

SH Series Pressure Transmitters / DP Transmitters

OVERVIEW

SH Series Pressure Transmitters adopts full-isolated electric circuit technology; both the power supply and the sensor signal are isolated to improve the stability and anti-interference ability.

As well as zero and span adjustment, zero pressure trim, other parameters can be set by using combination of F1, F2, and F3 buttons on the display, such as adjust measuring range, zero and full scale without adding pressure, changing the engineering units, convert linearity/square-root, set the damping time and fix the current output.,etc.

SH series transmitters can also backup the parameters data and restore the parameters. When the data is damaged, by using three buttons, it can restore the data on line and back up the modified data timely.



WORKING PRINCIPLE

1. Sensor Working Principle

Process (Liquid\gas or steam) pressure is on the sensor diaphragm through one side pressure chamber of pressure transmitters, it conducts to the interior of the "center of the measuring diaphragm" by the "fill fluid", when it measures absolute pressure, The reference pressure is zero. When it's for gauge pressure, the reference pressure should be atmosphere. When it's for differential Pressure transmitter, the reference pressure would be the pressure of lower side. It conducts to the interior of the "center of the measuring diaphragm" by the same way on the other side. The "center of the measuring diaphragm" is a tension and elastic element, it consists of Pressure Capacitance with two sides capacitors; if there is any pressure, The "center of the measuring diaphragm" produces displacement deformation, the size of the displacement deformation depends on the pressure or differential pressure, the maximum displacement is 0.1mm. When The "center of the measuring diaphragm" is under pressure, it will make capacitance difference signal on the Capacitor. The capacitance difference signal is converted to a binary output DC signal (4-20mA) finally by Electronic Components. The capacity between Capacitors or The "center of the measuring diaphragm" is about 150PF, it's driven by an oscillator circuit (The frequency is about 32KHZ, Amplitude[Vp-p] is about 25V), it goes out after the modem rectifier circuit .T

2. Electronic Components Working Principle

The oscillation demodulator of the transmitters receives differential capacitance signal from Pressure/differential Pressure Transmitter. It converts the signal into a DC voltage signal and sends to A/D signal converter, the Voltage Signal of thermistor which is used for temperature compensation is transferred into A/D directly;

Two voltage signals are transferred into complex digital signal after processed by A/D converter, then sent to microprocessor after it is isolated by "Optical coupling isolator" ;

The complex digital signal is then sent to D/A converter after treated by CPU, which converts the signal to be 4-20mA loop signal, and goes to control system to be handled by power isolation transformer;

The HART protocol is based on the Bell202 standard, using frequency shift keying (FSK) to communicate at 1200 or 2200 HZ added 4-20mA loop signal.

The HART digital signal which is delivered by HART communication in 4-20mA loop is demodulated by HART communication module and sent to CPU to be modulated, and then sent to communication module again, sent to 4-20mA loop circle, and received by HART communication finally.

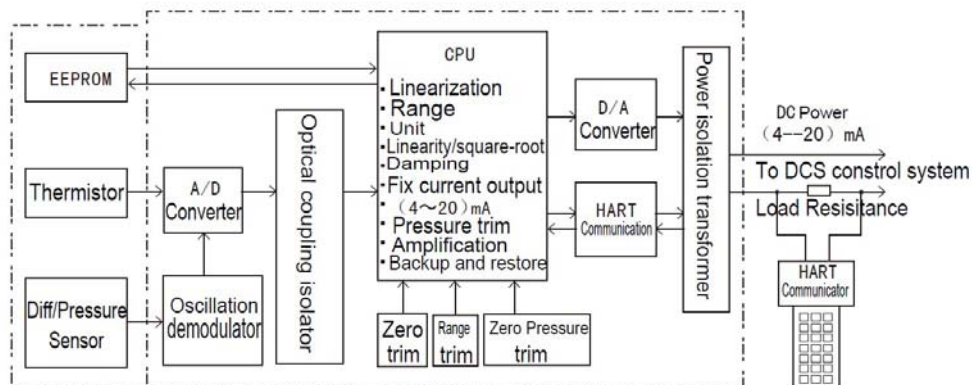


Figure 3. Electronic Components Working Principle

3. Power Voltage Load

Hart digital communication signal is on 4-20mA loop, it should be in series with load resistance to send and receive Hart digital signal. To ensure proper working of power supply and communication, the load resistance should be within specified range, shown as Figure 4:

