



**Intelligent Electropneumatic  
Valve Positioner**

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# 1 Overview

## 1.1. Product structure

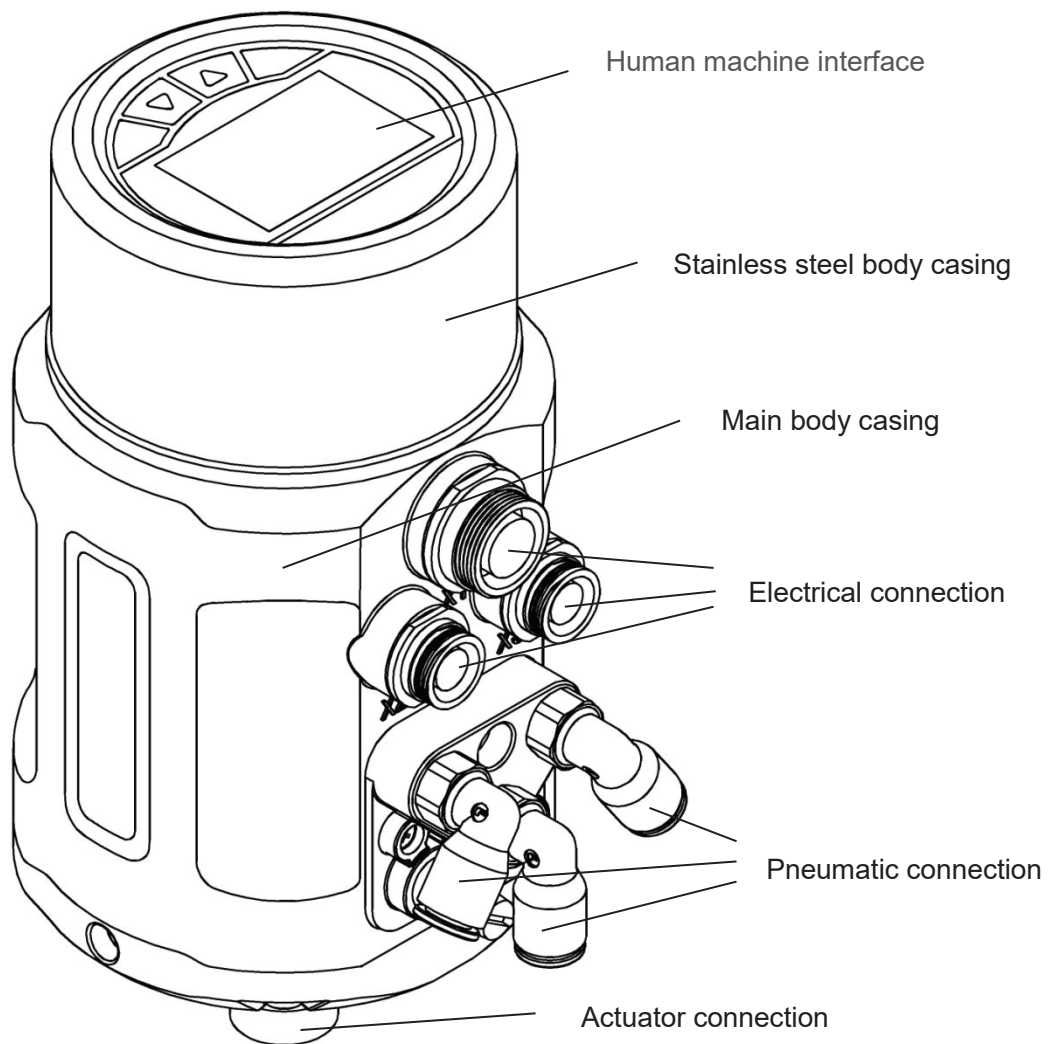


Figure 1. Positioner structure

## 1.2. Product description and application

1600 series intelligent electropneumatic valve positioner is a valve stroke controller based on microprocessor. The valve stroke can be set by external input signal. The positioner can adjust valve stroke quickly and accurately by using automatic control algorithm and PWM control technology, accordingly control the flow of fluid line.

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 transfer characteristic, safety position, cut off, etc. It is easy to install, operate, maintain and has low failure rate.

## 2. Installation

### 2.1. Mechanical dimensions

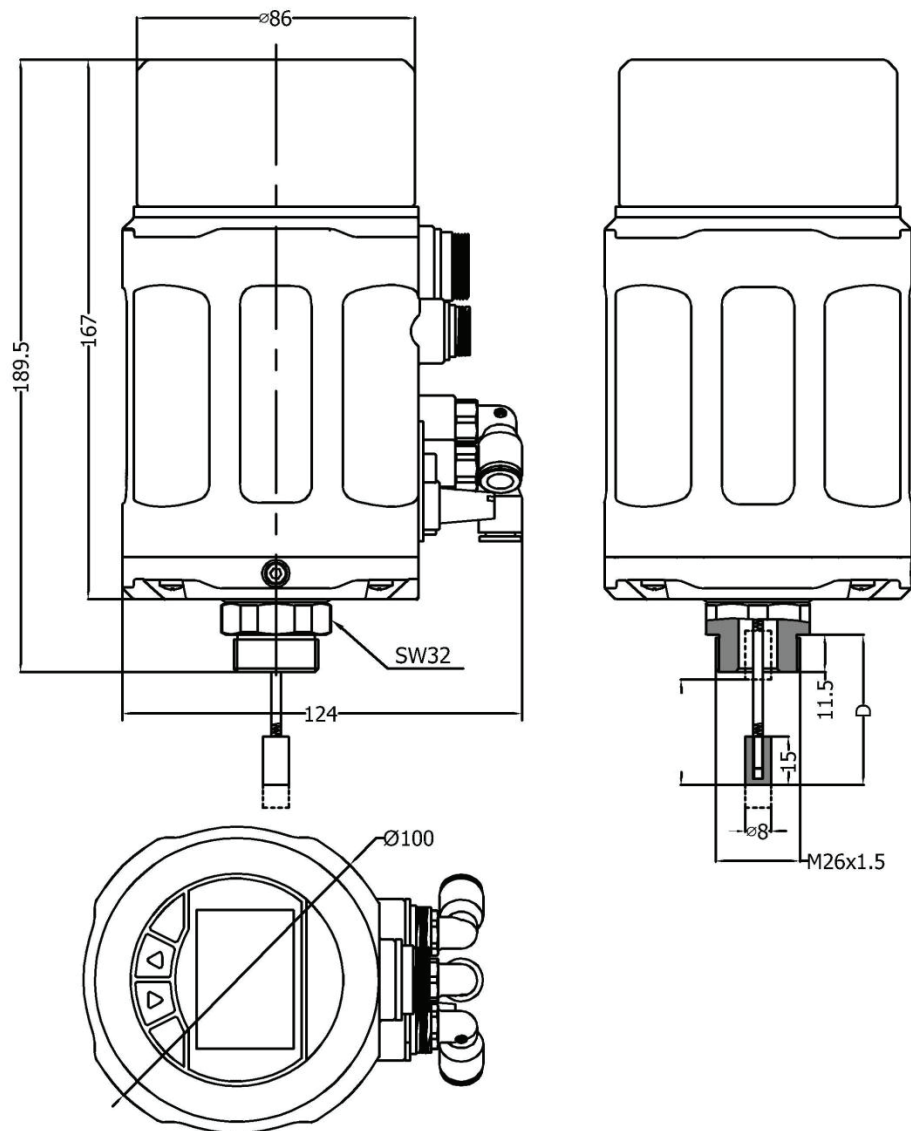


Figure 3. Mechanical dimensions for line stroke

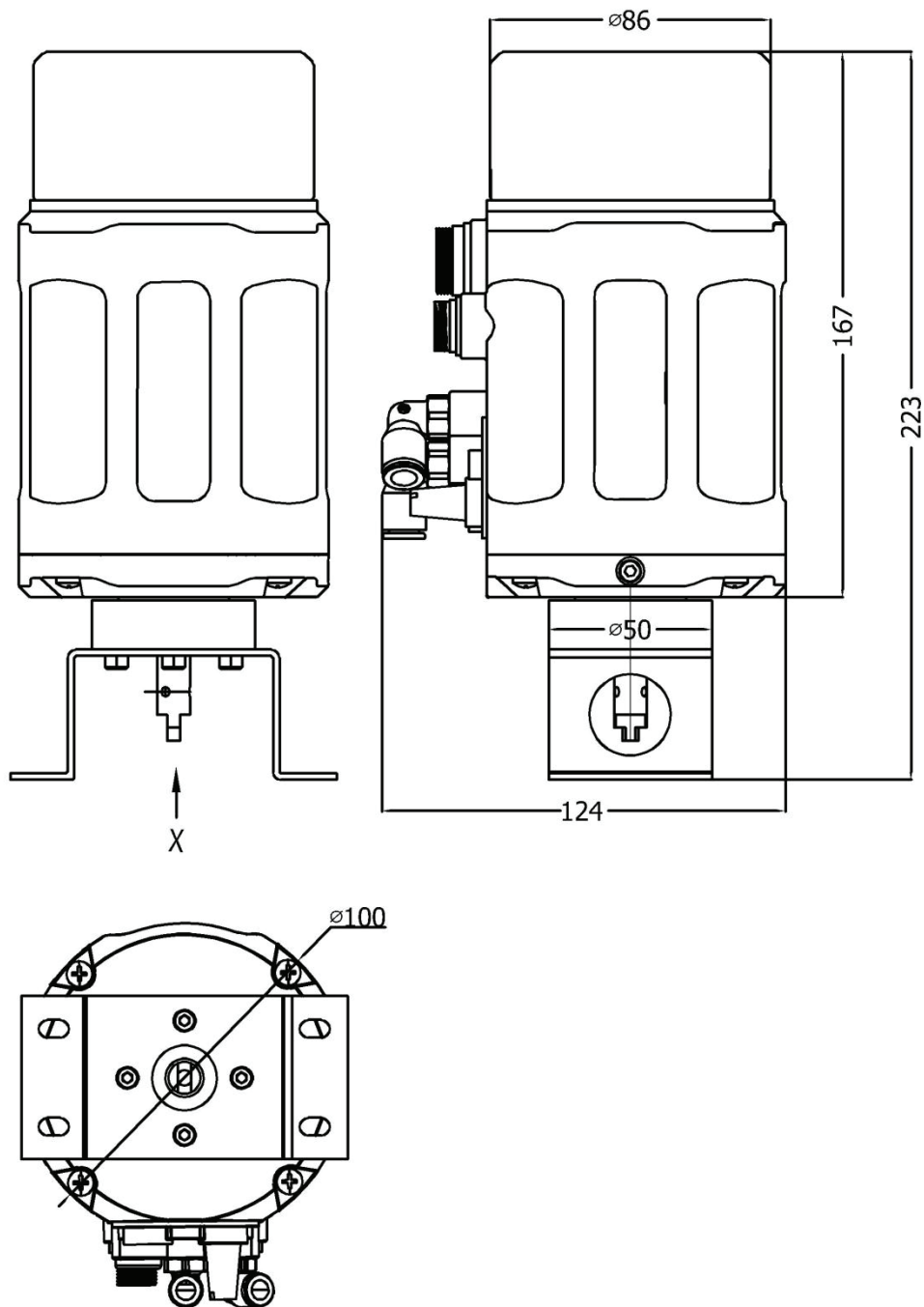
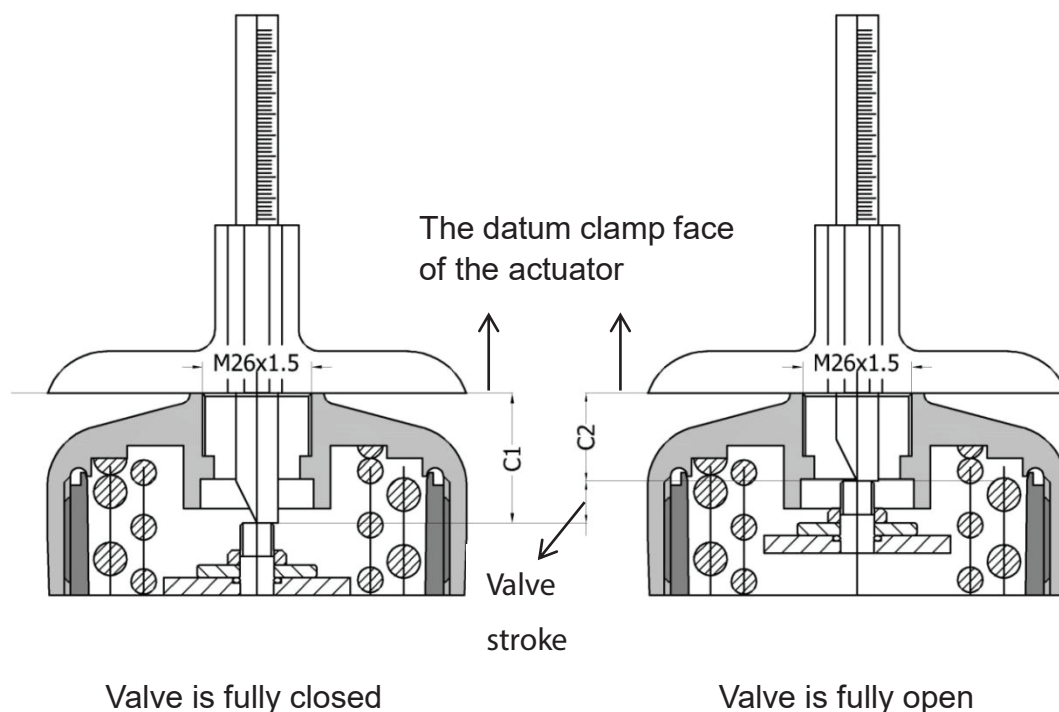


