm) may result in permanent damage to the device. Items that may damage the device include, but are not limited to: transformers, DC motors, and laminated magnet assemblies.
- Please do not place magnetic objects such as magnetic screwdrivers near the magnet, as these objects may affect valve control.

7.4. Position feedback module

If it is required，feedback module is available when user selects.

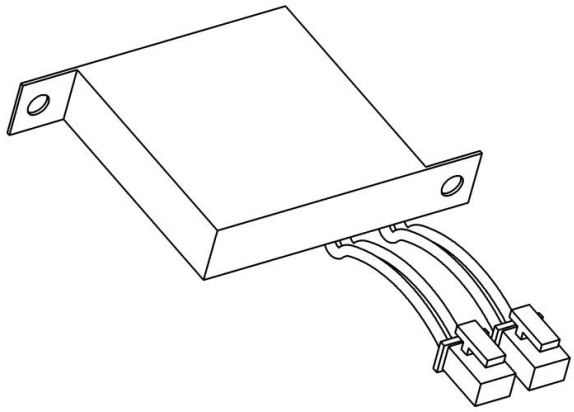


Figure 20. Feedback module

Installation of feedback module:

- Open the outer cover and take off the circuit board protective cover.

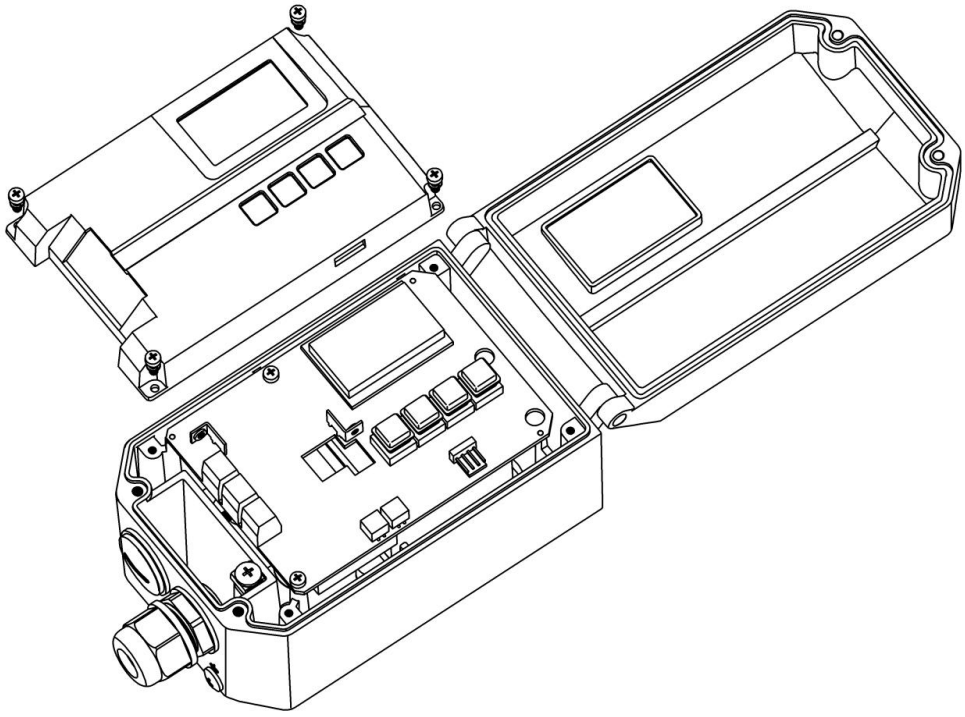


Figure 21. Remove the circuit board protective cover

- Install the feedback module according to the position as shown below, and connect electrical connectors of the module with the connectors on the circuit board according to the corresponding colors, fix the feedback module with M3 spring washer and M3 pan head screw, and finally install the circuit board protective cover.

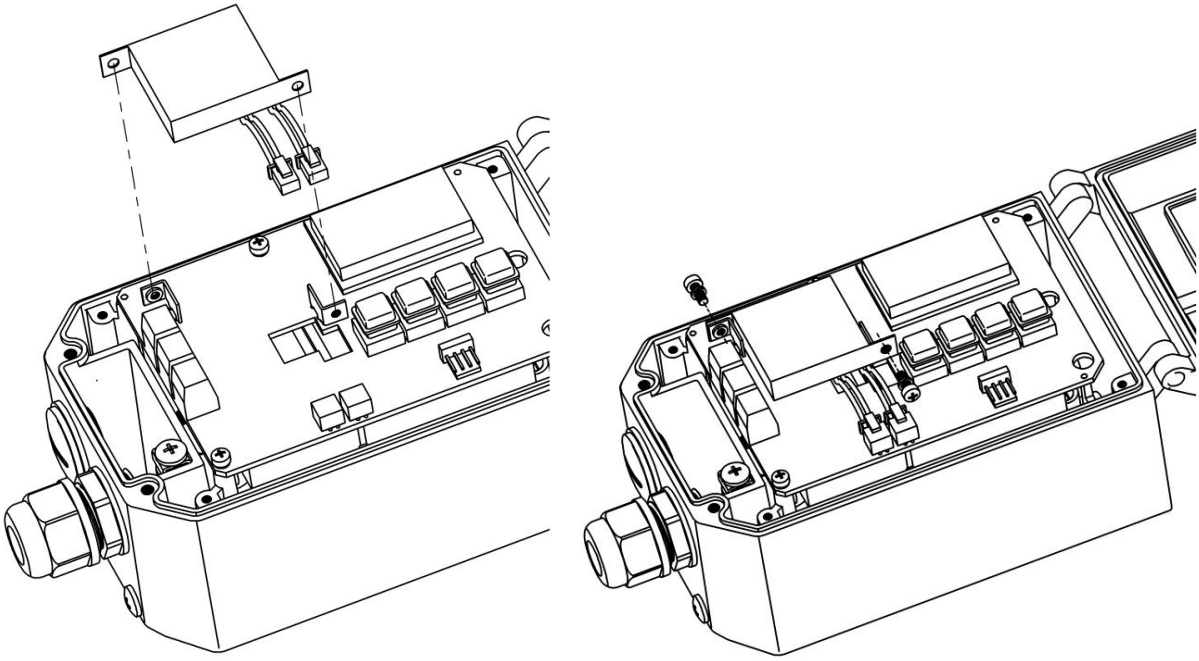


Figure 22. Feedback module installation

NOTE：Must install or remove the circuit board protective cover when the device is powered off.

8. Operation

8.1. Interface description

User's operating interface includes one LCD screen and 4 buttons.

LCD display description

Position	Description
Top line	● Display the percentage value of angle sensor in the initial interface (NOINI) or when running the initialization function. ● Display valve position percentage value in operating mode. ● Display parameter values in menu mode.
Bottom line	● Display indication signs in uninitialized state. ● Display automatic or manual mode in operating mode. ● Display setpoint percentage value in operating mode. ● Display function options in menu mode. ● Display initialization step and error sign in initialization process.

Button operation description

Button	Description
	● Enter the system menu. ● Switch automatic and manual mode in operating mode. ● Exit from the system menu to main interface ● Exit from submenu to previous menu.
	● Open or close valve in the initial interface (NOINI). ● Decrease the valve position value in manual mode. If press and hold this button first, then press and hold button, the valve position value will be reduced quickly. ● Select function options or parameters down and decrease parameter values in menu mode.
	● Open or close valve in the initial interface (NOINI). ● Increase the valve position value in manual mode. If press and hold this button first, then press and hold  button, the valve position value will be increased quickly. ● Select function options or parameters up and increase parameter values in menu mode.
	● Enter submenu, enable or confirm parameter modification in menu mode. ● Run initialization or reset to factory settings.

	● Run initialization in initial interface (NOINI) or in operating mode.

8.2. Display and operation of main interface

Positioner is in the uninitialized state before initialization. When LCD displays the sign **NOINI,** interface displays percentage value of sensor in the top line.

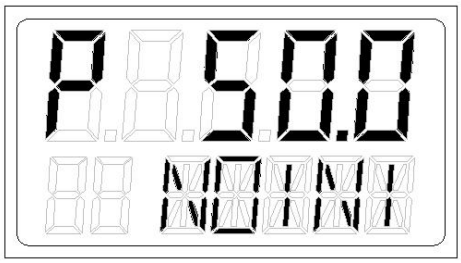


Figure 23. Uninitialized state interface

In this state, pressing [▼][▲] buttons can open and close valve. Open and close valve fully, and observe the percentage value of sensor displayed on the interface. Ensure that within the entire valve stroke range, the sensor percentage value changes monotonically. Otherwise, it is necessary to re-adjust the installation position. In addition, the minimum and maximum percentage difference of the sensor is required to be greater than 15%.

