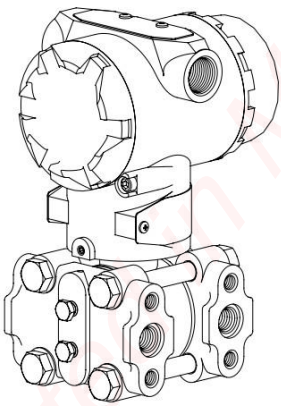
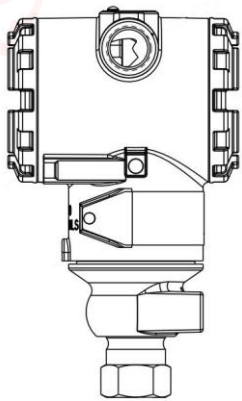
TEKSENS

T2906

DIGITAL INTELLIGENT PRESSURE TRANSMITTER / DIFFERENTIAL PRESSURE TRANSMITTER

INSTRUCTION MANUAL





Warning

1. Place the transmitter horizontally before adjusting.
2. Adjust the zero point of the transmitter after it is installed on site.
3. The process connection should be well installed and tightened before the transmitter is pressurized.
4. The transmitter should be installed in a dry environment preventing from getting wet by rain. In harsh environments, protection box for the transmitter should be used.
5. It is forbidden for the user to disassemble the transmitter by self.
6. Do not disassemble the transmitter cover in an explosive/flammable environment when power is on.
7. Please check if the transmitter power supply voltage meets the power supply voltage requirements in the manual.
8. The external grounding screw of the transmitter should be connected to the ground securely.
9. The installation of the transmitter in an explosive environment must comply with international, national and local standards, specifications and guidelines. Please refer to the restrictions on safe installation listed in the Explosion-proof section of the manual.
10. Installation and use of the intrinsically safe transmitter with safety barrier shall be carried out according to the specific instruction manual.
11. When doing transmitter calibration and temperature compensation using HART communication, use the communication equipment and software provided by the manufacturer.

Contents

Introduction

The intelligent transmitter produced by our company is a multi-functional digital instrument. It is designed with advanced, mature and reliable silicon sensor or capacitive sensor technology combined with advanced single-chip technology and sensor digital conversion technology.

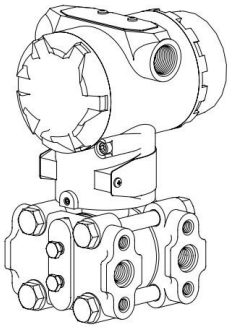
The powerful functions and high-speed computing capabilities of MCU, the core component, ensure the excellent quality of the transmitter. The entire design framework focuses on reliability, stability, high-precision and intelligence.

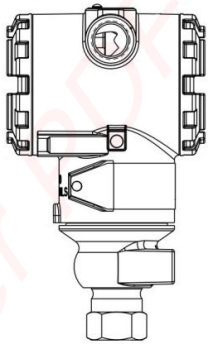
The transmitter has powerful interface operation function. The digital header can display pressure, percentage, current, and 0~100% analog indication. By key operation, zero point shift, range setting and damping setting can be easily completed without standard pressure source. The setting of basic parameters is very convenient for on-site comissioning.

Signal conversion, signal acquisition and processing, and current output control use the application-specific integrated circuit (ASICS) to make the transmitter stable, reliable, and vibration-resistant, with good interchangeability.

1.Introduction

1.1 Overall appearance





1.2 Intelligent transmitter working principle

1.2.1 Working principle

Figure 1-1 is an electrical block diagram of the basic working principle of an intelligent transmitter. The working principle and functions of the various components will be described below.

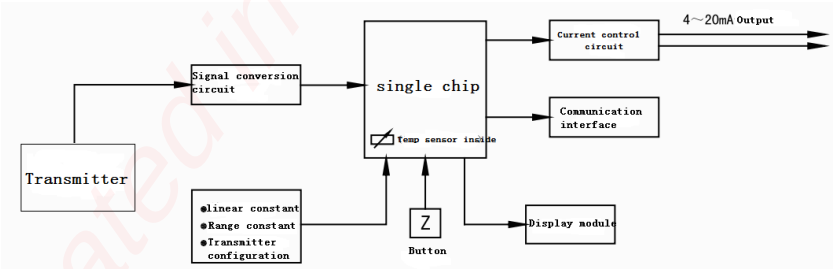


Figure 1-1 block diagram of Transmitter principle

1.2.2 Intelligent circuit board

1) A/D conversion

The A/D conversion circuit uses a dedicated low-power integrated circuit to convert the analog current output into a digital quantity by the demodulator with an accuracy of up to 18 bits, which is supplied to the microprocessor as an input signal.