Figure 4. Mechanical dimensions for angle stroke

## 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**

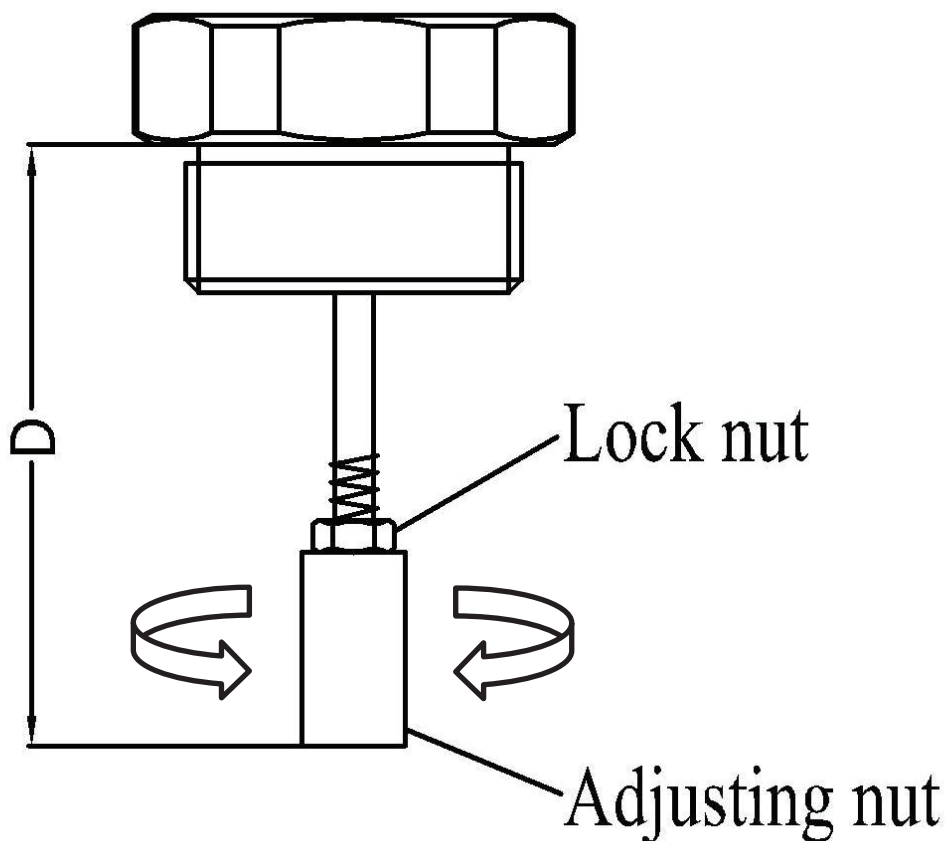
3. Adjust the adjusting nut of the displacement sensor. Then measure the D value (as shown in Figure 6) by **the depth ruler** in the state of the displacement sensor being completely loosened. Calculate the compression value  $L1 = D - C1$ ,  $L2 = D - C2$ . It is recommended that the compression value 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  $L1 > 0$ ,  $L2 <$  the maximum compression value of the displacement sensor. Otherwise, the positioner can not match the actuator.

Maximum valve stroke	D range	L1, L2 reference range
5~20 mm	36~44 mm	2.5~22.5 mm
20~30 mm	46~54 mm	3~33 mm
30~50 mm	66~74 mm	3.5~53.5 mm

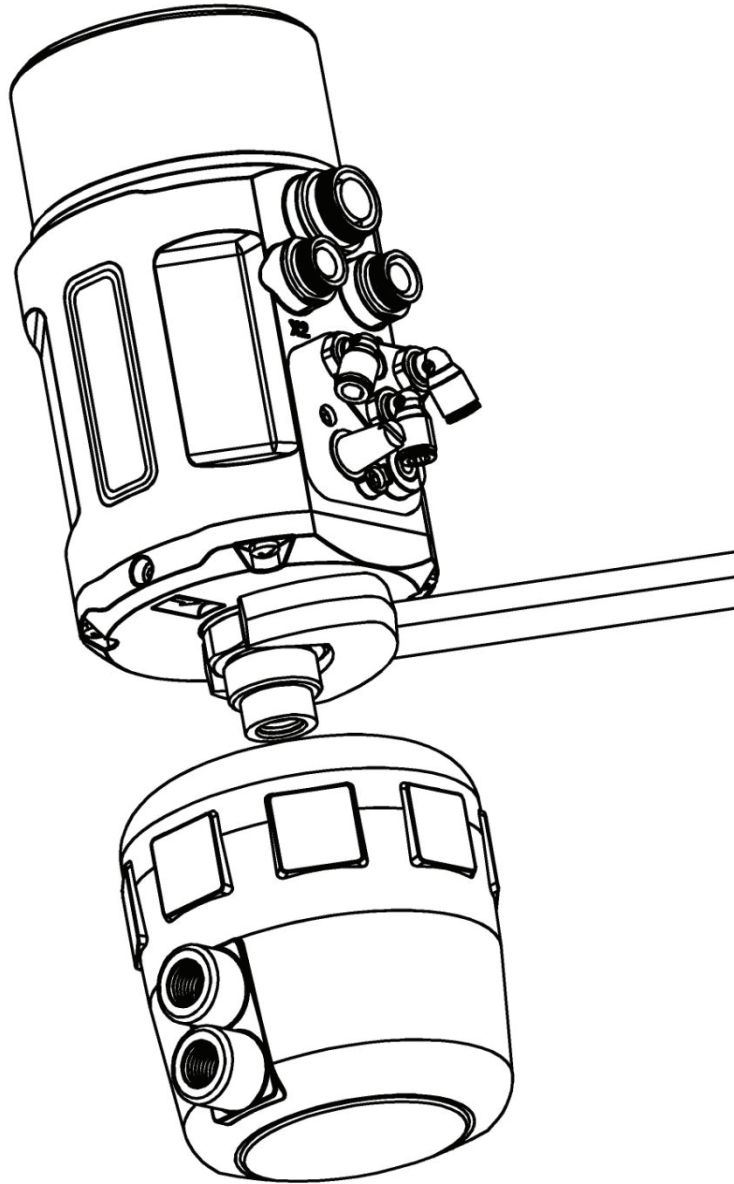
**Table 1. The reference range of the compression value**



**Figure 6. Travel sensor adjustment and measurement**



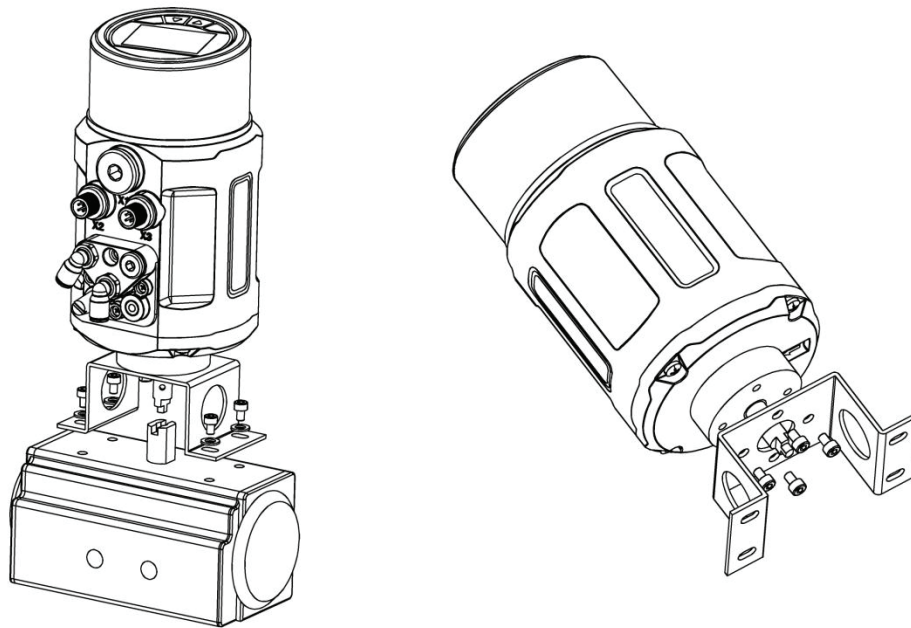
4. Make the actuator connection of the positioner entering into the thread connection of the actuator by **NO.32 wrench**. As shown in Figure 7.



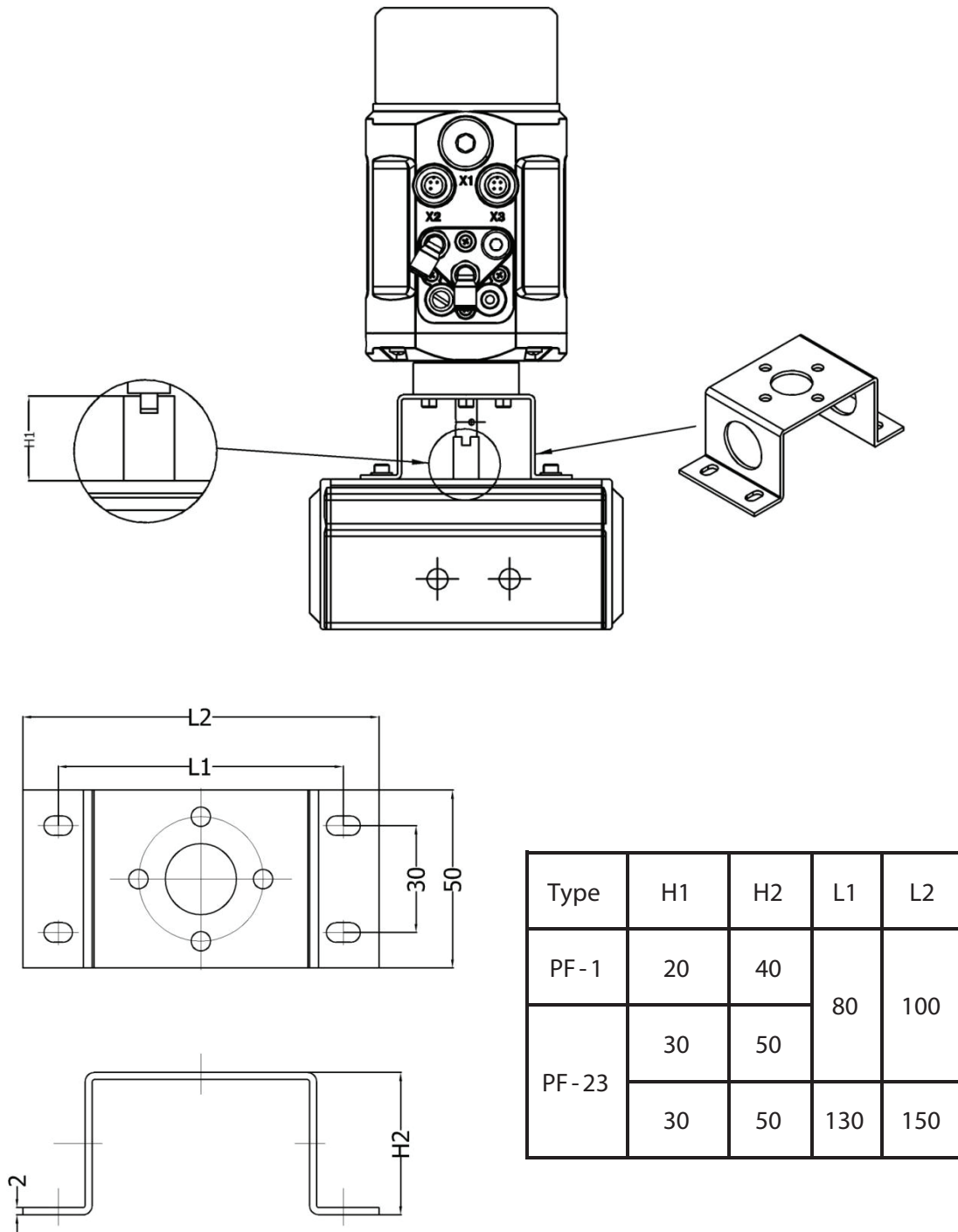
**Figure 7. Actuator Combination**

## 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**



**Figure 9. Mechanical dimensions of the mounting body**

## 2.3. Interface angle adjustment

If you need to adjust the interface angle, relax the hexagon screw in place A (As shown in Figure 7) first. Then adjust the angle clockwise or counter-clockwise in 180° range. After adjusting the angle, lock the angle by the hexagon screw.