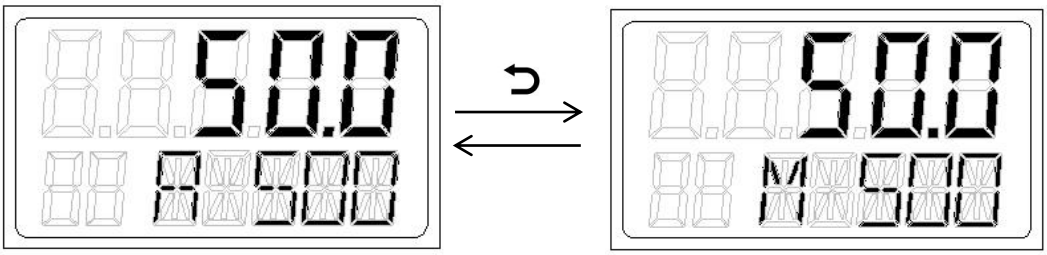
If you want to take a shortcut of running automatic initialization (**INITA**), press and hold [O] button for approx. 3s to run it in the initial interface (**NOINI**) or in the operating mode. In the initialization process, pressing [↩] button will exit. After exiting, if the initialization is completed before, system enters manual mode interface. Otherwise, system enters initial interface (**NOINI**). After the initialization is completed, press [↩] button to exit. After exiting, the system enters the manual mode interface.

Operating mode includes automatic mode and manual mode.

In automatic mode, system adjusts the valve position automatically by collecting the external 4-20mA input signal.

In manual mode, valve position can be adjusted by pressing [▼][▲] buttons manually.

In the main interface, the top line shows the valve position percentage value, and the bottom line shows the set-point percentage value. The last digit of the set-point percentage value is one decimal place. Sign **A** means automatic mode and sign **M** means manual mode. They can be switched by pressing [↩] button. If the release time after pressing the [↩] button is less than the operation time of entering the menu, operating mode can be switched. Otherwise, it will enter the menu.



Automatic mode **Manual mode**

Figure 24. Operating mode interface

PST (partial stroke test) function can be executed in the automatic mode. Press and hold ▼ button for approx. 3s to swtich to the PST operation interface. Press ↩ button to exit to the automatic mode interface. In the PST operation interface, if the PST function is not enabled, the first line of the interface will display **oFF**. If the PST function is enabled, when the absolute difference between the valve position and the starting position is within the tolerance range of the starting position and the PST parameter configuration is correct, Press and hold ○ button for approx. 3s to execute the PST function. The actuator moves from the starting position to the upper or lower limit of the target position according to the PST parameters. If the PST function is successfully executed, the interface will be display **SUCS**. If the PST function fails to execute, the interface will display **FAIL**. When executing PST function, the execution can be interrupted by pressing ↩ button. If the PST function does not meet the execution conditions, the following error code will be displayed.

Error code	Description
Err 1	The absolute difference between the valve position and the starting position is not within the tolerance range of the starting position.
Err 2	PST parameter configuration error. The upper limit of the target position must be ≤ 99%, and the lower limit of the target position must be ≥ 1%.

8.3. Menu and functions

8.3.1. Display and operation of menu

Press and hold ↩ button for approx. 3s to enter the menu. Press ↩ button, it will exit from menu interface to manual mode interface. The positioner with HART function cannot modify parameters or perform initialization operation through HART communication in the menu interface.

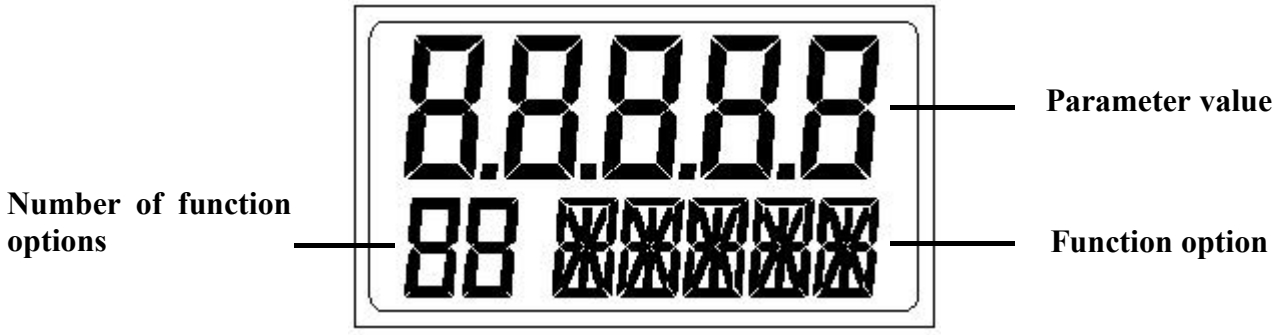


Figure 25. Menu interface

8.3.2. Functions description and operation

8.3.2.1. TYPE

TYPE is for setting the actuator type.

Options for setting parameter

Option	Description
Lin	Linear actuator.
Turn	Rotary actuator.

Select this function in the menu interface, press [O] button to start setting parameters, and the parameter will flash. Press [▼][▲] buttons to set parameter and press [O] button to confirm.

8.3.2.2. INITA

The function is auto initialization. It will automatically detect action direction, actual physical stroke of valve and control parameters.

Select this function in the menu interface, press and hold [O] button for approx. 3s to run, a scroll sign will appear in the lower left corner of LCD. Top line shows the percentage value of sensor and the step is showed in the bottom line. Sign **FINSH** will display on LCD after the auto initialization is completed.

For some reasons, the system will display an error message in the function option line during the auto initialization process and the auto initialization will be interrupted. Descriptions of error messages and solutions are showed in chapter 8.3.3.

8.3.2.3. INITM

The function is manual initialization. It is suitable for the user to confirm the valve stoke manually. The function requires the user to calibrate the valve stroke manually. Then it will automatically detect action direction and control parameters. The operation flow is as follows:

1) Select this function in the menu interface, press and hold [O] button for approx. 3s to run, a scroll sign will appear in the lower left corner of LCD. Top line shows the percentage value of sensor and bottom line shows **END 1**.
2) When LCD displays **END 1**, press [▼][▲] buttons to let the valve position move to the endpoint 1 of the manual calibrating stroke, and press [O] button to confirm, then LCD will display **END 2**. Next, press [▼][▲] buttons again to let the valve position move to the endpoint 2 of the manual calibrating stroke, and press [O] button to confirm.
3) If there isn't error message after confirmation of **END 2**, the system will run the step 1of initialization automatically and skip step 2 for stroke detection.

LCD will display **FINSH** when manual initialization is completed.

For some reasons, the system will display an error message in the function option line during the manual initialization process and the manual initialization will be interrupted. Descriptions of error messages and solutions are showed in chapter 8.3.3.

8.3.2.4. CAL

CAL is for calibrating 4-20mA input signal. When there is a big deviation between the set point

value and the output value of the signal source, it can be calibrated by this function.

Sub-function options **4mA** and **20mA** are used for calibrating minimum and maximum value of 4-20mA input signal separately.

Select this function in the menu interface, press [O] button to enter sub-function selection operation, and press [▲][▼] buttons to select **4mA** or **20mA**, press [O] button to start parameter setting, AD value of actual input signal flashes on LCD (Quantify the set signal numerically, ranging from 0 to 4095). For option **4mA**, set the front-end input signal to 4mA signal; for option **20mA**, set the front-end input signal to 20mA signal. For example, when the front-end input signal is 4mA, value 650 will flash on LCD. After the AD value on LCD is stable, press [O] button to confirm it. The system will record current AD value (650) and it will be displayed on LCD. When the front-end input signal is 20mA, value 3270 will flash on LCD. After the AD value on LCD is stable, press [O] button to confirm it. The system will record current AD value (3270) and it will be displayed on LCD. The calibration of the 4-20mA input signal is completed after the operation of option **4 mA** and option **20 mA**.

For example, if 4-20mA signal is set as 50%(12mA) in the field, while the actual signal value collected by positioner is 52% (12.32mA), it indicates that there is a deviation between the input signal and the signal actually collected by positioner. In this case, calibrate the input signal collected by the positioner by operating as above guidance to make it correspond to 4-20mA signal of the front-end of the system.

8.3.2.5. SDIR

SDIR function sets the corresponding relationship between 4-20mA set-point signal and set-point value.

Select this function in the menu interface, press [O] button to start setting, and the parameter will flash. Press [▼][▲] buttons to set parameter and press [O] button to confirm.

Options for setting parameter

Option	Description
riSE	4 mA → 0%，20 mA → 100%.
FALL	4 mA → 100%，20 mA → 0%.

