



Intelligent Valve Positioner 1601 Series User's Manual

(Please read the instruction manual carefully before installation and use)



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1 Overview

1.1. Product structure

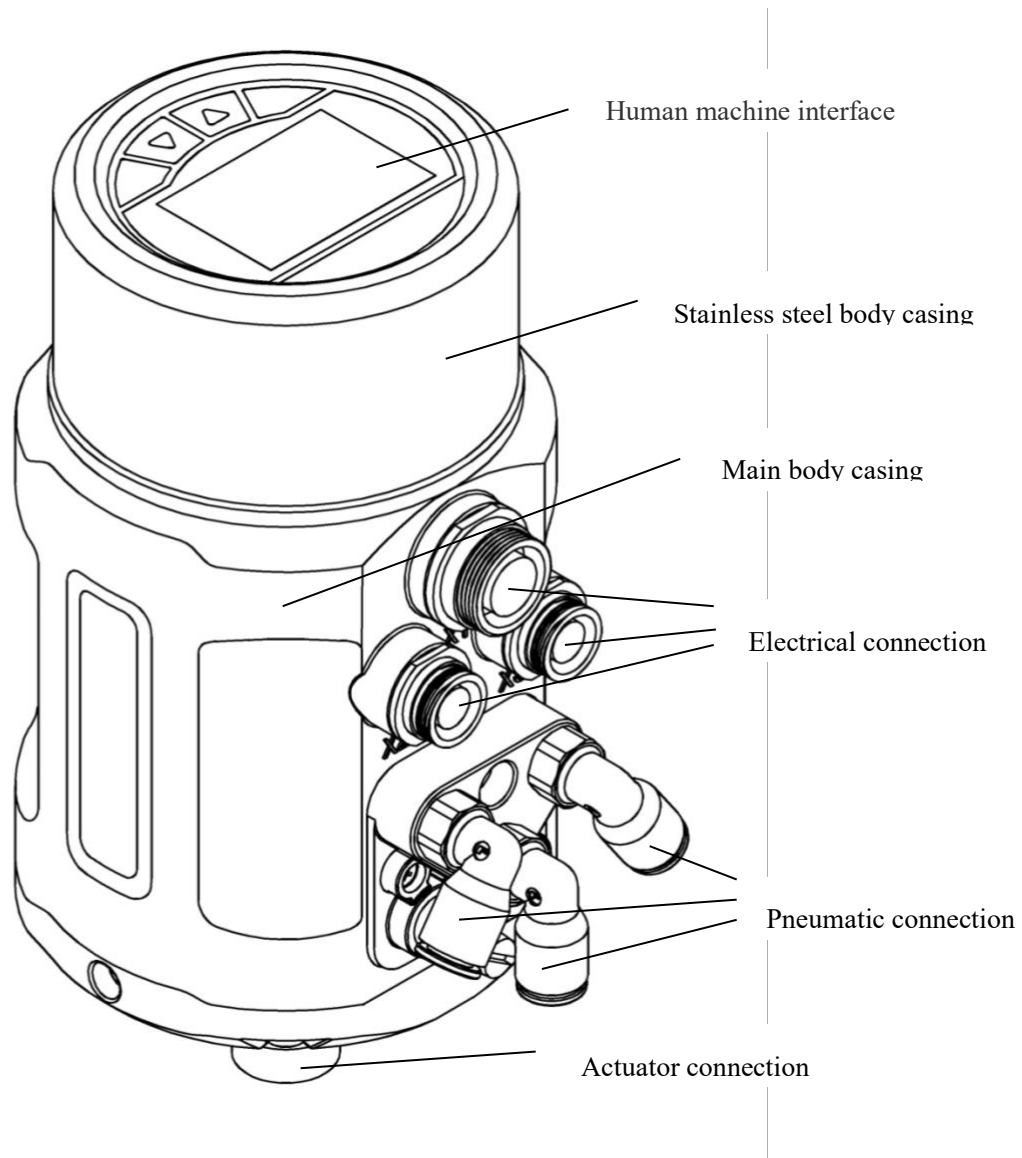


Figure 1. Positioner structure

1.2. Product description and application

1601 series intelligent valve positioner is a valve stroke controller for process control. The valve stroke can be set by external input signal or internal set manually. The positioner can adjust valve stroke quickly and accurately by using PID control algorithm and PWM control technology.

The positioner can combine with different pneumatically actuated valves for using. As shown in Figure 2.



with diaphragm valve

with angle seat valve

Figure 2. Combinations of positioner and pneumatically actuated valves

The product can be used in sealed space and controlled automatically and remotely. It has a variety of auxiliary functions such as flow linear, safety position, cut off, etc. It is easy to install, operate, maintain and has low failure rate.

2. Installation

2.1. Mechanical dimensions

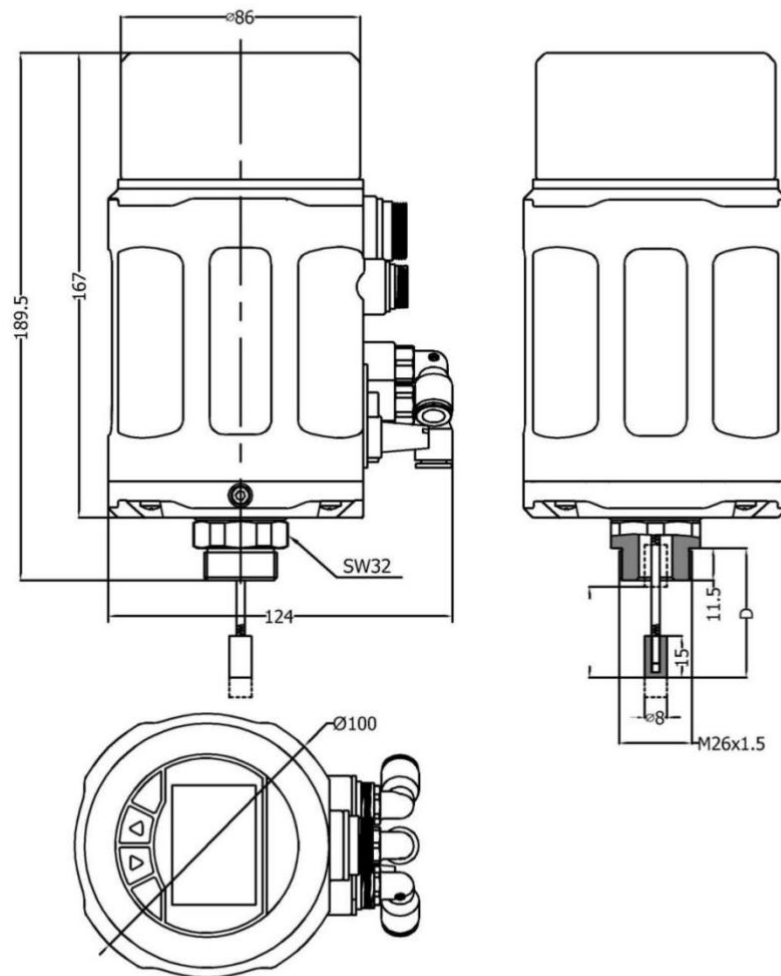


Figure 3. Mechanical dimensions for line stroke

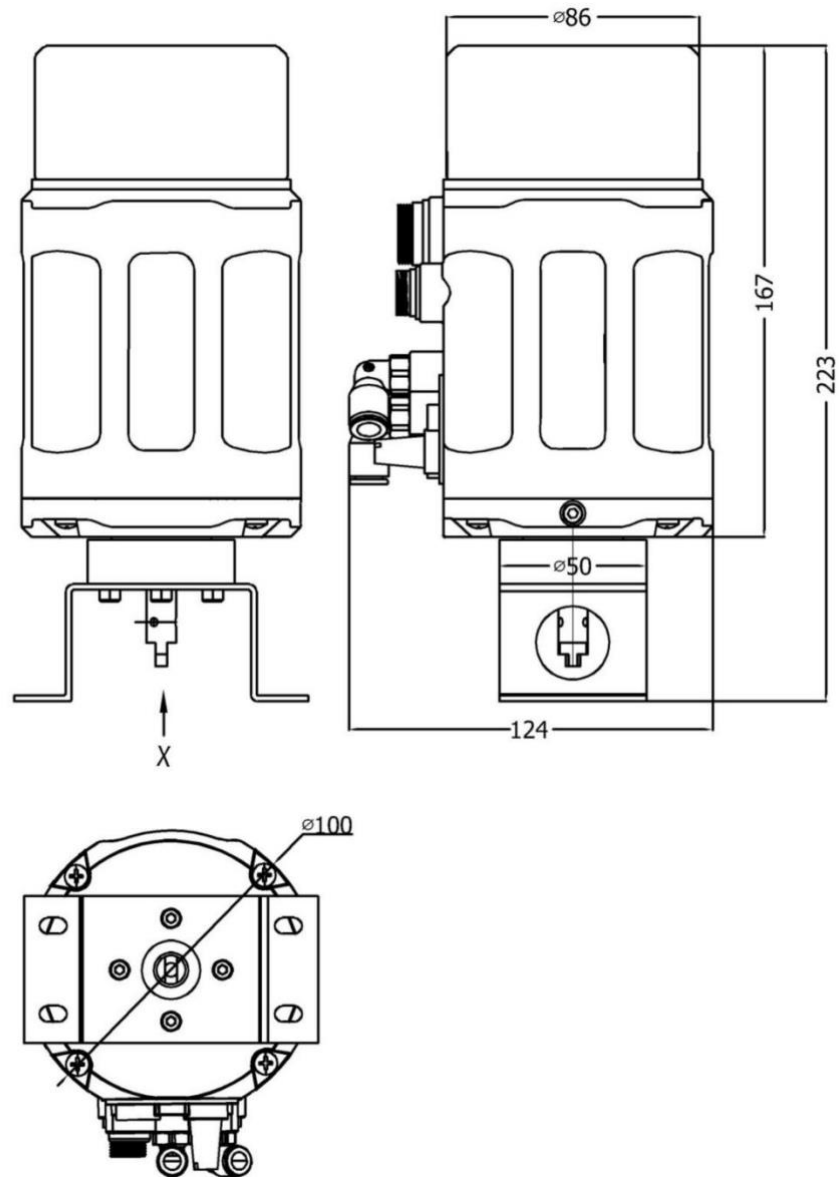


Figure 4. Mechanical dimensions for angle stroke

2.2. Actuator combination

2.2.1. Actuator of line stroke

1. Make sure that the stroke range and the screw thread size of the actuator which needs to combine meet the requirements.
2. Separately measure the C1 value when the valve is fully closed and C2 value when the valve is fully open by **the depth ruler**. The values are the distance between the stem top and the datum clamp face of the actuator. As shown in Figure 5.

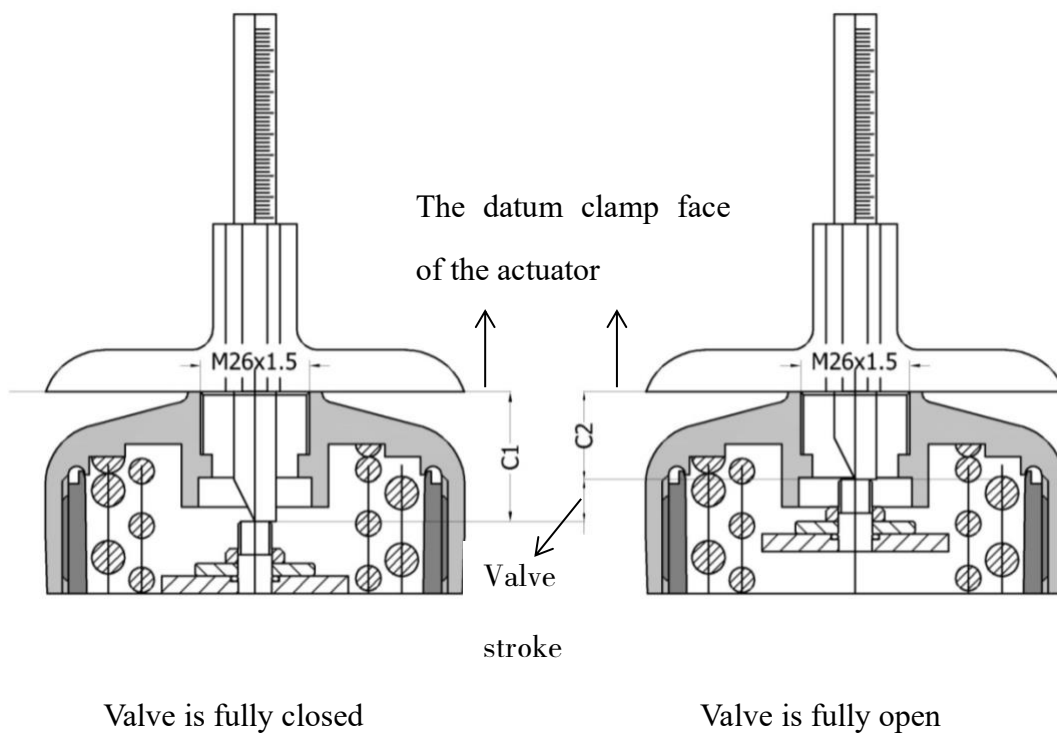


Figure 5. Actuator measurement

3. Adjust the adjusting nut of the displacement sensor. Then measure the D value (as shown in Figure 6) by **the depth ruler** in the state of the displacement sensor being completely loosened. Calculate the compression value $L1 = D - C1$, $L2 = D - C2$. It is recommended that the compression value L1 and L2 are both in the reference range which is showed in Table 1. If L1 value or L2 value is unable to meet the reference range, adjust the D value according to the actual situation.

NOTE !

The adjusted D value must ensure that $L1 > 0$, $L2 < \text{the maximum compression value of the displacement sensor}$. Otherwise, the positioner cannot match the actuator.

Maximum valve stroke	D range	L1, L2 reference range
5~25 mm	45~51 mm	3~28 mm
25~50 mm	65~71 mm	3.5~53.5 mm

Table 1. The reference range of the compression value

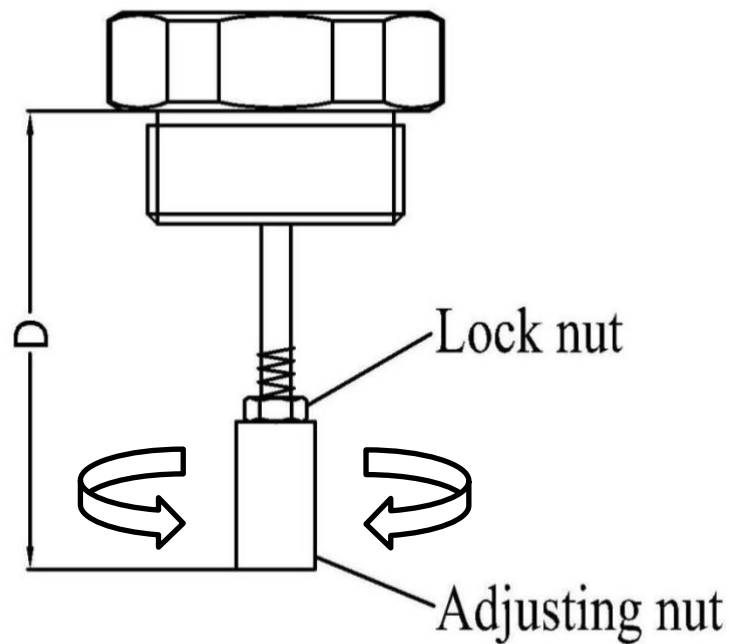


Figure 6. Travel sensor adjustment

4. Raise the internal valve stem of the actuator to the highest position. Make the actuator connection of the positioner entering into the thread connection of the actuator by **NO.32 wrench**. As shown in Figure 7.

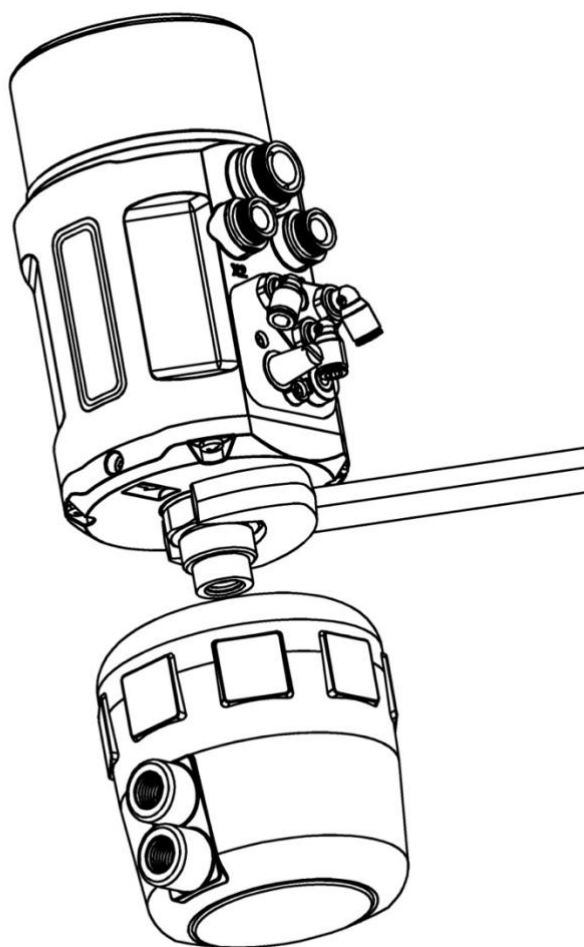


Figure 7. Actuator Combination

2.2.2. Actuator of angle stroke

1. Fix the mounting body under the positioner. As shown in Figure 8.
2. Connect the feedback pole of the positioner with the axis of the actuator. As shown in Figure 8.