Load resistance calculation:

$$RL = (Vs - 12) / 0.026 \Omega$$

RL-Load resistance

Vs-Power supply voltage

When in Hart Communication,

The power supply voltage range:

(18.5~45)VDC

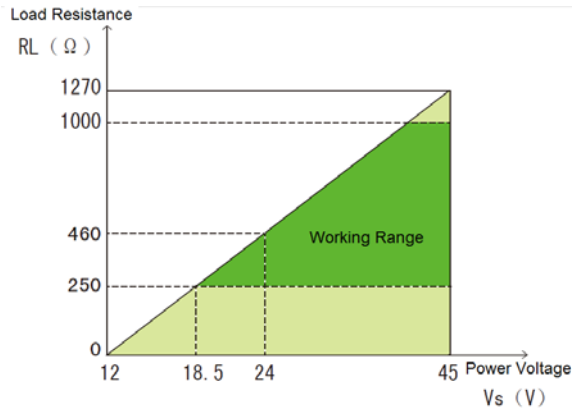


Figure 4: Power Voltage and Load Resistance

MODEL SELECTION

| Code | | | | | | |
|------|--|----|----|----|----|----|
| SH | SH Series Pressure transmitter/DP transmitters | | | | | |
| Code | Types | DR | DP | GP | HP | AP |
| DR | Low differential pressure | * | | | | |
| DP | Differential Pressure | | * | | | |
| GP | Gauge Pressure | | | * | | |
| HP | High Static Pressure | | | | * | |
| AP | Absolute Pressure | | | | | * |
| Code | Measuring Range | DR | DP | GP | HP | AP |
| 2F | (0-0.16~1.5)Kpa | * | | | | |
| 3E | (0-1.6~6)Kpa | | * | * | * | |
| 4E | (0-6~40)Kpa | | * | * | * | |
| 5E | (0-40~200)Kpa | | * | * | * | * |
| 6E | (0-0.16~1)Mpa | | * | * | * | * |
| 7E | (0-0.4~2.5)Mpa | | * | * | * | * |
| 8E | (0-1.6~8)Mpa | | | | * | * |
| 9E | (0-4~20)Mpa | | | | * | |
| 0E | 0-6~40)Mpa | | | | * | |
| Code | Accuracy | | | | | |
| 1 | 0.1 % | | | | | |
| 2 | 0.2 % | | | | | |
| 3 | 0.5 % | | | | | |
| Code | Explosion Proof | | | | | |
| P | Normal Type without Explosion proof | | | | | |
| d | Explosion proof Exd II BT4 | | | | | |
| i | Intrinsically safe explosion-proof Exia IIC T6 | | | | | |
| Code | Static Pressure | | | | | |
| 1 | ≤ 2.5Mpa | | | | | |