2) Microprocessor

The microprocessor of the intelligent transmitter controls the A/D and D/A conversion work, and can also complete self-diagnosis and realize digital communication. During work, a digital pressure value is processed by the microprocessor and stored as a digital to ensure precise correction and engineering unit conversion. In addition, the microprocessor can also perform sensor linearization, turndown ratio, damping time, and other functional settings.

3) EEPROM memory

The EEPROM stores all configuration, characterization and digital trimming parameters. This memory is non-volatile, so even if the power is turned off, the stored data can be kept intact, so that intelligent communication can be realized at any time.

4) D/A conversion

The D/A conversion converts the corrected digital signal sent from the microprocessor into a 4-20 mA analog signal and outputs it to the loop.

5) Digital communication

Transmitters with the HART protocol can test and configure intelligent transmitters via a single communicator. Or complete communication through any host system host that supports HART communication protocol. The HART protocol uses the industry standard BELL202 frequency phase shift keying (FSK) technology to superimpose the digital signal of 1200Hz or 2000Hz on the 4~20mA signal to realize communication. When communicating, the frequency signal does not cause any interference to the 4~20mA process.

Intelligent transmitters can be tested and configured with dedicated adapters and software without HART protocol transmitters.

6) Display and buttons

The Intelligent transmitter with liquid crystal display can display the pressure value, current value, 0%-100% ratio display and temperature value of the sensor measured by the transmitter, and the transmitter can be configured through the buttons on the LCD panel.

Intelligent transmitters without display can also be used to clear, actively calibrate the transmitter through the S and Z buttons on the line panel.

2. Installation

2.1 On-site installation

2.1.1 Installation method

Our pressure transmitters can be mounted directly on 2" pipes

Or mount directly on the wall and on the dashboard. (as shown in Figure 2-1 and Figure 2-2)

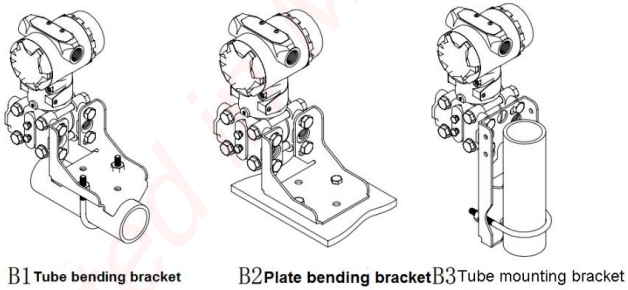


Figure 2-1 Capacitive transmitter installation

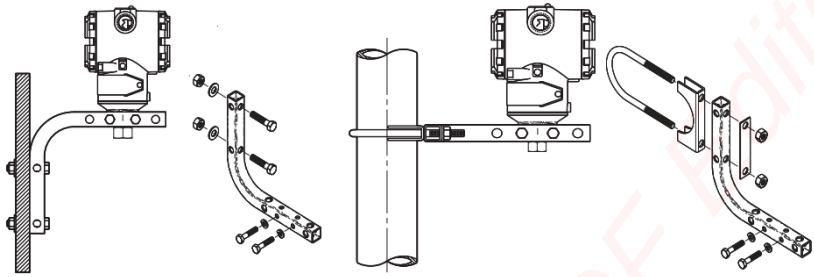


Figure 2-2 Piezoresistive transmitter installation

After loosening the locking screw, the electronic compartment can be rotated 90° left and right. As shown in Figure 2-3.

Warning: Do not rotate more than 90°! So as not to break the internal cable!

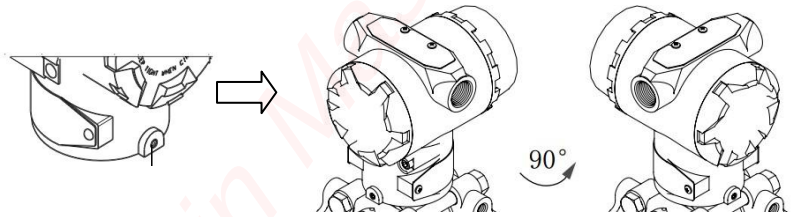
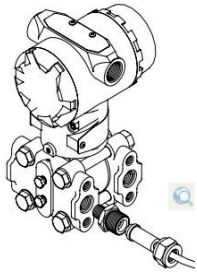


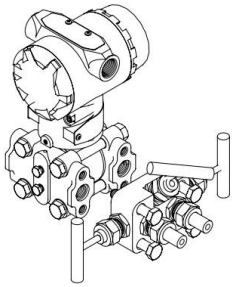
Figure 2-3 Housing rotation

2.1.2 Pressure method

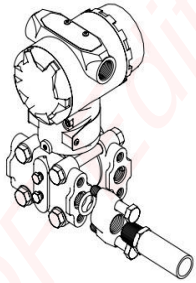
There are three types of capacitive transmitters, as shown in Figure 2-4:



Waist flange type



Welding pipe joint type



Integration of the three valve type

Figure 2-4 Capacitor transmitter pressur

The pressure-receiving type of the piezoresistive transmitter is mainly a screw connection method, and the user can provide a pressure-welded joint according to the specific thread specification.