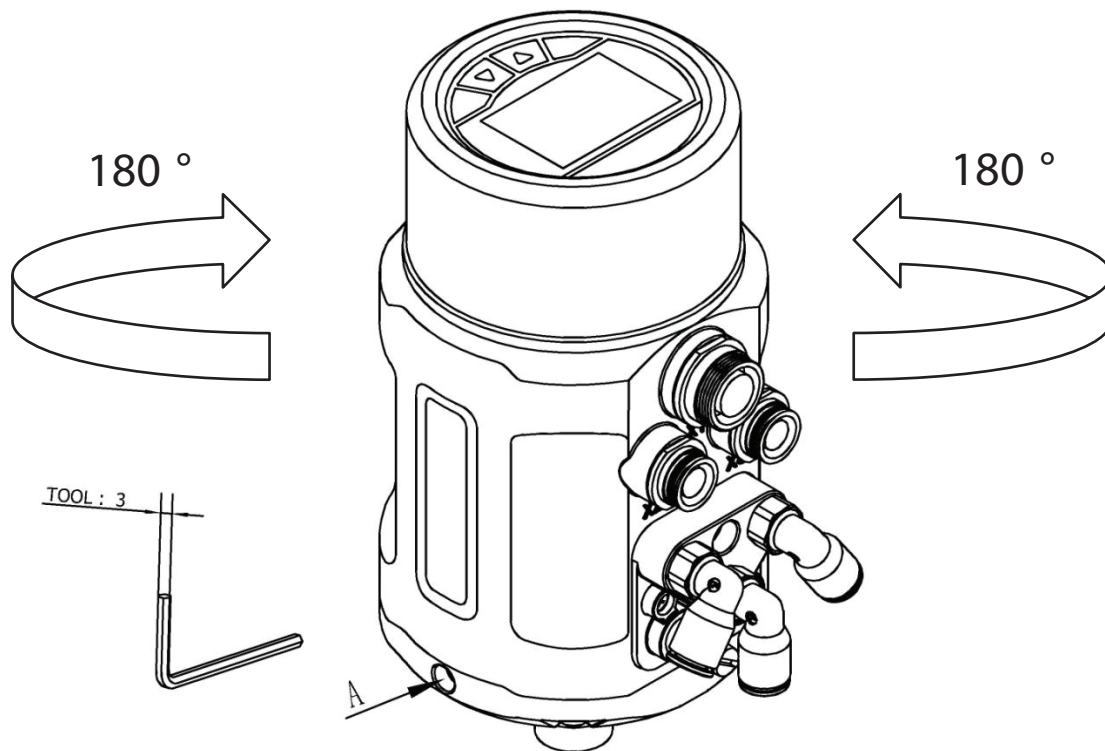


Figure 10. Graph operation

### 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

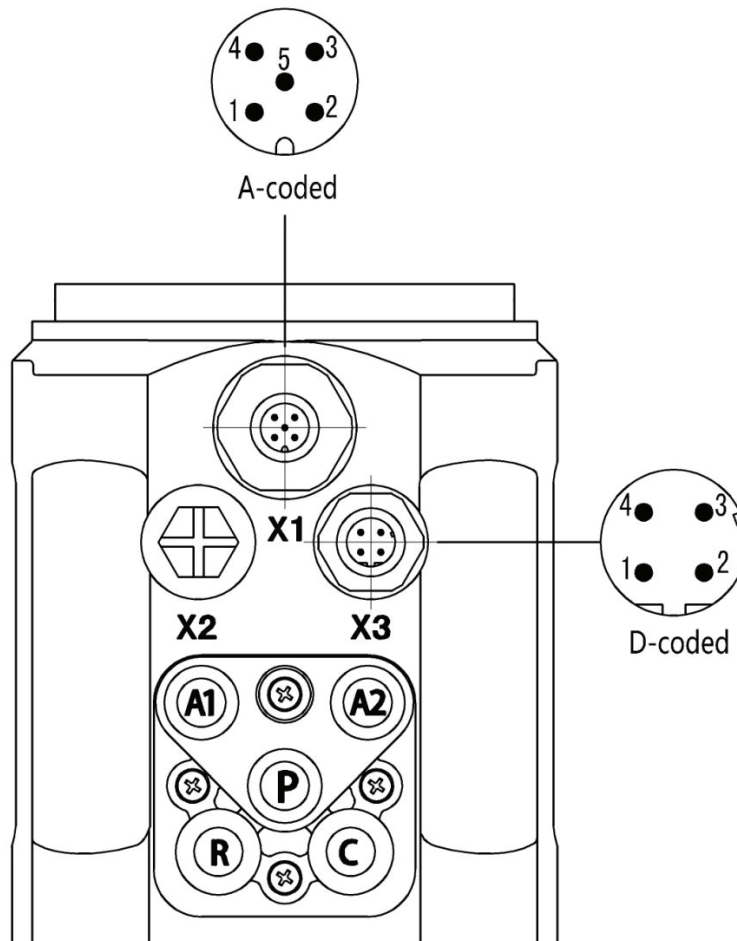


Figure 11. Connection

Connection	Pin	Description	Signal Type
X1	1	Analogue signal output +	0/4 – 20 mA or 0 – 5/10 V
	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
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 3. Electrical connection description – X3**

**NOTE !**

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

Connection	Description
<b>P</b>	Air supply enter (built-in filter, filter size 5 µm)
<b>R</b>	Air exhaust
<b>C</b>	Check valve
<b>A1</b>	Pilot air outlet 1
<b>A2</b>	Pilot air outlet 2

**Table 4. 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: 0~70°C

Protection class: IP66

### 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: 240 $\Omega$  at 0/4-20mA, 21K $\Omega$  at 0-5/10V

Input resistance for process signal: 240 $\Omega$

Analogue output signal:

maximum load 560 $\Omega$  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:

Clean dry air, according to ISO 8573-1;

maximum particle density 10 mg/ m<sup>3</sup>,

maximum particle size 40  $\mu$ m;

maximum oil content 25 mg/m<sup>3</sup>;

maximum pressure dew point -20 °C or minimum 10 degrees below the lowest operating temperature.

## 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.

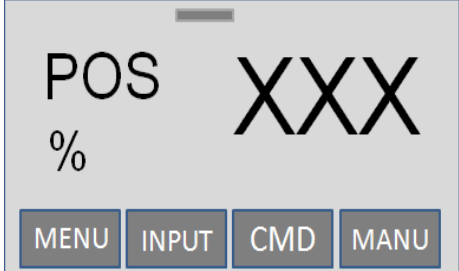
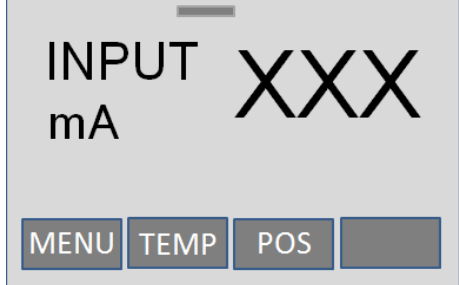
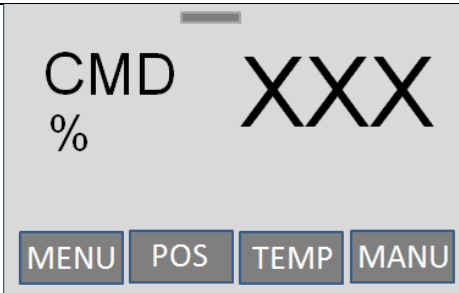
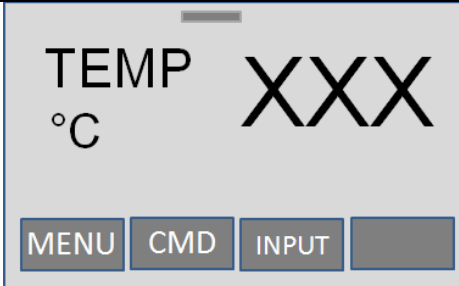
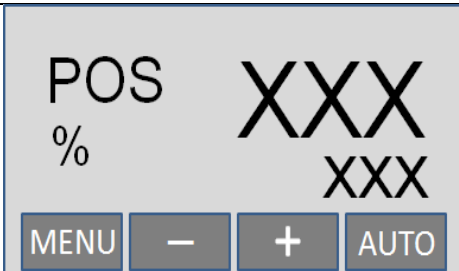
In the automatic mode, the positioner accepts the input signal for set-point value and adjusts the valve stroke automatically.

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



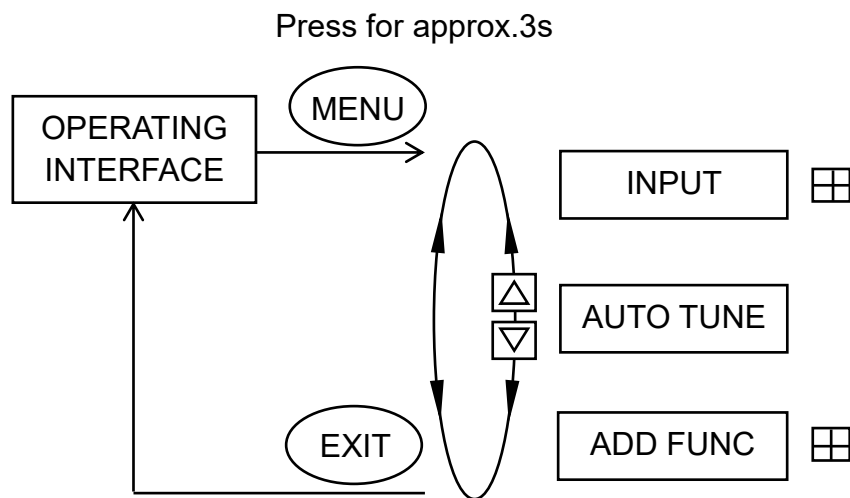
BINARY IN function for switching, switching by function keys is not effective. User can switch the operating interface by the function keys. The operating interfaces are described in Table 5. The interface will be locked if no keys are pressed for a long time. To unlock the interface, it needs to press both two  keys for about 3 seconds.

Display	Description
	<p>Current position in the automatic mode. Press “POS” key or “AUTO” key to display.</p>
	<p>The value of input signal in the automatic mode. Press “INPUT” key to display.</p>
	<p>The set-point value in the automatic mode. Press “CMD” key to display.</p>
	<p>The temperature value of internal system. Press “TEMP” key to display.</p>
	<p>Current position value (big font) and position set-point value (small font) in the manual mode. Press “MANU” key to display.</p>

**Table 5. Operating interface**

### 5.3. Main menu

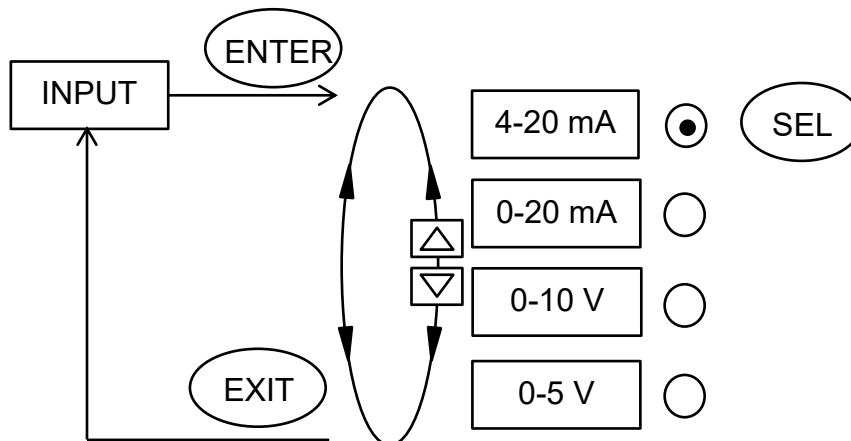
User can operate specific function or set specific parameters under the main menu. The menu interfaces have no lock function. So user should exit to the operating interface from the main menu after operating specific function or setting specific parameters.