| | | | | |
|-------------|--|-------------------------|----------------------------|----------------------|
| 2 | ≤ 6.4Mpa | | | |
| 3 | ≤ 10 Mpa | | | |
| 4 | ≤ 16 Mpa | | | |
| 5 | ≤ 25 Mpa | | | |
| 6 | ≤ 32 Mpa | | | |
| Code | Display | | | |
| / | No digital display | | | |
| M5 | Digital Display | | | |
| Code | Output | | | |
| E | (4-20mA) | | | |
| S | (4-20mA) & Hart | | | |
| Code | Material | | | |
| | Flange/Connector | Drain/vent valve | Isolation Diaphragm | Filled Liquid |
| 22 | 316 sst | 316 sst | 316L | Silicon oil |
| 23 | 316 sst | 316 sst | Hastelloy C | Silicon oil |
| 24 | 316 sst | 316 sst | Monel | Silicon oil |
| 25 | 316 sst | 316 sst | Tantalum | Silicon oil |
| Code | Process Connector | | | |
| C0 | 1/4"NPT (F) | | | |
| C1 | 1/2"NPT(M) | | | |
| C2 | M20×1.5(M) | | | |
| Code | Mounting Bracket | | | |
| B1 | Bent Bracket for pipe mounting (2" pipe) | | | |
| B2 | Bent Bracket for plate mounting | | | |
| B3 | Flat bracket for pipe mounting (2" pipe) | | | |

TECHNICAL SPECIFICATION

1. Parameter

Medium: Liquid, gas and steam

Table1 : Measuring Range

| Code | Range | DR*1 | DP*2 | HP*3 | GP*4 | AP*5 |
|------|----------------|------|------|------|------|------|
| 2E | (0-0.16~1) kPa | √ | | | | |
| 3E | (0-1~6) kPa | | √ | √ | √ | |
| 4E | (0-6~40)kPa | | √ | √ | √ | √ |
| 5E | (0-40~200)kPa | | √ | √ | √ | √ |
| 6E | (0-0.16~1)MPa | | √ | √ | √ | √ |
| 7E | (0-0.4~2.5)MPa | | √ | √ | √ | √ |

| | | | | | | |
|----|--------------|--|--|--|---|---|
| 8E | (0-1.6~8)MPa | | | | √ | √ |
| 9E | (0-4~20)MPa | | | | √ | |
| 0E | (0-6~40)MPa | | | | √ | |

Note:

DR*1: Low Differential Pressure Transmitter

DP*2: Differential Pressure Transmitter

HP*3: High Static Differential Pressure Transmitter

GP*4: Gauge Pressure Transmitter

AP*5: Absolute Pressure Transmitter

Output signal: Two wire(4~20)mA isolated direct current signal and Hart digital output, linearity/square-root option, max output current is not over 22 mA.

Power Supply: Working range (18.5~45)V, Normal power supply:24 VDC

Load Range: When HART Communication, the resistance in power circuit $\geq 250 \Omega$. Power supply voltage $\geq 18.5V$.

Communication Distance: When the diameter of conducting wire is more than 0.6mm, the max distance is 1500m.

Display: Intelligent LCD display with 5 digits. When combining using F1,F2 and F3 buttons, the unit can be displayed circularly or fixed: Kpa, mA,%, °C, mmH₂O,Mpa,Pa,mbar,atm,psi,Torr engineering units. It can also change the measuring range without adding pressure, set fix current output, change the damping time, set the linearity or square-root, backup and restore the data.

Zero or Span Shift: When the working range is within the sensor limit value, zero and span can be set to any 4-20mA corresponding point.

Zero Pressure Trim: The error caused by mounting position change or zero shift can be trimmed to zero pressure when using F3 button.

Damping Value: the settable damping value is 0~32 seconds.

Alarm Function: If self-diagnostics detects a transmitter failure, the analog signal will be either below 3.9 mA or higher than 20.8 mA to alert the user.

Restore the Data: When the data is damaged, the data can be restored by using three buttons on the display.

Temperature Commensuration: the CPU collects temperature data and converts into transmitters to realize temperature compensation.

Temperature Indication: Indication the transmitters working temperature.

Working Temperature: Electronic Circuit: (-40~85)°C; LCD display:(-30~80)°C;Silicon oil: (-40~104)°C; Inertia oil: (-18~71)°C;

Storage Temperature: (-45~90)°C;

Safety Protection: AND circuit protection design, anti-static shock & surge current, strong ability of over load protection.

Accuracy: 0.075%, 0.1%,0.2%, 0.5%

Stability: Not over basic error in a year within measuring range.