2.1.3 The process connection hole distance adjustment of differential pressure transmitter

The process connection holes on the pressure chamber are 1/4-18 NPT. These process connection holes require a thread seal. When using a waist flange joint, the transmitter can be easily removed from the production unit by simply removing the upper and lower bolts of the joint. The center distance between the two process connection holes is 54 mm. Rotating the waist flange joint, the center distance can be changed to 50.8 mm, 54 mm, 57.2 mm as shown in the figure 2-5：

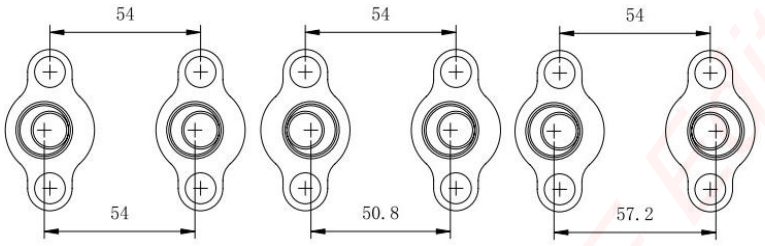


Figure 2-5 Connection hole distance of differential pressure transmitter

2.1.4 Installation Precautions

1. Prevent the transmitter from coming in contact with the measured medium with corrosivity or high temperature (≥ 90 °C).

2. Prevent the dross from depositing in the pressure tube.

3. Get the pressure tube shortened as possible as it can.

4. Keep balance between the liquid heads in the pressure tubes on both sides of the differential pressure transmitter.

5. Install the pressure tube in a place with small temperature gradient and temperature fluctuation.

6. Prevent from the crystallization or low-temperature freeze in the pressure tube.

2.2 Relevant Issues of measurement methods

Liquid measurement:

When measuring the flow rate of the liquid, the pressure tap should be opened on the side of the process piping to avoid sedimentation of the dross. At the same time, the transmitter should be installed beside or below the pressure tap to allow air bubbles to be discharged into the process piping.

Gas measurement:

When measuring the gas flow, the pressure tap should be opened on the top or side of the process piping. And the transmitter should be mounted beside or above the process piping so that the accumulated liquid can easily

flow into the process piping.

Steam measurement:

When measuring the steam flow, the pressure tap should be opened on the side of the process piping and the transmitter is installed below the pressure tap so that the pressure tube can be filled with the collected cold liquid. It should be noted that when measuring steam or other high temperature media, the temperature should not be higher than the limiting operating temperature of the transmitter. When the measured medium is steam, the pressure tube should be filled with water to prevent the steam from directly contacting the transmitter so that the volume change of the transmitter is negligible when the transmitter is working, and there is no need to install a condensing tank.

Level measurement:

The differential pressure transmitter used to measure the liquid level is actually the static head that measures the liquid column. This pressure is determined by the level and the specific gravity of the liquid, and it's equal to the liquid level above the pressure tap multiply by the specific gravity of the liquid, regardless of the volume or shape of the container.

- **Liquid level measurement of open containers**

When measuring the liquid level of the open container, the transmitter is mounted close to the bottom of the container to measure the pressure corresponding to the liquid level above the transmitter. The pressure of liquid level in the container acts on the high-pressure side of the transmitter while the low-pressure side is connected with the atmosphere. If the lowest level of the measured level changes is above the place where the transmitter is mounted, the transmitter must make the positive transfer.

- **Level measurement of closed containers**

In the closed container, the pressure P0 of the container above the liquid affects the measured pressure at the bottom of the container. Therefore, the

pressure at the bottom of the vessel is equal to the liquid level multiply by the specific gravity of the liquid plus the pressure P0 of the closed container. In order to measure the actual level, the pressure P0 of container should be subtracted from the measured pressure at the bottom of container. For this reason, open a pressure tap on the top of the container and get it connected to the low-pressure side of the transmitter. Thus, the pressure in the container acts on both the high and the low pressure sides of the transmitter at the same time. As a result, the differential pressure obtained is proportional to the product of the liquid level and the specific gravity of the liquid.

● Pressure connections

1) Dry pressure connection

If the gas above the liquid does not condense, the connecting tube on the low-pressure side of the transmitter will remain dry. This condition is called the dry pressure connection. The method of determining the measurement range of the transmitter is the same as the method of determining the measuring liquid level of opening container.

2) Wet pressure connection

If the gas above the liquid condenses, the liquid will gradually accumulate in the pressure tube on the low-pressure side of the transmitter so that the measurement error is caused. In order to eliminate this error, a certain liquid is previously filled in the pressure tube on the low-pressure side of the transmitter, which is called the wet pressure connection.

In the above case, there is a pressure head on the low-pressure side of the transmitter, so the negative transfer must be performed.