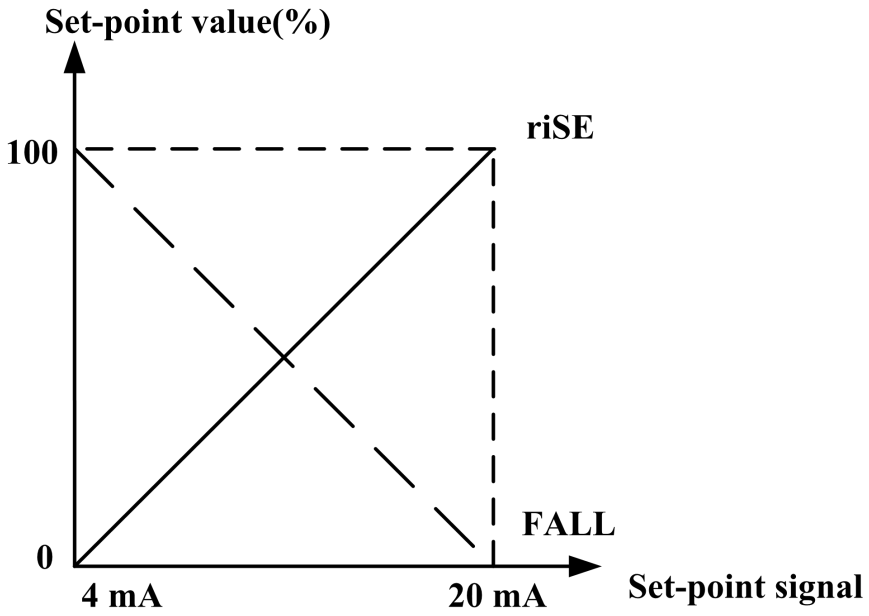


Figure 26. SDIR

8.3.2.6. CHAR

The characteristic curve is the relationship between set-point value and valve stroke.

In the actual control system, it is usually required to make the controlled variable have specific control characteristics (such as linearity). The user can choose and set the corresponding characteristic curve to achieve the control requirements.

The function is to determine the relationship between position set-point value and valve stroke.

Select this function in the menu interface, press [O] button to start setting, and the parameter will flash. Press [▼][▲] buttons to set parameter and press [O] button to confirm.

Option for CHAR

Option	Description
Lin	1:1 linear transfer relationship between position set-point value and valve stroke.
1-25	1:25 equal percentage transfer relationship between position set-point value and valve stroke.
1-33	1:33 equal percentage transfer relationship between position set-point value and valve stroke.
1-50	1:50 equal percentage transfer relationship between position set-point value and valve stroke.
n1-25	1:25 inverse equal percentage transfer relationship between position set-point value and valve stroke.
n1-33	1:33 inverse equal percentage transfer relationship between position set-point value and valve stroke.
n1-50	1:50 inverse equal percentage transfer relationship between position set-point value and valve stroke.
FrEE	Freely programmable transfer relationship between position set-point value and valve

	stroke for user. The position set-point value scale ranging from 0-100% is divided uniformly into 21 nodes. A freely programmable valve stroke ranging from 0-100% is assigned to each node. User can set value by selecting option **FR 0**, **FR 5**, …, **FR 100**.

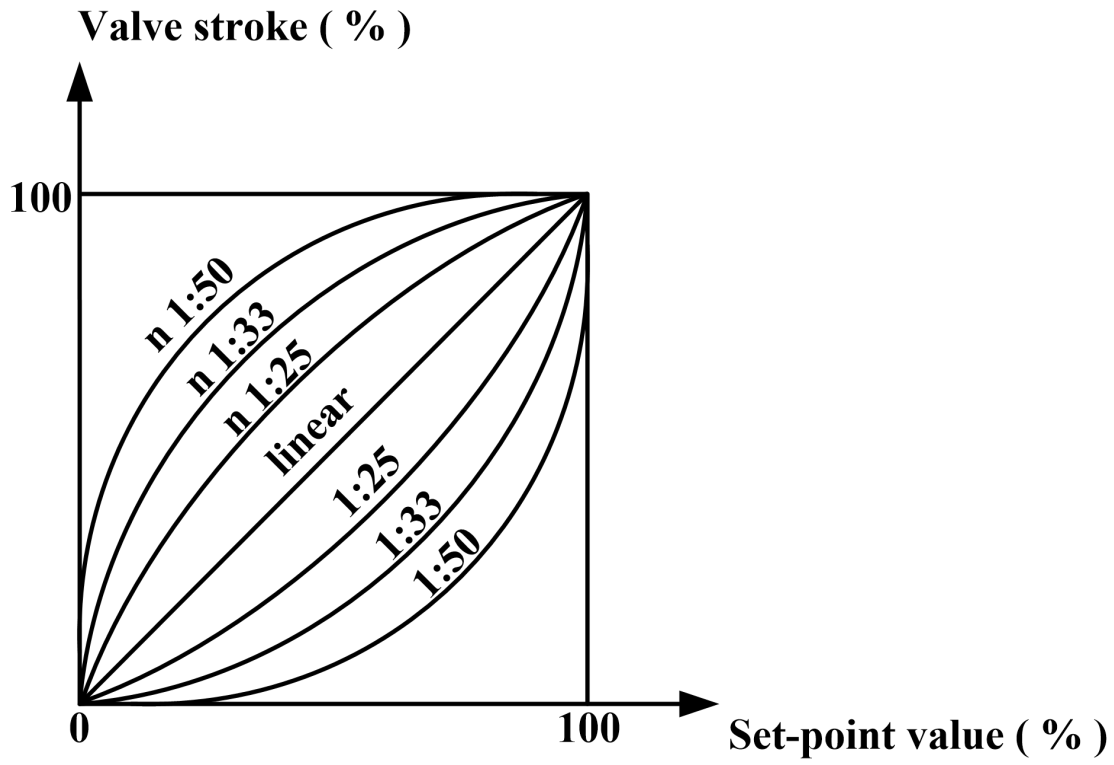


Figure 27. CHAR

8.3.2.7. FREE

Set value of **FrEE** characteristic curve in **CHAR** function option.

Sub-function options of **FREE** are **FR 0**, **FR 5**, … , **FR 100**, 21 set points in total.

Select this function in the menu interface, press [O] button to enter sub-function option, and select set point by pressing [▼][▲] buttons, then press [O] button to start setting parameter, and the parameter will flash. Press [▼][▲] buttons to set parameter, it can be modified quickly by pressing [▼] or [▲] button continuously, finally press [O] button to confirm.

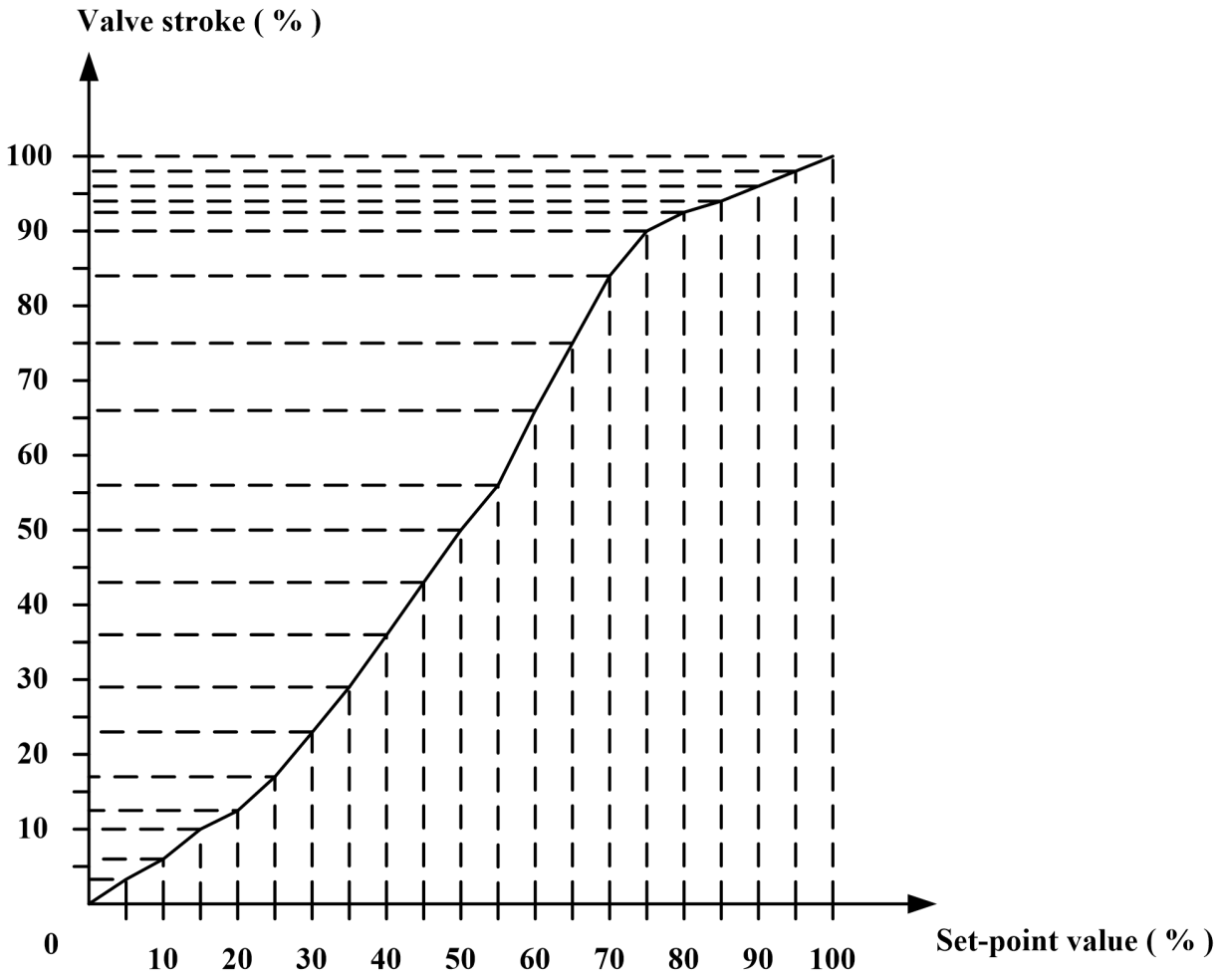


Figure 28. FREE

8.3.2.8. DB

Set Dead band zone of positioner.