Temperature Effect:

Table2 Pressure/Differential Pressure Temperature Coefficient Demand

| Accuracy | Temperature coefficient/%FS/10°C |
|----------|----------------------------------|
| 0.075 | ± 0.2 |
| 0.1 | |
| 0.2 | |
| 0.5 | ± 0.5 |
| 1.0 | |

Insulation: When the working environment is (15~35)°C, relative humidity is between 45%~75%,insulation resistance of transmitter output terminal to enclosure is less than 20MΩ; When imposing 500V test voltage of 50Hz frequency, no breakdown and flashover within one minute.

Static Pressure Effect: The static pressure effect only applies to differential pressure transmitters; it is measured by output lower limit and range change. Refer to Table3.

Table 3: Static Pressure on Pressure/Differential Pressure Transmitter

| Static Pressure (Mpa) | Accuracy | | | |
|-----------------------|------------------------|------|------|-----|
| | 0.1 | 0.2 | 0.5 | 1 |
| | Index (output scale %) | | | |
| ≤2.5 | 0.5 | 0.5 | 0.75 | 1 |
| ≤6.4 | 0.75 | 0.75 | 1 | 2 |
| ≤16 | 1 | 1 | 1.5 | 2.5 |
| ≤25 | 1.5 | 1.5 | 2 | 3 |
| ≤32 | 2 | 2 | 2.5 | 3.5 |
| ≤40 | 3 | 3 | 4 | 5 |

Vibration Effect: Less than ±0.075% of URL when tested per the requirements of IEC60770-1 field or pipeline with high vibration level (50 Hz 0.2mm displacement peak amplitude for 2

hours)

Mounting position effects: When the mounting position of the transmitter tilting $\pm 10^\circ$, the measuring lower limit and range change should be less than 1/3 of basic error or 200Pa(Whichever is the greater).

Process Connection: The process connection is NPT1/4; when there is tee-joint, the connection screw is M20*1.5(male).