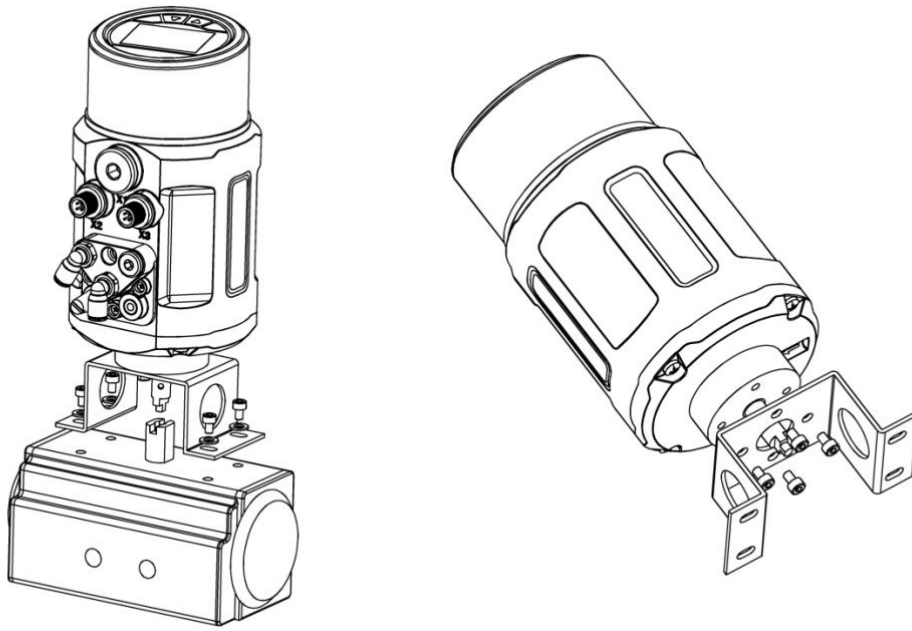
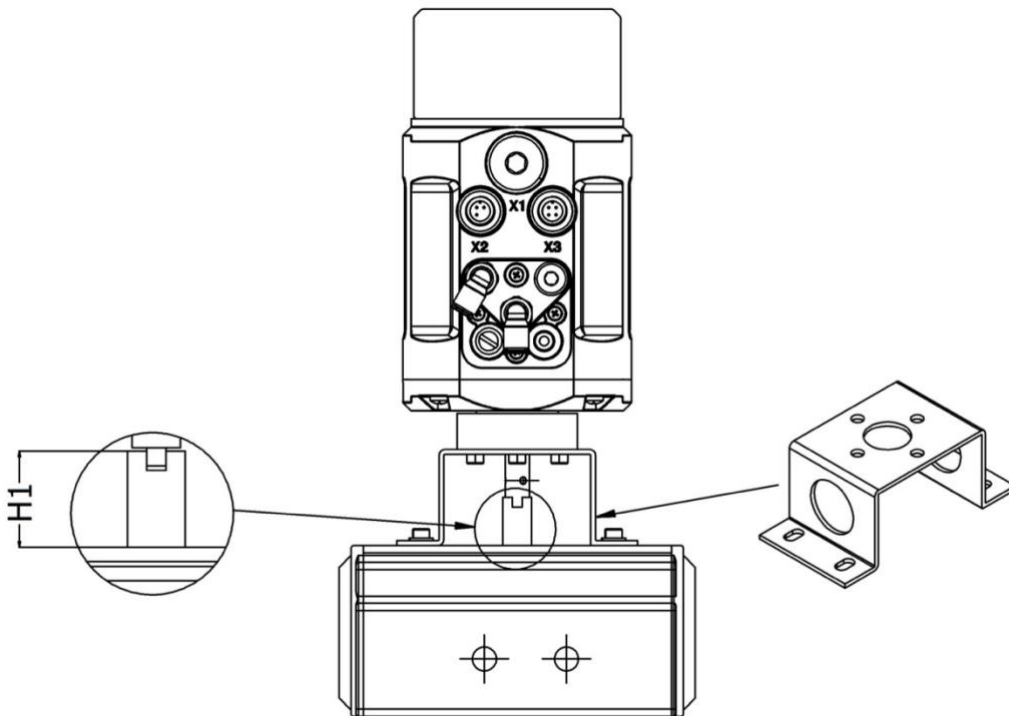
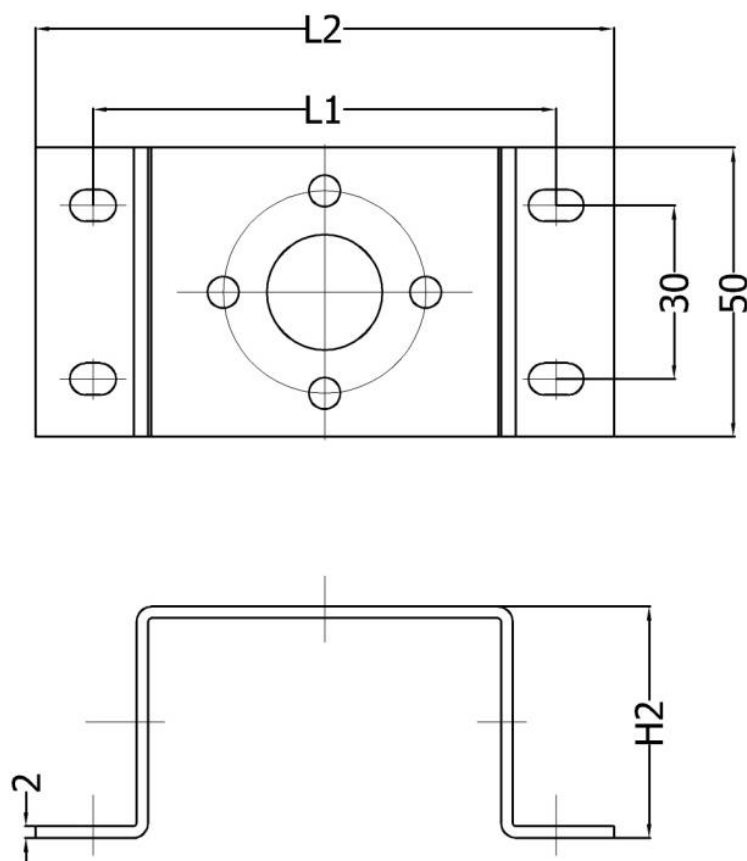


Figure 8. Graph Installation





Type	H1	H2	L1	L2
PF-1 (Default)	20	40	80	100
PF-2	30	50	80/130	100/150

Figure 9. Mechanical dimensions of the mounting body

2.3. Interface angle adjustment

If you need to adjust the interface angle, please relax the hexagon screw in place A(As shown in Figure 10) first. Then adjust the angle clockwise or counter-clockwise in 180°range. After adjusting the angle, lock the angle by the hexagon screw.

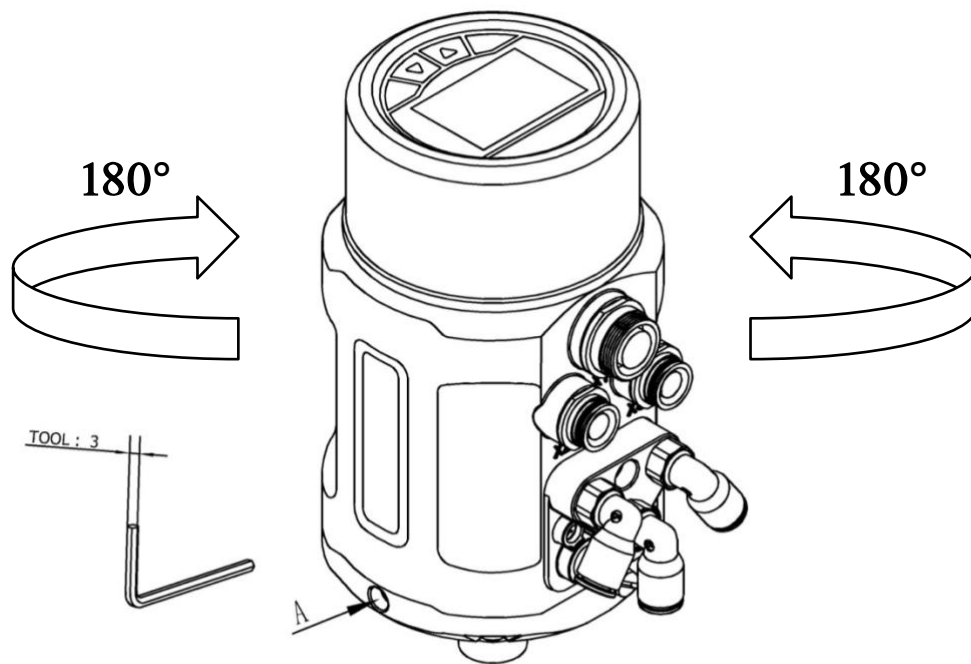


Figure 10. Graph operation

NOTE !

The positioner has rotation stopper mechanism. If it is restricted to rotate in one direction, please do not force to rotate continuously.

3. Connection description

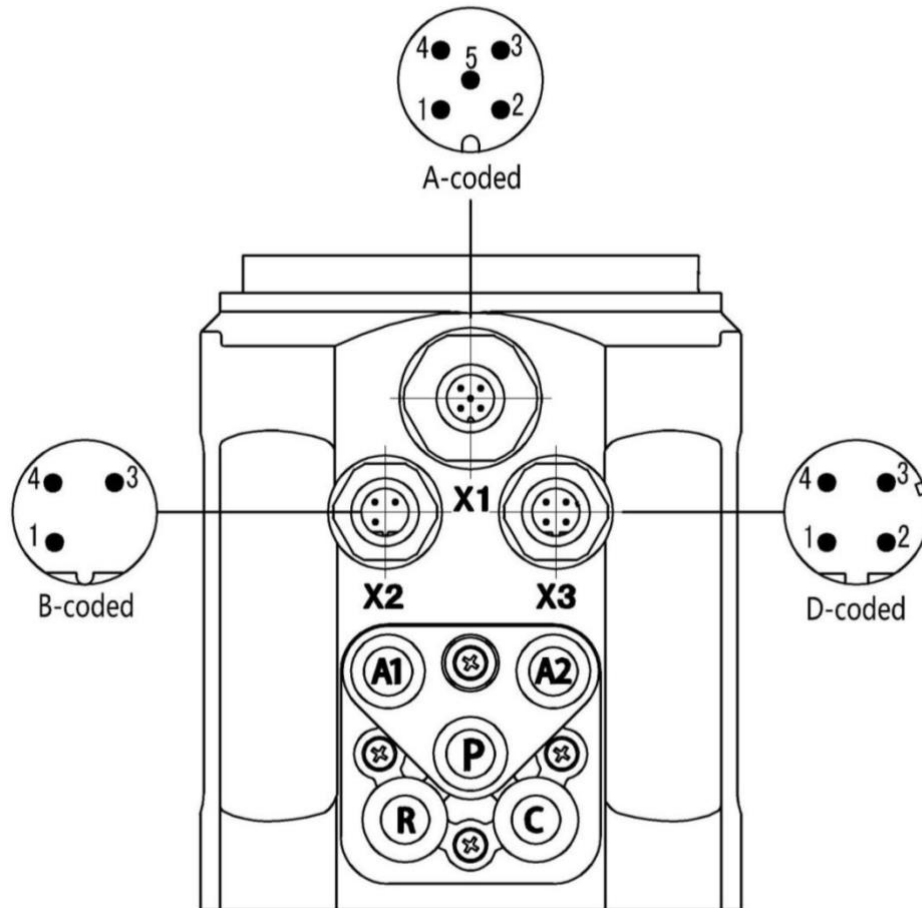


Figure 11. Connection

Connection	Pin	Description	Signal Type
X1	1	Analogue signal output +	0/4 – 20 mA
	2	Binary signal output 1	0/24 V
	3	Binary signal output 2	0/24 V
	4	Binary signal input +	0-3V =“0”, 15-30V =“1”
	5	Signal common GND	GND

Table 2. Electrical connection description – X1

Connection	Pin	Description	Signal Type
X2	1	Transmitter input +	+24 V
	3	Transmitter signal output	4-20 mA
	4	Transmitter GND	GND

Table 3. Electrical connection description – X2

Connection	Pin	Description	Signal Type
X3	1	Power supply +	+24 V
	2	Power supply GND	GND
	3	Set signal input +	0/4 – 20 mA or 0 – 5/10 V
	4	Set signal input GND	GND

Table 4. Electrical connection description – X3

NOTE !

Error connection of the electrical pin may cause the positioner damage.

Connection	Description
P	Air supply enter (built-in filter, filter size 20 µm)
R	Air exhaust
C	Check valve
A1	Pilot air outlet 1
A2	Pilot air outlet 2

Table 5. Pneumatic connection description

NOTE !

The air source pressure bigger than 7 bar may cause positioner damage.

4. Technical data

4.1. Working data

Ambient temperature: 0~60°C

Protection class: IP67

Vibration resistance parameter: 100Hz

4.2. Electrical data

Connections: cable gland

Supply voltage:

24 V DC $\pm$ 10 %, $\geq$ 1A. Recommend switching-mode power supply.

Power input: <5W

Input resistance for set-point signal: 140 Ω at 0/4-20mA, 20K Ω at 0-5/10V

Input resistance for process signal: 140 Ω

Analogue output signal:

maximum load 560 Ω at 0/4-20mA, maximum current 10mA at 0-5/10V

Binary output signal maximum current: 50mA

Binary input signal: 0-3V = logic "0", 15-30V = logic "1"

4.3. Mechanical data

Cover material: Polycarbonate (PC), Stainless steel (304)

Sealing material: Silicone rubber (SI)

Main body material: Polyamide Resin (PA6-GF30)

Control stroke range: 5-50 mm

4.4. Pneumatic data

Air pressure range: 3~7 bar, specific values depending on the actuator

Connections: Plug-in hose connector G1/4

Air quality:

ISO 8573-1

Solid particle size and density Class 3

Dew point Class 3

Oil content Class 3

Air flow rate:

17L/min (input pressure of 0.6Mpa)

95L/min (input pressure of 0.6Mpa, only single-acting)

5. Operation

5.1. Interface description

The positioner includes a 4-key control panel and a 128x64 dot matrix graphics display. User can switch the display and set parameters and functions by pressing the four keys. The functions of the keys are represented in the 4 lower grey bars on the LCD display panel.

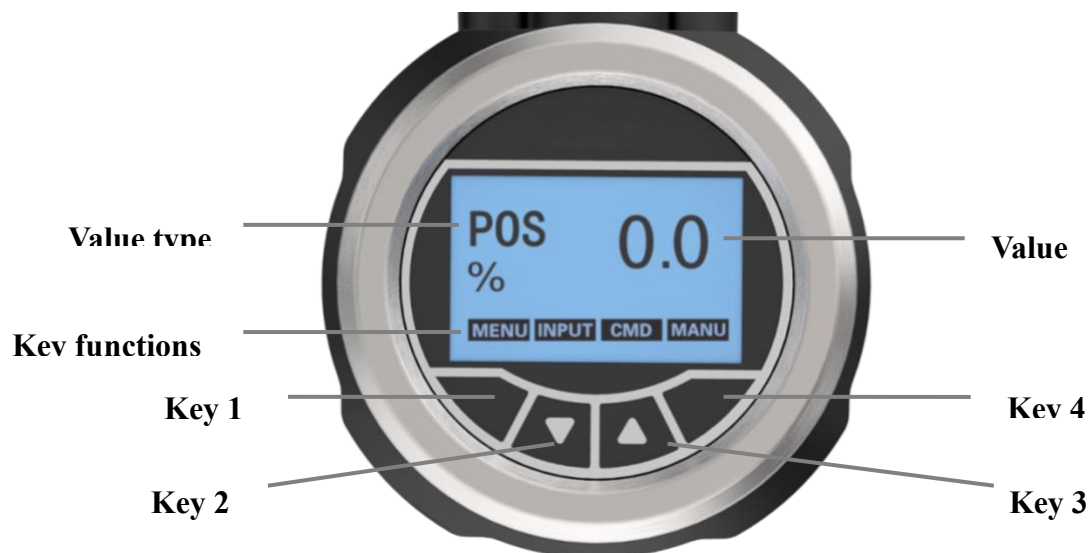


Figure 12. Operating interface

5.2. Operating mode and operating interface

The positioner has two operating mode: automatic mode (AUTO) and manual mode (MANU).

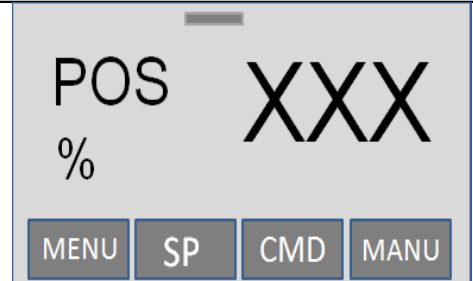
The positioner default operates in the automatic mode when powering up. At this time, the interface is locked. To unlock the interface, it needs to press both two  keys for about 3 seconds.

In the automatic mode, the positioner accepts the input signal for process set-point value or user sets the process set-point value manually on the interface. The positioner calculates the position set-point value and adjusts the valve stroke according to the process set-point value and process feedback signal.

In the manual mode, user must press the “+/-” key to adjust the valve stroke manually. The set-point value is the current valve position after adjusting the valve stroke manually or the current valve position after switching from the automatic mode to the manual mode. It is displayed on the manual mode interface.