**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.

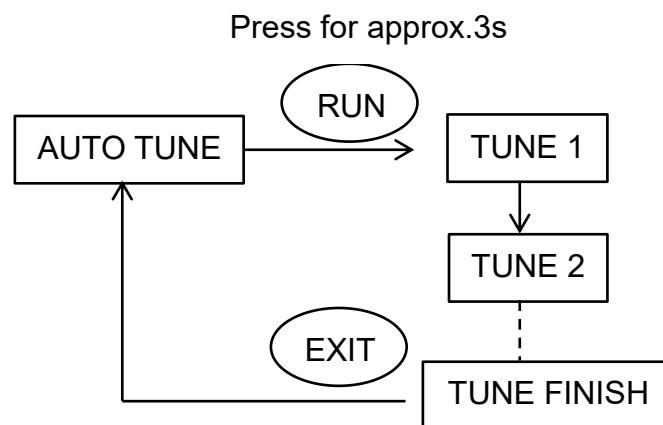


**Figure 14. Operating structure INPUT**

### 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 parameters may be error.

### 5.3.3. Auxiliary functions

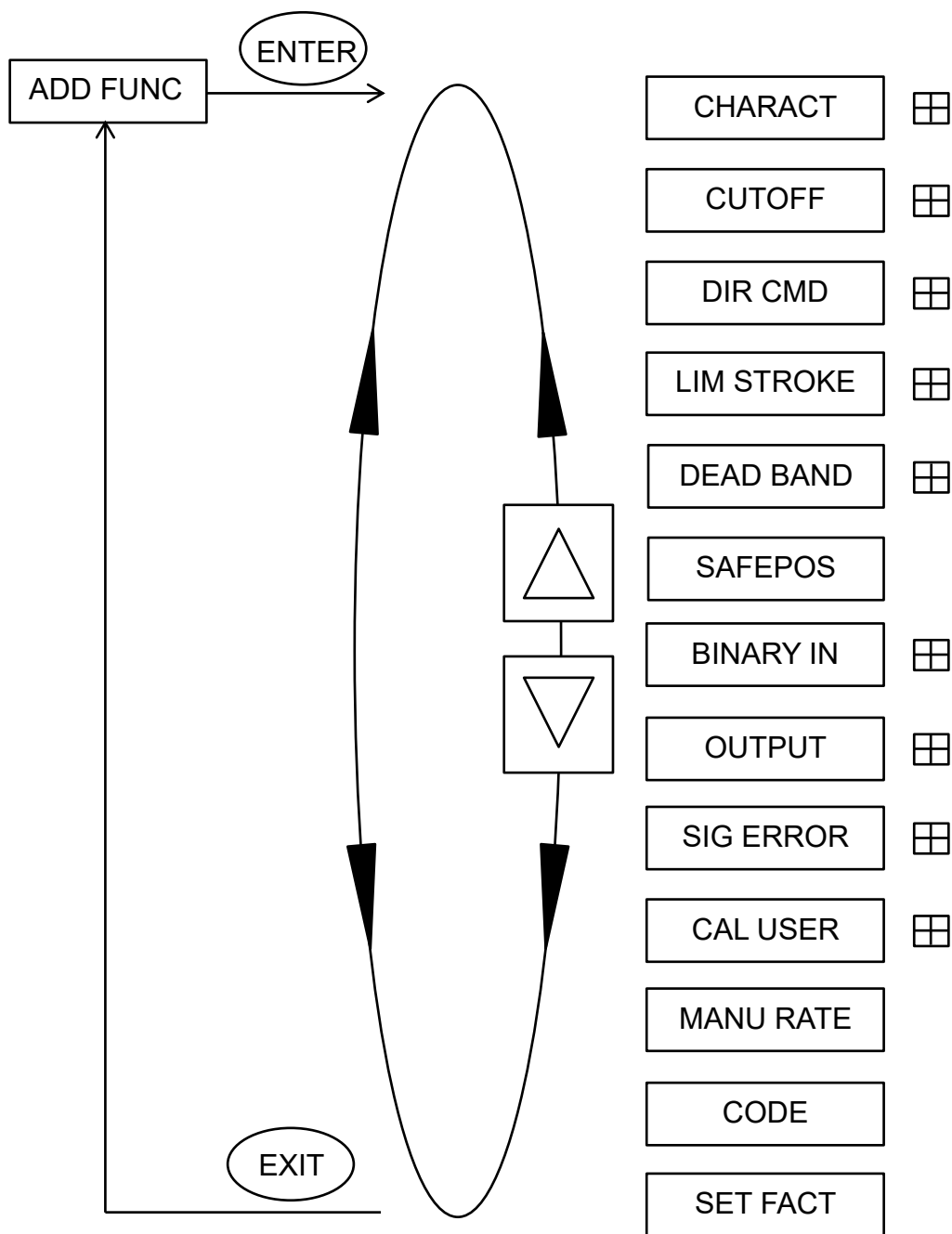


Figure 16. operating structure ADD FUNC

### 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.

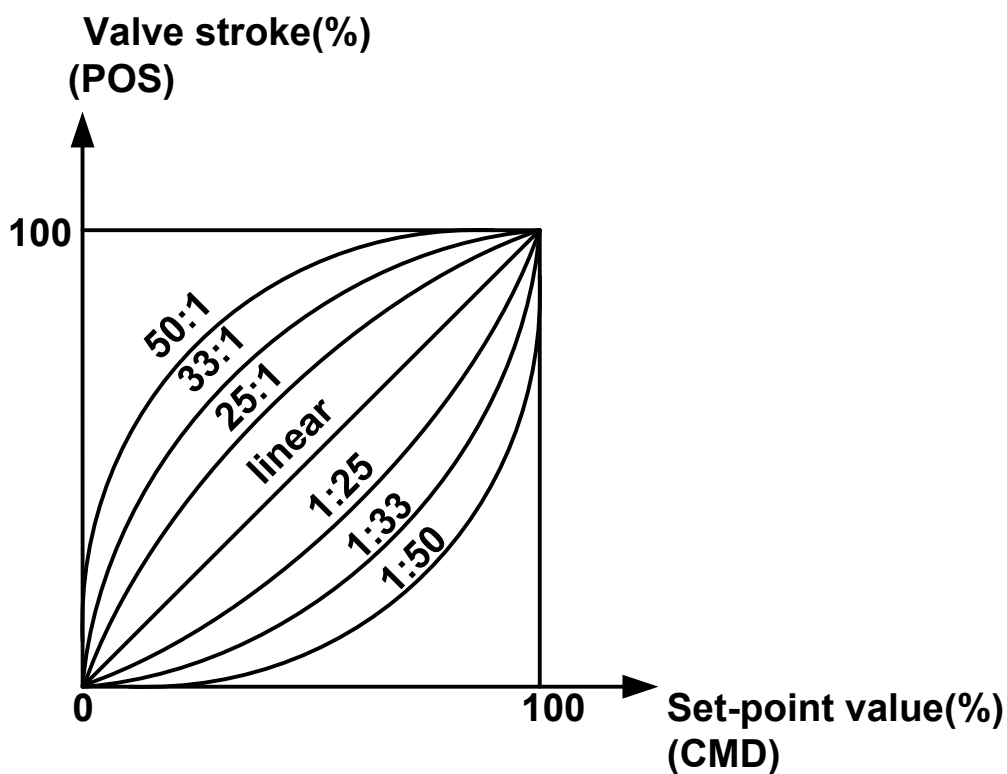
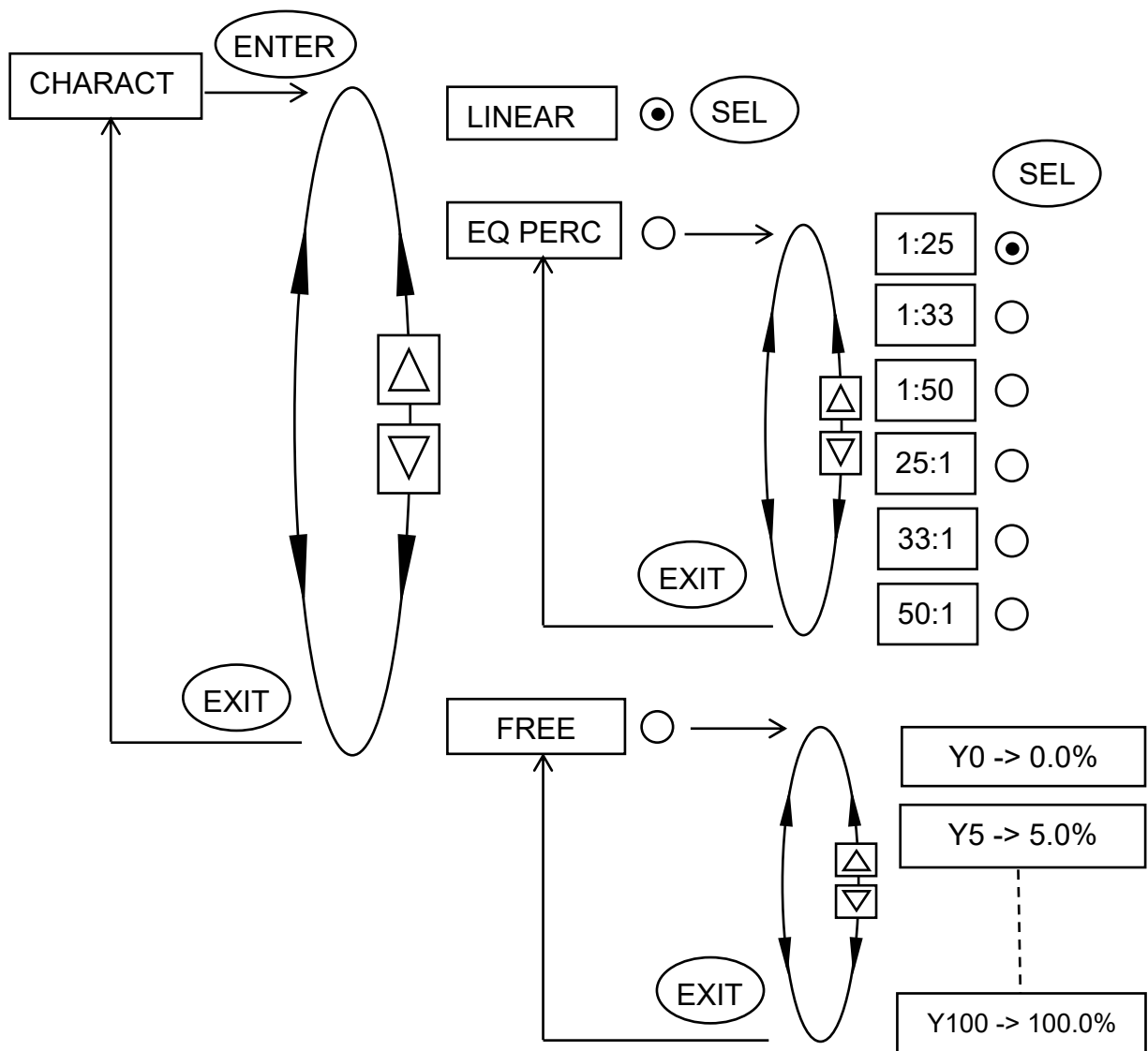