Weight:5 KG

Explosive: Explosive proof: Exd IIBT4. Intrinsically Safe:Exia IICT6

OUTLINE

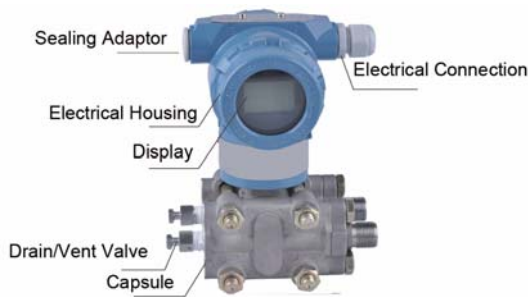


Figure 2-1 SH Capacitance Transmitter Front View

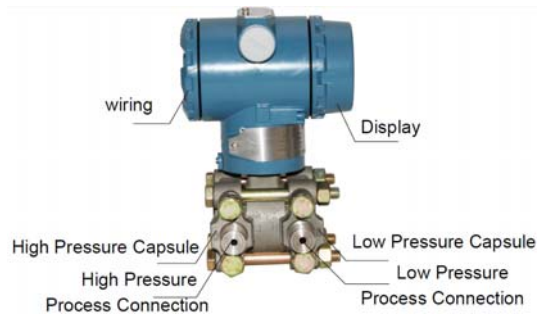


Figure 2-2 SH Capacitance Transmitter Side View

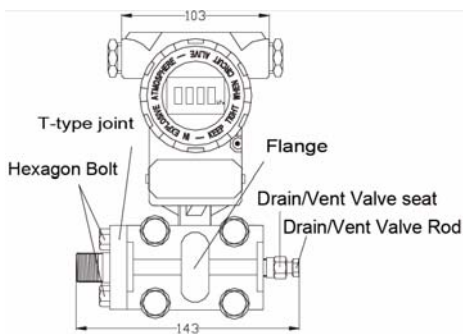


Figure 2-3A SH Capacitance Transmitter Front View

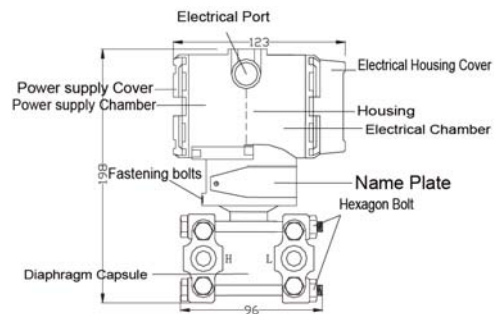


Figure 2-3B SH Capacitance Transmitter Side View

ELECTRICAL INSTALLATION

1. Electrical Installation

The power supply wire and signal wire share the same wire, no additional connection is needed. Remove the housing cover on terminal compartment side; connect the positive and negative lead to the positive and negative terminals.

The signal wire can be twisted-pair cable; shielded wire is recommended when there is electromagnetic interference and should be well grounded. The sectional area of power signal wire should be $0.5\text{mm}^2 \leq S \leq 2.5\text{mm}^2$ and should not be in the same metallic conduit or wire slot with other power supply cable.

Plug and seal unused conduit connection on the transmitter housing to avoid moisture accumulation in the terminal side. If conduit connection is not sealed, the connection should be adown.

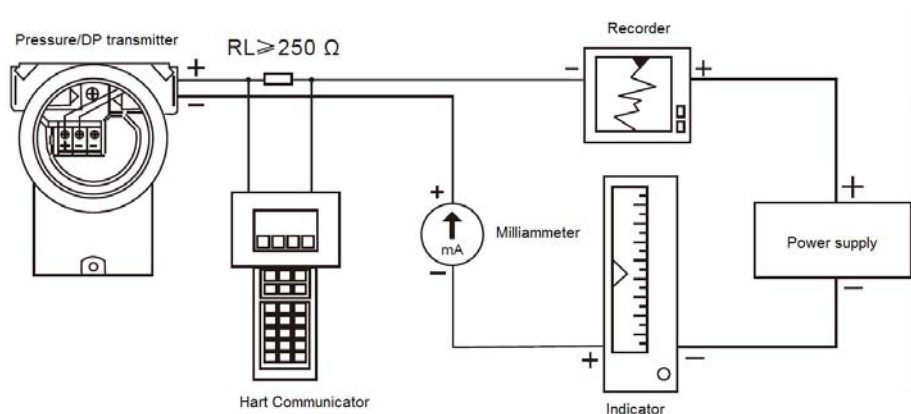


Figure 5 Transmitter Wiring

2. Mechanical Installation and Measurement

Installation types

Transmitters can be installed on the measuring point, it can also be installed on the wall or the 2" pipes with the mounting brackets. Main Installation types: bent bracket for pipe mounting, bent bracket for plate mounting, flat bracket for pipe mounting shown as Figure 5-1A,5-1B,5-2A.