The operating mode can be switched by AUTO key and MANU key if BINARY IN function is not enabled for switching the operating mode. If enabling the BINARY IN function for switching, switching by function keys is not effective.

User can switch the operating interface by the function keys. The operating interfaces are described in Table 5. The interface will be locked if no keys are pressed for a long time. To unlock the interface, it needs to press both two  keys for about 3 seconds.

Display	Description
	Current position in the automatic mode. Press “POS” key or “AUTO” key to display.

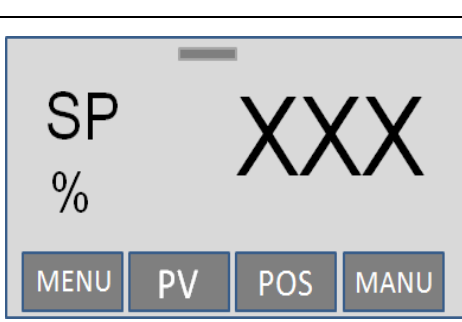
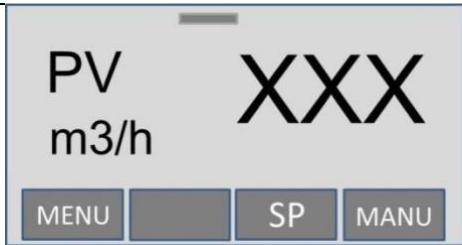
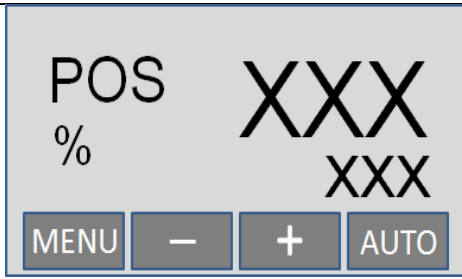
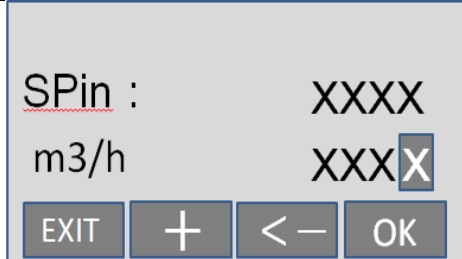
	The position set-point value in the automatic mode. Press “CMD” key to display.
	The process set-point value in the automatic mode. Press “SP” key to display. When the set-point value is internal set, in order to set the set-point value, the “MANU” key is changed to “INPUT” key on this interface.
	The process feedback value in the automatic mode. Press “PV” key to display.
	Current position value (big font) and position set-point value (small font) in the manual mode. Press “MANU” key to display.
	Set internal process set-point value manually on this interface.

Table 6. Operating interface display

5.3. Main menu

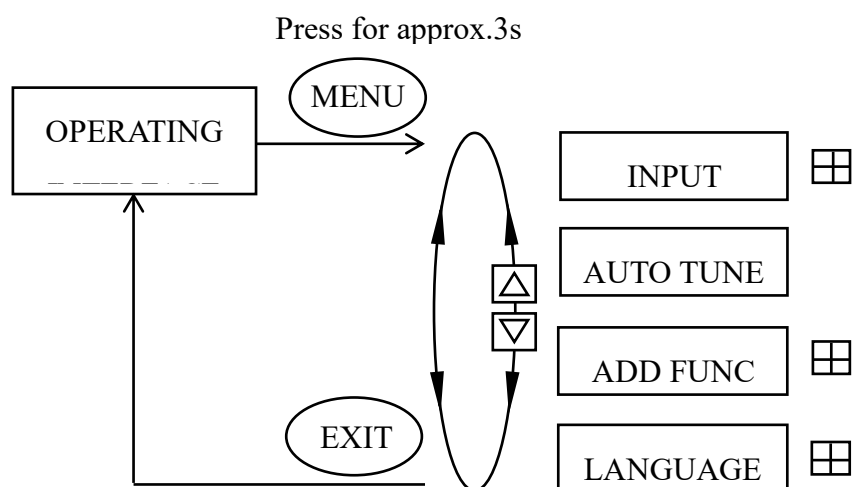


Figure 13. Operating structure main menu

5.3.1. Input signal

The option is used to select the type of the input signal for set-point value.

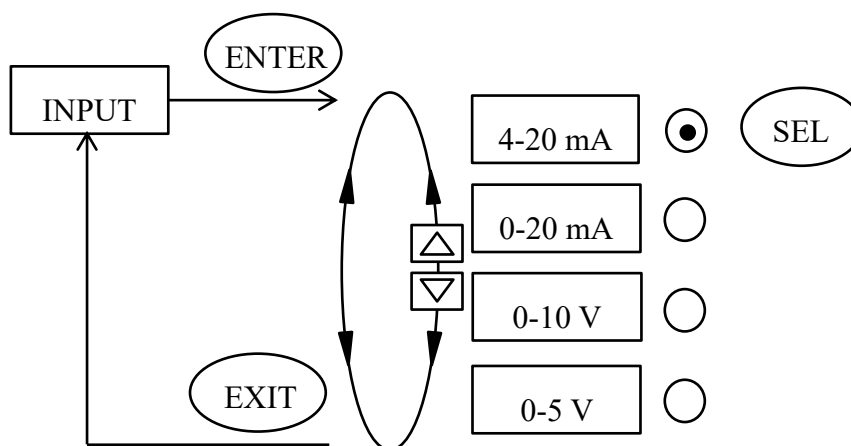


Figure 14. Operating structure INPUT

5.3.2. Automatic adjustment

The automatic adjustment function (AUTO TUNE) can test the related control parameters including the direction between the aeration state of the actuator and the actual position, the total valve scale, PWM parameters. The whole process will continue for about 2-3 minutes if running normally.

System will check whether the whole valve stroke range is in the effective range of the displacement sensor during the automatic adjustment process. When the whole valve stroke range is out of the effective range of the displacement sensor, if the minimum value of the whole valve stroke range is smaller than the minimum value of the effective range of the displacement sensor, LCD displays “POS MIN ERROR”, if the maximum value of the whole valve stroke range is larger than the maximum value of the effective range of the displacement sensor, LCD displays “POS MAX ERROR”. If LCD displays the error information above, it is need to re-match the positioner and the actuator, refer to Chapter 2 for details.

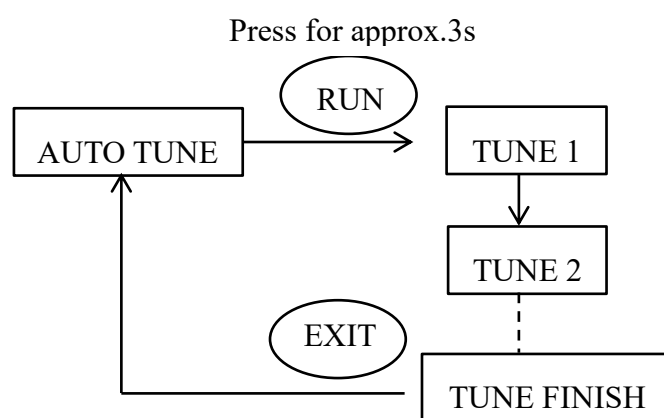


Figure 15. Operating structure AUTO TUNE

NOTE !

- Although the positioner has ran the automatic adjustment function in the factory. In order to get the control parameters of the actual work environment, the positioner must run the function again in the actual work environment.
- Make sure that the air supply pressure is in the working range of the actuator and has no big wave. Otherwise the automatic adjustment may fail or the test

5.3.3. Auxiliary functions

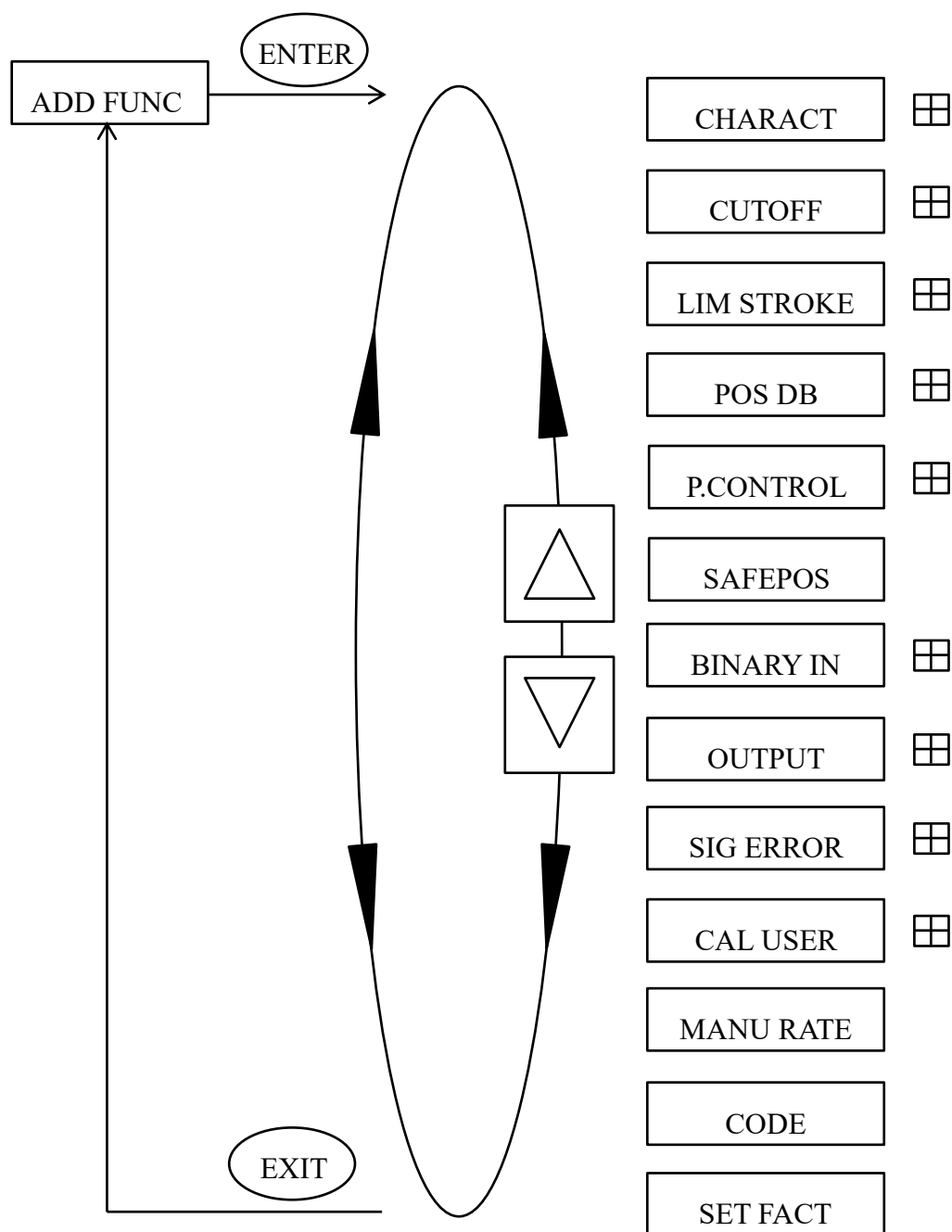


Figure 16. operating structure ADD FUNC

5.3.3.1. CHARACT

Factory setting:

CHARACT option: LINEAR

EQ PERC option: 1:25

FREE value: 0%, 5%, 10%.....95%, 100%

The CHARACT function is to determine the relationship between position set-point value and valve stroke. In the actual control system, the controlled variable is usually required to have specific control characteristic, such as linearity. User can select or set the characteristic option to meet the control requirement in the function menu.

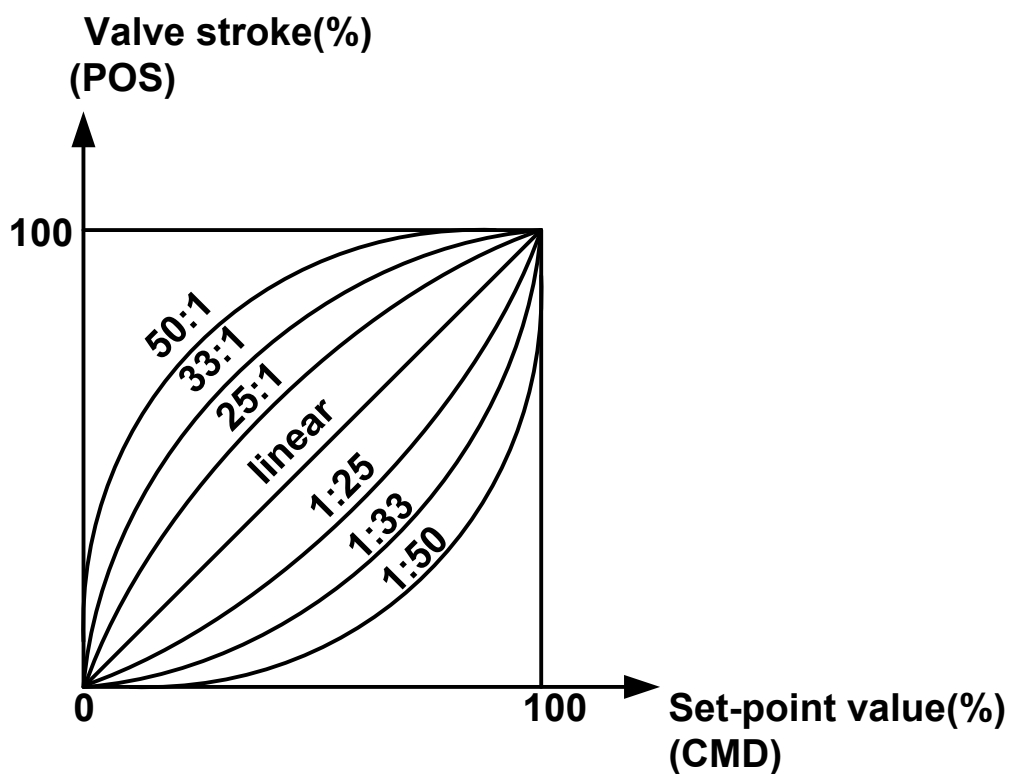


Figure 17. Graph characteristics of linear and equal percentage

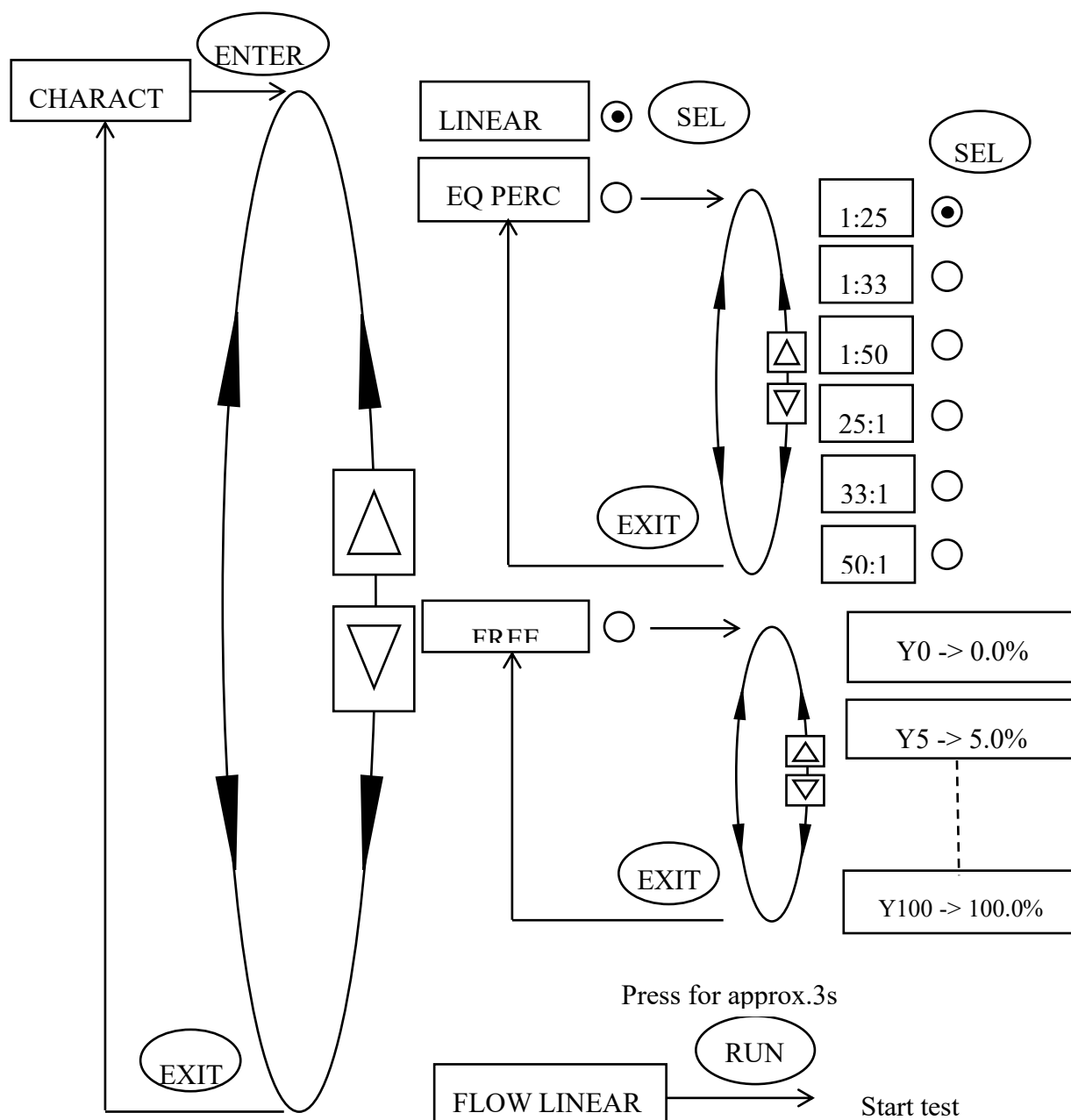


Figure 18. Operating structure CHARACT

Option	Description
LINEAR	1:1 linear transfer relationship between position set-point value and valve stroke.
EQ PERC	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.
FLOW LINEAR	Test the data which can make the characteristic of flow control

	linear.
--	---------

Table 7. Option CHARACT

Equal percentage characteristic

The Equal percentage characteristic includes the options of 1:25, 1:33, 1:50, 25:1(inverse), 33:1(inverse), 50:1(inverse).