Reduce the error

The pressure tube connects the transmitter to the process piping, and transfers the pressure at the pressure tap on the process line to the transmitter. The causes of errors in the pressure transfer process are as follows:

1) Leakage;

2) Wear loss (especially when the detergent is used)
3) There is the gas in the liquid pipeline (causing the pressure head error).
4) Accumulated liquid in gas pipeline (causing the pressure head error)
5) Density difference between the pressure tubes on both sides due to the temperature difference (causing pressure head error)

The methods of reducing the errors are as follows:

1) The pressure tube should be as short as possible.
2) The pressure tube should be connected upward to the process pipeline and its slope should be less than 1/12 When measuring liquid or steam.
3) For the gas measurement, the pressure pipe should be connected downward to the process pipeline, and its slope should be not less than 1/12.
4) The layout of the liquid pressure pipeline should avoid the occurrence of high points in the middle, and the layout of the gas pressure tube should avoid the occurrence of low points in the middle.
5) The two pressure should maintain the same temperature.
6) In order to avoid the influence of friction, the diameter of the pressure tube should be large enough.
7) There should be no gas in the pressure tube filled with liquid.
8) When using the spacer liquid, the liquid in the pressure tubes on both sides should be the same.
9) When using the cleaning agent, the connection of the cleaning agent should be close to the pressure tapping of the process pipeline. The length and diameter of the pipes through which the cleaning agent passes should be the same. The cleaning agent should be prevented from passing through the transmitter.

2.3 Electrical Installation

Wiring diagram of system:

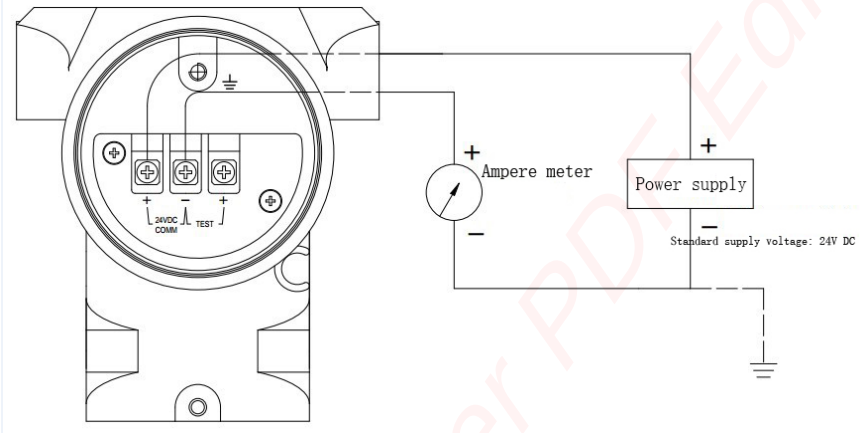


Figure 2-6

(Note 1: Please refer to the usage methods of distributor and safety barrier if the users require the distributor or safety barrier according to the site and design requirements.)

It is recommended to wire the explosion-proof cable to the terminal, the cable diameter is φ8~ φ12. The terminal of the cable is designed with the test end to facilitate the operator to test online. The signal terminals are located in a separate cabinet of the electrical box. Unscrew the cover of indicator to make the wire connection. The upper terminal is the signal terminal and the lower terminal is for the test meter. Figure 2-11 shows the terminal position. The test terminal is used to connect with the optional indicator or for testing. The power is sent to the transmitter through the signal line, no additional wires are required.

! Pay special attention:
Do not connect the signal line with power to the test terminal, otherwise the diode inside the test terminal will be destroyed.

If the diode is damaged unfortunately, the direct connected (not through the shield plate) test terminal can make the transmitter keep working, but it will not be able to connect to the local indicator.

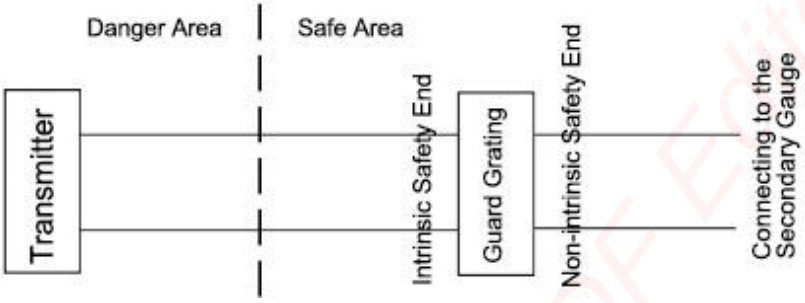
The signal line does not need to be shielded, but the effect will be better if the stranded wire is used. The signal line should not be arranged together with other power lines, or near the heavy current installation.

The threading hole of the transmitter housing should be sealed or inserted with a plug coated with the sealant, so as to prevent the moisture accumulation in the housing. If there is no sealing for the wiring, during the transmitter installation, the threading hole should face downward to discharge water.