The system does not adjust the valve stroke when the gap between the stroke value and the position set-point value is not bigger than the dead band value.

For example, positioner will not do adjustment if the actual valve position is not in the range of 50±1% when the position set-point value is 50% and dead band value is 1%. If it's not in the range of 50±1%, the piezoelectric module will be driven to adjust valve position until it's in the range of 50±1%.

It's recommended to increase the dead band value if the valve position oscillates. The smaller the dead band sets, the higher control accuracy gets.

Select this function in the menu interface, press [O] button to start setting, and the parameter will flash. Press [▼][▲] buttons to set parameter, it can be modified quickly by pressing [▼] or [▲] button continuously, finally press [O] button to confirm.

8.3.2.9. LIM

This function limits the automatic adjustment range in the whole valve physical stroke.
The **LIM** sub-function options **L MIN** and **L MAX** of set the minimum and maximum limits of the stroke respectively.
Select this function in the menu interface, press [O] button to enter sub-function option, press [▼] [▲] buttons to select option **L MIN** or **L MAX**, press [O] button to start setting, and the parameter will flash. Press [▼][▲] buttons to set parameter, it can be modified quickly by pressing [▼] or [▲] button continuously, finally press [O] button to confirm.

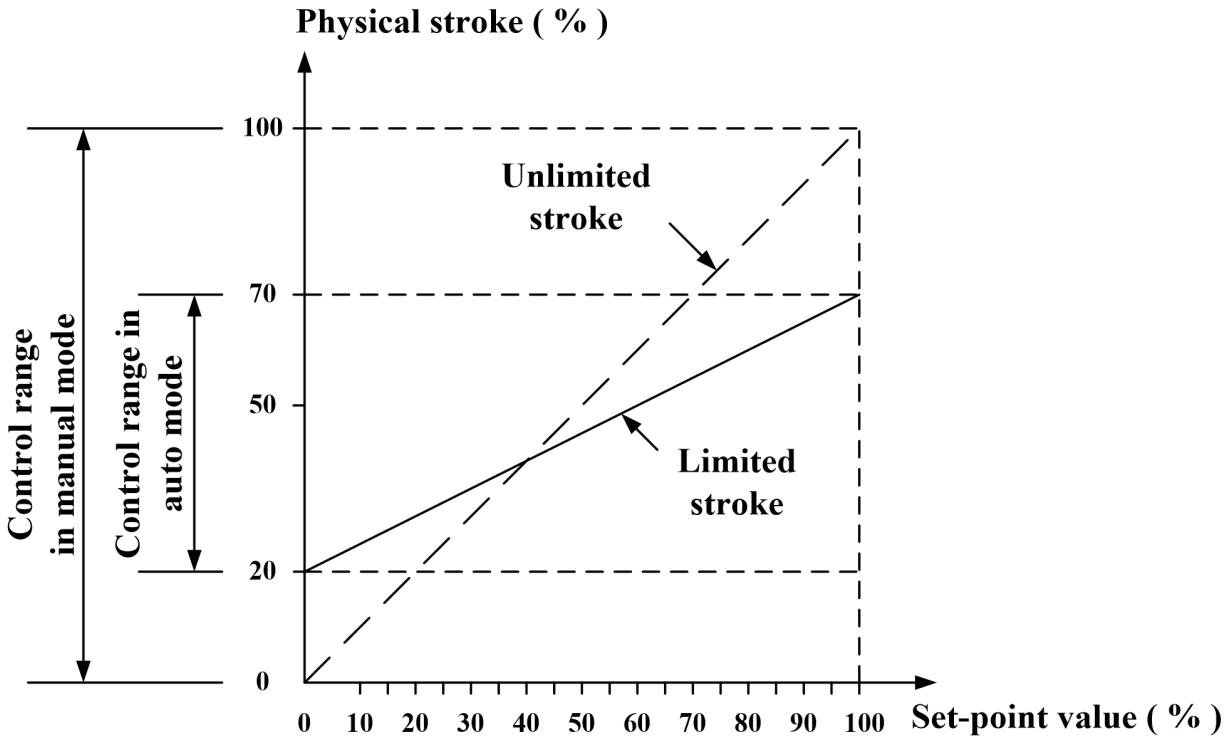


Figure 29. LIM

8.3.2.10.YDIR

This function is used to set the acting direction of the set-point value display, the position value display and position feedback signal output.
Select this function in the menu interface, press [O] button to start setting, and the parameter will flash. Press [▼][▲] buttons to set parameter and press [O] button to confirm.

Options for setting parameter

Option	Description
riSE	The setpoint display, position value display, and position feedback signal output are upward trending.
FALL	The setpoint display, position value display, and position feedback signal output are downtrending.

8.3.2.11. CUT

This function is used for the positioner to fully close or open the valve in automatic mode. When the function is enabled, sign **CU** displays in the left bottom in main interface.

The **CUT** sub-function options **C MIN** and **C MAX** respectively set the minimum and maximum values.

Select this function in the menu interface, press [O] button to enter sub-function option, press [▼] [▲] buttons to select option **C MIN** or **C MAX**, press [O] button to start setting, and the parameter will flash. Press [▼][▲] buttons to set parameter, it can be modified quickly by pressing [▼] or [▲] button continuously, finally press [O] button to confirm.

When **C MIN** value is 0, full closing is disabled. When **C MAX** value is 100, full opening is disabled.

When valve is in the positioning state, if the set point value ≤ **C MIN**, the valve will be fully close; if set point value ≥ **C MAX**, it will be fully open.

When the set point value ＞ **C MIN** + 1%, valve will disengage from the full closing state.

When the set point value ＜ **C MAX** - 1%, valve will disengage from the full opening state.

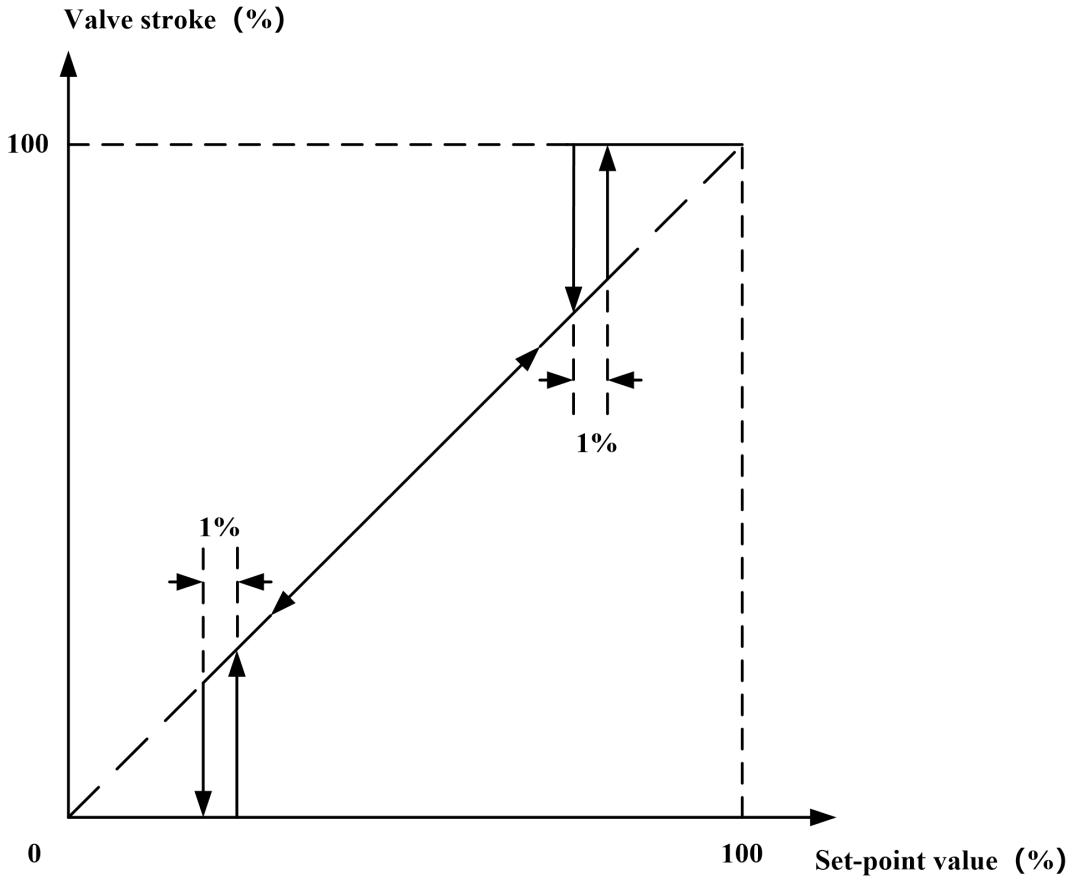


Figure 30. CUT

8.3.2.12. POS

This function is used to set the standard of position display and feedback signal output.