Freely programmable characteristic

User can program free characteristic by operating the FREE option.

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.

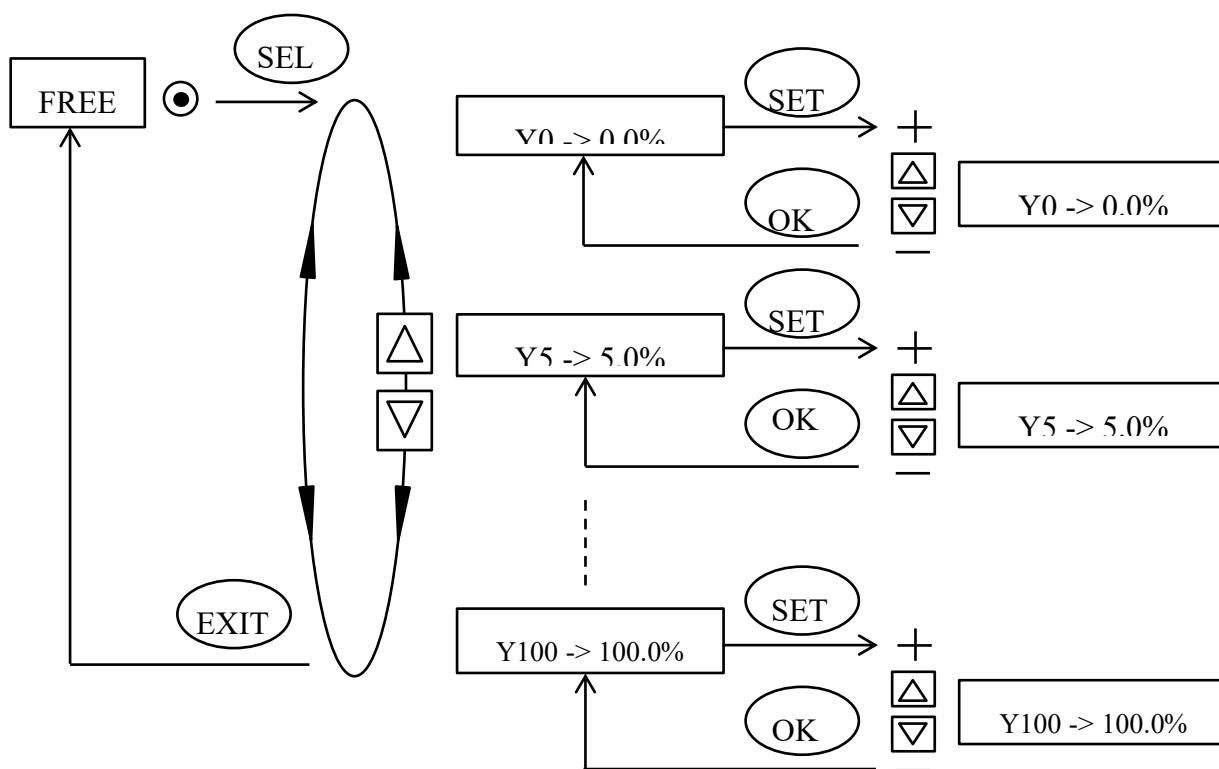


Figure 19. Operating structure CHARACT FREE

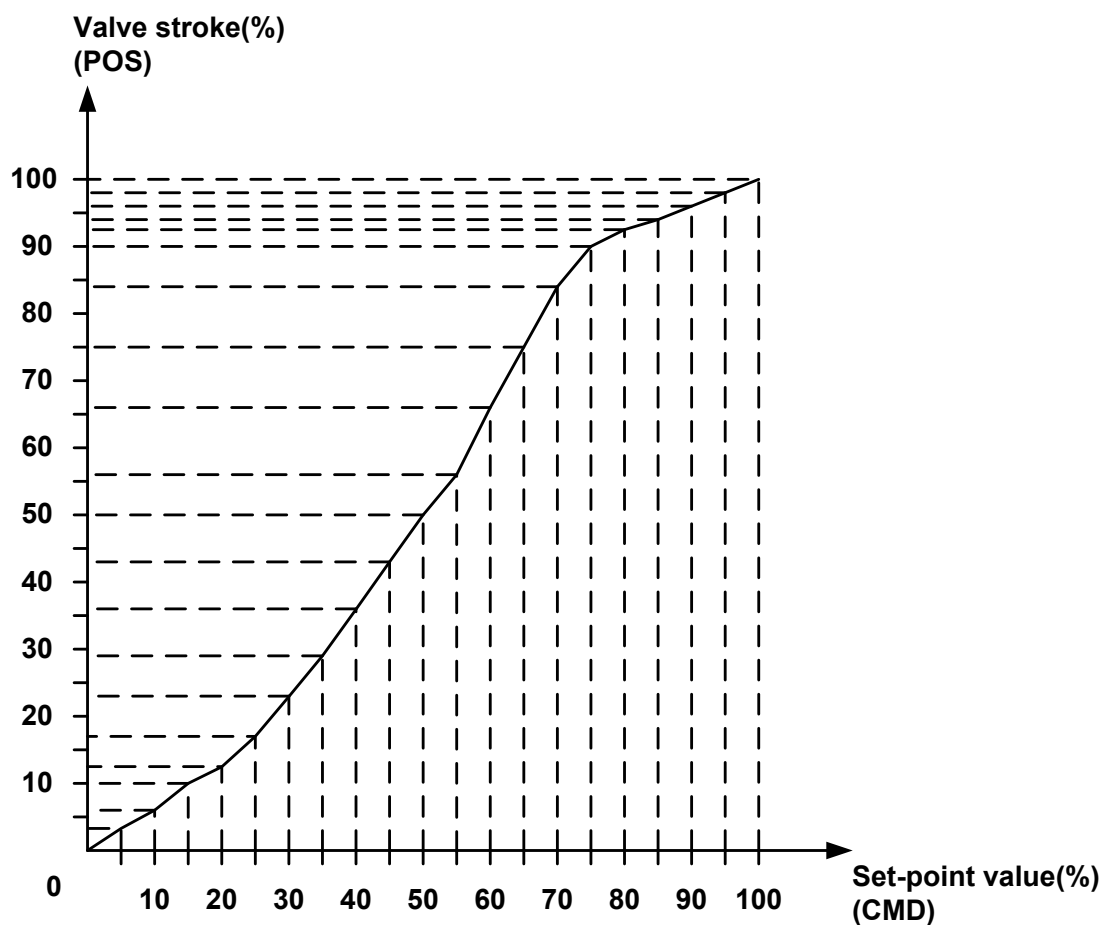


Figure 20. Graph CHARACT FREE

FLOW LINEAR

This function is to make the characteristic of flow control linear. The position set-point value scale ranging from 0-100 % is divided uniformly into 21 nodes (0%, 5%, 10%...100%) . Then system tests the flow value under every node successively from 0% to 100%. Finally system calculates the data which reflect the transfer relationship between position set-point value and valve stroke according to the test data, and replaces the current data under the FREE option.

5.3.3.2. CUTOFF

Factory setting:

AUTO CUT MIN value: 1%, AUTO CUT MAX value: 99%

MANU CUT MIN value: 2%, MANU CUT MAX value: 98%

When the percentage of set-point value is in the enabled range of CUTOFF, the valve is fully deaerated or aerated. The valve is fully close when the percentage of set-point value is less than or equal to MIN setting parameter and is fully open when the percentage of set-point value is greater than or equal to MAX setting parameter.

The function divides into AUTO CUT function in the automatic mode and MANU CUT function in the manual mode. In the automatic mode, the function judges the process set-point value. In the manual mode, the function judges the position set-point value. Parameter MIN range: 0-25%, Parameter MAX range: 75-100%. When the function is enabled, the sign “cut off” is indicated on the operating interface.

In the automatic mode, when the MIN data is 0%, CUTOFF for closing the valve is inactive; when the MAX data is 100%, CUTOFF for opening the valve is inactive.

When the positioner is running the function, due to the actuator internal characteristics, the valve position will have some deviations after the valve being fully closed or fully opened. As a result, the position value may be smaller than 0% when the valve is fully closed or bigger than 100% when the valve is fully opened.

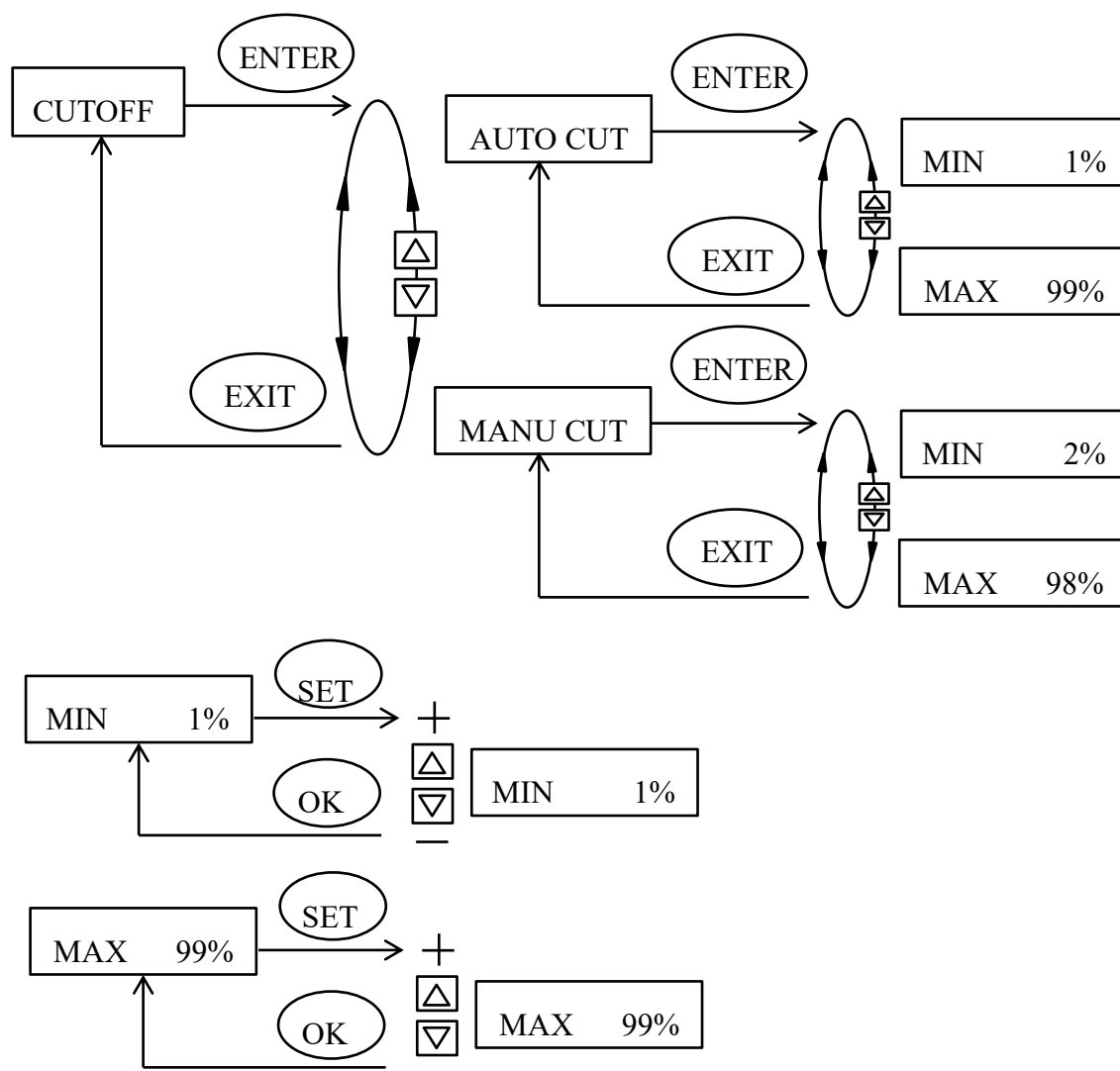


Figure 21. Operating structure CUTOFF

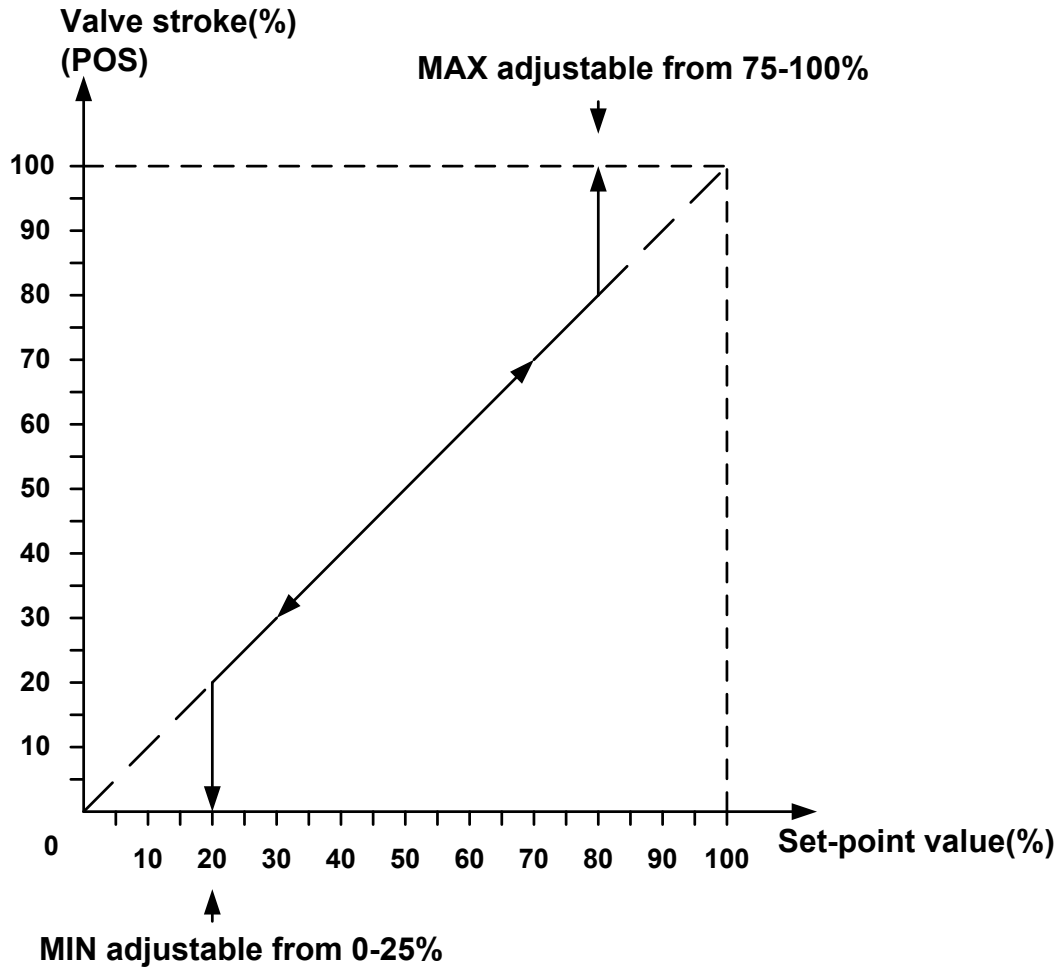


Figure 22. Graph CUTOFF

5.3.3.3. LIM STROKE

Factory setting:

LIM STROKE MIN value: 0% (unlimited)

LIM STROKE MAX value: 100% (unlimited)

The function limits the automatic adjustment range in the whole valve physical stroke. After setting the limit value, the value of valve stroke (POS) on the display may bigger than 100% or smaller than 0%.

MIN adjustment range: 0 – 50 % of the total physical stroke.

MAX adjustment range: 50 – 100 % of the total physical stroke.

The minimum gap between Min and Max is 50 % of the total physical stroke.

5.3.3.4. POS DB

Factory setting:

AUTO DB value: 1%

MANU DB value: 1%

The function parameters are set for valve position control. The system does not adjust the valve stroke when the gap between the current position value and the position set-point value is not bigger than the dead band value. The dead band value is divided into automatic dead band value and manual dead band value. The automatic dead band value corresponds to limited scale of the valve stroke. The dead band range is 0.1%-10%.