Figure 17. Graph characteristics of linear and equal percentage



**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.

**Table 6. Option CHARACT**

### Equal percentage characteristic

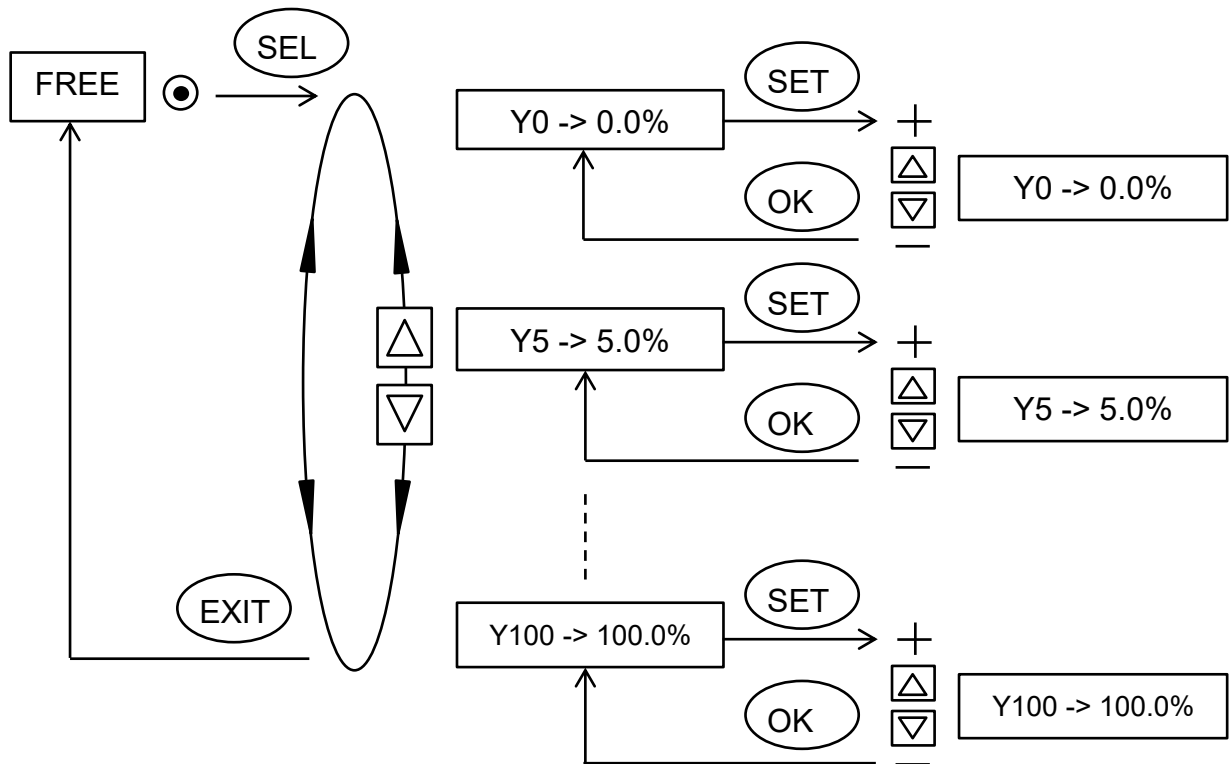
The Equal percentage characteristic includes the options of 1:25, 1:33, 1:50,

25:1(inverse), 33:1(inverse), 50:1(inverse).

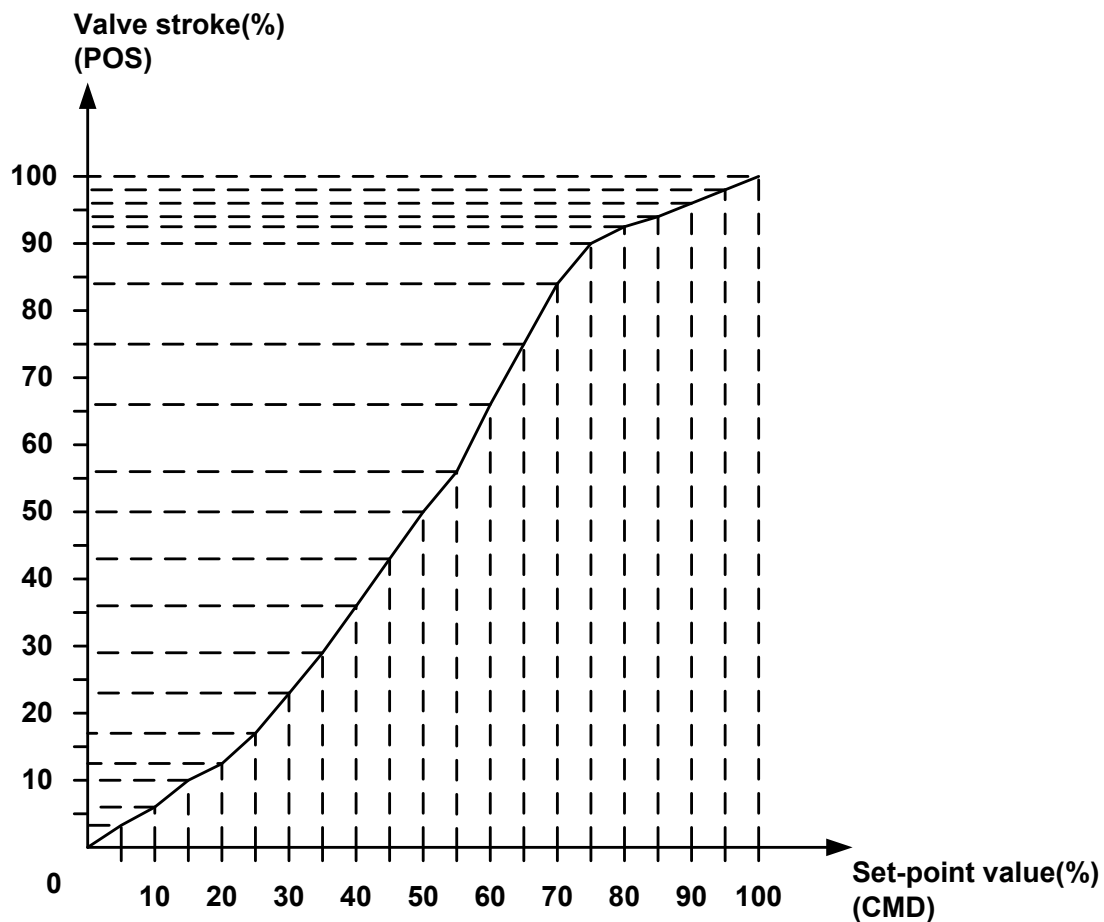
**Freely programmable characteristic**

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**

### 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.

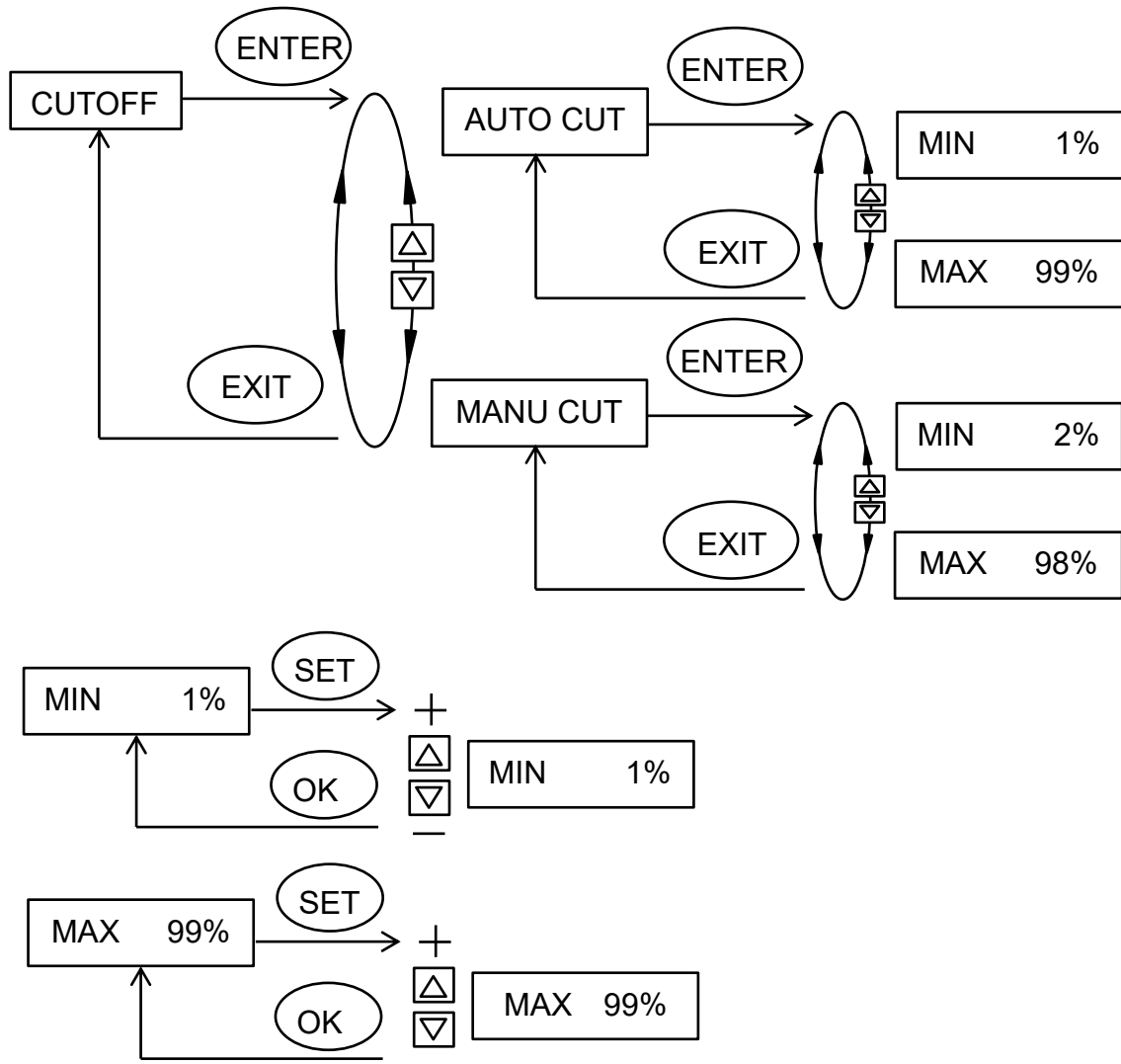
The function divides into AUTO CUT function in the automatic mode and MANU CUT function in the manual mode. Parameter MIN range: 0-25%, Parameter MAX range: 75-100%. When the function is enabled, the sign “cut off” is indicated on the operating interface.

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**

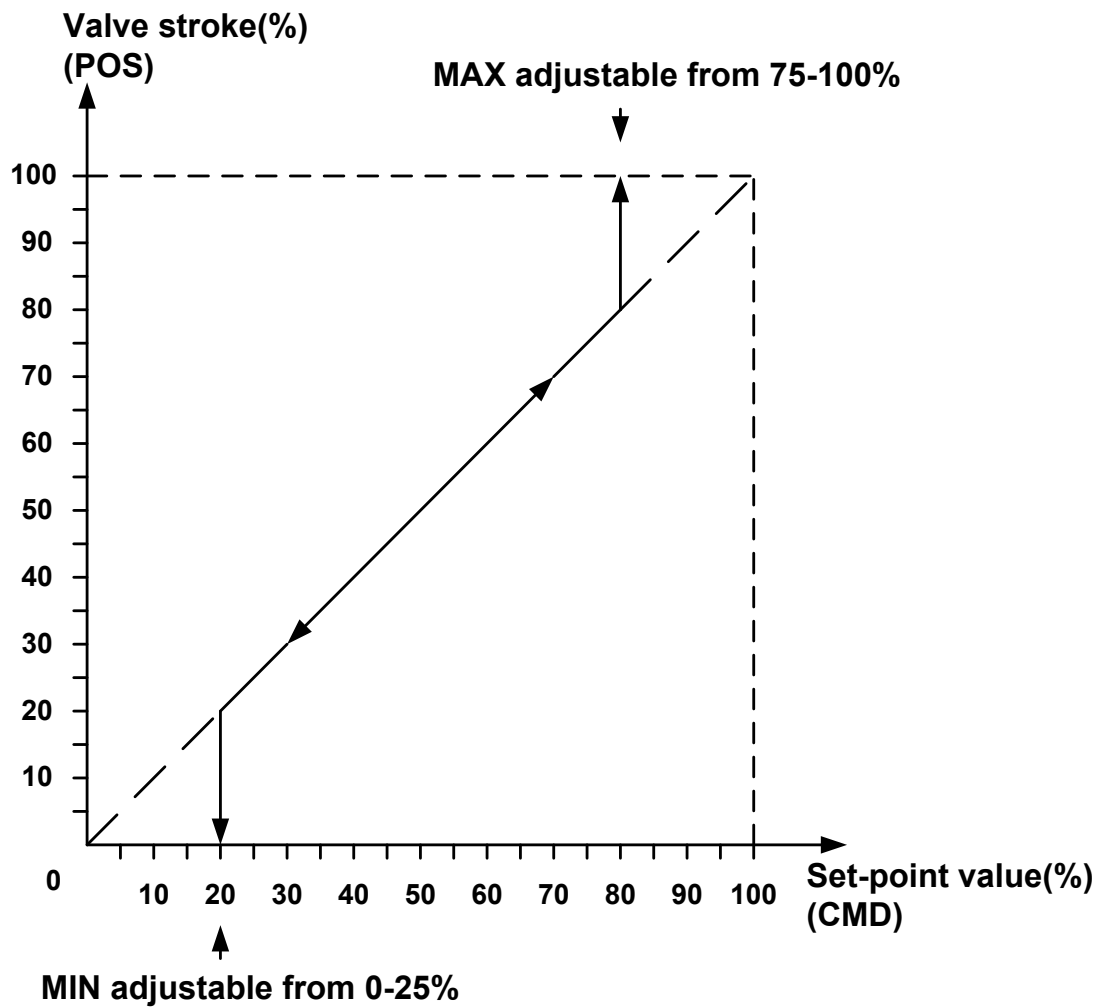


Figure 22. Graph CUTOFF

### 5.3.3.3. DIR CMD

Factory setting:

DIR CMD option: RISE

The function is to set the effective sense of direction between the input signal and the position set-point value (CMD).