Select this function in the menu interface, press [O] button to start setting, and the parameter will flash. Press [▼][▲] buttons to set parameter and press [O] button to confirm.

Options for setting parameter

Option	Description
FS	The position display and feedback signal output correspond to 0-100% of mechanical stroke. The set-point value is displayed as the actual valve position set value. Not affected by the **L MIN** and **L MAX** parameters.
LS	The position display and feedback signal output take the form of 0-100% to represent the range between the **L MIN** and **L MAX** parameters. The set-point value is displayed with this standard.

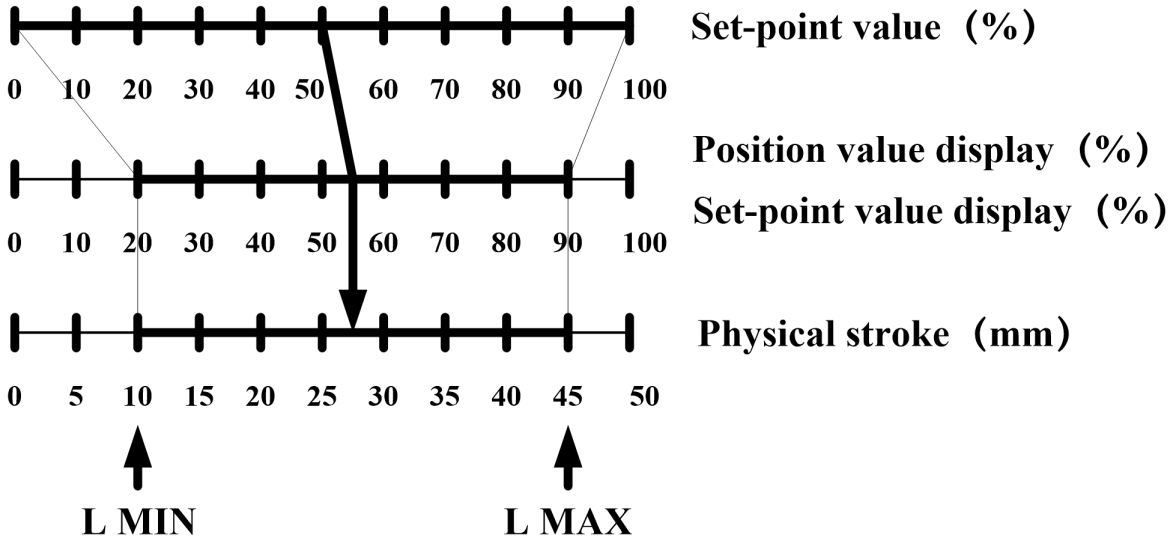


Figure 31. Example: POS = FS, L MIN = 20%, L MAX = 90%

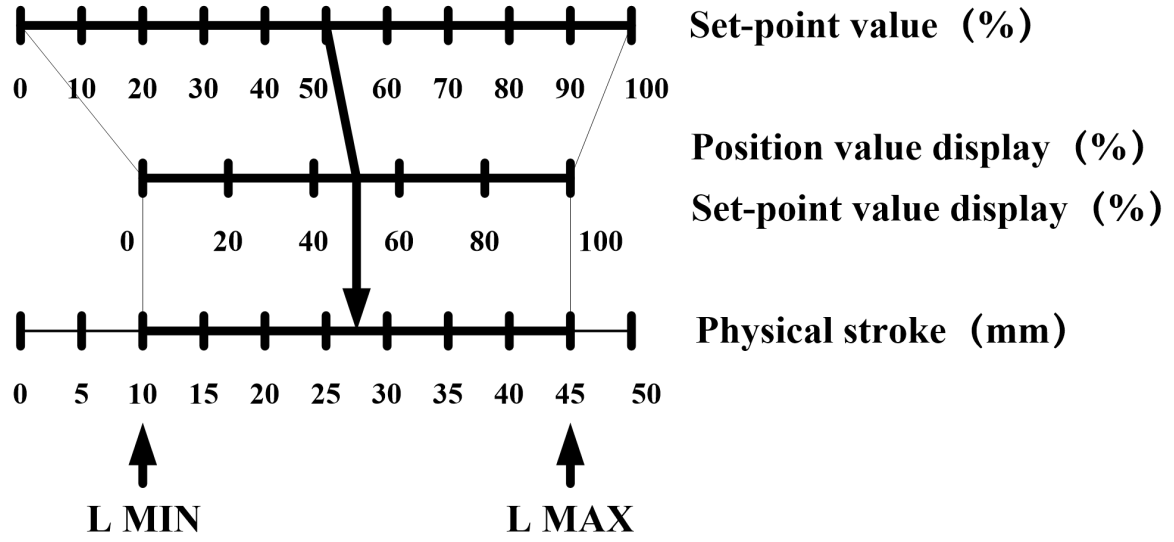


Figure 32. Example: POS = LS, L MIN = 20%, L MAX = 90%

8.3.2.13.FACT

Restore factory settings.

Select this function in the menu interface, press and hold [O] button for approx. 3s to reset to

factory setting. Then the system is in an uninitialized state and the LCD displays **FINSH**.

8.3.2.14.WP

This function is a parameter write protection function. The parameter **oFF** is write protection disabled, and the parameter **on** is write protection enabled.
Select this function in the menu interface, press [O] button to start setting, and the parameter will flash. Press [▼][▲] buttons to set parameter and press [O] button to confirm.
When write protection is enabled, most menu option parameters cannot be modified, and initialization and factory reset functions cannot run.

8.3.2.15.ACT

This function is used to set acting mode. It is used for the manufacturer. It is not recommended for users to operate this option without special circumstances.

8.3.2.16.REC

Record the running data of the positioner. The parameters cannot be restored to factory values by running the **FACT** function.

Options for data recording

Option	Description
HOURS	Running hours count. Start recording after the positioner are powered on.
P CNT	Positive deviation count. In automatic mode, when the positioner is in position control, the position value corresponding to the initialized mechanical stroke is compared with the position set-point value. If the set-point value is greater than the position value, and the deviation between the two exceeds the dead zone value + 10% and lasts for more than 1 minute, the cumulative count is carried out once.
N CNT	Negative deviation count. In automatic mode, when the positioner is in position control, the position value corresponding to the initialized mechanical stroke is compared with the position set-point value. If the position value is greater than the set-point value, and the deviation between the two exceeds the dead zone value + 10% and lasts for more than 1 minute, the cumulative count is carried out once.
CLR	Clear the HOURS, P CNT, N CNT records. Select this option in the submenu of REC, press and hold [O] button for approx. 3s to run the function. Then the records are cleared and the LCD displays **FINSH**.
S/W	Enable or disable the data recording. The parameter **oFF** is disabled, and the parameter **on** is enabled.

8.3.2.17.LCD

This function is used to set the LCD display direction. The parameter **uP** is positive direction, and the parameter **do** is reverse direction. The parameter cannot be restored to factory value by running the **FACT** function.

For individual linear valves, if the device needs to be mounted in reverse direction to the valve, this parameter can be set so that the LCD is displayed in a positive direction.

Select this function in the menu interface, press [O] button to start setting, and the parameter will flash. Press [▼][▲] buttons to set parameter and press [O] button to confirm.

8.3.2.18.DIAG

Diagnostic parameters. Select this option in the menu interface, press [O] button to enter.

8.3.2.19.1. PST

Partial stroke test parameters. The parameters **STPOS**, **RANGE**, **STEP**, and **DIR** are associated with the stroke of the initialization.

Select the parameter option in the menu interface, press [O] button to start setting, and the parameter will flash. Press [▼][▲] buttons to set parameter and press [O] button to confirm.

To perform PST function (partial stroke test), please refer to section 8.2 for details.