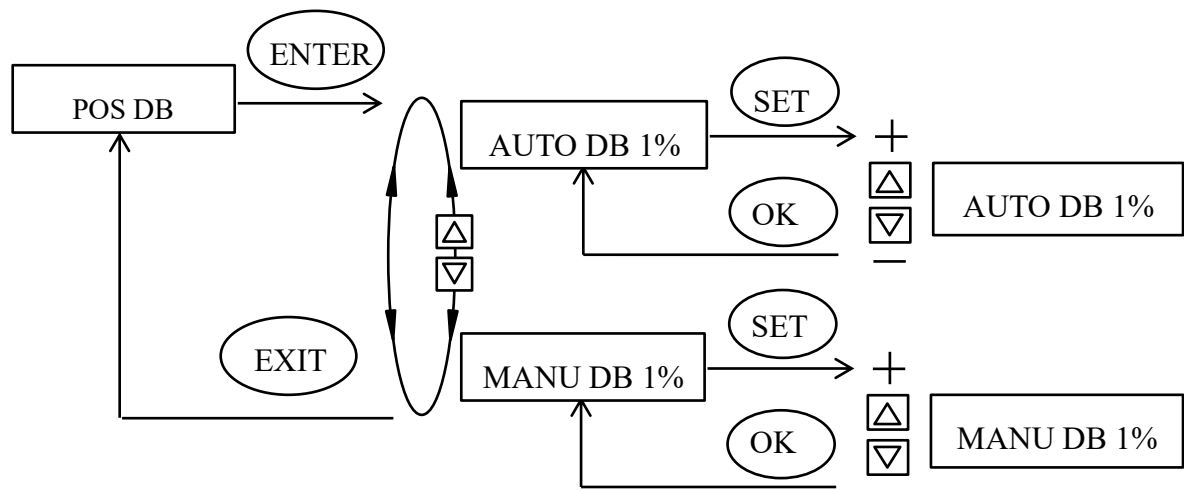


Figure 25. Operating structure POS DB

NOTE !

The smaller the dead band setting, the higher the control accuracy getting.

Please set the dead band value in reason. Because the too small value may cause the solenoid valve in the body to act frequently and lead to long adjustment time and

5.3.3.5. P.CONTROL

Factory setting:

P.DB value: 2%

ADJ PER value: 1.0s

ADJ DIR option: POSITIVE

PARA P, PARA I, PARA D value: 1.00, 0.0s, 0.0s

FILTER value: 255

UNIT value: %

DECIMAL value: 0

SP INPUT option: INTERNAL

SP MIN value: 0

SP MAX value: 100

PV MIN value: 0

PV MAX value: 100

The function is used to set the process control parameters. It is necessary to set correct and reasonable parameters for process control. The determination of the control parameters needs debugging in practical applications by professional and technical persons.

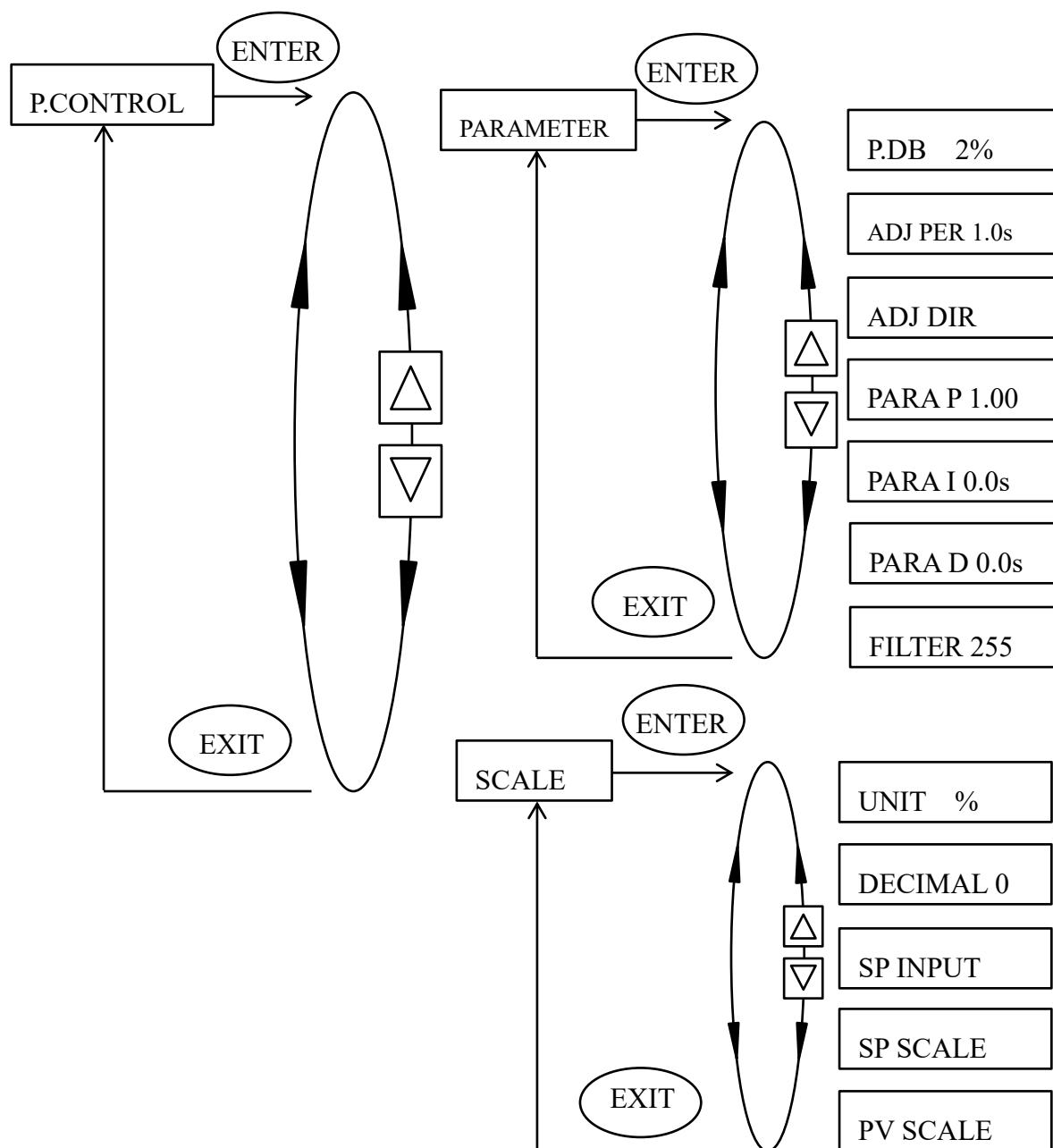


Figure 26. Operating structure P.CONTROL

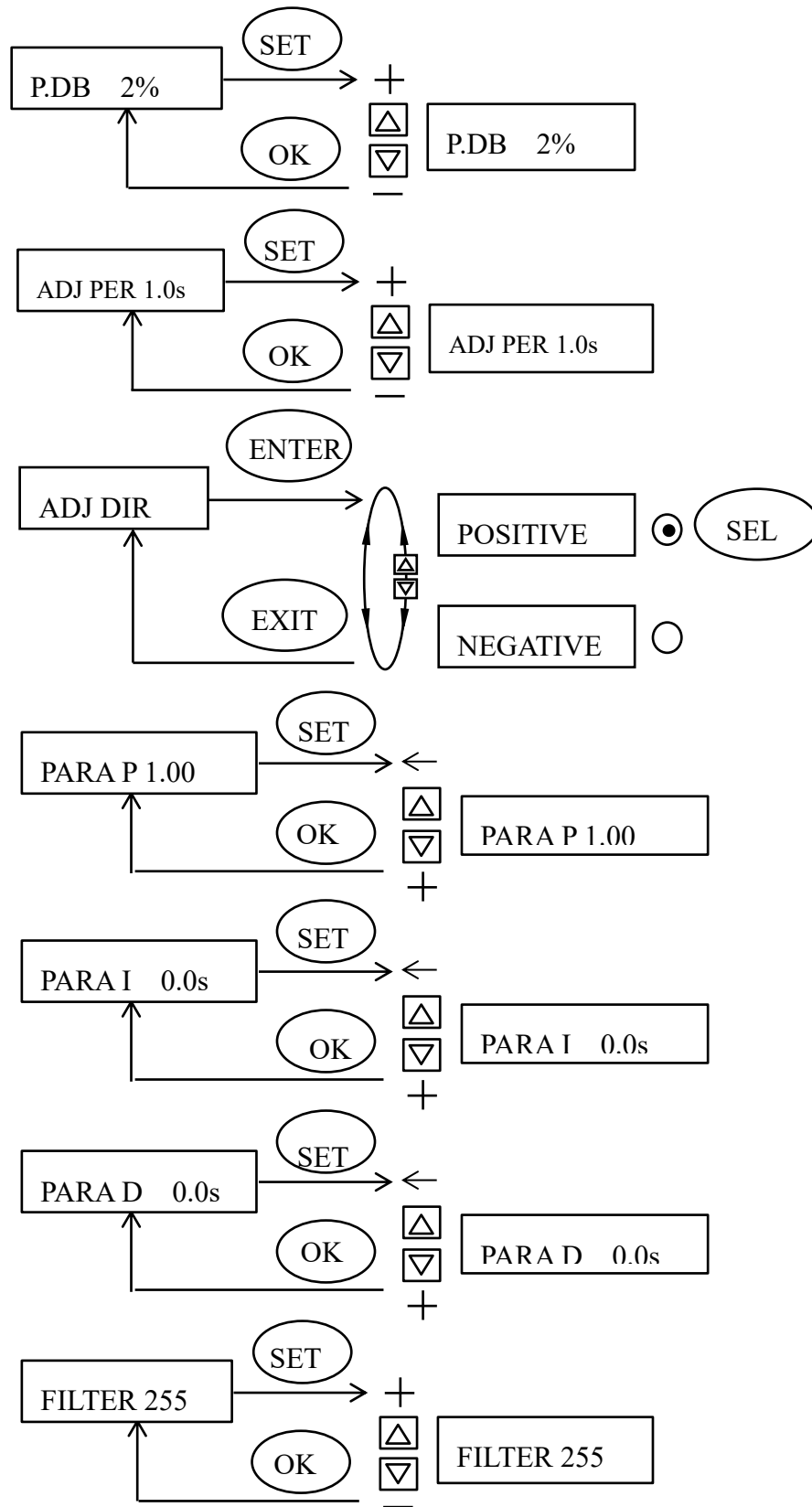


Figure 27. Operating structure P.CONTROL PARAMETER

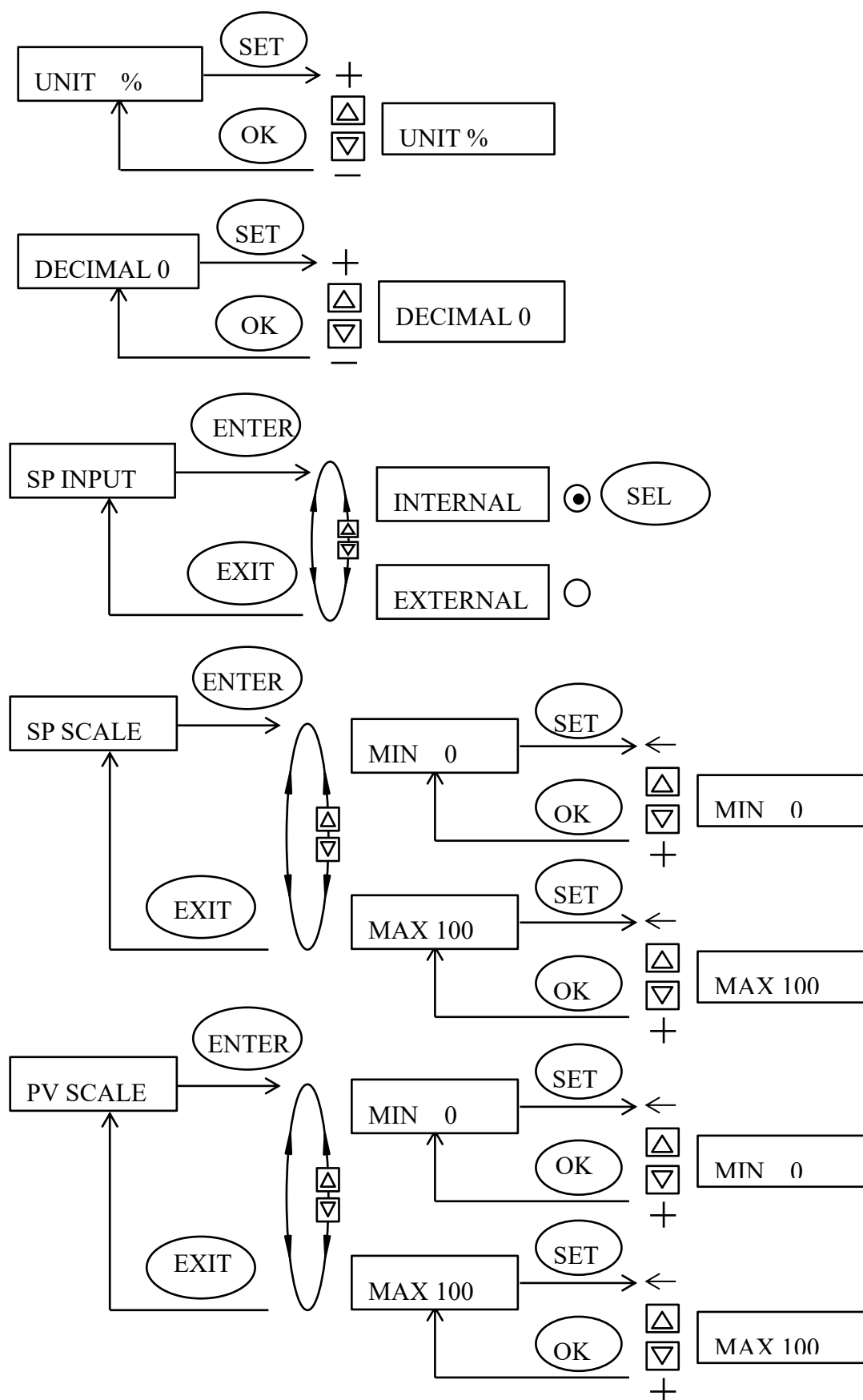


Figure 28. Operating structure P.CONTROL SCALE

Option	Description
P.DB	The dead band value for process control. When the deviation between the process set-point value and the process feedback value is in the range of the process dead band, system keeps the current state and stops adjustment. The range: 1~10 %.
ADJ PER	The period for PID adjustment. The range: 0.5~20.0 s
ADJ DIR	The relationship of monotonous increment or monotonous decrement between the process control deviation and the valve

	position. Monotonous increment is positive direction, and monotonous decrement is negative direction.
PARA P	Proportion parameter for PID adjustment. The range: 0~99.99.
PARA I	Integration parameter for PID adjustment. The range: 0~999.9 s. No integration action when the value is zero.
PARA D	Differentiation parameter for PID adjustment. The range: 0~999.9 s.
FILTER	Filter coefficient of first-order digital low-pass filter for process feedback signal. The bigger the value, the smaller the filtering effect. The range: 1~255.

Table 8. Option P.CONTROL

Option	Description
UNIT	Set the unit of process value. UNIT: %、 m ³ /h, m ³ /min, l/s, l/min, l/h, UG/s, UG/min, UG/h, IG/s, IG/min, IG/h, bar, mbar, psi, °C, °F, none.
DECIMAL	The decimal places for process value. The change of the value will change process feedback scale value, process set-point scale value and process set-point value. Please set the value in reason for actual application.
SP INPUT	The set mode for process set-point value. When selecting the INTERNAL option, user can press the "INPUT" key on the SP interface to enter the value set interface and set the process set-point value. When selecting the EXTERNAL option, the value of external set-point signal is the process set-point value. And the "INPUT" key changes to "MANU" key on the SP interface.
SP SCALE	Set the scale values of process set-point signal. When the process set-point value is internal set, the parameters are not effect.

PV SCALE	Set the scale values of process feedback signal.
----------	--

Table 9. Option P.CONTROL SCALE

5.3.3.6. SAFEPOS

Factory setting:

SAFEPOS value: 0%

The function is used to set a safety position which the valve stroke is adjusted to for some specific conditions. The safety position is adjusted by the binary input signal or an error signal for set-point value. When the adjustment for the safety position is enabled, the sign “safe pos” is indicated on the operating interface.



Figure 29. Operating structure SAFEPOS

5.3.3.7. BINARY IN(optional)

Factory setting:

SWITCH option: CLOSE

FUNCTION option: SAFEPOS

TYPE option: NORMAL OPEN

The function is used to operate the positioner to achieve some functions by binary input signal. If the product selection has no feedback signal, this function is invalid.