RISE: 0/4 mA or 0 V → 0%, 20 mA or 5/10 V → 100%.

FALL: 0/4 mA or 0 V → 100%, 20 mA or 5/10 V → 0%.

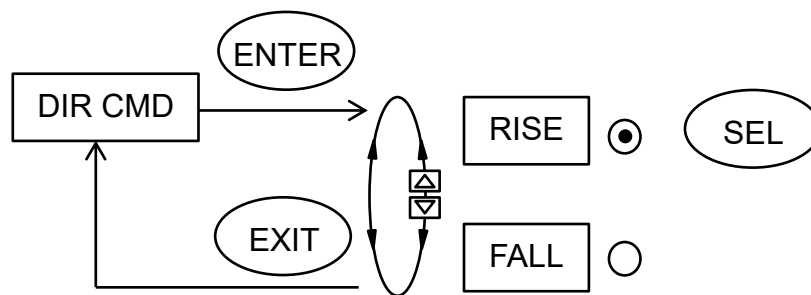


Figure 23. Operating structure DIR CMD

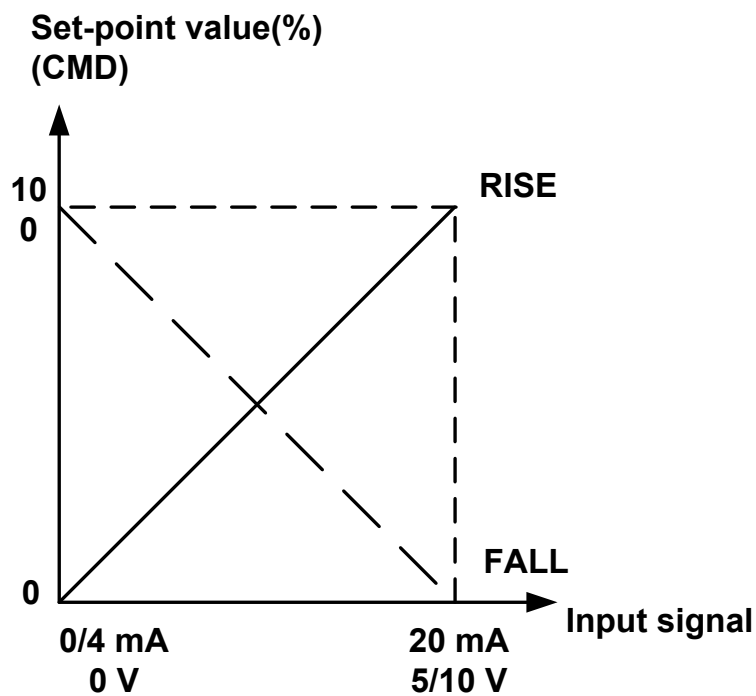


Figure 24. Graph DIR CMD

#### 5.3.3.4. 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 be 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.

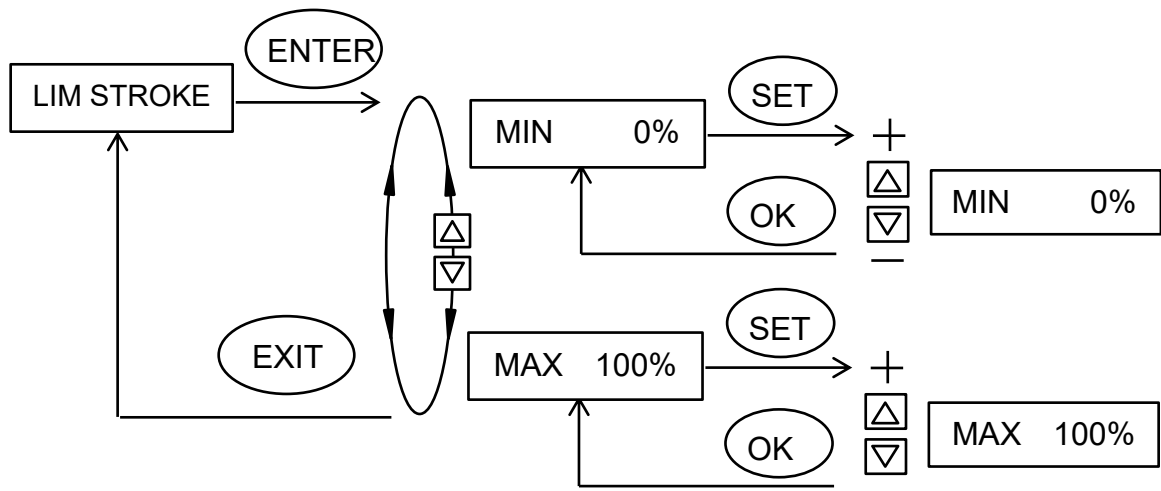


Figure 25. Operating structure LIM STROKE

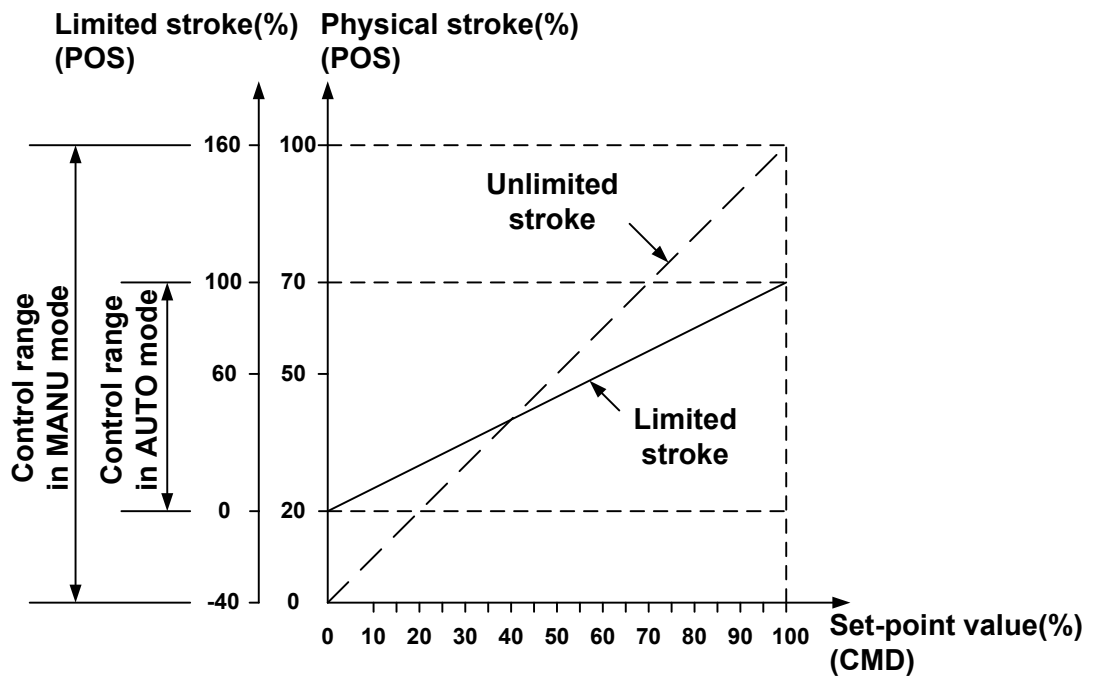


Figure 26. Graph LIM STROKE

**NOTE!**

Please do not set the minimum gap between Min and Max too small in application, since it may increase the difficulty of valve stroke adjustment. If to do so for necessary, please change the AUTO DB value bigger.

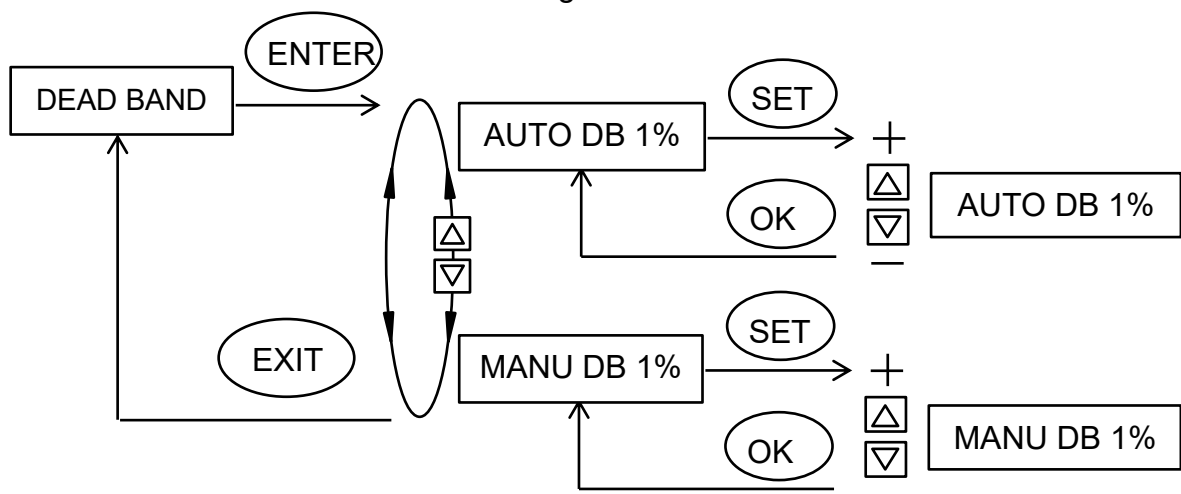
### 5.3.3.5. DEAD BAND

Factory setting:

AUTO DB value: 1%

MANU DB value: 1%

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. 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 27. Operating structure DEAD BAND**

#### NOTE !

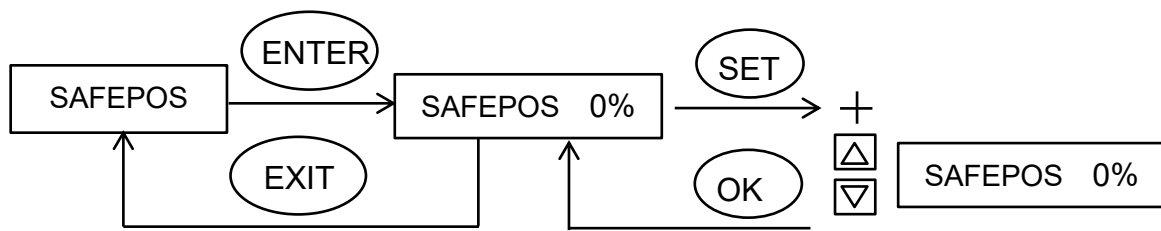
The smaller the dead band setting, the higher the control accuracy getting. Please set the dead band value in reason. Because the too small value may cause the solenoid valve in the body to act frequently and lead to long adjustment time and unstable working state.