Option	Description
S/W	Enable or disable partial stroke test. The parameter **oFF** is disabled, and the parameter **on** is enabled.
STPOS	Starting position for partial stroke test.
RANGE	The tolerance range for the starting position. For example, the starting position is 50% with a tolerance range of 2%. Only perform partial stroke test when the valve position is within the range of 48% to 52%.
STEP	Step stroke.
DIR	Stroke direction for partial stroke test. **uP**: The actuator moves upwards, from the starting position to the upper limit of the target position. **do**: The actuator moves downwards, from the starting position to the lower limit of the target position. **uP do**: The actuator moves up and down, first moving from the starting position to the upper limit of the target position. Then move from the upper limit of the target position to the lower limit of the target position. Upper limit of the target position = **STPOS + RANGE + STEP**。 Lower limit of the target position = **STPOS - RANGE - STEP**。
TIME	Limit time for partial stroke test. Unit: seconds. After starting the partial stroke

	test, if the limit time is reached and the actuator has not yet moved to the upper or lower limit of the target position, the test is considered to have failed. Please set this value reasonably based on the actual operating condition of the valve.

8.3.2.19.SPLIT

This function is used for split range control.

The **SPLIT** sub-function options **S MIN** and **S MAX** respectively set the minimum and maximum values. It is recommended that the difference between **S MAX** and **S MIN** should not be less than 30.

Select this function in the menu interface, press [O] button to enter sub-function option, press [▼] [▲] buttons to select option **S MIN** or **S MAX**, press [O] button to start setting, and the parameter will flash. Press [▼][▲] buttons to set parameter, it can be modified quickly by pressing [▼] or [▲] button continuously, finally press [O] button to confirm.

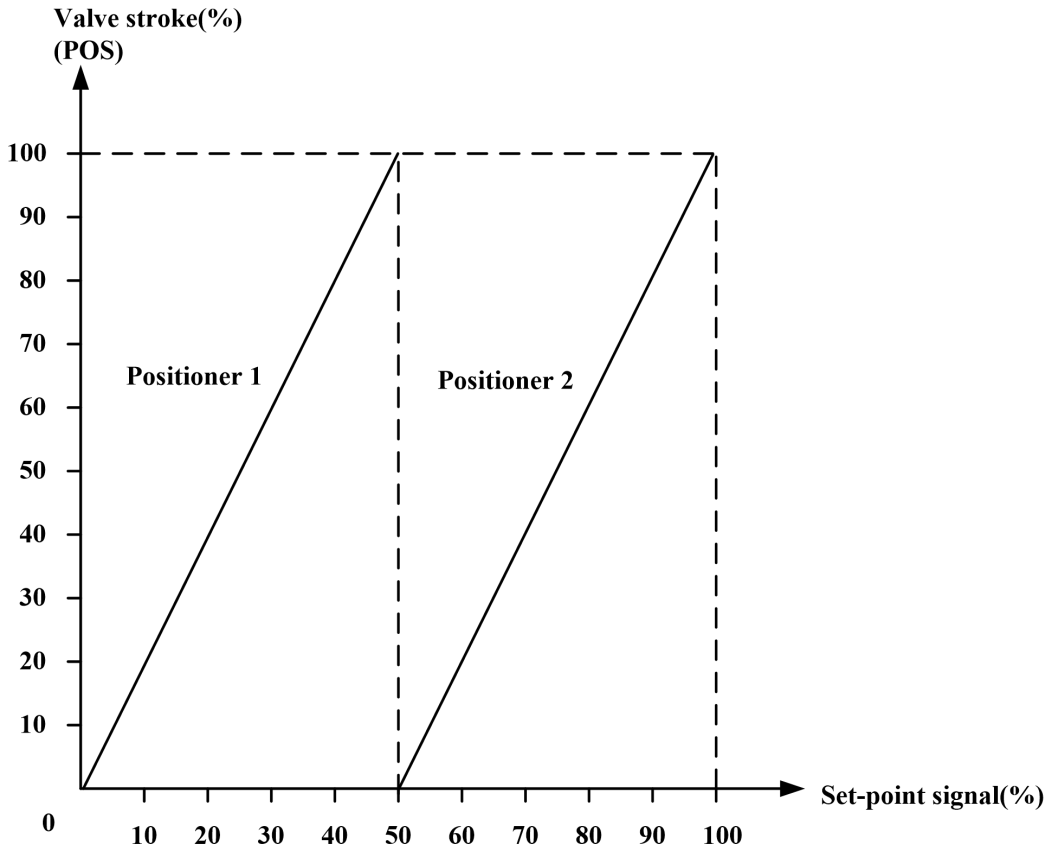


Figure 33. SPLIT

8.3.2.20.EXT

This function is used to optimize the display of position values at 0% and 100% of the stroke endpoint.

When the valve position is at 0% or 100% of the stroke endpoint, the position value displayed on the LCD may not be 0% or 100%. For example, displaying 0.2% at 0% of the stroke endpoint. If the user wants the position value to be displayed as 0%, set this function parameter. When the absolute

value of the difference between the position value and 0% or 100% is less than or equal to the parameter value, the LCD displays 0% or 100%.

Select this function in the menu interface, press [O] button to start setting, and the parameter will flash. Press [▼][▲] buttons to set parameter, it can be modified quickly by pressing [▼] or [▲] button continuously, finally press [O] button to confirm.

8.3.3. Error message during initialization

Sign	Meaning	Possible reasons	Solutions
ERR 1	Actuator action error	● No air pressure or insufficient air pressure ● There is a leakage from actuator or positioner.	● Check air source and it's pressure to make sure that it meets the requirement ● Eliminate air leakage
ERR 2	Valve stroke does not meet requirements.	● The valve stroke does not match the sensor range. ● The valve stroke is too short. It is below the minimum stroke requirement. ● When running the manual initialization, the difference from **END 1** to **END 2** doesn't meet the installation requirements.	● Select the sensor and the valve with appropriate ranges to match. ● If it's in the manual initialization operation process, press [▼][▲] buttons to re-calibrate **END 1** and **END 2**, make sure that difference percentage value between two endpoints of sensor is bigger than 15%.

8.3.4. Tips of menu option or function cannot access

When setting menu option parameters or running initialization, the following signs may appear to indicate that they cannot be accessed. See the table below for specific instructions.

Sign	Meaning
P1	Write protection is enabled.

8.3.5. Menu function options summary description

Options	Functions	Parameter value	Factory settings
1 TYPE	Actuator type setting	Lin Turn	Lin
2 INITA	Auto initialization		
3 INITM	Manual initialization		
4 CAL→4 mA	Calibrate 4mA set point signal	Current signal AD value	800
4 CAL→20 mA	Calibrate 20mA set point signal	Current signal AD value	4000
5 SDIR	Set the direction of set point signal	riSE FALL	riSE
6 CHAR	Select characteristic curve	Lin 1:25 1:33 1:50 n1:25 n1:33 n1:50 FrEE	Lin
7 FREE→FR 0, FR 5…FR 100	Custom parameters settings	0.0% – 100.0%	0.0% 5.0% etc. to 100.0%
8 DB	Set dead band	0.2 – 10.0%	1.0%
9 LIM→L MIN	Set minimum value for stroke range limit function	0.0% – 100.0%	0.0%
9 LIM→L MAX	Set maximum value for stroke range limit function	0.0% – 100.0%	100.0%
10 YDIR	Set the acting direction of position display, set-point display and position feedback signal output	riSE FALL	riSE
11 CUT→C MIN	Set minimum value for tight cut function	0.0% – 100.0%	1.0%
11 CUT→C MAX	Set maximum value for tight cut function	0.0% – 100.0%	100.0%
12 POS	Set Position display and feedback signal output standard	FS LS	FS
13 FACT	Reset to factory setting		

14 WP	Write protection	oFF on	oFF
15 ACT	Acting mode selection		
17 REC→HOURS	Running hours count	0-876000	0
17 REC→P CNT	Positive deviation count	0-99999	0
17 REC→N CNT	Negative deviation count	0-99999	0
17 REC→CLR	Clear data recording		
17 REC→S/W	Enable or disable the data recording	oFF on	on
18 LCD	LCD display direction	uP do	uP
A PST→S/W	Enable or disable PST	oFF on	oFF
A PST→STPOS	PST starting position setting	0.0% – 100.0%	100.0%
A PST→RANGE	PST starting position tolerance range setting	0.2% – 10.0%	2.0%
A PST→STEP	PST step stroke Setting	1.0% – 98.8%	10.0%
A PST→DIR	PST stroke direction setting	uP do uPdo	do
A PST→TIME	PST limit time setting	1s – 100s	50s
20 SPLIT→S MIN	Set minimum value for split range control function	0.0% – 70.0%	0.0%
20 SPLIT→S MAX	Set maximum value for split range control function	30.0% – 100.0%	100.0%
21 EXT	Optimization display of stroke endpoint position value	0.0% – 10.0%	0.0%

8.4. HART DD file and DTM file description

8.4.1. Device dynamic variable description

Dynamic variable	Description
PV	Position setpoint percentage value
SV	Position percentage value

8.4.2. Device custom function description

The device custom function is in the **Detailed setup** directory of the DD file and DTM file. The function options and descriptions are shown in the following table:

Options	Description
TYPE	See chapter 8.3.2.1 for details.
INIT	Automatic initialization start or stop, initialization status indication. For the initialization function, please refer to Chapter 8.3.2.2 and Chapter 8.3.2.3.
SDIR	See chapter 8.3.2.5 for details.
CHAR	See chapter 8.3.2.6 for details.
FREE	See chapter 8.3.2.7 for details.
DB	See chapter 8.3.2.8 for details.
LIM	See chapter 8.3.2.9 for details.
YDIR	See chapter 8.3.2.10 for details.
CUT	See chapter 8.3.2.11 for details.
POS	See chapter 8.3.2.12 for details.
FACT	See chapter 8.3.2.13 for details.
REC	See chapter 8.3.2.16 for details.
Setpoint	Setpoint value setting.
Status	System status indication.
DIAG→PST	See chapter 8.3.2.19.1 for details.