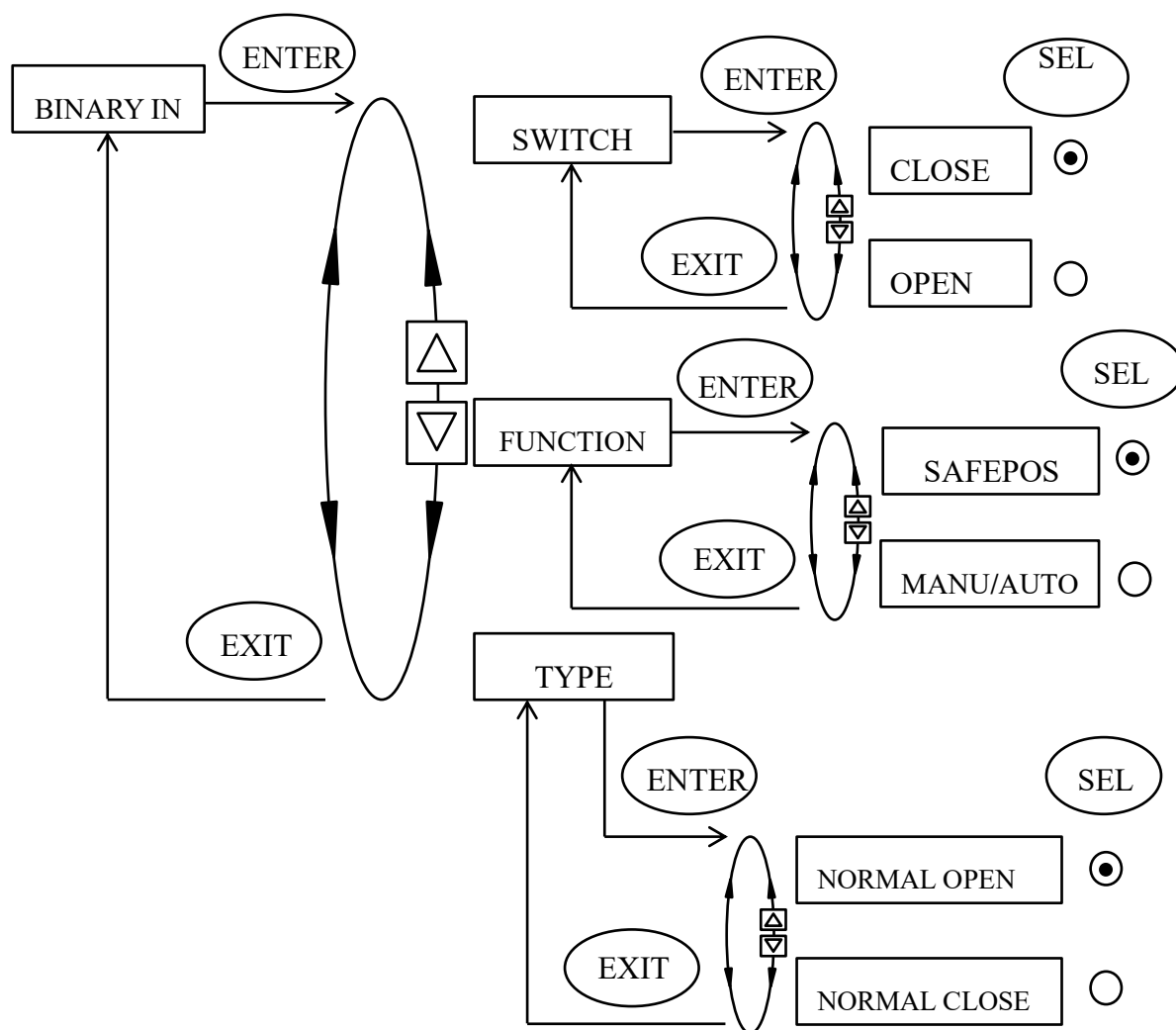


Figure 30. Operating structure BINARY IN

Option	Description
SWITCH	Open or close the BINARY IN function.
FUNCTION	Select the operating function of binary input signal.
TYPE	Select the effect type of binary input signal. When selecting NORMAL OPEN option, 0-3V = logic "0", 15-30V = logic "1". When selecting NORMAL CLOSE option, 0-3V = logic "1", 15-30V = logic "0".

Table 10. Option BINARY IN

Option	Description
SAFEPOS	The position of valve stroke is adjusted to the safety position by logic “1”. The function inactive by logic “0”. The function is only active in the automatic mode.
MANU/AUTO	The system operates in the automatic mode by logic “0”. The system operates in the manual mode by logic “1”. Switching the operating mode is inactive by the function key on the operating interface when the function is enabled.

Table 11. Option BINARY IN FUNCTION

5.3.3.8. OUTPUT(optional)

Factory setting:

ANALOGUE option: POS

ANALOGUE TYPE option: 4-20 mA

BINARY option: POS DEV

BINARY VAL DEV value: 10%

BINARY VAL LIM value: 100%

BINARY TYPE option: NORMAL OPEN

The function is used to let system output related control parameters or operating states to the other terminals.

One analogue output (can be selected according to product type selection): analogue signal for current position (POS), position set-point value (CMD), process feedback value (PV), process set-point value (SP). Two output signal types (4-20mA, 0-20mA) can be selected.

Two binary outputs: 0/24V binary signal of operating state related with the system.

If the product selection has no feedback signal, this function is invalid.

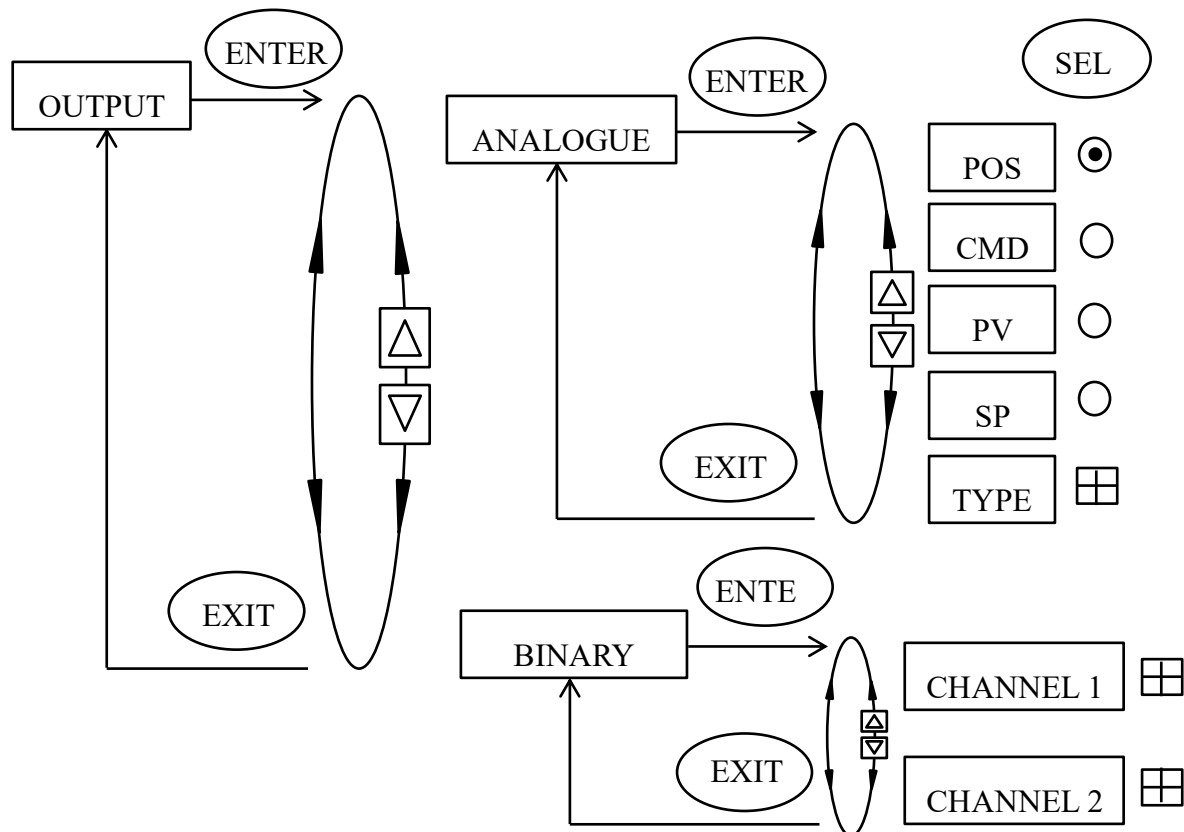


Figure 31. Operating structure OUTPUT

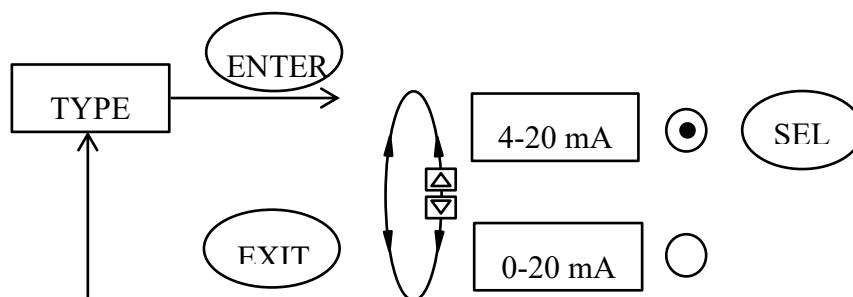


Figure 32. Operating structure ANALOGUE TYPE

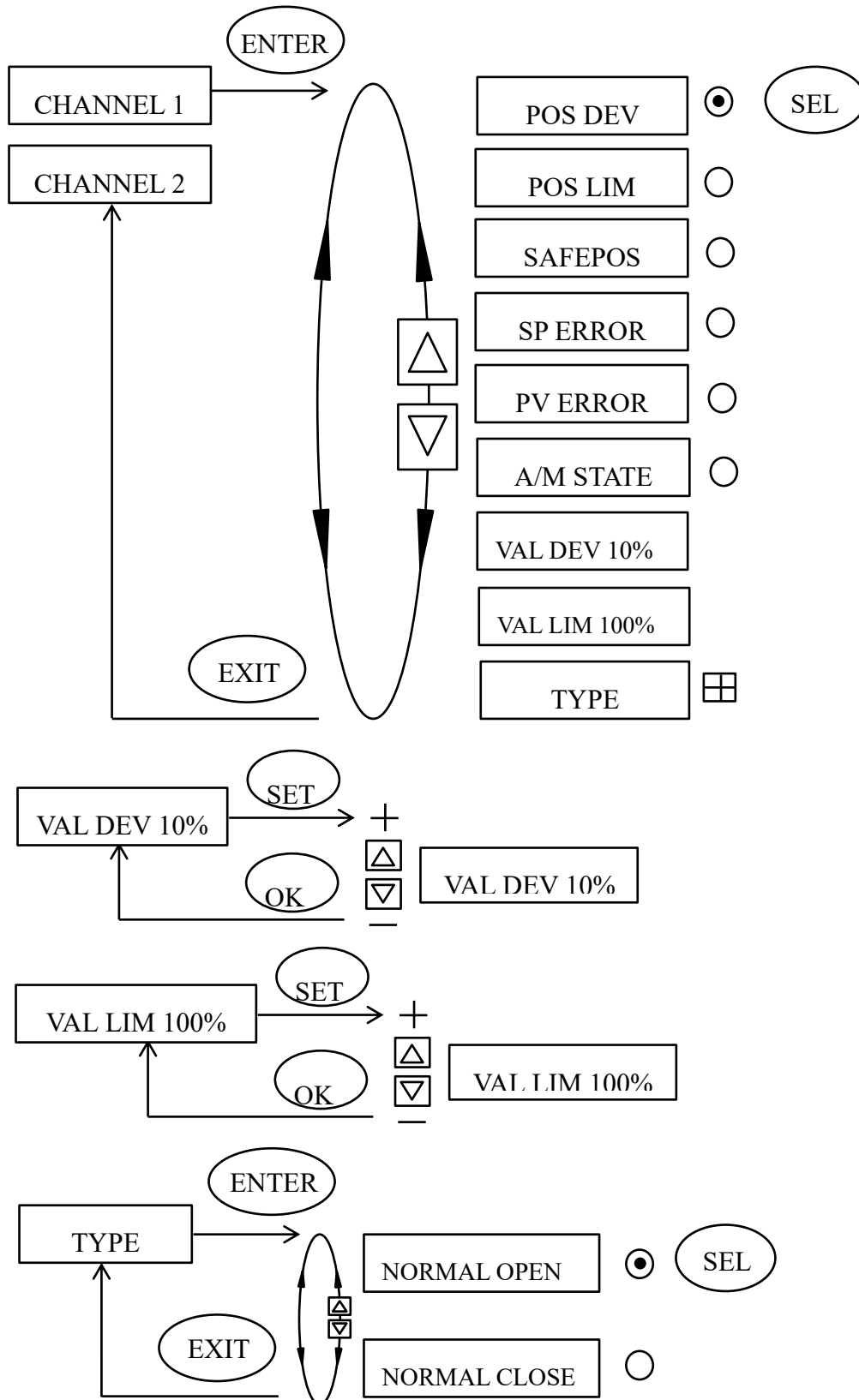


Figure 33. Operating structure OUTPUT BINARY

Option	Description
POS	Output for valve position percent.
CMD	Output for valve position set-point percent. When the valve position set-point percent value is error, the output value is Minimum.
PV	Output for process feedback percent. When the process feedback percent value is error, the output value is Minimum.
SP	Output for process set-point percent. When the process set-point percent value is error, the output value is Minimum.
TYPE	Select for analogue signal types. It has 4-20mA, 0-20mA, 0-10V, 0-5V can be selected.

Table 12. Option OUTPUT ANALOGUE

Option	Description
POS DEV	Output for excessively large control deviations of the positioner in the automatic mode. System outputs 24V signal (NORMAL OPEN) or 0V signal (NORMAL CLOSE) when the deviation between position value and position set-point value bigger than the setting deviation set in the VAL DEV option. Otherwise system outputs 0V signal (NORMAL OPEN) or 24V signal (NORMAL CLOSE). The function is inactive in the manual mode and keeps previous state.
POS LIM	Output for the compare relation between the current position and a specified limit position in the automatic mode. System outputs 24V signal(NORMAL OPEN) or 0V signal (NORMAL CLOSE) when the current position bigger than the specified limit position set in the VAL LIM option. Otherwise system outputs 0V signal (NORMAL OPEN) or 24V signal (NORMAL CLOSE). The function is inactive in the manual mode and keeps previous state.

SAFEPOS	Output for the current position whether is in safety position in the automatic mode. System outputs 24V signal (NORMALLY OPEN) or 0V signal (NORMAL CLOSE) when the current position is in safety position. Otherwise system outputs 0V signal (NORMALLY OPEN) or 24V signal (NORMAL CLOSE). The function is inactive in the manual mode and keeps previous state.
SP ERROR	Output for error signal for process set-point value. System outputs 24V signal (NORMAL OPEN) or 0V signal (NORMAL CLOSE) when detecting the error signal for set-point value. Otherwise system outputs 0V signal (NORMAL OPEN) or 24V signal (NORMAL CLOSE).
PV ERROR	Output for error signal for process feedback value. System outputs 24V signal (NORMAL OPEN) or 0V signal (NORMAL CLOSE) when detecting the error signal for process value. Otherwise system outputs 0V signal (NORMAL OPEN) or 24V signal (NORMAL CLOSE).
A/M STATE	Output for the state of operating mode. System outputs 24V signal (NORMAL OPEN) or 0V signal (NORMAL CLOSE) when the positioner is working in the manual mode. System outputs 0V signal (NORMAL OPEN) or 24V signal (NORMAL CLOSE) when the positioner is working in the automatic mode.
VAL DEV	The setting of deviation value for POS DEV option.
VAL LIM	The setting of limit position value for POS LIM option.
TYPE	Select the effect type of binary output signal.

Table 13. Option OUTPUT BINARY

5.3.3.9. SIG ERROR

Factory setting:

SIG SP option: ERROR OFF

SIG SP SAFEPOS option: CLOSE

SIG PV option: ERROR OFF

SIG PV SAFEPOS option: CLOSE

The function is used to detect the error of 4-20mA set-point signal and 4-20mA process feedback signal, but cannot detect other type signals. The error condition is the value of 4-20mA signal $\leq 3.5\text{mA}$. If opening the error detecting, the set-point value will instruct "ERROR" on the operating interface in the case of detecting the error signal. If the safety position is not enabled, the single-acting power-off safe positioner will exhaust the actuator cylinder's air and the single-acting power-off freeze positioner will keep the valve position and the double-acting positioner will leave the valve position in a free state.

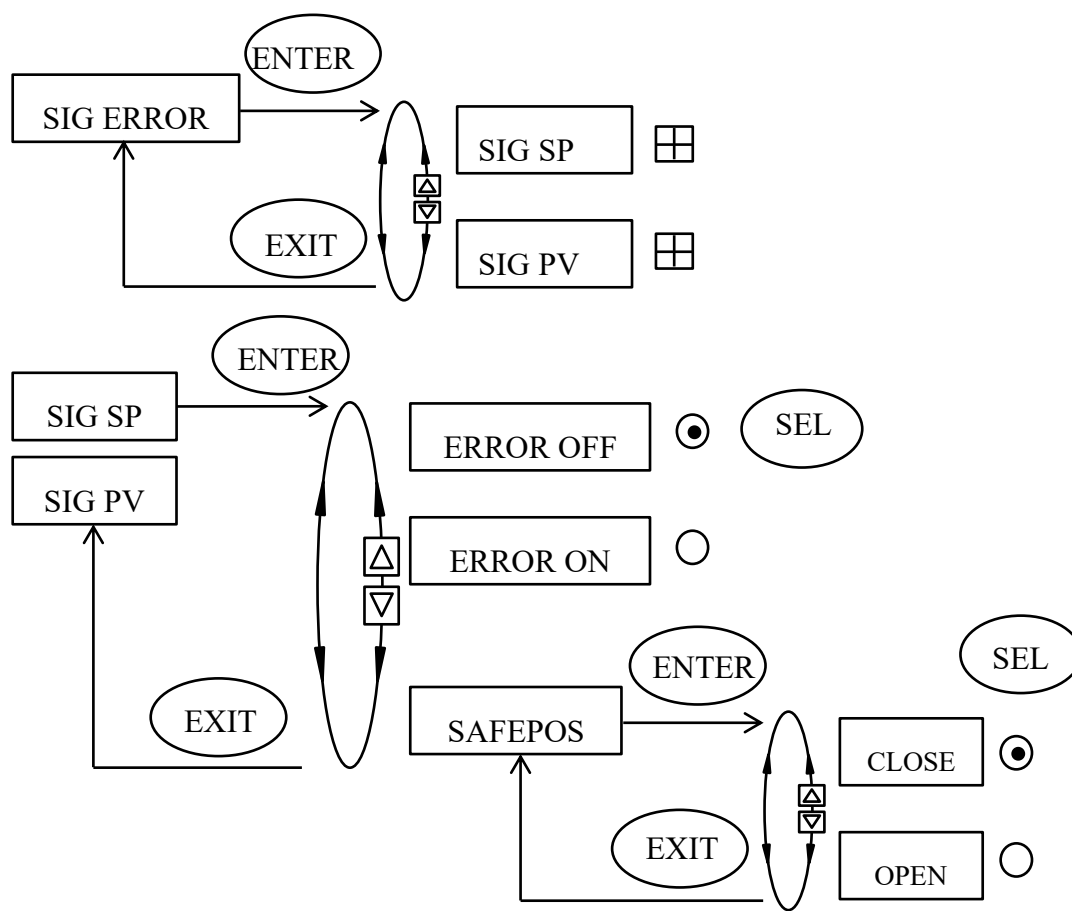


Figure 34. Operating structure SIG ERROR

Option	Description
ERROR OFF	Signal error detection is inactive.
ERROR ON	Signal error detection is active.
SAFEPOS	The SAFEPOS function is enabled by selecting OPEN and ERROR ON option when detecting the error signal.