### 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 28. Operating structure SAFEPOS**

### 5.3.3.7. BINARY IN

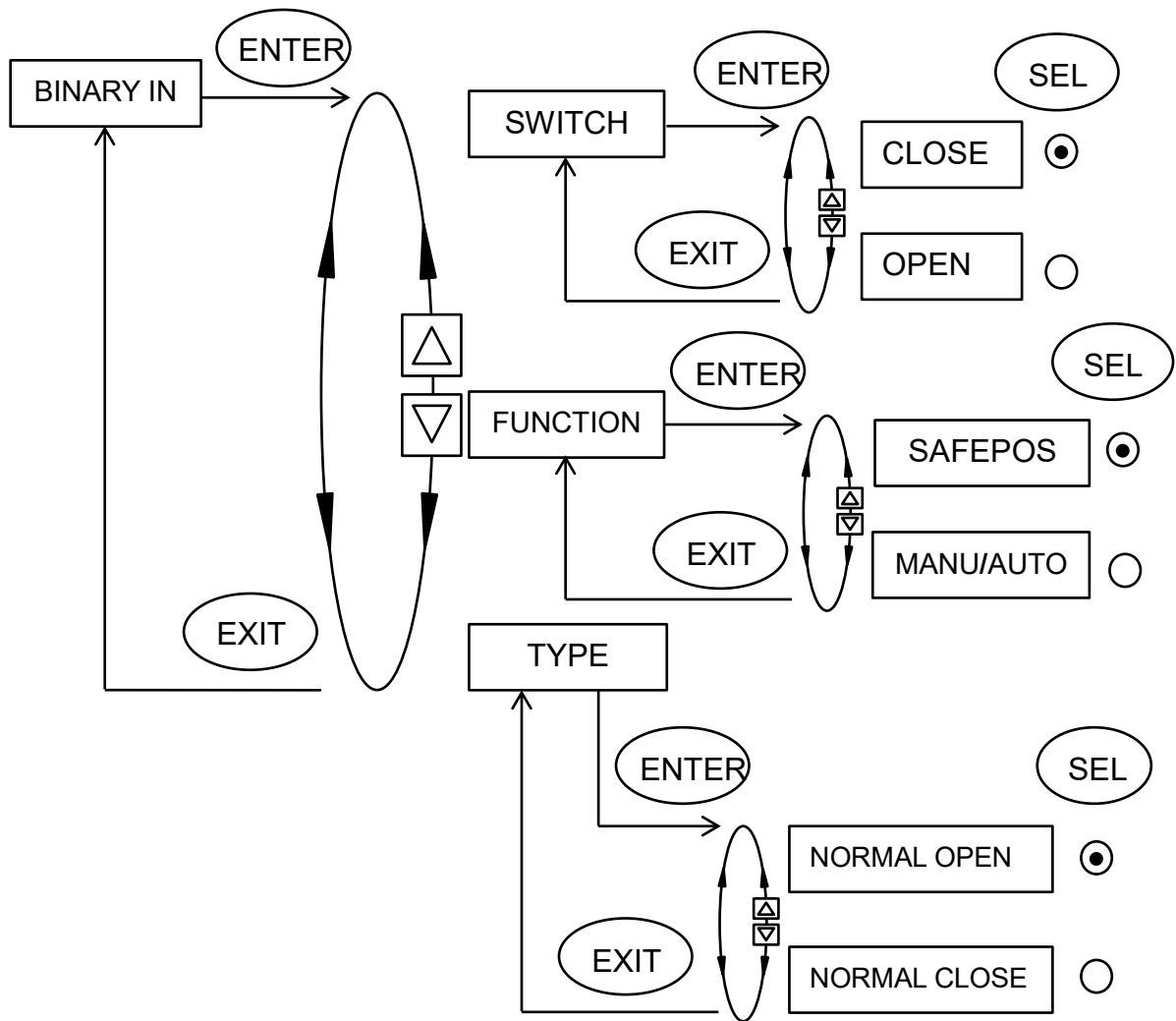
Factory setting:

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.



**Figure 29. 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 7. Option BINARY IN**

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

**Table 8. Option BINARY IN FUNCTION**

### 5.3.3.8. OUTPUT

Factory setting:

ANALOGUE option: POS

ANALOGUE TYPE option: 4-20 mA

BINARY option: LIM DEV

BINARY VAL DEV value: 10%

BINARY VAL POS 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: analogue signal of the current position (POS) or of the set-point value (CMD). Four output signal type (4-20mA, 4-20mA, 0-10V, 0-5V) can be selected.

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



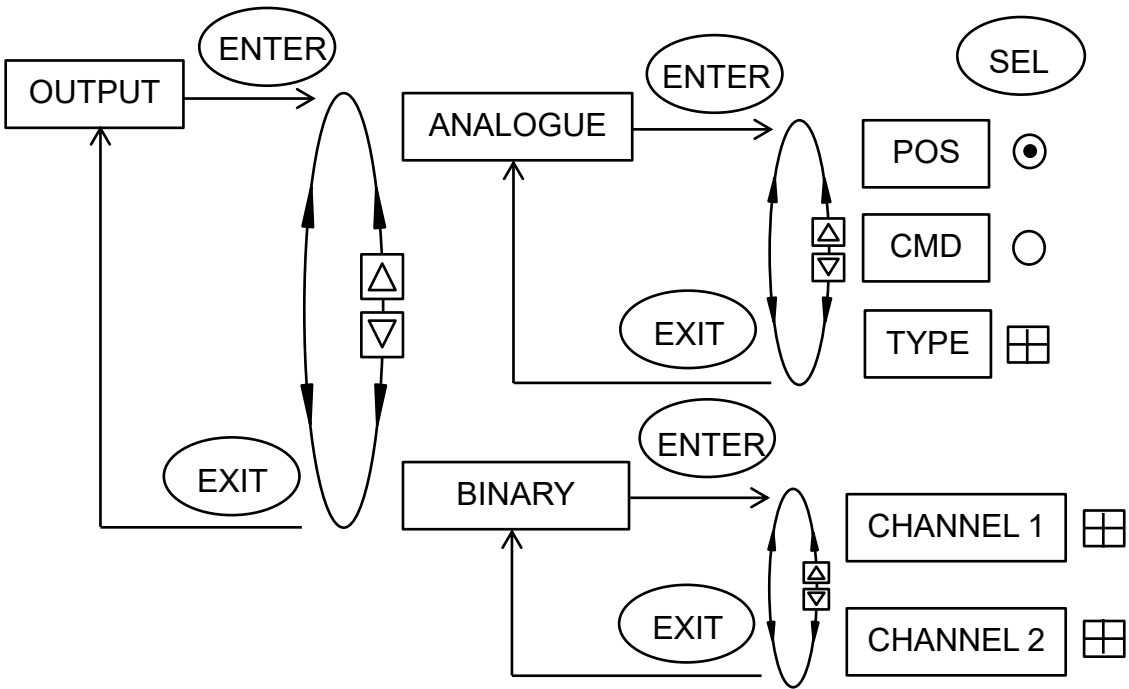


Figure 30. Operating structure OUTPUT

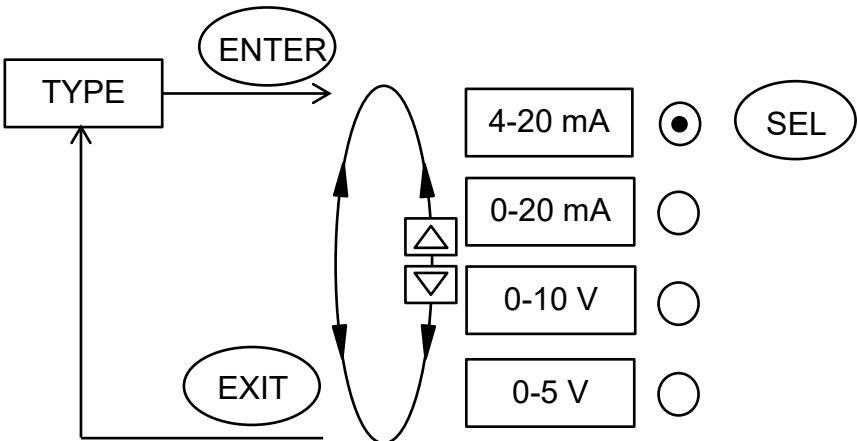
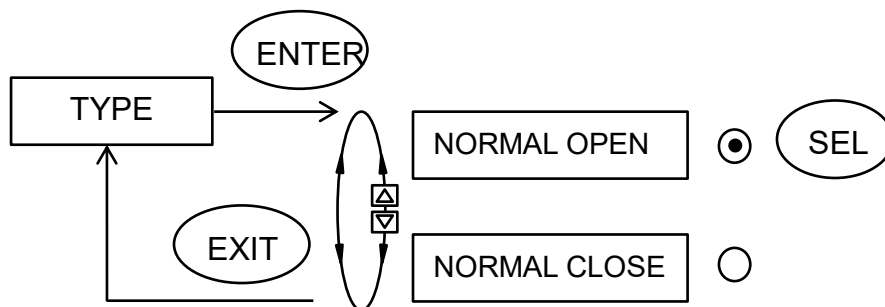
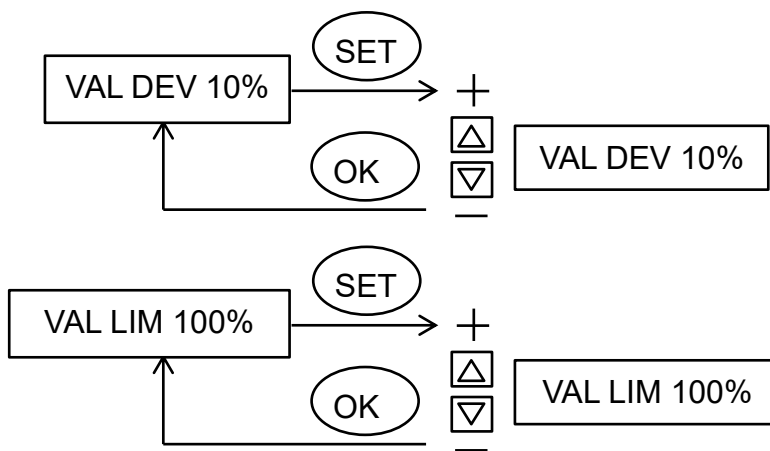
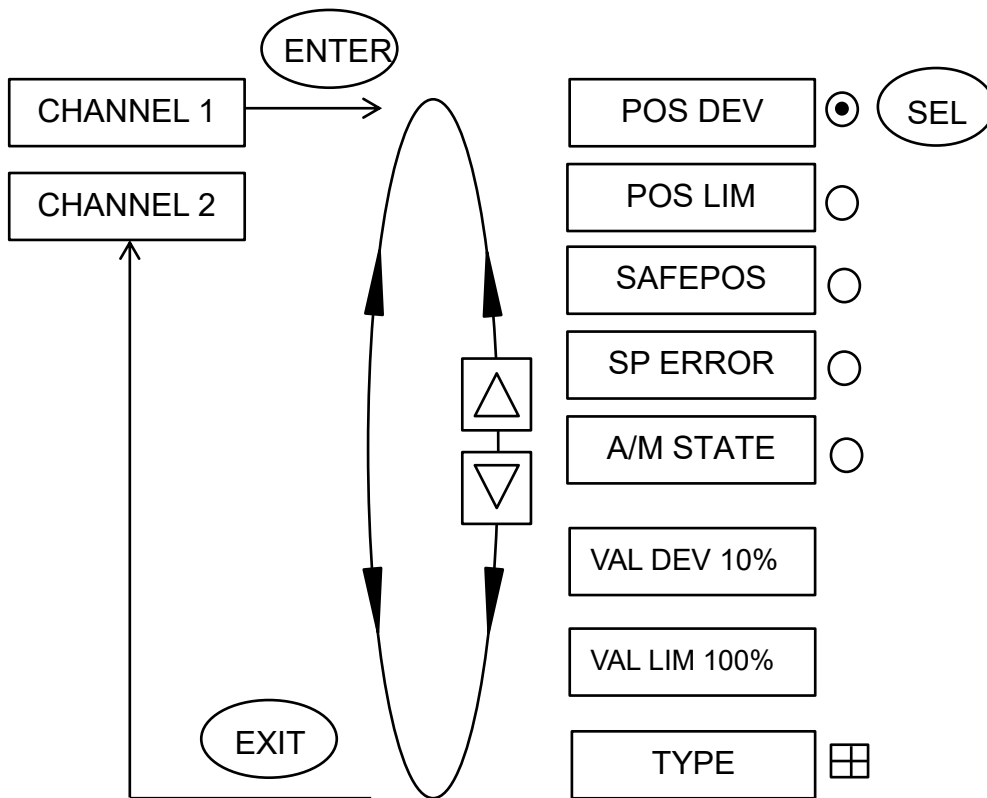