The options and descriptions in the **INIT** directory are shown in the following table:

Options	Description
INIT status	Initialization status indication.
INIT start	Automatic initialization starts.
INIT stop	Automatic initialization stops.

INIT status signs and descriptions are shown in the following table:

Signs	Description
NOINI	Uninitialized.
FINSH	Initialization finish.
STEP1, STEP2, STEP3	Initialization steps.
ERR 1, ERR 2, ERR 3, ERR 4	Initialization error message.

The options and descriptions in the **Setpoint** directory are shown in the following table:

Options	Description
PV	Device dynamic variable.
SV	Device dynamic variable.
Setpoint source	Set the setpoint source. Can be set to **4-20mA** or **HART**, the default is **4-20mA**. When set to **4-20mA**, the setpoint value is determined by the external 4-20mA signal. When set to **HART**, the setpoint value is determined by the input value from HART communication. The **HART Setpoint input** option is jumped out from the directory. It is used to enter the setpoint value.
HART Setpoint input	Enter the setpoint value if **Setpoint source** is set to **HART**.

The options and descriptions in the **Status** directory are shown in the following table:

Options	Description
Working status	System working status.
Cutoff status	Cutoff status in automatic mode.

Working status signs and descriptions are shown in the following table:

Signs	Description
NOINI	The system is not initialized.
Config mode	The system is in menu configuration mode or performing initialization.
Auto mode	The system is in automatic mode.
Manu mode	The system is in manual mode.

Cutoff status signs and descriptions are shown in the following table:

Signs	Description
No	The system is not in cutoff status.
Cutoff down	Cutoff status corresponds to **C MIN**.
Cutoff up	Cutoff status corresponds to **C MAX**.

The options and descriptions in the **DIAG→PST** directory are shown in the following table:

Options	Description
Parameters	PST parameters.
Test	Operate PST.

The options and descriptions in the **PST→Test** directory are shown in the following table:

Options	Description
PST start	Start PST.
PST stop	Stop PST.
PST status	PST status indication.

PST status signs and descriptions are shown in the following table:

Signs	Description
Not running	PST is not running.
Running	PST is running.
SUCS	PST is successful.
FAIL	PST is failed.

8.5. Feedback signal

The positioner can be optionally equipped with a 4-20 mA feedback signal. It indicates the percentage value of the valve position.

The feedback signal module is based on a two-wire system, it needs 24V DC power supply. The feedback signal will stop updating after entering the menu.

8.6. Adjust air flow

1. Remove the circuit board protective cover.

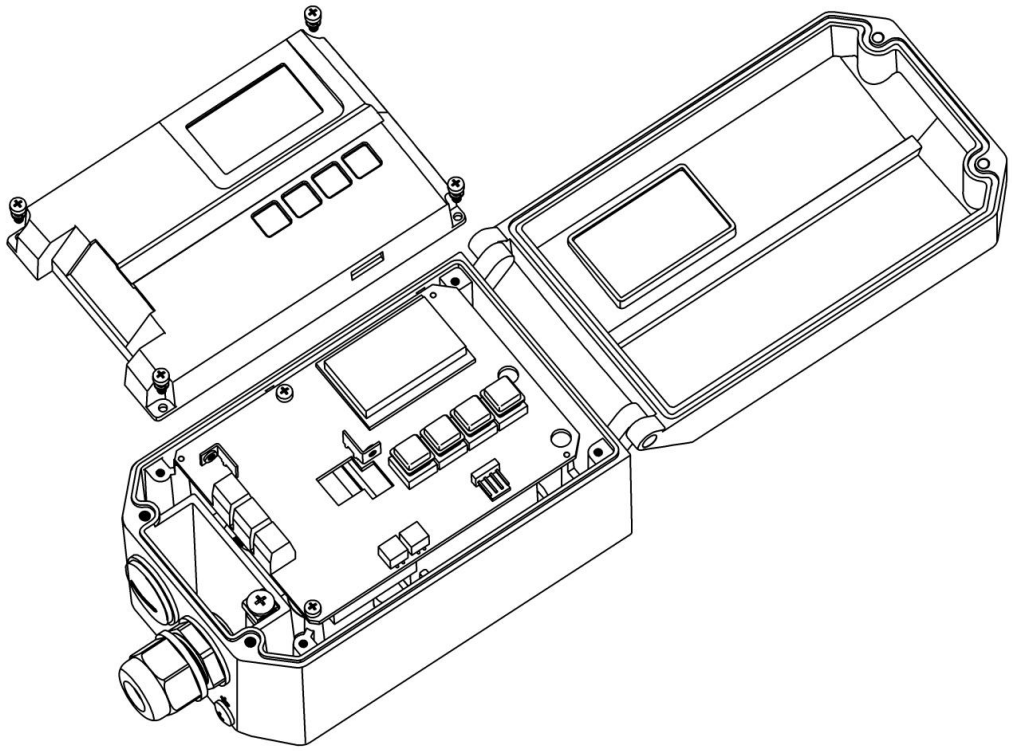


Figure 34. Remove the circuit board protective cover

NOTE：Must install or remove the circuit board protective cover when the device is powered off.

2. Adjust restrictors

- Restrictors Y1① and Y2② can reduce air output to increase the stability of positioning for small volume actuators.
- Turning the Restrictors in clockwise direction with a flat blade screwdriver can reduce the air flow until it is cut off.
- When adjusting restrictors, it is recommended to close them first and then open them again slowly.
- Make sure two restrictors are turned to the similar position for the double-acting actuator.

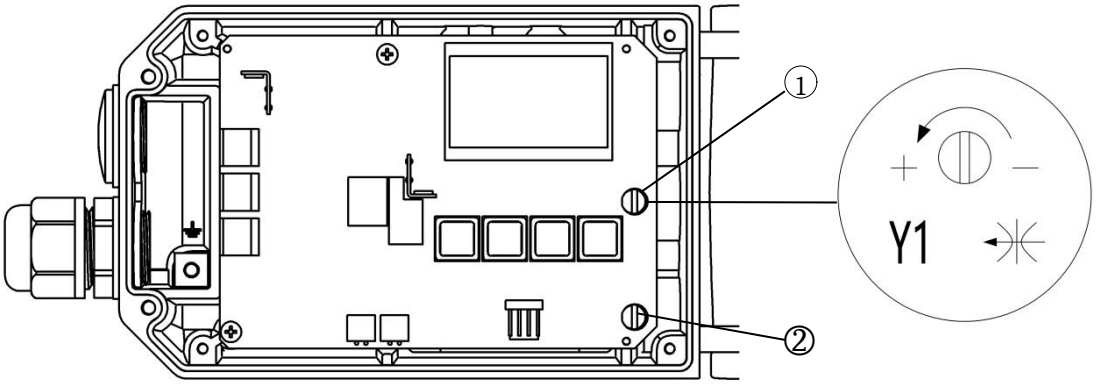


Figure 35. Air flow adjustment

① Restrictors Y1

② Restrictors Y2，only for double-acting actuator.

9. Trouble shooting

Contents	Possible reasons	Solutions
LCD has no display	Error electrical connections.	Check the electrical connections
	No current output from current source	Make sure that there is current output from the current source.
	The current source is out of specified range	Use the proper current source.
	Others	Consult with manufacturer.
There is no air output in **OUT1** or **OUT**2 (Without any action)	The air supply pressure is abnormal	Check the setting of the air pressure reducing valve.
	No input current	Make sure the input current is proper. (4-20mA DC)
	Accessory pipe leakage	Check the pipe and connection to make sure that there isn't any leakage.
	Others	Consult with manufacturer.
Bad accuracy (Linear and hysteresis phenomena)	The air supply pressure changes	Check whether there is any abnormality of the air supply pressure reducing valve
	The mounting bolts loose	Make sure the mounting bolts are tightened.
	The connection place between the positioner and the actuator has gap	Check the connection.
	Set-point value deviation	Adjust the current output signal.
		Calibrate the set-point signal.
	Others	Consult with manufacturer.