Table 14. Option SIG ERROR

5.3.3.10.CAL USER

Factory setting:

CAL POS MIN: the AD value of minimum position by AUTO TUNE function.

CAL POS MAX: the AD value of maximum position by AUTO TUNE function.

CAL SP MIN for 4-20mA: 765

CAL SP MAX for 4-20mA: 3823

CAL SP MIN for 0-20mA: 0

CAL SP MAX for 0-20mA: 3823

CAL SP MIN for 0-10V: 0

CAL SP MAX for 0-10V: 3413

CAL SP MIN for 0-5V: 0

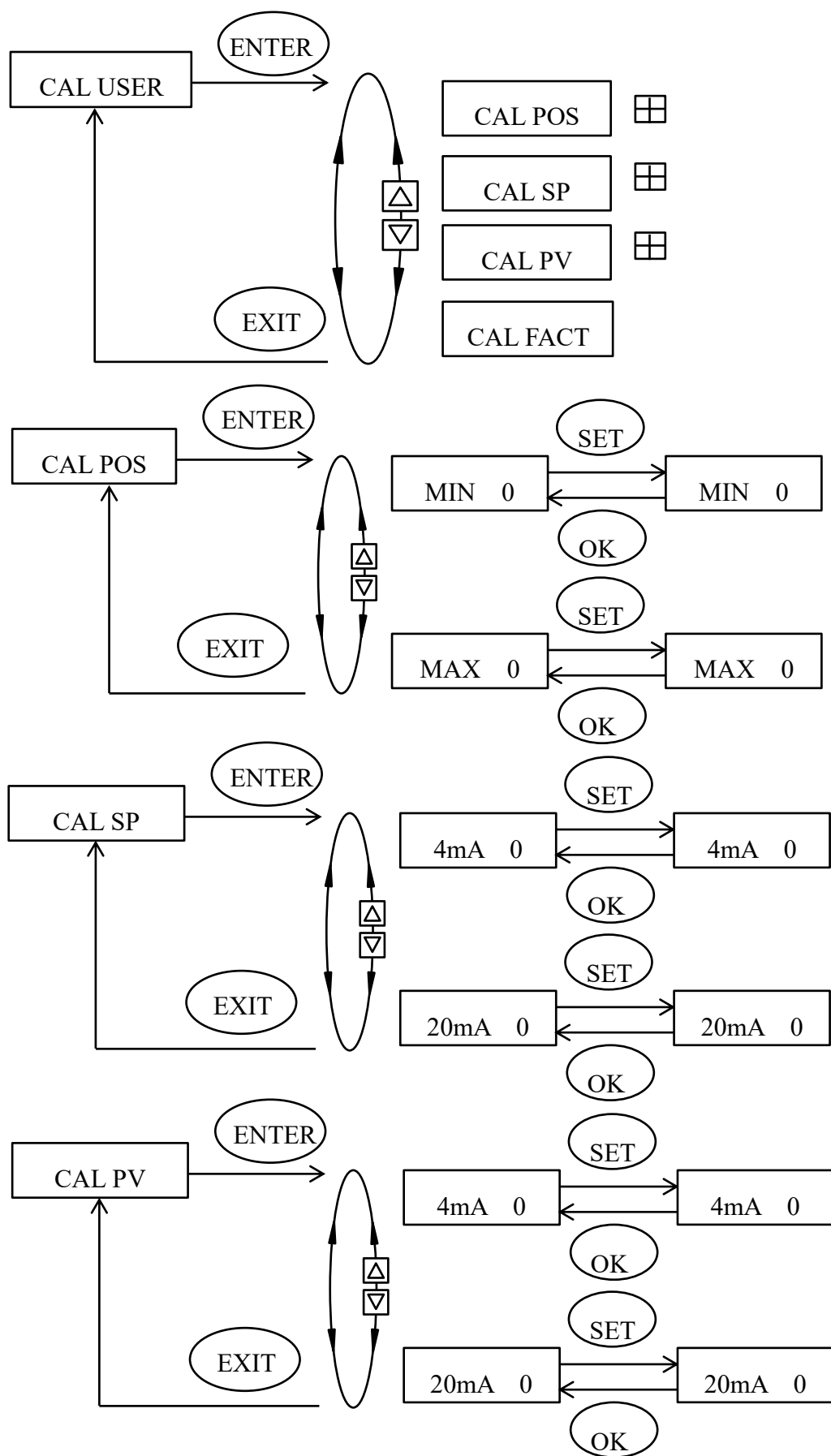
CAL SP MAX for 0-5V: 1707

CAL PV MIN for 4-20mA: 765

CAL PV MAX for 4-20mA: 3823

The function is used to calibrate the scale value for valve stroke, process set-point signal and process feedback signal. And it is not recommended to be used for general users.

The value of calibration is a 12bit AD sample value in the system, the range is 0-4095.



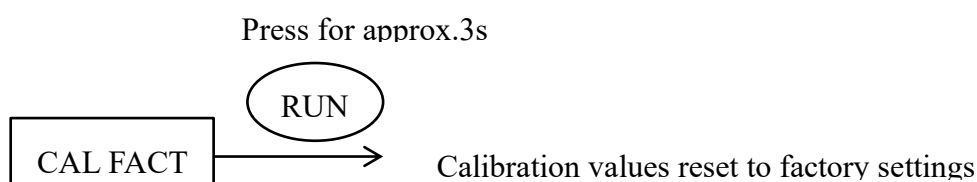


Figure 35. Operating structure CAL USER

Option	Description
CAL POS	Calibrating the scale values for valve stroke. When setting the MIN value, the actuator is fully close automatically. When setting the MAX value, the actuator is fully open automatically. The setting interface will display the present AD value of calibration and the lighted AD value of current position.
CAL SP	Calibrating the scale values for process set-point signal. When setting the option, the actuator is fully deaerated and does not operate other functions. The setting interface will display the present AD value of calibration and the lighted AD value of current input signal.
CAL PV	Calibrating the scale values for process feedback signal. When setting the option, the actuator is fully deaerated and does not operate other functions. The setting interface will display the present AD value of calibration and the lighted AD value of current input signal.
CAL FACT	The parameters of CAL POS, CAL SP and CAL PV reset to factory settings.

Table 15. Option CAL USER

When the system is running the calibration function, user should watch the lighted changing value whether tends to be stable. The stable value can be judged according to the range of digital number changing less than 5 for a long time. After judging the stable value, press “OK” key on the display to record current changing value as the new calibration value. The recorded value may be different with the changing value which before recording.

NOTE!

Write down the current changing value before recording. The changing value to be recorded may be different with the value after being recorded. If the deviation of digital number between them is less than 3, the recorded value is available. Otherwise please run the calibration for the related value again.

5.3.3.11.MANU RATE

Factory setting:

GRADE: 2

The function is used for setting the rate for adjusting valve stroke in the manual mode. The grade of adjustment rate: 1-5, 1 is the slowest adjustment rate, 5 is the fastest adjustment rate.

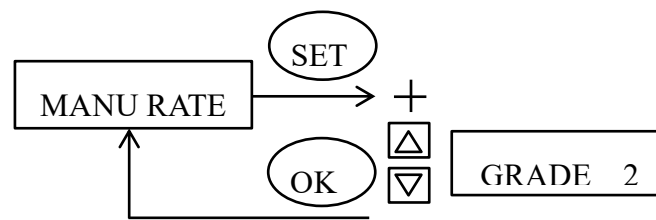


Figure 36. Operating structure MANU RATE

5.3.3.12.CODE

Factory setting:

Code: 0000

Protect options: none

The CODE function is to prevent some soft functions of the positioner being accessed. If enabling the CODE function, it needs to input the code before opening the protected menu or running the protected functions.

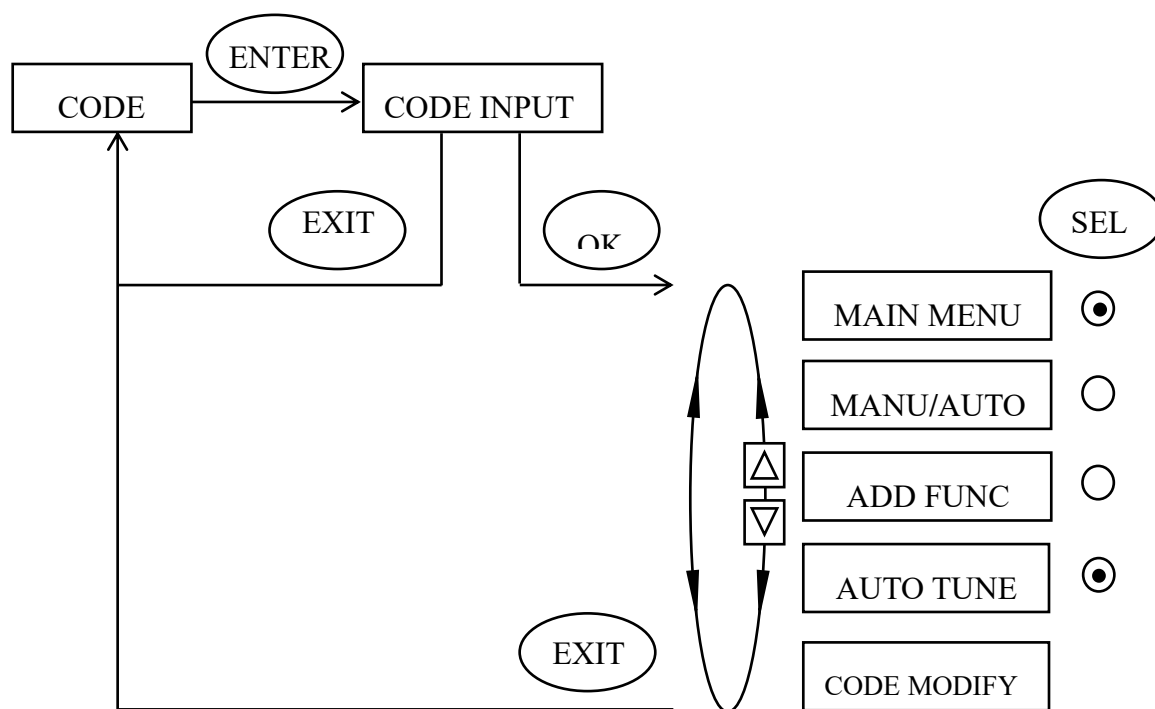


Figure 37. Operating structure CODE

Options	Description
MAIN MENU	Code protection for entering the main menu.
MANU/AUTO	Code protection for switching between automatic mode and manual mode.
ADD FUNC	Code protection for entering the auxiliary function menu.
AUTO TUNE	Code protection for running automatic adjustment.
CODE MODIFY	Modify the code for protected options and entering the CODE menu.

Table 16. Option CODE

5.3.3.13.SET FACT

All setting parameters reset to factory default value except the parameters of AUTO TUNE and CAL USER. To do so, enter the menu of auxiliary functions, then select the SET FACT option and press the “RUN” key for about 3s.

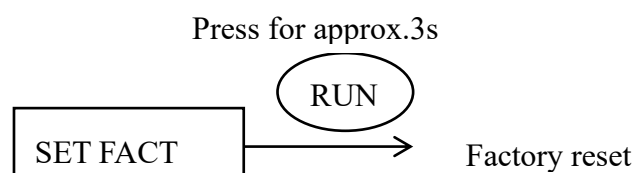


Figure 38. Operating structure SET FACT

5.3.4. LANGUAGE

The option is used to select the interface language.

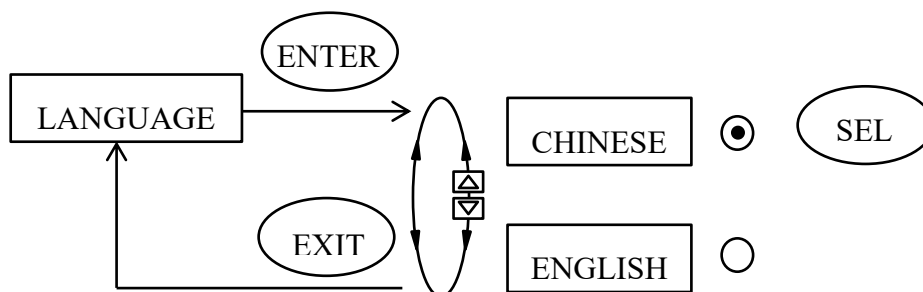


Figure 39. Operating structure LANGUAGE

6. Trouble shooting

1. LCD does not light after the positioner powers up.

Make sure that the 24V DC power supply is normal.

Make sure that the power cables are connected correctly.

2. The positioner is unable to locate position. The valve cannot be fully opened or fully closed for a long time.

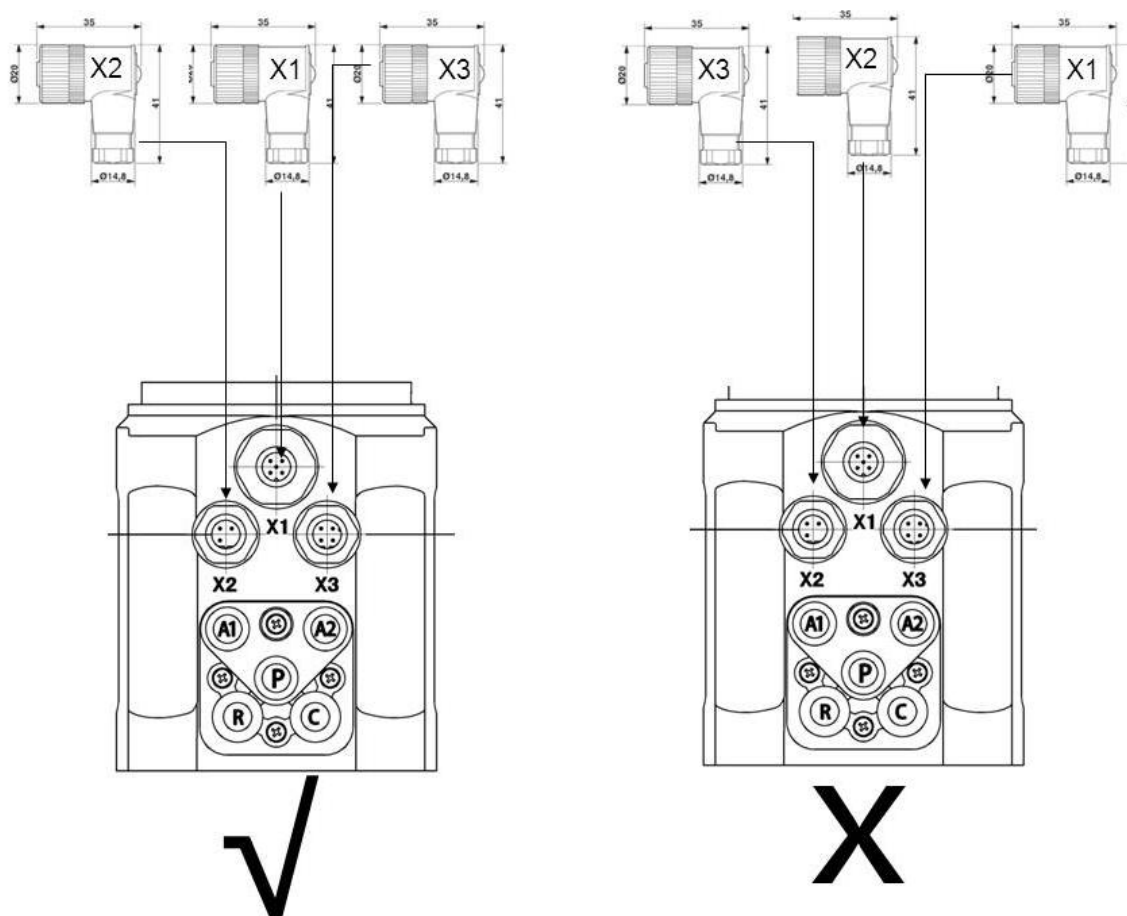
Make sure that the pressure of air supply meets the requirement.

Make sure that the setting value of limit stroke or dead band are not too small.

Make sure that the pneumatic connections of the positioner and actuator are not leaking.