Figure 31. Operating structure ANALOGUE TYPE



**Figure 32. Operating structure OUTPUT BINARY**

Option	Description
POS DEV	<p>Output for excessively large control deviations of the positioner in the automatic mode.</p> <p>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).</p> <p>The function is inactive in the manual mode and keeps previous state.</p>
POS LIM	<p>Output for the compare relation between the current position and a specified limit position in the automatic mode.</p> <p>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).</p> <p>The function is inactive in the manual mode and keeps previous state.</p>
SAFEPOS	<p>Output for the current position whether is in safety position in the automatic mode.</p> <p>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).</p> <p>The function is inactive in the manual mode and keeps previous state.</p>
SP ERROR	<p>Output for error signal for set-point value.</p> <p>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).</p>
A/M STATE	<p>Output for the state of operating mode.</p> <p>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</p>

	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 9. Option OUTPUT BINARY**

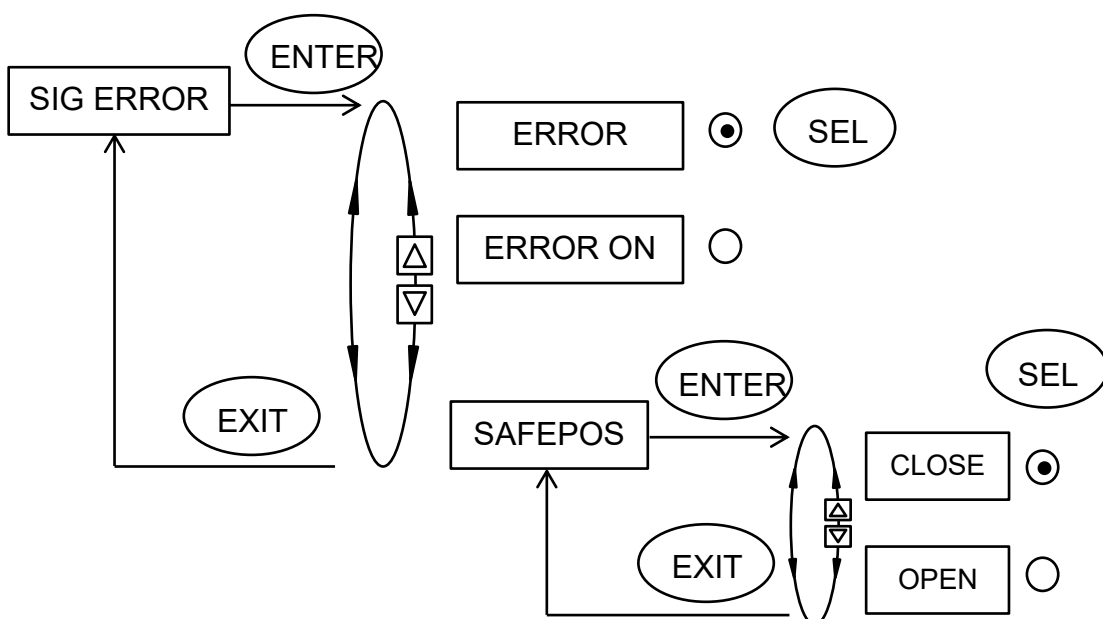
### 5.3.3.9. SIG ERROR

Factory setting:

SIG ERROR option: ERROR OFF

SIG ERROR SAFEPOS option: CLOSE

The function is used to detect the error of 4-20mA input signal, but can not detect input signal of other types. The error condition is the value of 4-20mA input 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.



**Figure 33. Operating structure SIG ERROR**

Option	Description
ERROR OFF	Signal error detection is inactive.
ERROR ON	Signal error detection is active.
SAFEPOS	<p>The SAFEPOS function is enabled by selecting OPEN and ERROR ON option when detecting the error signal.</p> <p>The Actuator is fully deaerated by selecting CLOSE and ERROR ON option when detecting the error signal.</p>

Table 10. 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 INPUT MIN for 4-20mA: 786

CAL INPUT MAX for 4-20mA: 3932

CAL INPUT MIN for 0-20mA: 0

CAL INPUT MAX for 0-20mA: 3932

CAL INPUT MIN for 0-10V: 0

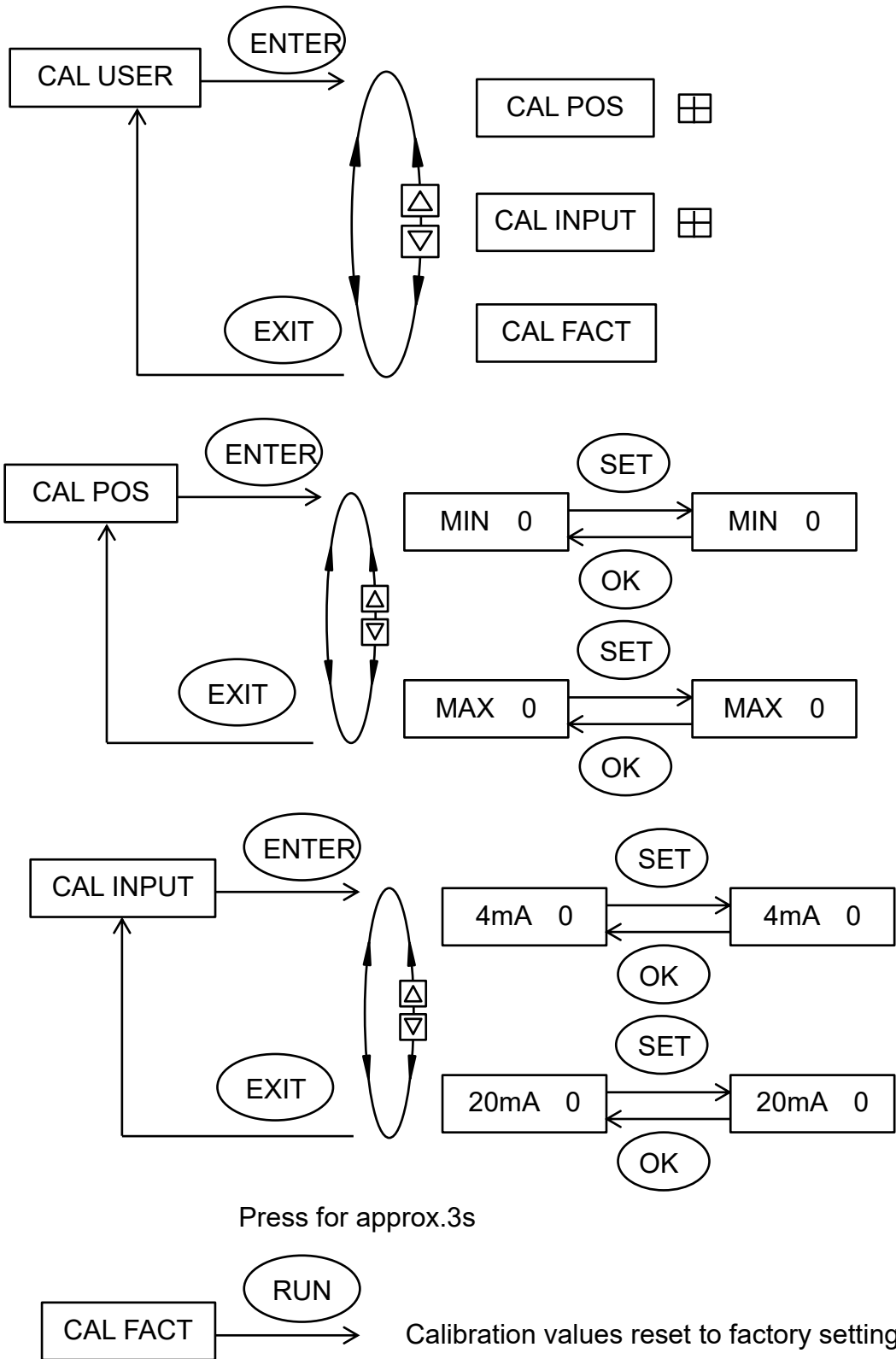
CAL INPUT MAX for 0-10V: 3901

CAL INPUT MIN for 0-5V: 0

CAL INPUT MAX for 0-5V: 1950

The function is used to calibrate the scale value for valve stroke and input 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 34. 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 INPUT	Calibrating the scale values for input 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 and CAL CMD reset to factory settings.

**Table 11. Option CAL USER**

When the system is running CAL POS or CAL INPUT 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.

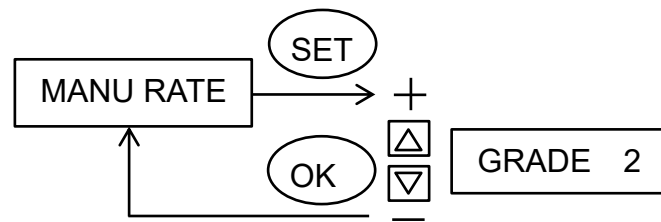
**5.3.3.11. MANU RATE**

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 35. Operating structure MANU RATE**

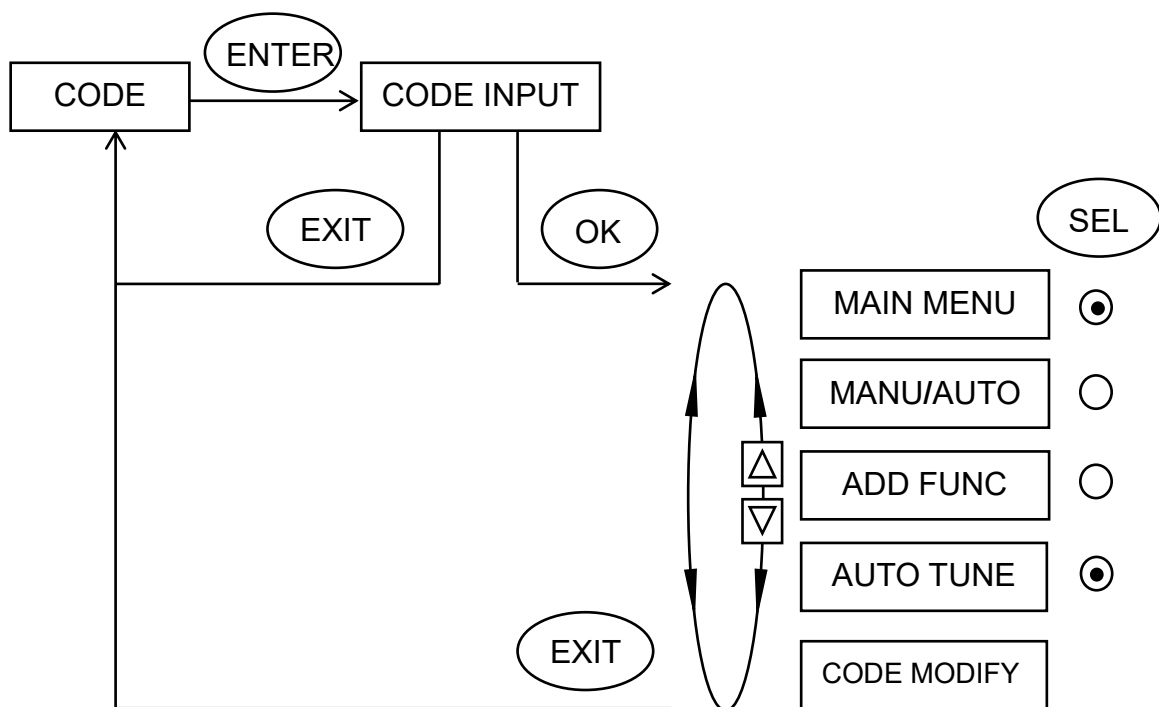
### 5.3.3.12. CODE

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 36. Operating structure CODE**

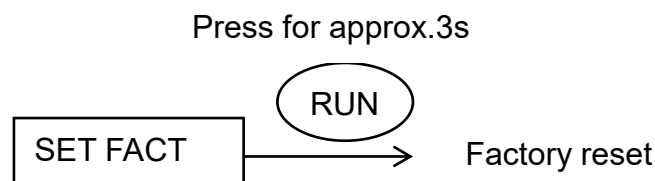


Options	Description
MAIN MENU	Code protection for entering the main menu.
MANU/AUTO	Code protection for switching between automatic mode and manual mode.
ADD FUNC	Code protection for entering the auxiliary function menu.
AUTO TUNE	Code protection for running automatic adjustment.
CODE MODIFY	Modify the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

**Table 12. 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 37. Operating structure SET FACT**

## 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 can not 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. 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 product warranty period is 18 months from the date of 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. Such as follows:
    - 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.



Version 1.0.3

The changed contents of this manual are not noticed.

The Company reserves the final interpretation for related technical updating.