The signal line can be un-grounded (floating) or the ground connection can be on the arbitrary point of the signal loop line. The transmitter housing can be grounded or un-grounded; there is no voltage stabilization requirement for the power supply, and even if the peak-peak value of the power ripple reaches 1V, the transmitter output ripple can still be ignored. Because the ground connection of the transmitter is through capacity coupling, please don't use the high voltage tramegger to check the insulation resistance. The voltage to be used to check the lines should not be more than 100V.

The transmitter circuit design is the intrinsic safety circuit, and the output current is limited below 24mA DC (24mA DC under the condition of high temperature or high supply voltage).

2.4 Intrinsic Safety Explosion-proof Type Transmitter System Wiring Diagram



Ui:28v DC	Um ≥ 250V AC/DC
Ii:30mA	Uo ≤ 28V DC
Pi:0.84W	Io ≤ 30mA

Notes: ① Please refer to GB3836, 4-2000 standards for the definitions of Vm, Vo, Io, Po, Vi, Ii and Pi.

② The maximum allowable distributed capacitance CP for the wire or cable connection between the guard grating and the transmitter is not greater than 0.02uF, and the maximum allowable distributed inductance LP is not greater than 2.0mH.

2.5 Isolation Explosion-proof Type Transmitter Instruction

■ During the installation for the isolation explosion-proof type transmitter, attention should be paid to the protection for the explosion-proof joint face and the explosion-proof measures; the end cover must be screwed tightly and the locking device must be locked tightly; the housing should be grounded; during the loading and unloading for the parts of the plane gap, please prevent the gap from becoming bigger caused by plane collision and scratch; please prevent the housing from falling, crash or damage, so as not to reduce the strength; after the completion of the instrument maintenance inspection, all the bolts, housings and wirings must be fastened, and cannot be damaged, or else the explosion-proof performance will be lost.

■ For the isolation explosion-proof type transmitter, it is forbidden to open or loosen the end cover or housing under the energized condition on site.

■ The isolation explosion-proof type transmitter has two outlet ports, and one of them is adopted for leading in cable connection, and its cable connector should adopt the dedicated compression nut type explosion-proof leading-in device. The tightly screwed hollow bolt, gasket, sealing rubber ring are set along the external diameter of the cable, put into the port and screwed tightly; the sealing ring must be ensured to be tightly packed along the external diameter of the cable, and the hollow bolt must be screwed in for over 6 screw threads. The other outlet port must be equipped with the sealing rubber ring, gasket, solid bolt as well, and the solid must be screwed tightly; it must be screwed in for over 6 screw threads, too. In order to meet the explosion-proof requirements, the cable with the model KVVR with the diameter of 1.5*4 and the outside core diameter of 10mm(10.5mmMAX) should be selected.

■ The structure and parts of the isolation explosion-proof type transmitter has passed the strict inspections and tests according to the isolation explosion-proof type standard, conforming to the regulation of the national standard GB3836.2—2000 Explosion-proof Electrical Equipment and Isolation Explosion-proof Type Electrical Equipment “d” Applied in the Explosive Environment, and its symbol is EXds Ⅱ BT5.

3.Debugging and Operation

3.1 Overview

Panel Figure for the Circuit Board without Display

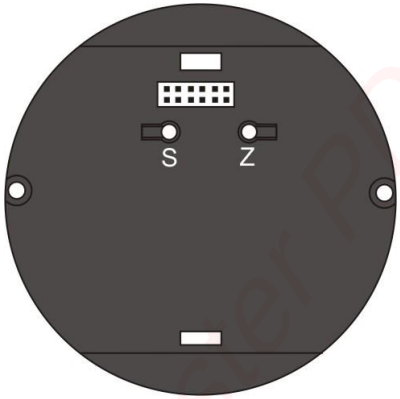


Figure 3-1

Panel Figure for the LCD Display Gauge Head

Figure 3-2

3.2 Button Operation for the Transmitter without the LCD Display

When the transmitter has no display gauge head, the following operations can be performed by using the buttons S and Z (as shown in Figure 3-1) originally equipped on the circuit board.

3.2.1 Resetting

Please make sure the transmitter is in the “power on” status and in the status of zero pressure compression, press and hold both S button and Z button for more than 5 seconds, then release the two buttons at the same time, press and hold the two buttons again for about 2 seconds, and the transmitter will be reset according to the current pressure value.

3.2.2 Lower limit calibration (Zero point active transfer)

Please make sure the transmitter is in the “power on” status and in the status of lower limit pressure range compression, press and hold both S button and Z button for more than 5 seconds, then release the two buttons at the same time, press and hold Z button again for about 2 seconds, and the transmitter will adopt the current pressure as the lower limit of the pressure range, but the pressure range of the transmitter won’t be changed. For example, the pressure range of the transmitter is 0-5kpa, and the current pressure is -1kpa; after this operation is carried out, the pressure range of the transmitter becomes -1-4kpa.