7. Attention

1. The power supply voltage of the positioner is 24V DC $\pm 10\%$. Please check the power supply before connecting the power cable to the electrical terminal. Make sure that the power supply is cut off before connecting the power cable. If the product is damaged by high voltage, it will lose warranty.
2. **Air supply use specification**
 - 1> The air pressure should be less than 0.7MPa.
 - 2> Install the filter pressure reducer (5 μ m filtration accuracy) in front of the air supply inlet of the positioner to prevent moisture or oil from infiltrating. In the situation of much oil in the air, it is suggested to additionally install oil separator (3 μ m filtration accuracy) in front of the air supply inlet of the positioner. It is suggested to use the combination of SMC brand filter pressure reducer and SMC brand oil separator. Its model is AC20D-01CG-A. If the product is damaged due to the oil entering the product without oil separator or filter pressure reducer being installed, it will lose warranty.
3. **Waterproof electrical connectors use specification**
 - 1> The electrical connectors have foolproof design. Please connect the electrical female connector with the electrical male connector of the positioner according to the sign X1, sign X2 and sign X3. Error connecting by strong force will destroy the electrical male connector.

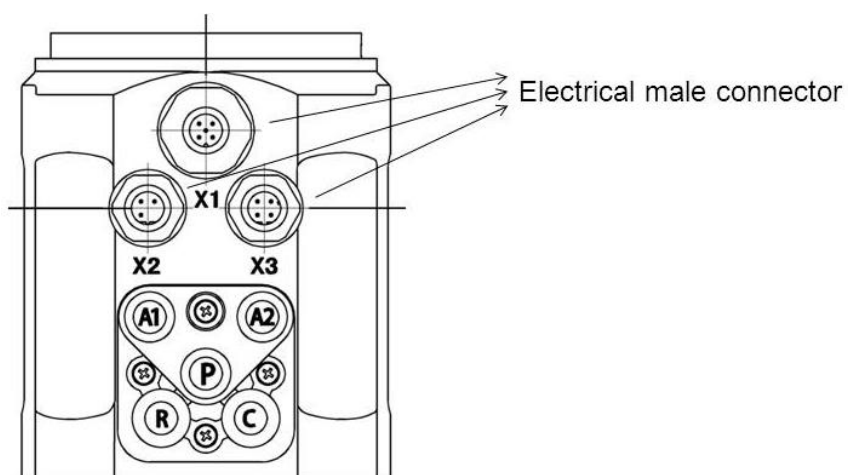


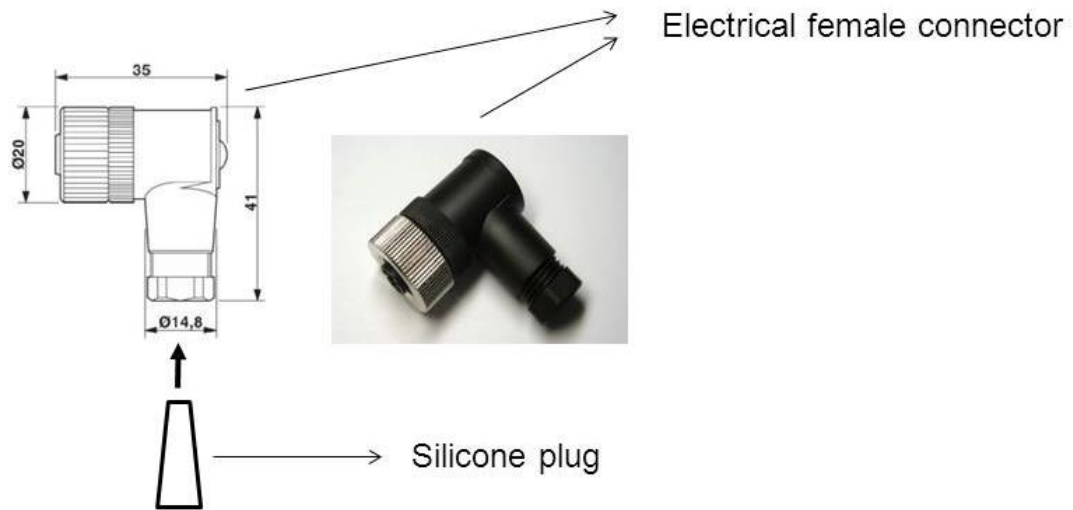
- 2> The cable diameter which is compatible with the waterproof electrical connectors is PG7 (4mm-6mm). Please use the multi - core cable with external insulation protection skin, otherwise the electrical connectors cannot achieve IP66 protection class.

Correct and error wiring ways are showing in the following pictures.



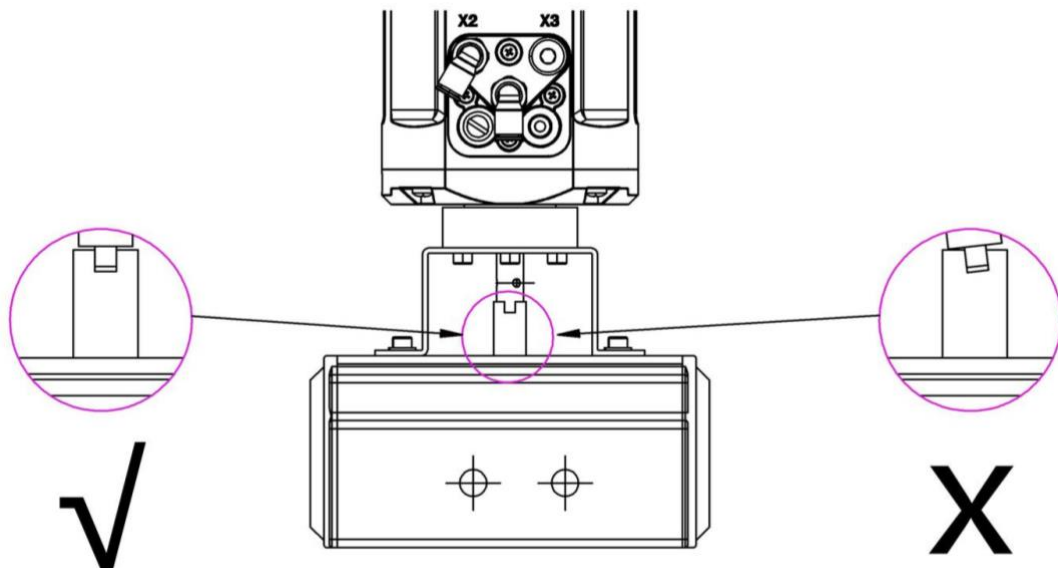
- 3> If the electrical male connectors are not used for a long time, to prevent water vapor or corrosive gases corroding the connector pins or entering the positioner inside, please screw on the electrical female connectors and block another side of the electrical female connectors with the silicone plugs. As shown below.





If the product is damaged by error operations for the waterproof electrical connectors, it will lose warranty.

4. If the product is damaged by the user removing the pneumatic connectors or the filter elements near the pneumatic connectors, it will lose warranty.
5. For matching the angle stroke actuator, make sure that the groove of the actuator axis is vertical, so that the connection between the actuator axis and the positioner sensor is suitable. Otherwise the radial load force will destroy the sensor. If the product is damaged by the above reason, it will lose warranty.



8. 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.
 - (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.

9. Selection and ordering data

1600 Without process control function 1601 With process control function	Product series
N No feedback signal Y 4-20mA feedback signal	Feedback signal
S Single-acting D Double-acting	Actuator type
S2 Line 5-25 mm S3 Line 25-50 mm S4 Angle 90°	Valve max stroke
Q1 17 l/min Q2 95 l/min	Air flow rate
T1 G1/4 T2 M16 * 1 T3 M22 * 1.5 T4 M26 * 1.5	Thread type
S Safe F Freeze	Power off state for single-acting

1600	—	N	—	S	—	S2	—	Q1	—	T1	—	S
------	---	---	---	---	---	----	---	----	---	----	---	---

Remark:

In the **air flow rate** option, code Q1 is suggested to match the actuator of 40-100 mm internal gas chamber diameter, code Q2 is suggested to match the actuator of 125-160 mm internal gas chamber diameter. Code Q2 is only used for single-acting actuator, and only in **Freeze** state when power-off. The air flow rates for code Q1 and Q2 are under the condition of 0.6Mpa input pressure.

In the **valve max stroke** option, AT actuator range for code S4 is AT50~AT125. For other actuator models, please consult our company. It is no need to select the **thread type** option for code S4.

Power off state for single-acting option is **Safe** by default.

V251127

The changed contents of this manual are not noticed.

The Company reserves the final interpretation for related technical updating.

Attachment

Air Supply Requirements for Intelligent Valve Positioner

All Series Products

In accordance with technical specifications, all series of intelligent valve positioners require Class 3 quality compressed air supply. Supplying compressed air that meets the air source standards ensures stable normal operation of the positioners.

Class 3 Dew Point: Dew point shall be -20°C . (If the actual operating ambient temperature of the positioner is lower than -20°C , the dew point of the supplied compressed air shall be 10°C lower than the actual operating ambient temperature of the positioner accordingly.)

Class 3 Solid Particle Size & concentration: 5.0 mg/m^3 (corresponding particle size: $5.0\text{ }\mu\text{m}$). Particles larger than $5.0\text{ }\mu\text{m}$ are prohibited from entering the equipment.

Class 3 Oil Content: 1.0 mg/m^3 , the cumulative oil content per cubic meter of air shall not exceed 1.0 mg .

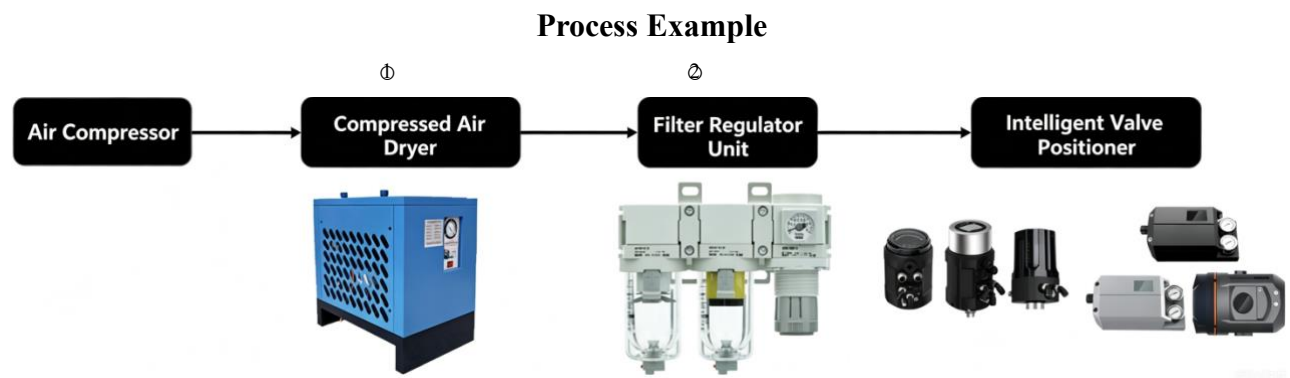


Figure 1. Process Flow Diagram

- ① Install a compressed air dryer on the main pipeline to remove most moisture contained in compressed air; the pressure dew point after filtration can reach -20°C .
- ② Select one of the air preparation assemblies shown in Figure 2 and install it upstream of the positioner. Depending on the selected configuration, install the filter regulator or air filter upstream, followed by the mist separator downstream. The filtration system shall remove particles larger than $5.0\text{ }\mu\text{m}$ and reduce the residual oil concentration to no more than 1.0 mg/m^3 .

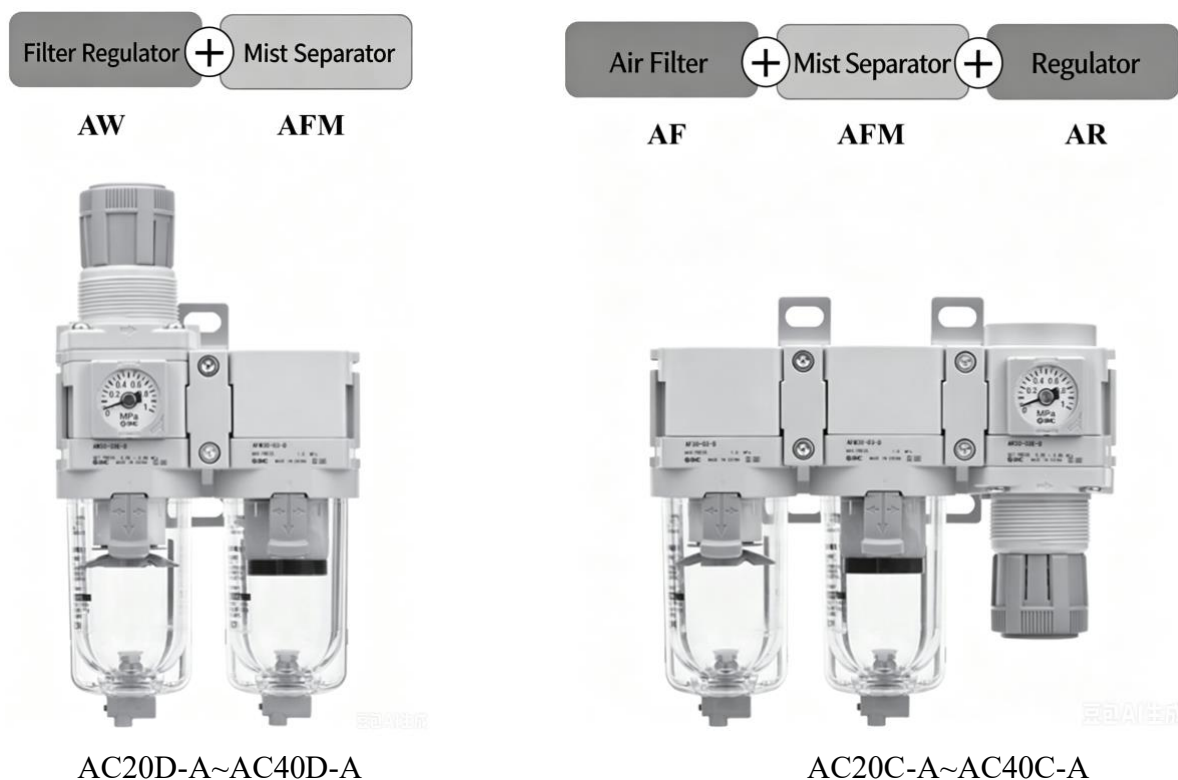


Figure 2. Filter Regulator Assembly

Filter Regulator Selection Recommendations

Selection Combination	Air Filter + Mist Separator + Regulator AF AFM AR 		Filter Regulator + Mist Separator AW AFM 
	AC 30 C- 03 DG- -A 1 2 3 4 5 6	AC 30 D- 03 DG- -A 1 2 3 4 5 6	
Selection Model No.	SMC AC20C-02G-A		SMC AC20D-02G-A SMC AC30D-02G-A
	When the quality of compressed air at the inlet side is slightly lower than the operating requirements of the positioner		When the compressed air quality at the inlet meets the operating requirements of the positioner

Basic Parameters	Fluid: Air Ambient & Operating Temperature: -5~60°C (no freezing) Proof Pressure: 1.5 MPa Operating Pressure Range: 0.05~1.0 MPa Adjustable Pressure Range: 0.05~0.7 MPa Filtration Rating: AW: 5 µm, AFM: 0.3 µm (99.9% collection efficiency) Bowl Material: Polycarbonate Structure: Relieving type		
Selection Parameters	① Main Body Size: 20 Rated Flow Rate: 200 L/min Bowl Guard: Standard (Steel Band) Weight: 0.39 kg ② Thread Type (No Mark): Rc ③ Port Size Code 02: 1/4 ④ No Mark: Manual Drain Pressure Gauge G: Round Pressure Gauge with Limit Indicator ⑤ No Mark: No Accessories ⑥ No Mark: No Special Options	① Main Body Size: 20 Rated Flow Rate: 150 L/min Bowl Guard: Standard (Steel Band) Weight: 0.33 kg ③ Thread Type (No Mark): Rc ④ Port Size Code 02: 1/4 ⑤ No Mark: Manual Drain Pressure Gauge G: Round pressure gauge with limit indicator ⑥ No Mark: No accessories ⑥ No Mark: No special options	① Main Body Size: 30 Rated Flow Rate: 330 L/min Bowl Guard: Standard Equipment (Polycarbonate) Weight: 0.66 kg
1Series Positioner*	●	●	/
IP Series Positioner*	●	/	●

*●Recommended selection

Note: The rated air handling flow rate of the filter shall be higher than the maximum operating flow rate of the positioner. If multiple positioners are installed on the same air supply line, the total maximum operating flow rate shall be the sum of each unit. (1 Series Max Flow: 1500 / 1600: Q1-17 L/min, Q2-95 L/min 1880S: 17 L/min IP Series Max Flow: IP5500: 155 L/min IP6000 / IP6500: 187 L/min IP6000d: 150 L/min All above data are measured under 0.6 MPa supply pressure.)

Important Notes

1. Select filter regulators with suitable performance based on site working conditions to avoid equipment failure caused by high temperature, low temperature, high pressure, corrosive atmosphere and other harsh environments. Refer to the selection table at the end of this appendix.
2. Regularly inspect the condition and performance of the filter. Increase inspection frequency under high-frequency operating conditions to prevent malfunctions caused by clogged filter elements. (Typical failures include: ① Loss of filtration performance, allowing foreign matter to enter and damage the positioner; ② Clogging of the filter elements, resulting in an abnormal air supply and preventing the positioner from operating normally.)
3. For filter regulators with an auto-drain function, blockage of drain holes shall be prevented. Regular inspections can avert excessive water accumulation in the filter bowl caused by filter malfunctions. Manually drained filter regulators shall be drained manually on a regular schedule according to the water accumulation rate under actual working conditions.
4. Carry out regular maintenance or replace any nonconforming filter/regulator units in accordance with the operating instructions of the filter regulator to avoid unnecessary failures.