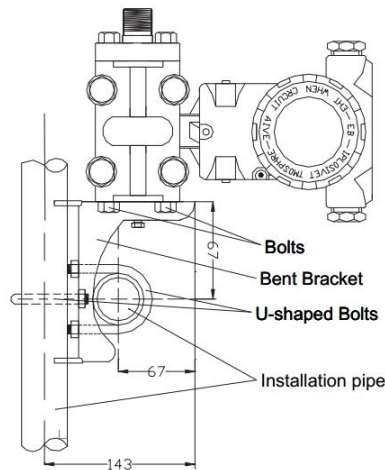


Figure 5-1A Bent Bracket For Pipe Mounting

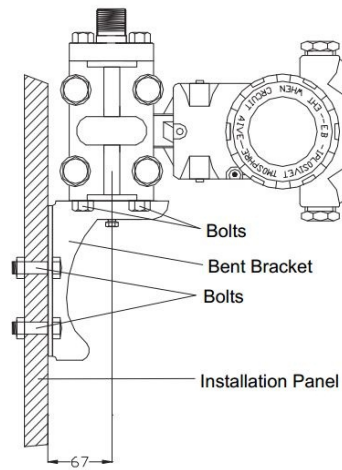
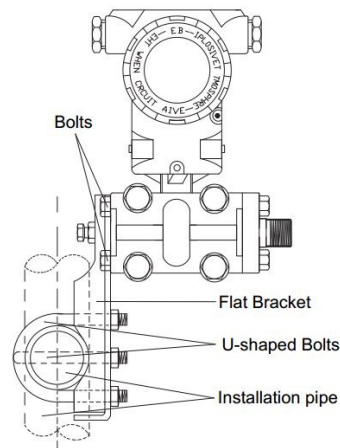
Figure 5-1B Bent Bracket For Plate
Mounting

Figure 5-2A Flat Bracket for Pipe Mounting

HAZARDOUS AREA CLASSIFICATION AND PROTECTION.

There is explosive proof and intrinsically safe transmitters, both of them should be approved from related organizations which are appointed by the state.

Explosive Proof-A type of protection that utilizes an enclosure that is capable of withstanding an explosive gas or vapor within it and or preventing the ignition of an explosive gas or vapor that may surround it and that operates at such an external temperature that a surrounding explosive gas or vapor will not be ignited thereby. This type of protection is referred to as Exd IIBT4.

Intrinsically Safe-A type of protection in which the electrical equipment with the safety barrier under normal or abnormal conditions is incapable of releasing sufficient electrical or thermal energy to cause ignition of a specific hazardous atmospheric mixture in its most easily ignitable concentration. This type of protection is referred to as Ex ia IIC T6.

Meaning of Signs:

(1) Exd: Explosive Proof; Ex ia: Intrinsically Safe

(2) I: Group I -Electrical Equipment used in mines;

II: Group II -Electrical Equipment used in Factory;

(3) C or B: MESG (Maximum Experimental Safe Gap) of explosive proof electrical equipment and MICR (Minimum Ignition Current Ratio) of intrinsically safe electrical equipment in explosive gas mixture, there are A,B,C Grades (see table 4).

T: Electrical Equipments max allowable surface temperature, it can be divided into T1~T6 (see table 5).

| Grade | MESG(mm) | MICR |
|-------|--------------------------|---------------------------|
| IIA | >0.9 | $MICR > 0.8$ |
| IIB | $0.9 \geq MESG \geq 0.5$ | $0.8 \geq MICR \geq 0.45$ |
| IIC | $0.5 > MESG$ | $0.45 > MICR$ |

| Temperature Grade | T1 | T2 | T3 | T4 | T5 | T5 |
|---------------------------------------|-----|-----|-----|-----|-----|----|
| Max Allowable Surface Temperature(°C) | 450 | 300 | 200 | 135 | 100 | 85 |

Notice of Usage of Explosive Proof Transmitters

- ① The explosive proof transmitters should meet the “People's Republic of China Electrical Equipments Safety Regulations Used in Hazardous Area” and GB50058“Electrical Equipments Design Regulations in Explosive and Flame Hazardous Area”. Transmitter explosive grade, temperature grade and safety barriers should be carefully considered and properly selected.
- ② Electronic and electrical cover must be tightened, and equipped with locking device, not allowed to open electronics and power supply cover when the transmitters are energized.
- ③ The electrical port of the transmitters must have good sealing; the housing of the transmitters should be well grounded.
- ④ The power line of intrinsically safe transmitters should be shield insulating sheath cable, and connected to transmitter through the safety barrier. The safety barrier should be installed in safety area, shield cable and transmitter shell should be isolated and grounded in safety area. When wiring, should stay away from high voltage electrical equipments, wiring alone, separated from the other electrical equipments wiring.
- ⑤ The Device with Hart Protocol (Like PDA or PC for Communication) can't be used in Hazardous Area. Just in secure Area.