3.2.3 Upper limit calibration (Extreme point calibration)

Please make sure the transmitter is in the “power on” status and in the status of lower limit pressure range compression, press and hold both S button and Z button for more than 5 seconds, then release the two buttons at the same time, press and hold S button again for about 2 seconds, and the transmitter will adopt the current pressure as the upper limit of the pressure range, but the lower limit of the transmitter pressure range won’t be changed. For example, the pressure range of the transmitter is 0-5kpa, and the current

pressure is 4kpa; after this operation is carried out, the pressure range of the transmitter becomes 0-4kpa.

3.3 Button Operation for the Transmitter with the LCD Display

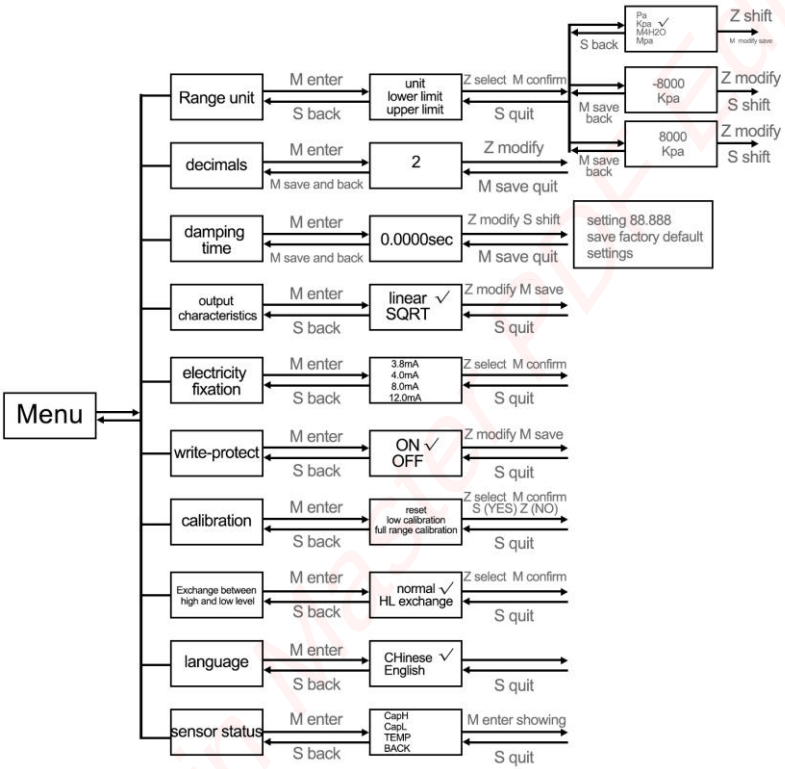
When the transmitter has the LCD display gauge head, the transmitter can not only realize the operation described in Item 3.2, but also realize the parameter configuration for the transmitter by using the three build-in buttons of the LCD display gauge head. Please refer to Figure 3-2 for the buttons.

Note: If the transmitter parameters cannot be modified, please modify the menu item "write-protection" into "off".

3.3.1 Button Instruction

Button Schema	Button Name	Button Function
	S	Return key under menu condition; Shift key under parameter setting condition; this key also have S key function of 3.2 item.
	M	Ack key of menu and parameter
	Z	Selection key under menu condition; Shift key under parameter setting condition; this key also have Z key function of 3.2 item.

3.3.2 Menu structure



3.3.3 Configuration operation

Make sure the transmitter has been turned on with the measurement display situation when the transmitter has been made a configuration operation. Press and hold down M key 5 seconds, and release the key after showing the main menu interface to enter the configuration menu interface. Return to main menu interface by pressing S key. The menu interface can be selected by

pressing Z key. The M key is confirming button.

After enter into parameter setting interface, we can select the item that includes figure, decimal point and minus which need to be modified circularly by pressing S key. The selected item can be modified by pressing Z key. When figure is +1, the decimal place will be moved circularly, and the minus place is plus or minus selection. These modified items can be saved by pressing M key. The M key also can return to the previous menu.

For example:

1) Modifying unit

On the main menu interface

→Press Z key, and up and down arrow keys to move options. Select "range unit" and press M key.

→ Press Z key, and up and down arrow keys to move options. Select "unit" and press M key.

→ Press Z key to select unit and confirm by pressing M key. If we can see √ on the right side, that will be succeed, or we should check if the key "write-protection" is turned off.

→ Return to the previous menu by pressing S.

2) Modifying lower limit

On the main menu interface

→Press Z key, and up and down arrow keys to move options. Select "range unit" and short press M key.

→ Press Z key, and up and down arrow keys to move options. Select "lower limit" and short press M key.

→Select modifying place by pressing S key and short press Z key to modify the figure. Please check if "write-protection" is turned off if the key is not work.

→Save and return to the previous menu by pressing M.