10. Warranty terms

1. If the product is found to have quality problems which are confirmed by our company staff, customers have after-sale services for product maintenance or free replacement in the warranty period. Service response time is 24 hours (excluding non-working days).
2. The warranty period of the product is based on the company's latest warranty policy, which is no less than 12 months after the sale.
3. The following situations for repaired product do not belong to the warranty range:
   (1) The date is not in the warranty period.
   (2) The product is disassembled without authorization and permit by the product company.
   (3) The damage causes from the operation which is not according to the product instruction manual or other human factors. Including but not limited to:
      1> The product surface has collision scars.
      2> Error wiring or error power supply makes the product damaged.
      3> Parts and accessories are lost.
      4> The product is damaged due to the oil entering the product without oil separator or filter pressure reducer being installed.
      5> Error using the waterproof electrical connectors makes the product damaged.
      6> Plugging or removing the vent plug without permission.
   (4) Force majeure (natural disasters) causes product failure or damage.
4. According to the actual situation, the product company offers the free or fee-based maintenance services outside the warranty range.
5. The terms become effective since the two sides signed a supply contract.

V260414

本说明书内容变更，恕不另行通知。

相关技术更新本公司保留最终解释权。

The changed contents of this manual are not noticed.

The Company reserves the final interpretation for related technical updating

附件

智能阀门定位器气源要求

全系列产品

按照技术要求，全系列的智能阀门定位器气源要求为 3 级，提供符合气源要求的压缩空气，可以确保定位器的正常使用。

露点 3 级：露点为-20°C。（若定位器实际工作环境温度低于-20°C，则使用的压缩空气露点需
相应低于定位器实际工作环境温度-10°C）

固体颗粒大小和密度 3 级：5.0mg/m3（对应粒径为 5.0um），不允许有粒径大于 5.0um 的颗粒进入。

含油量 3 级：1.0mg/m3，每单位立方米的空气累积油含量不超过 1.0mg。

流程示例

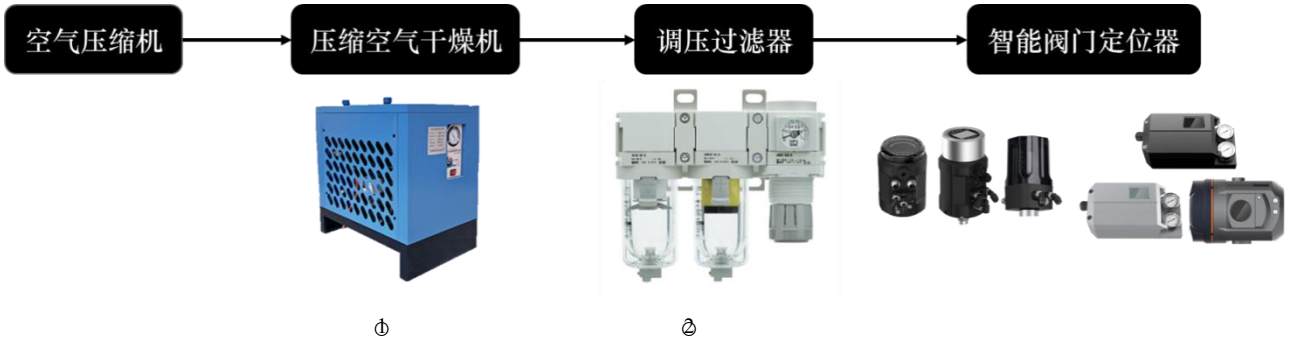
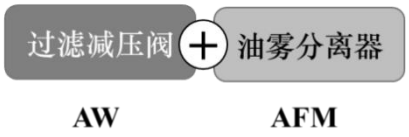


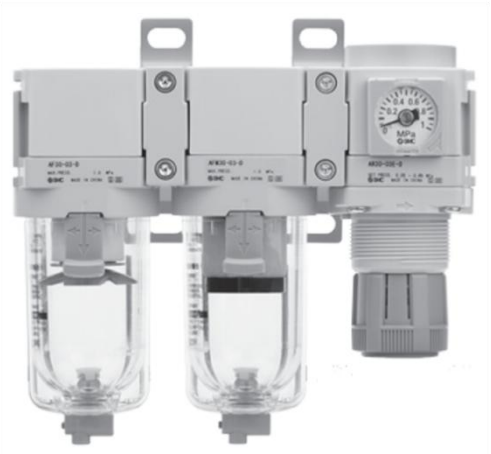
图 1.　流程图

①在主管路中配备压缩空气干燥机，过滤掉压缩空气中产生的大部分水分，过滤后的压力露点可达到-20°C；

②选择任意与图 2 一致的调压过滤器组合安装在定位器管路的前端，安装时需过滤减压阀（空气过滤器）在前，油雾分离器在后，要求过滤器过滤粒径在 5.0um 以上的颗粒，最高残余油含量≤1.0mg/m^3。



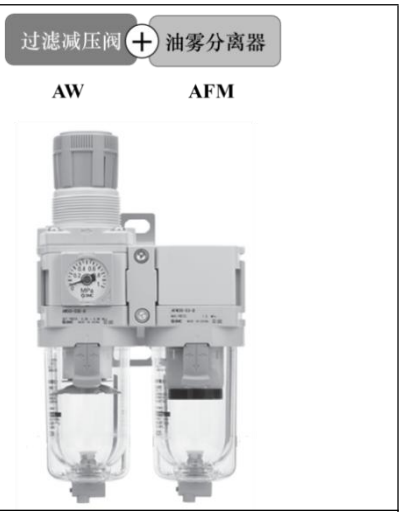
AC20D-A~AC40D-A 系列



AC20C-A~AC40C-A 系列

图 2.　调压过滤器组合

过滤器选型推荐

选型组合	 AC 30 C– □ 03 DG – □ – □ – A 1 2 3 4 5 6	 AC 30 D– □ 03 DG – □ – □ – A 1 2 3 4 5 6
选型编号	SMC AC20C-02G-A	SMC AC20D-02G-A　SMC AC30D-02G-A
	入口侧压缩空气质量略低于定位器使用要求时	入口侧压缩空气质量符合定位器使用要求时
基础参数	流体：空气	

<table>
<tr><td></td><td colspan="3">环境温度及使用温度：-5~60°C（未冻结）
耐压：1.5MPa
使用压力范围：0.05~1.0MPa
设定压力范围：0.05~0.7MPa
过滤精度：AW:5um、AFM：0.3um（捕集效率 99.9%)
杯体材质：聚碳酸酯
结构：溢流型</td></tr>
<tr><td rowspan="2">选型参数</td><td rowspan="2">④主体尺寸：20
额定流量：200L/min
杯体保护罩：标准（钢带）
质量：0.39kg
②螺纹种类（无记号）：Rc
③接口管径 02：1/4
④无记号：手动排水器
压力表 G:圆形压力表(带限位指示器)
⑤无记号：无附件
⑥无记号：无特殊选择</td><td>④主体尺寸：20
额定流量：150L/min
杯体保护罩：标准（钢带）
质量：0.33kg</td><td>④主体尺寸：30
额定流量：330L/min
杯体保护罩:标准装备（聚碳酸酯）
质量：0.66kg</td></tr>
<tr><td colspan="2">②螺纹种类（无记号）：Rc
③接口管径 02：1/4
④无记号：手动排水器
压力表 G：圆形压力表（带限位指示器）
⑤无记号：无附件
⑥无记号：无特殊选择</td></tr>
<tr><td>1 系列定位器*</td><td>●</td><td>●</td><td>/</td></tr>
<tr><td>IP 系列定位器*</td><td>●</td><td>/</td><td>●</td></tr>
</table>

*●为推荐的选择

注：过滤器处理空气额定流量需大于定位器的最大工作流量，在同一串联管路上存在多台定位器时则最大工作流量需相加计算（ 1 系列最大流量 1500、1600：Q1-17L/min；Q2-95L/min；1880S：17L/min IP 系列最大流量 IP5500: 155 L/min； IP6000/IP6500/IP7000:187 L/min；IP6000d：150 L/min 以上数据均为 0.6MPa 下测量所得）。

注意事项

1. 应视工况要求选择不同性能的调压过滤器，避免因工作环境的高温、低温、高压、腐蚀等原因导致调压过滤器失效,详见末尾附录选型表。
2. 定期巡查过滤器的使用情况，若使用频繁的工况应提高巡查次数，避免因过滤器滤芯堵塞导致的故障问题（故障举例：①过滤失效，导致定位器进入异物，致使定位器故障；②滤芯堵塞，导致气源供应异常，定位器无法正常工作等）。
3. 采用自动排水功能的调压过滤器需要避免排水孔的堵塞，定期巡查可避免过滤器故障导致滤杯内大量积水。手动排水的应视工况下过滤器的积水速率，定时人工排水。
4. 按照调压过滤器的使用说明，定期维护或更换不合格的产品，可避免不必要的故障出现。