3) Exchange between high and low level

On the main menu interface

→Press Z key, and up and down arrow keys to move options. Select “exchange between high and low level” and short press M key.

→ Press Z key, and up and down arrow keys to move options. Select “HL exchange” and short press M key. If we can see √ on the right side, that will be succeed, or we should check if the key “write-protection” is turned off.

→Save and return to the previous menu by pressing M.

4) Factory reset

On the main menu interface

→Press Z key, and up and down arrow keys to move options. Select “damping time” and short press M key.

→Select modifying place by pressing S key and short press Z key to modify the figure as “88.888”.

→Save by pressing M. The parameter of transmitter will be reset to the factory defaults.

Other operation can be seen in menu structure.

In the situation of menu or parameter setting, transmitter will be quitted from parameter configuration operation and return to the measurement status when there is no operation for the key around 15 seconds.

4.The flange transmitter installation & operation instructions

4.1 Overview

Capacitive flanged differential pressure or pressure transmitter was connected by flange and the parts to be tested. It was applied to the conditions as below.

① Put the high temperature medium and transmitter in insulation.

②The measured medium is corrosive to the transmitter sensitive element.

③The measured medium is suspension liquid or with high viscosity.

④The measured medium is easy to solidify because of the changing of environment or temperature.

⑤ Use the measuring head that will be purified strictly to replace the measured medium.

⑥ Make sure the measuring head is cleaned. Capacitive flange differential pressure or pressure transmitter will be used to measure the differential pressure parameter of liquid, gas and vapor and the liquid level, interface and density of liquid. The measuring head can measure the flow rate of gas, liquid and vapor and put the measured signal changed into 4～20mA DC two-wire system signal output together with orifice set, which will be regarded as instructions, records and the input signal of regulator to constitute automatic detection, records and controlling industrial automation system together with other instruments or industrial controlling computer.

4.2 Installation site

The flanged level transmitter was made by installing the flange into the tank or tank wall. When the pressure diaphragm position being strictly vertical the maximum zero changing is 28mm H2O. When the pressure diaphragm

position being strictly horizontal the minimum zero changing is 100mm H2O, when will be eliminated if it has no influence for the range. (we need add a insertion length variation for the plug-in flange.)

4.2.1 The installation site for the fareastone flange

When installing the fareastone flanged transmitter, there are restrictions on the height difference between pressure transmitter and flange and differential pressure level transmitter and flange.

We can see the data as below.

Range No.	Permissible height difference	
	Filling silicone oil	Filling fluorocarbon oil
4	3.84	1.89
5	19.2	9.48
6、7、8	Without this limit	

When pressure transmitter and flange or differential pressure level transmitter and flange are not in a same height, the zero will be changed because of the liquid column affecting. So it should be returned to zero after installation.

4.2.2

The changing of the measured medium temperature and environment will cause the zero drifting of transmitter. It can reduce the impact if we install as the methods below.

1.The transmitter and fareastone equipment does not shined by the sun directly.

2.Adjust zero with the changing of season.

3.Maintain the temperature constancy of fareastone capillary.

4.3 Calibration instrument

The calibration of flanged transmitter is generally same with normal transmitter. The only difference is that it needs certain equipment to make seal connection with flange. This equipment will show us the measurement

standard pressure.

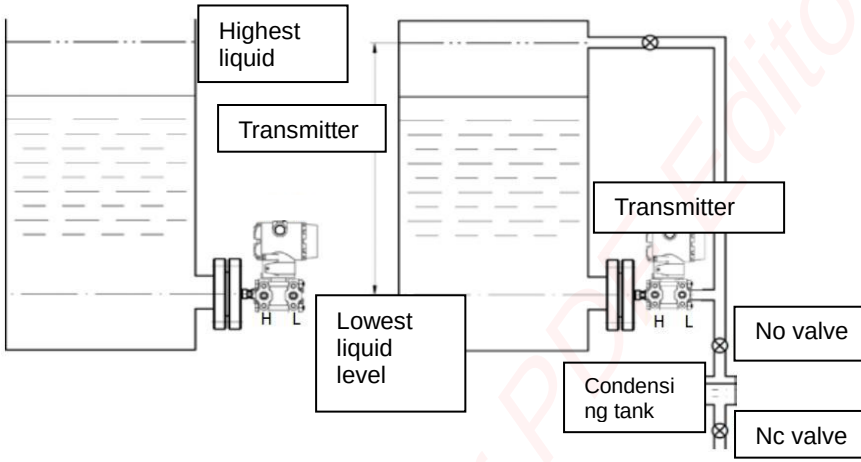
4.3.1 Flanged level transmitter

There are some notes in the using of flanged level transmitter. Flat flanged level transmitter should be used for normal sticky medium. Inserted flanged level transmitter should be used for big viscidity, easy to precipitate and suspension liquid medium. The measuring diaphragm must be penetrated into tower inwall, at least next to tower inwall. The measured medium may abrade the diaphragm if it has big flow rate and strong grinding. It can be used after adopting corresponding measures.

The measurement computing method of flat flanged level transmitter and inserted flanged level transmitter is same.

4.3.2 Using without migration (see below figure)

The instrument should be installed in the lowest liquid level as the same horizontal height. When we measure the open capacity, negative pressure diaphragm plate of instrument will be filled in atmosphere. When we measure the sealed container, the upside of vessel will be covered in negative pressure side diaphragm plate. If the side of negative pressure can keep dry, condensing tank will not be installed. Or condensing tank will be installed. The condensate will be drained away from the tank. Turn off the NO Valve when the condensate was drained away in order to make transmitter to support one-way pressure.



4.3.3 Using with negative migration (see below figure)

If it is inconvenience for installing condensing tank, or in order to prevent corrosive medium into negative pressure side, we can use spacer fluid as figure 4. In this situation, the differential pressure of the instrument is:

ΔP=r1(H＋H0)－r2h=r1H－(r2h－r1H0)

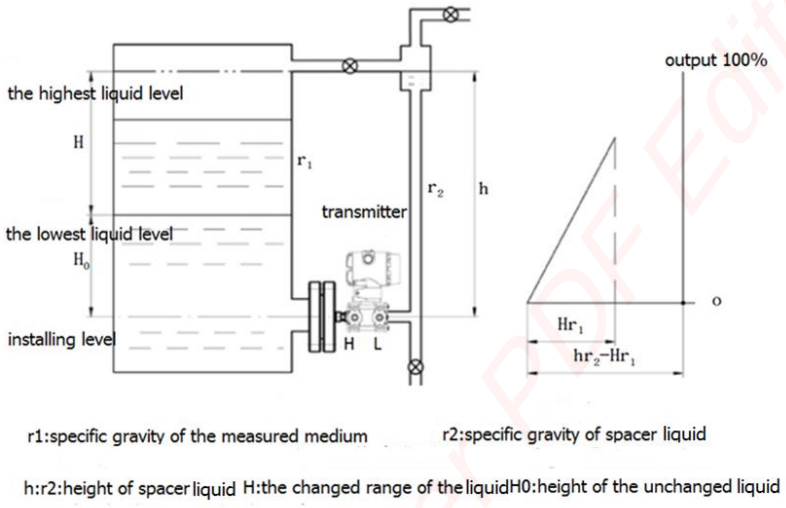
Volume of migration：B=r2h－r1H0

Range：P=r

For example：r1=1.4g/cm3，r2=0.89g/cm3

H=500mm，H0=100mm, h=1700mm

Range ：ΔP=r1·1=1.4×500=2100(mmH2O)



4.3.3 Usage of instrument with negative transfer (see figure below)

If it is inconvenient to install the condensing tank, or in order to isolate the corrosive medium from the negative pressure side, the spacer fluid can be used as shown in figure 4. In this case, the differential pressure of the instrument is:

ΔP=r1(H＋H0)－r2h=r1H－(r2h－r1H0)

Migration: B=r2h－r1H0

Range: P = r

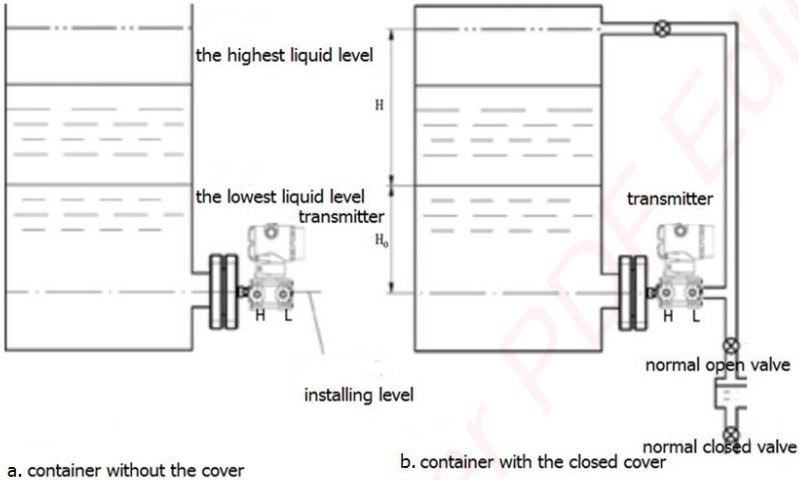
Example: known r1=1.4g/cm3，r2=0.89g/cm3

H=500mm，H0=100mm, h=1700mm

Range: ΔP=r1·1=1.4×500=2100(mmH2O)

Negative displacement: B=r2h－r1H0=0.8×700－1.4×100=1220(mmH2O)

Before installation the range shall be adjusted to -1220～880（mmH2O）



a. container without the cover

b. container with the closed cover